

CHECKING THE NET CONTENTS OF PACKAGED GOODS



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NBS HANDBOOK 133 - SECOND EDITION CHECKING THE NET CONTENTS OF PACKAGED GOODS

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PURPOSE

This handbook has been prepared as a procedural guide for compliance testing of net contents statements on packaged goods. Compliance testing of packaged goods is the determination of the conformance of the results of the packaging, distribution, and retailing process (the packages) with specified legal requirements for net contents declarations. Although the handbook has been developed primarily for use by weights and measures officials of the States, counties, and cities, it also should be useful to commercial and industrial establishments involved in the packaging, distribution, and sale of commodities.

SCOPE

In 1959, the National Bureau of Standards published Handbook 67, "Checking Prepackaged Commodities", also a guide for compliance testing the net contents of packages. This handbook differs from NBS Handbook 67 in two significant areas:

- 1. Two categories of sampling plans are presented for packages subject to the average requirement.
 - The sampling plans in Handbook 67 have been modified and appear as "Category B" sampling plans in Handbook 133.
 - A new set of sampling plans ("Category A") have been introduced.
- 2. Comprehensive test procedures are provided in detail for a wide variety of commodities. Handbook 67 described tests on packages labeled by weight and by volume only.

This handbook provides procedures using statistical sampling techniques to test individual lots of packages for conformance with legal requirements. Anything that is put into a container, wrapped, or banded, and labeled as to quantity may be inspected.

The labeled quantity may be of: weight; volume; linear, square, or cubic measure; count; or combinations thereof. Packaged commodities may be examined to determine conformance with Federal, State, or local net contents labeling regulations. Compliance testing of packaged goods is generally directed toward protecting the consumer/purchaser from receiving packages with less than the labeled quantity of contents and to advise the manufacturer when improvements in delivered product quantities are necessary. Tests for health and safety may require different sampling and test measurements.

Inspection for compliance with other labeling requirements (such as size of lettering or units of measurement) may also accompany package quantity compliance testing, but is not covered in this document.

INTRODUCTION TO THE SECOND EDITION

Based on experience gained by conducting numerous package testing workshops around the country since the first edition was published, the authors made significant improvements in report forms and in the arrangement of the tables. In 1983, comments on the first edition were requested of government officials and industry and business representatives in anticipation of publishing a second edition. The comments were compiled and used as a further basis for changes to the first edition.

Major differences between the 1981 edition and the present one are:

- o Category A and Category B sampling plans are compared graphically in the second edition. There is no general linkage between the categories of plans and types of enforcement action.
- o The number of sampling plans in Category A have been reduced.
- o The recommendation that wet tare be used wherever possible has been dropped. Whatever tare is available is acceptable.
- o The Maximum Allowable Variations (MAV's)¹ for packages with labeled weights less than 1.28 oz and more than 54.40 lb have been changed.
- The MAV's for packages with labeled lengths less than one yard have been changed.
- o A test method for bark mulch has been added.
- Significant changes have been made to improve the report forms and worksheets.
- o The decision charts have been eliminated.
- The most-used procedure has been designated as a "CORE METHOD" and other procedures build on it.
- o Greater detail has been added to the random-pack package and milk testing procedures.
- All tables and forms have been placed in separate sections for ease of reference.

1See page 1-2 for definition and Section 2.12. for magnitudes.

HOW TO USE THIS HANDBOOK

This manual contains information on equipment, test methods, calculations, and test reporting. The handbook is divided into five chapters. The first chapter covers several introductory items directed primarily to the administrator of a package testing program. The remainder (Chapters 2 through 5 and the appendices) is intended as a handbook for the field testing official.

The second chapter discusses fundamentals and general sampling procedures. The testing official should study this chapter thoroughly before attempting to follow the test procedures given in the rest of the handbook.

The third, fourth, and fifth chapters detail the test methods. Chapter 3 covers packages labeled by weight; Chapter 4 covers packages labeled by volume; and, Chapter 5 covers other package quantities. These three chapters provide the test methods for checking different types of packages.

Appendix A contains report forms and worksheets for field test use. Appendix B contains all the tables that are referred to in Chapters 1 through 5 of the handbook. The testing official should tab these tables for quick reference in the field. Appendix C is a glossary of terms that are used throughout the handbook. Appendix D contains a compilation of pertinent parts of net contents regulations at the Federal level and those recommended by the National Conference on Weights and Measures for State adoption. Appendix E contains descriptions of how to select a random sample. This section, like Chapter 2, should be studied by the testing official prior to following the test procedures in Chapters 3, 4, and 5. Appendix F and G are random number tables, and should also be tabbed for easy reference. Appendix I lists equipment tolerances for field test weights and flasks. Appendix J is an excerpt from the USDA Meat and Poultry Inspector's Manual. At the end of the handbook is an index which will be valuable for directing the official to the appropriate test method for specific commodities.

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CHAPTER 1. INTRODUCTION

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- 1.2. Package requirements
- 1.3. The package testing program
- 1.4. Inspection by sampling
- 1.5. Audit testing
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- 1.7. Sampling plans for the average requirement
- 1.8. Why there are two categories of sampling plans
- 1.9. Allowances for variations due to moisture loss or gain
- 1.10. Decisions preliminary to package inspection

CHAPTER 1. INTRODUCTION

This chapter provides background information on package regulations, regulatory and enforcement agencies in the United States, and package testing programs. The concept of checking packaged goods by sampling is introduced. Other terms that are routine to package inspection are also discussed in the context of this handbook, such as the average requirement, audit testing, and moisture allowance.

1.1. REGULATORY AGENCIES

In the United States, several regulatory agencies have authority in packaged product labeling. At the national level, the U.S. Department of Agriculture promulgates requirements for packaged goods containing meat or poultry, as part of the department's responsibility under the Federal Meat Inspection Act as amended by the Wholesome Meat Act and the Poultry Products Inspection Act as amended by the Wholesome Poultry Products Act. The Food and Drug Administration under the U.S. Department of Health and Human Services promulgates requirements for packages containing all other food products and all drug and cosmetic products and medical devices as part of this agency's responsibility under the Food, Drug, and Cosmetic Act and the Fair Packaging and Labeling Act (FPLA). The Federal Trade Commission promulgates requirements for many nonfood consumer-sized packaged products as part of the agency's responsibility under the FPLA.

The Environmental Protection Agency promulgates requirements for packaged pesticides as part of the agency's responsibility under the Federal Insecticide, Fungicide and Rodenticide Act. 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 for sale also come under the jurisdiction of State and local weights and measures agencies, which have their own legal requirements for packaged goods.

Those parts of the pertinent Federal and State regulations are listed in Appendix D.

Federal statutes set requirements that affect State regulations. Therefore, State 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.

1.2. PACKAGE REQUIREMENTS

1.2.1. The Average Requirement

Although net-contents regulations often differ in wording, a uniform operational interpretation has traditionally been applied for the purpose of testing the net contents of packages for compliance with these regulations. There are two requirements that the quantity of contents of packaged goods must meet. First, the average quantity of contents of packages in a lot, shipment, or delivery must equal or exceed the quantity printed on the label. The second requirement applies to the individual package: the variation of individual package contents from the labeled quantity must not be "unreasonably large". Both requirements apply simultaneously to any given collection of packages, and this handbook provides methods to test packages against them. Limits of "reasonable variation" for individual packages are listed in tables of "MAV"¹ (See Section 2.12. and pages B-9 through B-15.)

In common parlance, these two requirements that the package net contents must meet are called "the average requirement" (even though there are two requirements).

1.2.2. An Exception

The National Conference on Weights and Measures (NCWM), an organization of State and local weights and measures officials, has adopted standards, called "uniform laws and regulations", upon which individual jurisdictions may model their laws and regulations. Several States have adopted that portion of the NCWM Uniform Regulation for the Method of Sale of Commodities² which provides a tolerance for pressed and blown glass tumblers and stemware. In this regulation, such a tolerance is called an "allowable difference". When packaged product quantities are given tolerances, the average and individual package requirements described above do not apply. This handbook provides procedures for testing glassware in Section 5.7.

¹The acronym "MAV" is from the term "maximum allowable variation". The meaning of the term derives from the regulations that permit no unreasonable variations.

²This regulation is part of National Bureau of Standards (NBS) Handbook 130, "Uniform Laws and Regulations" as adopted by the National Conference on Weights and Measures, revised and printed each year by the U.S. Government Printing Office.

1.3. THE PACKAGE TESTING PROGRAM

For the benefit of the regulatory agency program administrator, several items are discussed in this section concerning the establishment of a broad and diversified package testing program.

1.3.1. Where to Test

Package commodities may be tested in any location from packaging plant to retail outlet.

Point of Pack

Checking packages at the location where they are packaged ("point of pack") has the greatest impact on the packaging process. The official can sample from the largest number of packages of a single product available at one place, and the manufacturer can immediately correct any problems found before packages are distributed. Small economies are obtainable if the packager can recover and repackage the product from packages that must be opened for testing purposes.

When the product is packaged at the retail store (the supermarket meat counter being the classic example), package inspection at retail is equivalent to inspection at the point of pack.

Package testing at production point cannot entirely replace that at wholesale or retail outlets. Since only manufacturing practices can be examined at production point, testing of packages at wholesale and retail outlets must also be part of a complete package inspection program. The results of distribution practices, possible tampering with the product, and environmental effects can only be detected by wholesale and retail checking. Thus, inspection resources should be divided, if possible, between testing at the packaging location and testing at wholesale and retail locations.

The effectiveness of package testing programs conducted by individual State and local agencies would be maximized if these agencies established reciprocity with other State, county, and city jurisdictions to recognize results of tests carried out by other agencies at packaging plants.

Wholesale

When possible, warehouse-outlet package testing is a good alternative to testing at the production point with respect to testing large amounts of product. There is a severe drawback to checking at wholesale, however, namely getting to the stacks of pallets, breaking down film-wrapped or wired skids, and opening sealed cartons. Labor costs, equipment, and time requirements, including the time needed to restack skids and pallets, can be excessive. Because of the importance of wholesale testing to the follow-up of inaccuracies discovered during retail checking, guidelines are given in Appendix E to simplify selection of the package sample at wholesale outlets.

Retail

Package testing at retail checks the soundness of the manufacturing, distribution, and retailing processes of the widest variety of goods available at a single location.

Package testing at retail locations checks the accuracy of the package label at the locations where consumers purchase the product. It is an excellent means for State and local jurisdictions to monitor packaging procedures and to detect present or potential problems.

Retail package testing is not conducive to checking very many lots of an individual product or a substantial amount of any single production lot. Thus, it is more difficult to detect generally good or bad packaging processes, and the impact of a single inspection on a packager and the packaging process is small. Therefore, at the very least, follow-up inspection of a particular brand or lot code number at a number of retail and wholesale outlets is extremely important in any retail checking scheme.

At the point of sale, a large number of processes impinge on the quality or quantity of the product. Hence, there may be many possible reasons for any inspection lot being out of compliance. A shortage in weight or measure may be the result of mistreatment of the product in the store, of a failure to rotate stock, of mishandling by a middle agent, or of failure of some part of the packaging process. Therefore, locating fault in order to correct defects will be more difficult when retail testing is employed.

Moisture Loss

Allowance for moisture loss during the course of good distribution practices must be made when Federal or State regulations provide for them. Allowances for moisture loss are not applied at point of pack testing, to hermetically sealed packages, or to pesticides.

1.3.2. What to Test

The products to be tested can be chosen in many ways. For a State or local government agency, the decision can be based on marketplace surveys (e.g., sales volume and sales value of various packaged goods) and audit testing (see Section 1.5.) to cover as large a product variety as possible at food stores, farm stores, drug, hardware, or specialty outlets, discount and department stores. Follow-up of possible problems detected in audit testing or in review of past performance will tend 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, of course, be balanced against the cost of testing. Expensive products should be tested because of their cost per unit; however, inexpensive items also should be tested because of their sales volume, the overall cost to individual purchasers becoming considerable over an extended period. Items on special sale and special products produced for local consumption should not be overlooked.

Some officials may have a roster of packaging plants (or an individual plant) to inspect for a broad range of items, one of which will include net quantity. In such cases, the official may be instructed as to what to test.

1.3.3. Special Precautions

In testing food, cosmetic, or drug products, the inspector must observe all health standards and regulations for handling the product. For the safety of the inspector and public, pesticides, herbicides, and other poisonous or hazardous materials should be handled (and, if necessary, disposed of) with extreme caution, observing all health standards and label warnings.

The procedures in this handbook are designed to be technically sound. The measurements and the recording of these measurements must be performed by the official carefully, so that they are also legally defensible. The forms and worksheets are designed to provide assurance that all the required data will be entered instead of leaving it to memory and judgment. For similar reasons, it is also important to maintain an unbroken "chain of custody" when taking sample packages back to a laboratory for further measurements.

1.4. INSPECTION BY SAMPLING

Weights and measures regulation, testing, and enforcement require a balance between the need to assure equity and the need to minimize the cost of testing to the taxpayer. Testing a "sample" of packages is one means of achieving this balance.

This handbook describes package compliance testing methods to be used in conjunction with sampling techniques.

The only alternative to sampling to determine compliance with package requirements is 100% testing. (See Section 1.6.)

The techniques of statistically sound sampling based on a sampling plan provide important benefits. First is conservation of the inspector's time needed to test a single lot, thus reducing the cost of such testing. Since testing entails some package destruction, package integrity can be preserved to a large extent by following a sampling plan.

A second benefit is the increased impact of an inspector on the package production, distribution, and marketing sectors. Sampling according to prescribed sampling plans is a most effective and efficient method of marketplace surveillance. Surveillance by sampling is an efficient means to protect package purchasers (who cannot check the quantity of contents themselves) and also to encourage good manufacturing and distribution processes among packagers and package sellers.

Compliance testing using a sampling plan utilizes a step-by-step method of obtaining evidence, comparing the evidence with package requirements, then making a decision about the compliance of the packages.

Sampling plans are discussed further in Sections 1.7. and 1.8. and in detail in Chapter 2. Inspection procedures using sampling plans consist of five steps:

- o Define and count the number of packages comprising the "inspection lot", upon which action is taken. (The "inspection lot" is defined in Section 2.3., page 2-5.)
- o Choose a random sample. (Instructions for taking a random sample are given in Appendix E.)
- o Measure as appropriate each package in the sample (described in Chapters 3, 4, and 5).
- o Perform calculations based on individual measurements (described in Sections 2.6. and 2.7. and as part of the package checking routine in Chapters 3, 4, and 5).
- o Decide whether the "inspection lot" is in conformance with the requirements. This decision is based upon the criteria established in the sampling plan (described in Sections 2.6. and 2.7. and as part of the package checking routine in Chapters 3, 4, and 5).

1.5. AUDIT TESTING

In order to speed the process of detecting possible package net contents violations, officials often use audit testing procedures. These may entail, for example, very small sample sizes or predetermined and catalogued tare weights, or any other shortcut in testing.

Audit procedures are not definitive, but are fast and enable an inspector to cover more products at a single location than would otherwise be possible with the more rigorous techniques. An official who finds a possible violation should then use the more rigorous methods given in this handbook to confirm the condition of the lot, that is, to determine whether or not the packaged product complies with net contents labeling requirements. This handbook does not discuss audit testing at length, but does provide audit methods for packaged goods labeled by count (Section 5.1.2.) and for paint, varnish, or lacquers (Sections 4.9.2. and 4.9.3.).

Although mixed lot code testing is not intended just for audit testing, it can be a time saver for audit tests. When packages are checked at retail, inspection lots may be defined as identically labeled packages that are mixed with respect to lot code (helping to indicate a manufacturer's overall process quality). If testing reveals poor quality, segregation by lot code before further testing will simplify follow-up inspection.

1.6. 100% TESTING

Upon occasion, it may be necessary to check every package in a lot, shipment, or delivery.

State regulations and those of the Federal Trade Commission (see Appendix D) are specific in this instance:

- o the average of a lot, shipment, or delivery must equal or exceed the labeled net contents;
- o no "unreasonable" shortage in any package is permitted.

Other Federal requirements are not so explicit, but are compatible with the requirements noted above.

When every package in the lot is tested, no (zero) packages may fall below the limits set by the MAV, and, at the same time, the average quantity of contents of the lot, shipment, or delivery must equal or exceed the labeled quantity.¹

¹See Section 5.7. for testing glassware, which is provided a tolerance.

If a packager uses checkweighers, not only should the average of the lot equal (or exceed) the label, but under no circumstances should the checkweigher accept packages that are short measure by more than the $\dot{M}AV$.

1.7. SAMPLING PLANS FOR THE AVERAGE REQUIREMENT

Several categories of sampling plans are provided in this handbook. Two categories of sampling plans, Category A and Category B, are provided for testing packages subject to the average requirement.

The regulatory agency has the authority to specify the appropriate sampling plan categories according to the agency's operating procedures.

As mentioned in Section 1.2., packages must meet two requirements when they are subject to the average requirement. The first, which applies to the whole inspection lot, is that the average net contents must equal or exceed the labeled contents. The descriptions of the sampling plan categories have specific computations to provide evidence that this requirement has been met. The second requirement is that individual package variations may not be "unreasonable". The limits of reasonable individual package variations are called MAV's in this handbook. When using sampling techniques for compliance testing of packaged goods, a very few packages in any given sample may be allowed to exceed the limits defined by the MAV.

1.8. WHY THERE ARE TWO CATEGORIES OF SAMPLING PLANS

Judgments based on sampling (less than complete information) are by nature subject to uncertainty. There is an inherent risk of making wrong decisions. Lots that do not conform to the regulation may be mistakenly accepted and lots that do conform may be erreoneously rejected.

Many kinds of sampling plans can conceivably be devised, categorized according to their probability of accepting inspection lots whose average net contents at least equals the declared net contents. For the moment, we will set aside requirements on individual packages in our discussion of Category A and B plans.

Category B plans split the risks of making incorrect decisions between the packager and the consumer, giving acceptable inspection lots a 50% probability of acceptance. Category A sampling plans give acceptable inspection lots a "high" probability of acceptance. Figure $1-1^1$ illustrates some of the differences between Category A and Category B sampling plans.



Lot Average

Figure 1-1. Differences between Category A and Category B.

Lots That Average at the Labeled Net Contents

For lots that average at the labeled net contents (see the dashed vertical line):

- o We expect Category B sampling plans to pass 50% of all such lots sampled (point "a").
- We expect Category A sampling plans to accept a much larger percentage of all such lots sampled (point "b").

¹This description has been greatly simplified by showing only lots that have a variability that fits well within the MAV limits. For further information, see G. N. Lauer, "Probabilities of Noncompliance for Sampling Plans in NBS Handbook 133", in the Journal of Quality Technology, Vol. 14, p. 162, July 1982.

Lots That Average Below the Labeled Net Contents

For lots that average less than the labeled net contents (see the dotted vertical line):

- o The same relationship holds, that is, Category A plans pass a greater fraction of lots than do Category B plans (compare point d to point c) but,
- o Both categories pass fewer below-average lots than lots that average at the labeled contents. (Compare point d to b and point c to a.)

Lots That Average Above the Labeled Net Contents

- o The same relationship again holds, that is, Category A plans pass more lots than Category B plans, but
- o The probability of such lots being passed by either Category increases, as one should expect.

It has been traditional in package testing in the U.S. for Federal, State, and local regulatory officials to use sampling plans similar to Category B. Frequently, many jurisdictions applied a variety of "allowances" to their measurement results before taking enforcement action. Category A sampling plans are provided in order to reduce the risk of failing a lot when it averages at the labeled weight. Category A plans provide a rational, uniform alternative to the variety of allowances or tolerances formerly in use.

In the foregoing discussion of differences between A and B, it was assumed that the sample sizes are the same for A and B. For any given sample size, however, Category A plans, while reducing the probability of rejecting "good" lots, increase the probability of accepting "bad" lots. The Category A plans have therefore been designed to reduce the risk of accepting too many "bad" lots while still providing reasonably high probability of accepting "good lots". As a result, the sample sizes (for any given lot size) for Category A are larger than those for Category B.

Because Category A plans require larger sample sizes and additional arithmetic computation, jurisdictions (in the interests of economy and practicality) may not find Category A suitable for routine testing purposes.

1.9. <u>ALLOWANCES FOR VARIATIONS DUE TO MOISTURE LOSS OR</u> GAIN

Some packaged products may lose or gain moisture (and, therefore, lose or gain weight) after packaging. Depending upon the nature of the product, its environmental history, and the packaging material and method, moisture loss may occur even when good distribution practices are followed. Whenever the Federal or State laws or regulations governing packaged products allow variations in individual packages for loss or gain of moisture¹, these allowances have to be applied to individual packages and, thus, to the average net contents before a decision as to lot conformance can be made.

On the basis of technical and regulatory information presently available, this handbook cannot provide definitive moisture allowances or procedures for determining compliance with those regulations that allow for quantity variations due to moisture loss or gain. (The agencies responsible for such regulations are listed in Table 1-1, page B-1.)

1.10. DECISIONS PRELIMINARY TO PACKAGE INSPECTION

Prior to any package inspections, the package testing official's supervisor or program administrator must, at the very least, give directions concerning:

- o which sampling plan category is to be used under what circumstances in the jurisdiction, and
- o what procedures are to be followed when inspecting packages susceptible to moisture loss.

¹Certain nonfood, packaged consumer items under the authority of regulations promulgated by the Federal Trade Commission are permitted variations "due to exposure". This may include solvent evaporation, not just loss of water.

CHAPTER 2. GENERAL CONSIDERATIONS

- 2.1. The package checking routine
- 2.2. The report forms and worksheets
- 2.3. Definition of the lot
- 2.4. Package errors
- 2.5. Selecting the sampling plan
- 2.6. Sampling plans in Category A
- 2.7. Sampling plans in Category B
- 2.8. Individual packages
- 2.9. Recording package errors
- 2.10. The criteria for weighing packages not labeled by weight
- 2.11. Tare
- 2.12. MAV's
- 2.13. Exceptions to the MAV's
- 2.14. Moisture allowance

CHAPTER 2. GENERAL CONSIDERATIONS

This chapter introduces several subjects that require special study by the inspector prior to actual package testing. Chapter 2 provides explanations on how to define the group of packages upon which action will be taken, how to fill out a report form, how to read the tables in Appendix B, and how to perform the arithmetic required in the procedures in chapters 3, 4, and 5. This chapter also describes general principles that will be followed throughout the handbook concerning measurement accuracy (the MAV/6 principle), recording package errors (using dimensionless units), the criteria for weighing packages not labeled by weight, and information on tare. A thorough study of Appendix E is also recommended before using the methods detailed in Chapters 3, 4, and 5.

2.1. THE PACKAGE CHECKING ROUTINE

The following topics in capital letters are explained in this chapter and in Appendix E, but not necessarily in the order in which the official will handle them during field testing. Step-by-step instructions for field testing are given in Chapters 3, 4, and 5.

In package testing, after determining the location of test and packaged product to be tested, the official will be expected to:

- o identify the INSPECTION LOT to be tested,
- o fill out a REPORT FORM, including information from the product label and the MAV (selected according to the labeled net contents),
- o count the number of packages in the lot and record the LOT SIZE,
- o refer to the designated SAMPLING PLAN and record SAMPLE SIZE, TARE SAMPLE SIZE, and ALLOWED NUMBER OF UNREASONABLE ERRORS,
- o select a RANDOM SAMPLE and the RANDOM TARE SAMPLE,
- o if label is not in terms of net weight, determine if WEIGHING METHOD may be employed (using one of the WORKSHEETS),
- o determine UNIT OF MEASURE and the MAV in DIMENSIONLESS UNITS (the use of dimensionless units is optional),

2 - 1

- o determine AVERAGE TARE (and CORRECTED TARE in some instances), and record on WORKSHEETS and REPORT FORM,
- o determine PACKAGE ERRORS (using a NOMINAL GROSS WEIGHT where possible), and record values on REPORT FORM, and
- o apply DECISION CRITERIA to determine whether the lot does or does not conform to net quantity requirements.

Tables and other material introduced in this chapter are referenced in Chapters 3, 4, and 5 when circumstances require their use. All report forms and worksheets appear in Appendix A and all tables are in Appendix B.

2.2. THE REPORT FORMS AND WORKSHEETS

It is necessary to document the results of package testing on a report form. An example of a form for standard pack packages is shown on page A-1. In the following sections and in subsequent chapters, the official will be referred to locations indicated by box numbers on this report form. Chapters 3 and 4 introduce other report forms, derived from this example.

Several worksheets are also introduced in Chapters 3, 4, and 5 and Appendix E.

For those reading the handbook for the first time, we suggest that the reader keep handy a copy of the report form on page A-1 and refer to it while reading the text. The numbered boxes are listed in Table 2-1 (on page B-2), together with the sections of the text in which they are explained. In addition, the page numbers of the look-up tables in the handbook are printed in the report form boxes.

2.2.1. Filling Out the Report Form Heading

The report form on page A-1 provides boxes for recording all the pertinent information for the simplest type of package — the "standard pack" package. (See Section 2.3.1. for a definition of "standard pack".) Figure 2-1 shows the report form heading. Lot code information will help in follow-up testing. The labeled net contents is recorded in box 1. It is used to look up the "MAV", which is to be entered in box 3 (see Section 2.12.). The selection of a "unit of measure" (box 2) is also guided by the labeled net contents. (See Sections 2.9.1. for general information about the "unit of measure", 3.3. for packages labeled by weight, and 4.4. for packages labeled by volume.) ("Dimensionless units" (box 4) will also be explained in Section 2.9.1.) The official must
first designate the "inspection lot" before determining the size of the lot to be tested (box 5). This is described in Section 2.3. Once the size of the lot is known, the official can look up the appropriate sample size (box 6), tare sample size (box 7), and the number of package errors allowed to exceed the MAV (box 8) in Table 2-2 (Category A) or Table 2-5 (for Category B plans).

DATE		REPORT NUMBER				
Location of TEST (Name, Address)	Retailer Wholesaler Packager	PRODUCT IDENTITY	BRAND	LOT CODE(S)	CONTAINER DESCRIPTION	
		1 LABELED CONTENTS	2 UNIT OF MEASURE	3 MAV (same units as label)	4 MAV (dimensionless units)	
5 LOT SIZE (N) 6 SAMPLE SIZE (n)						
A (p. 8-3) B (p. 8-5) 7 TARE SAMPLE SIZE Alternative (p. 8-6)						
B Allowed Number UNREASONABLE ERRORS						

Figure 2-1. The standard pack report form heading.

2.2.2. Filling Out the Tare Information on the Report Form

The determination of tare is covered generally in Section 2.11. The next section of the report form (see Figure 2-2) provides space to record the "gross weight" (unopened total package weight) in boxes labeled "a" and the "tare weight" in boxes labeled "b" for up to five packages. An additional worksheet may be appended if more than five packages are opened to determine tare. This section of the report form is used when the packages are labeled by weight. Special worksheets are provided to record this information for packages labeled in other units (volume, count, etc.).

Section 2.11.4. describes a special method to be used when tare variability is appreciable with respect to the variability of the net weight (boxes 9 through 12).

The average tare weight is recorded in box 13 and any corrections to the tare are entered in box 13a. Box 14 is used to record the "nominal gross weight", the weight against which all package gross weights will be compared to determine the package errors.



Figure 2-2. Places to record tare sample information and the nominal gross weight on the standard pack report form.

2.2.3. <u>Recording Package Errors and Determining Whether the Lot</u> Conforms to the Requirements.

Section 2.9.3. describes how to record package errors in the crosshatched area of the report form. See Figure 2-3.

Appendix H explains how to calculate a "range" (R). The actual number of "unreasonable errors" (box 16) and the criterion for individual package errors (box 17) are explained in Sections 2.6.1. (for Category A plans) and 2.7.1. (for Category B). The "average error" (boxes 18 and 19) is explained in Sections 2.6.2. (Category A) and 2.7.2. (for Category B). The special additional steps (boxes 21 through 27) to determine lot conformance when following a Category A sampling plan (when the average error is a minus value) are described in Section 2.6.2.

The final disposition of the lot is recorded in box 28 and is a composite of the information recorded in boxes 17, 20, and 27.



Figure 2-3. The crosshatched area of the report form and place to record lot disposition.

2.3. DEFINITION OF THE LOT

As a first step in package testing, the official designates the collection of packages upon which action will be taken as a result of the official's tests. This is the "INSPECTION LOT". Based on the factors likely to cause variations in quantity, the official should designate as the inspection lot the largest possible group of packages, in accordance with the following guidelines:

(i) The inspection lot must consist only of packages of the same product, with the same label (except for the lot code), from the same packer.

For example, a lot shall consist of cans of peach halves, syrup added, 500 grams net weight, Brand X.

This rule should never be violated.

(ii) To the greatest extent possible, the inspection lot should consist only of packages packed at the same place, at the same time, under the same conditions. This guideline is in addition to the provisions of guideline (i). Therefore, a lot should consist of packages of the same product and the same label. They should also have the same lot code number if inspection is done at the warehouse, or be packages from the same filling line, packed during the same period, if inspection is done on-line at the packing plant.

It is not always possible to take the second guideline into account in designating lots. In fact, taking both guidelines into account may lead to a very small inspection lot, a result which is undesirable. The inspection lot should be as large as possible without violating guideline (i), yet taking into account the factors mentioned in guideline (ii).

If the official cannot reach some packages because of physical or other constraints, those packages are not part of the inspection lot to be acted upon. In general, such restrictions on sampling should be avoided whenever possible.

State and local regulations apply to "lots", "shipments", or "deliveries". A shipment or delivery will rarely be comprised of only one or two packages. If only one or two packages are found on retail shelves, more packages should be sought in storerooms or cases. When only one or two packages are available for test in a single location and it is evident that the shipment or delivery was larger, the average net contents of the shipment or delivery cannot be determined. Only individual package errors can be ascertained and compared with the limits of reasonable variation (called "MAV's"). If shortages are found for one or two packages, records should be kept and follow-up inspections conducted on larger lots or in other locations.

2.3.1. The Inspection Lot of Standard Pack Packages

"Standard pack" packages are defined as those packaged with identical labels in a few selected quantity sizes. For example, canned ham labeled "5 pounds" is a standard pack meat item.

The inspection lot must always consist of packages with identical labels (except for the lot code).

• When the location of test is a retail store: Because state and local regulations apply to "lots, shipments, or deliveries", a shipment or delivery comprised of packages with different lot codes may be acted upon as a single inspection lot. Follow-up inspection will require segregation of lots by lot code.

- o When the location of test is a warehouse: The inspection lot must consist of packages with the same manufacturer's lot code.
- When the location of test is on-line at a packing plant: The inspection lot must consist of packages with the same manufacturer's lot code and should not exceed one uninterrupted production run. As small as one hour's production may be convenient for sampling purposes.

Note that the inspection lot is not, in general, the same as the "production lot".

2.3.2. The Inspection Lot of Random Pack Packages

"Random pack" packages are defined as those packaged with identical labels except for the labeled quantity.¹ These packages are usually individually weighed and subsequently marked.

An example of a random pack meat item is whole chicken labeled by weight.

o When the location of inspection is a retail store: An inspection lot may consist of all the packages packaged at that location and available for inspection at one time. Since the same production factors apply to all such packages, the entire meat counter, for example, may be considered the lot, except for those packages on the counter put up elsewhere than at the store. (See Appendix E for more discussion on selecting the sample from this kind of lot.)

> State and local regulations apply to "lots, shipments, or deliveries". A shipment or delivery comprised of packages with different codes may be acted upon as a single inspection lot. Follow-up inspection will require segregation of lots by lot code.

¹The National Conference on Weights and Measures Uniform Packaging and Labeling Regulation (NBS Handbook 130) defines a "random pack package" as a "package that is one of a lot, shipment, or delivery of packages of the same consumer commodity with varying weights; that is, packages of the same consumer commodity with no fixed pattern of weight." The procedures in this handbook for random pack packages apply to consumer and non-consumer packages with quantity declarations of weight or of other measures.

- o Upon occasion, the official may wish to define a lot of only one kind of packaged goods (e.g., ground beef) for special reasons, such as the large number of packages of one kind of goods, prior history of product or store, the unit price of the product, or because the results of audit testing indicate the possibility of shortage in a particular item.
- When location of inspection is either a warehouse or on-line at the packaging plant, the definition of the inspection lot is the same as that for standard pack packages except that "identical labels" is construed to mean identical except for the numerical quantity of contents.

2.3.3. Size of the Inspection Lot

Refer to discussion on the definition of lot (Section 2.3.) for further information on forming the inspection lot from which a sample will be drawn. Count the number of packages in the inspection lot. This is the size of the inspection lot, (N), to be entered on the report form (page A-1) in box 5.

2.4. PACKAGE ERRORS

In general, the actual package quantities that the official measures will not be the same as the labeled quantity. The deviation from the labeled quantity, rather than the actual package quantity, is the matter of interest to the official. Hence, positive or negative deviations from the label (called plus or minus errors or, in general, "package errors") will be the focus of the procedures in this handbook.

Package Error = (Measured Net Contents) - (Labeled Net Contents)

The official will record the individual package errors on the report form and then determine lot conformance based on these package errors.

2.5. SELECTING THE SAMPLING PLAN

The average requirement applies to the vast majority of packages to be tested, and Category A or B plans (described below) should be used in these instances. Special sampling plans for pressed and blown glass tumblers and stemware are presented in Section 5.7. (pages 5-20 and B-23). Special sampling plans must be used for packages labeled by count and containing less than 51 units per package. These plans are introduced in Section 5.2. (pages 5-5 and B-22).

All the sampling plan tables (Table 2-2, 2-5, 5-1, or 5-2) are tabulated according to lot size. The official may use a larger sample size (a line further down the table) but must follow the entire sampling plan (all of the corresponding horizontal line).

The official enters the tables by finding the horizontal line that corresponds to the size of the inspection lot (first column). The other columns detail the size of the sample (second column), the number of packages to be selected for tare determination (third column) and the number of individual packages permitted to exceed a "reasonable" value (last column).

2.6. SAMPLING PLANS IN CATEGORY A

Table 2-2 on page B-3 lists six sampling plans according to the inspection lot size, N, indicated in column 1. For each plan,¹ column 2 indicates the number of packages to be chosen at random from the lot; this is the "sample size", n. Appendix E describes several methods for obtaining a random sample. (Note the special precautions for sample selection on page E-10.) Column 3 of Table 2-2 indicates the number of packages to be chosen randomly from the sample or from the stock of unused tare materials for determination of tare; this is the "tare sample size". Appendix E also describes methods for tare sample selection. Column 4 indicates the number of minus package errors that are allowed to exceed the MAV. (This is the allowed number of unreasonable errors.)

After recording the lot size in box 5 on the report form (page A-1), the official selects a sampling plan according to the lot size and records the corresponding sample size in box 6 (checking that a Category A plan is being followed). The corresponding tare sample size is recorded in box 7 and the allowed number of unreasonable errors is recorded in box 8 on the report form.

¹Sample sizes of 50 and over are the same as those in Military Standard 105-D, but the sampling plans are <u>not</u> the same as Military Standard 105-D because the decision criteria are different. In addition to the decision criterion for individual packages (Section 2.6.1), the lot must also pass the decision criterion for the average (Section 2.6.2).

As mentioned in Section 2.5., Table 2-2 lists the <u>minimum</u> sample size to be used for any given lot size. A larger sample size may be chosen at any time as long as the official follows the entire sampling plan (all of any given horizontal line, including the decision criteria corresponding to that sampling plan and that line). For example, the official may choose to take a sample size of 50 for a lot of 750 packages, rather than a sample of 30. However, the official must also take 5 packages to determine the tare and the lot can be considered out of conformance only if 3 or more packages in the sample of 50 are short measure by more than the MAV from the labeled quantity (or if the sample fails the average error requirement).

Obviously defective individual packages are not to be selected from the inspection lot to become part of the sample. (See Appendix E for guidance in this situation.) However, obviously defective packages should not be reintroduced into commerce.

After the quantity of contents in each sample package is measured and recorded, the decision criteria of the plan are applied. The decision criteria indicate the conformance or nonconformance of the lot with the package requirements.

2.6.1. Decision Criterion: Individual Packages

First, conformance is checked with the package requirement that permits individual packages to differ from the labeled quantity by a "reasonable" amount. The package error (see Section 2.4.) for each package in the sample is compared to the MAV for that package type and size. (See Section 2.12. for more information about MAV's.) The minus errors that exceed the MAV are called "UNREASONABLE ERRORS". If the number of unreasonable errors exceeds the limit indicated in column 4 of Table 2-2 (page B-3) (corresponding to the sample size), the lot fails to conform with the package requirements. No further testing of the lot is necessary. On the report form on page A-1, the allowed number of unreasonable errors from column 4 of Table 2-2 is recorded 8 and the individual package errors in the in box crosshatched area of the report form. (See Section 2.9. for more information about recording package errors.) Each minus package error that exceeds the MAV should be circled on the report form and the number of circled package errors (the number of unreasonable errors) should be recorded in box 16 on the report form.

For example, the MAV for a 12 oz package is 0.036 lb (found by looking up the MAV in Table 2-8). Suppose the lot size is 500 packages. Table 2-2 indicates that a sample size of 30 and tare sample of 2 is to be selected. Column 4 of Table 2-2 indicates that only one package may exceed the MAV. A "1" is therefore entered in box 8 on the report form. Suppose that three packages in the sample of 30 are short weight by more than 0.036 lb. They are circled and a "3" is entered in box 16. Since this value is greater than the value in box 8, the "yes" box is checked in box 17. The lot, in this example, fails to conform to the net contents requirements.

If the number of unreasonable errors in the sample (recorded in box 16) is less than or equal to the number recorded in box 8, the lot complies with this first requirement. The average error must then be computed according to Section 2.6.2. before a final decision can be made as to the compliance of the lot with net quantity regulations.

When the lot size is 30 or less, all packages are tested. The lot is nonconforming if any minus package errors exceed the MAV. (This corresponds to 100% testing.)

2.6.2. Decision Criterion: The Average Error

The "average error" for the sample is computed by dividing the sum of the individual package errors (called the "total error" and recorded in box 15 on the report form on page A-1) by the number of packages in the sample (box 6). (The use of the crosshatched area of the report form to compute the average error is described in Section 2.9.3.) The average error is recorded in boxes 18 and 19 on the report form. "Dimensionless units" are explained in Section 2.9.1. If the total error (and, consequently, the average error) is zero or a positive number, a final decision on the lot can be made at this point; that is, the lot conforms with the package net quantity requirements.

When the lot size is 30 or less, all packages are tested; the lot is nonconforming if the total error has a minus value. (This corresponds to 100% testing.)

When the sample average is minus, the statistical terms "d", "f", and "T" are computed (as described below) and used to determine whether the lot conforms.

(i) First compute "d".

 $d = \overline{R} \times (0.8598 / \sqrt{n})$

where

 \overline{R} is the average range of package errors for groups of 5 packages taken in the order of weighing and n is the number of packages comprising the sample. (Appendix H contains a detailed example of how to calculate \overline{R} .)

For the convenience of the official, Table 2-3 in column 2 (page B-3), gives values of $0.8598/\sqrt{n}$ for each sample size to use in the calculation of d.¹

 $\overline{\rm R}$ is recorded in box 21 and the value from column 2 of Table 2-3 is recorded in box 22 on the report form.

For example, if the sample size is 30, and $\overline{R} = 2$,

d (= Table 2-3, column 2 value x \overline{R}) = (0.1570) x (2) = 0.3140. See Figure 2-4 for example.

d is recorded in box 23 and, as indicated on the form, is the value recorded in box 21 multiplied by the value in box 22.

¹Alternatively, a calculator which gives "standard deviation" directly may be used to determine d. Since commonly available hand calculators may not have enough storage capacity to calculate the standard deviation for large sample sizes, the average range method, described above, is acceptable. If a calculator that gives the standard deviation is being used, $d = 2s/\sqrt{n}$, where s is the standard deviation and n is the number of packages comprising the sample. For convenience, Table 2-3, column 3 gives values of $2/\sqrt{n}$ to use in this calculation. Slightly different values for d will be obtained using the standard deviation rather than the average range. If the standard deviation is used in the calculation, the report form must be modified to indicate the Table 2-3, <u>column 3</u>, value in box 22.

RANGES		1							1	5 TOTAL ERROR
3	4	1	2	I	1					9
16 NO. UNREASONABLE 17 IS 16 Greater than B MINUS ERRORS VES LOT FAILS O VES LOT FAILS		er than 8 FAILS NTINUE	18AVERAGE ERROR19AVERAGE ERROR(Dimensionless Units)(labeled units) $15 + 6 = -0.30$ 003 Lb.		ERROR hits)	20 IS 18 ZERO OR PLUS? CNO→C Cat B, Lot Fails & Cat. A, go to 21 □ YES→LOT PASSES				
21 AVERAGE	RANGE 2	2 Use 6 to I	ook up value	23 d = 21 ×	22 =	24 (n/N) × 100	= 30 × 100	25 Use 24 t	o look up f in	26 T = 23 × 25 =
2		in Table 2-3. (0.15	ol 2 (p B-3)	.31	40	(6÷5)×	100 = 60	Table 2-4	(p B-4) f = 63	0.20
27 Disregarding the signs, is 18 larger than 26 ?										
28 DISPOSIT OF LOT		Approved Rejected	Comments							
Acknowledged	Receipt of Re	port				Official				

Figure 2-4. Example of calculation of T.

(ii) Calculate the percentage of the lot that the sample represents.

For example, if the lot consists of 50 packages (N) and a sample of 30 packages (n) is to be selected from the lot, the sample represents $30/50 \times 100 = 60\%$ of the lot. This value is recorded in box 24 on the report form. See Figure 2-4.

(iii) Look up "f", listed in Table 2-4 on page B-4, based on the percentage of the lot that the sample represents (as recorded in box 24). The value of f from Table 2-4 is recorded in box 25 on the report form.

For the above example, the f value is 0.63. See Figure 2-4.

(iv) Calculate "T",

T = d x f

Record T in box 26 on the report form (where it is indicated that T is the value in box 23 times the value in box 25).

Following the above example, with d = 0.3140 and f = 0.63, $T = d \times f = 0.20$. See Figure 2-4.

(v) Compare the observed average error with T to determine lot conformance. If the average error recorded in box 18 (disregarding its minus sign) is larger than T, the lot does not conform with the package requirements. Record results in box 27.

> In the above example, the average error is -0.30, hence the lot fails to comply with the package requirements since the value in box 18 (-0.30) disregarding its sign is larger than the value in box 26 (0.20). See Figure 2-4.

It should be remembered that the calculations in steps (i) through (v) above have to be made only when the average error is minus.

2.7. SAMPLING PLANS IN CATEGORY B

Table 2-5 on page B-5 provides the two Category B sampling plans. Depending on the size of the lot,(N), shown in column 1, column 2 indicates the number of packages to be chosen at random from the lot (the "sample size", n) and column 3 shows the number of packages that must be opened to determine the average tare ("tare sample size"). Column 4 shows that **no** (zero) packages are permitted to exceed the MAV. On the report form on page A-1, the lot size is recorded in box 5, the sample size in box 6 (check the box indicating that a Category B plan is being followed), and the tare sample size in box 7. A zero is recorded in box 8.

Obviously defective individual packages are not to be selected from the inspection lot to become part of the sample. (See Appendix E for guidance in this situation.) However, obviously defective packages should not be reintroduced into commerce.

After the quantity of contents in the sample packages is measured and recorded, it is then necessary to compare these measurements with the package requirements.

2.7.1. Decision Criterion: Individual Packages

Minus package errors that exceed the magnitude of the MAV (Section 2.12.) are called "UNREASONABLE ERRORS". Category B permit no unreasonable errors in the sample. (See Column 4 of Table 2-5.)

On the report form on page A-1, the number of unreasonable errors found in the sample is recorded in box 16.

If there are any unreasonable errors in the sample, the lot fails to conform with the individual package requirement (see box 17 on the report form). No further testing is necessary to determine lot conformance.

If there are no unreasonable errors in the sample, the total error and the average error must be calculated before making a final decision on the conformance of the lot.

2.7.2. Decision Criterion: The Average Error

The "average error" of the sample is calculated from the values obtained from individual package measurements. The average error is obtained by dividing the sum of the individual package errors in the sample (called the "total error" and recorded in box 15 on the report form) by the number of packages in the sample (box 6).

If the total error (and consequently the average error) is zero or a positive number, the lot conforms with the package requirements. If the total error (and consequently the average error) is minus, the lot fails to conform with the package requirements.

The average error is recorded in boxes 18 and 19 on the report form. (Dimensionless units are explained in Section 2.9.1.) Whether the average error is a zero, plus, or minus value is recorded in box 20.

2.8. INDIVIDUAL PACKAGES

Even when a lot complies with the package requirements as determined by either a Category A or B sampling plan, individual packages in the sample may be short weight or measure by more than the MAV from the labeled quantity. However, any individual package that is short by more than the MAV from the labeled quantity is considered defective. Defective packages should not be reintroduced into commerce.

Disposition of such packages may be recorded on the report form on page A-1, for example, under "Comments".

2.9. RECORDING PACKAGE ERRORS

Measurement details are described in Chapters 3, 4, and 5. This section describes the method for recording measurement results on the report form.

2.9.1. The Unit of Measure and Dimensionless Units

It is convenient to record package errors in terms of "dimensionless integers" or "dimensionless units". Mechanical package testing scales are traditionally designed to be read either in terms of units of weight or in terms of the number of scale graduations (see Figure 3-2, page 3-2). When recording scale readings in terms of the number of scale graduations without regard to their weight value, the inspector is using "dimensionless units". Package errors must be multiplied by the value of the scale graduation (called the "unit of measure") in order to arrive at the actual package error in weight units. For example, assume that an official measures package errors to the nearest 0.002 lb. The scale used to weigh the packages has 0.002-lb divisions on its face. If an individual package error is "-0.022 lb", the official may record the unit of measure as 0.002 lb, count the number of divisions on the scale face, then record this number as the individual package error, here "-11".

It is possible to use this type of notation with electronic digital scales as well. If an electronic device reads out to 0.001 lb, the inspector may record the unit of measure as 0.001 lb and then record package errors without regard to the decimal place.

The report forms on pages A-1 and A-3 are designed on the assumption that dimensionless units will be used. Other forms may be designed to provide more room for recording individual package errors with the units of weight (or other measure) for each package.

It is essential that all comparative values be converted to dimensionless units as well, or else the package measurements must be converted back to the units of measure.

Following the earlier example, suppose the MAV for these packages is 0.020 lb. The official converts the MAV to a dimensionless unit by dividing by the unit of measure used to record the package errors. With a unit of measure of 0.002 lb, the MAV in dimensionless units =

 $\frac{0.020 \text{ lb}}{0.002 \text{ lb}} = 10.$

On the report form on page A-1 the unit of measure is recorded in box 2 (i.e., 0.002 lb). The MAV in dimensionless units is recorded in box 4 (i.e., 10).

2.9.2. Choosing the Unit of Measure

As a general rule, the official should record package measurements in a unit of measure less than or equal to the MAV/6.This is consistent with the principle expressed in NBS Handbook 44¹ that the error of standards used without correction "should be not greater than 25 percent of the smallest tolerance to be applied when the standard is used." Since packages must meet both the individual package requirement and the average requirement, errors made in individual package measurements are additive (and do not cancel one another). Therefore the 1:4 principle is tightened to 1:6, a ratio well suited to readily available testing equipment. For example, the MAV for packages labeled 2.50 lb is 1 3/8 oz (see Table 2-8 page B-10.) MAV/6 is 0.229 oz. Since a 1/4 oz unit is larger than 0.229 oz, a 1/8 oz unit of measure would be the largest appropriate for recording measurements on these packages.

In Chapter 3, Table 3-1 presents recommended maximum units of measure to be used in recording package weights when the packages are labeled by weight and in Chapter 4, Table 4-2 presents maximum units of measure for common consumer products labeled by liquid volume.

It should be kept in mind that the MAV's for packages labeled in units other than weight (Tables 2-9, 2-10, or 2-11) apply to such packages, even though weighing may be the means of package contents measurement. For example, packages labeled "48 fl oz" have an MAV of 1.25 fl oz. Assume that an inspector finds that 32.00 fl oz of the product under test weighs 2.000 lb. Then, the MAV of 1.25 fl oz is equivalent to:

 $\frac{(1.25 \text{ fl oz}) (2.000 \text{ lb})}{(32.00 \text{ fl oz})} = 0.0781 \text{ lb}$

The MAV/6 value is 0.013 lb or about 3/16 cz. In this instance, therefore, 1/8-oz units (or 0.008-lb units) are appropriate for testing the packages. If these same 48-fl oz packages had a weight of 1.000 lb for each 32 fl oz, the MAV of 1.25 fl oz would be equivalent to only 0.0391 lb and MAV/6 = 0.007 lb. Thus, units of 1/16 oz (or 0.004 lb) would be a better choice for measuring these packages.

Equipment used to measure package quantities should be capable of discriminating measurements to 1/6 of the MAV for an individual package. This handbook suggests equipment that meets this criterion.

¹Section 1.11. Fundamental Considerations, Subsection 3.2, NBS Handbook 44,"Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Equipment", revised and printed each year by the U.S. Government Printing Office.

2.9.3. How to Use the Crosshatched Area of the Report Form

On the standard pack report form on page A-1, package errors are entered in the "crosshatched" area¹. Five values are entered down the first column, then the next five in the second column, and so on. This area of the form is designed to aid the official in summing the individual package errors and determining the range of package errors (Computations are explained in Section 2.6. and Appendix H.) Each package error is entered in a two-triangle block according to the following scheme:



If the package error is minus, it is entered in the lower left triangle of the block:



This example indicates a package error of -2.

If the error is plus, it is entered in the upper right triangle of the block:



This example indicates a package error of +1.

Zero errors are also recorded in the upper right triangle of the block.

When checking sample sizes greater than 50, additional report forms must be used to record the package errors.

To obtain the sum of package errors, add the individual package errors horizontally across the rows in the crosshatched area, separately adding lower left and upper right triangles. Record the sum of each horizontal row in the "totals" column on the extreme right, then add up the rightmost column, taking care to observe the plus and minus values. (See Figure 2-5 for an example.) Record the total error in box 15. The average error of the sample is obtained by dividing the total error by the number of packages in the sample. The average error is recorded in box 18.

¹This portion of the report form is based on that of the Division of Measurement Standards, Department of Food and Agriculture, State of California (Report Form 524-003).

In order to obtain the average range needed for Category A, the range for each set of five package errors (each column of package errors) can be recorded at the bottom of the crosshatched area in the spaces marked "Ranges".

Follow Appendix H for determining the range for each group of five packages. Sum the individual ranges and divide by the number of groups of five packages in order to determine the average range and record in box 21.

For example, with a sample size of 30, six groups of five packages will be listed in six columns in the crosshatched area. (See Figure 2-5.)



Figure 2-5. Example of package errors, ranges, and total error recorded on part of the report form.

2.10. THE CRITERIA FOR WEIGHING PACKAGES NOT LABELED BY WEIGHT

The preferred method for testing packages labeled in units other than weight is to weigh such packages. If the official can determine the weight of the labeled quantity of product, that weight plus the empty container weight can be used to compare with the weights of unopened packages. Otherwise, the official must open and measure the contents of every package in the sample -- a time-consuming and costly alternative. However, two criteria must be met before the official may use a weighing technique:

(i) The equipment used must be able to discriminate differences in package content weights corresponding to the MAV/6.

(Most common liquid commodities will meet this criterion; see step 1, footnote, in Section 4.4.)

If the equal-arm scales described in Section 3.1. are used, this criterion can be met if 1/2 the smallest scale division is equal to or smaller than MAV/6. If a digital-readout scale is used, the smallest increment in the readout must not be larger than the MAV/6.

(ii) The weight of a known quantity of product must not vary significantly from package to package. (See Section 4.4. for liquid volume, 5.1.3. for count, 5.3.2. for linear measure.)

Chapters 4 and 5 describe in detail the procedures necessary to determine whether weighing can be used to determine net contents conformance for packages labeled in units other than weight (See Chapter 4 for volume and Chapter 5 for length, area, and count).

2.11. TARE

In compliance testing of packaged goods, the enforcement agency utilizes nondestructive tests insofar as possible, that is, testing that requires opening the fewest packages. The net weight of a package may be determined by weighing the unopened package called the "gross weight" - and subtracting from that weight the average weight of the packaging materials, called the "average tare weight", provided that the actual tare weights of individual packages do not vary too much (see Section 2.11.4.). In more complicated situations, the official first determines whether the labeled unit of measure, if it is not weight (e.g., volume), can be converted to a weight value (using the measured weight of a known volume, in the example of volume). If this is possible, the net contents of a package can be found by subtracting the tare weight from the gross weight (and converting the resultant value from units of weight to the units on the package label).¹

¹In actual practice, a "nominal gross weight" value will be determined (and recorded in box 14 of the report form shown on page A-1). The "nominal gross weight" is the sum of the average tare weight and the labeled weight. This weight value may then be easily compared with the actual gross weight of each unopened package in order to arrive at the individual package errors. For example, see steps 5 and 6 of Section 3.5.

The packages that are used to determine the average tare weight constitute the "tare sample". At least two determinations of individual package tare weights should be used to obtain an average tare value (that is, the tare sample size should be at least 2). For larger package sample sizes, the average tare value should be obtained from more than two determinations. (See Tables 2-2 and 2-5, pages B-3 and B-5, column 3, for tare sample sizes corresponding to various sample sizes.)

The average tare is recorded in box 13 on the report form on page A-1.

Two tare definitions are used commonly for the inspection of packaged goods:

- o <u>Dry tare</u> comprises all packaging materials (including glue, labels, ties, etc.) that will contain or enclose a product; it includes prizes, gifts, coupons, or decorations that are not part of the product. Dry tare is measured before the product is introduced into the container. <u>Dry tare is unused</u> tare.
- o <u>Wet tare</u> comprises all packaging materials that can be separated from the packaged product, whether 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 such as oven drying. As in the dry tare definition, prizes, decorations and such are also part of the wet tare. <u>Wet</u> tare is used tare.

In some cases (e.g., canned or glass- or plastic-packed goods) dry tare weights are equivalent to wet tare (within the measurement precision of field test scales). However, the net contents value that is obtained when a dry tare weight is subtracted from the package's gross weight will not always represent the amount of product that can subsequently be recovered from the package. For example, oils or moisture from the product may be absorbed by the packaging material when in contact with the product thereby increasing the weight of the packaging material and decreasing the weight of the product after packaging.

Tare weight can 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 the situation for most packaged products, it is a major problem with glass or aerosol containers. Therefore, an "alternative tare determination" procedure is provided in Section 2.11.4. This procedure must be used for glass or aerosol containers and is optional for any other container. There are several instances in which this procedure will prove useful to the official; the method is so simple that it can be used routinely. For example, relatively heavy containers (e.g., plastic buckets or cans) can vary considerably in tare weight, especially in a retail store inspection lot, which may be composed of packages from more than one production facility, and with containers made of different materials or made by different manufacturers. The procedure of Section 2.11.4. will indicate if this tare variability is sizable in comparison with the net weight variability, and whether the official should open more packages to obtain the average tare weight.

Direct measurement of net contents is necessary when the product cannot be checked by weighing. (For example, packaging materials and individual units in packages labeled by "count" sometimes differ enough in weight from each other such that the gross weight of a package minus the tare weight may not adequately indicate the count of units inside the package.)

The direct measurement of net contents is also necessary when the net content is defined as the "drained weight" of product inside the package. "Drained weight" is prescribed by regulatory agencies in those instances in which it has been concluded that the only usable or consumable material inside the package is the solid portion, whereas the liquid portion is disposed of and therefore "drained away". Common examples are canned or bottled olives and mushrooms. The liquids in which they are packed are not considered part of the net contents. Drained weight procedures are provided in Sections 3.10. and 3.13.

2.11.1. Choosing Packages for Tare

The tare sample should be a random sample. Appendix E contains descriptions of random sample and random tare sample selection. The packages to be opened for tare are determined as part of the random number selection process that determines the whole sample.

Some jurisdictions traditionally have taken the lightest and heaviest packages with respect to their gross weights as the tare sample. We recommend against this approach since variations in gross weight can be due to variations in tare weight, net weight, or both.

If dry tare is used, Appendix E procedures should be used to select the tare sample from the lot or lots of tare material.

Tare values are determined by weighing the empty package materials.

2.11.2. Cleaning Tare Materials

The method used for cleaning packaging material for tare weight determination depends on the tare material and the product it contains. In general, a common sense approach should be followed in cleaning tare materials. A bread bag, for example, may be turned inside out to remove all crumbs.

Care should be taken in cleaning tare material such as metal cans with paper labels so that the labels are not wet with water or other solvent used to clean the container. The interior of the containers should be thoroughly dried with a clean dry cloth or air dried, whichever is the most practicable. Butter or bacon wrappers, for example, should be scraped and wiped clean but no effort should be made to extract product contents absorbed by the tare. Caulking compound tubes should be cut open and scraped and wiped. Solvent may be used if the package is foil-lined, but precautions should be taken to avoid wetting the outside of the tube with solvent. Packages containing oil-based products may require several detergent washes to remove the product from the container.

The above are just a few of the approaches that may be used to clean packaging materials prior to determination of the tare weight.

2.11.3. Tare Neither Glass nor Aerosol

Table 2-2 and Table 2-5 (pages B-3 and B-5) indicate in column 3 how many packages to open or how many tare units to select at random in order to determine the average tare. The tare sample size is recorded in box 4 of the report form on page A-1.

The weights of the individual tare units (after cleaning) are recorded on the report form in the spaces marked "b" (see Figure 2-2) and should be averaged and entered in box 13. This average tare weight plus the declared net weight (subtracting any corrections) is the "NOMINAL GROSS WEIGHT" (box 14). The gross weights of unopened packages in the sample are compared with the nominal gross weight to determine their individual package errors.

2.11.4. Alternative Tare Procedure¹

The following procedure must be followed for glass or aerosol containers and is optional for all other packages. For example, it has been noted that the tare variability is large for the metal cans and plastic overcaps for ground coffee and products in large cans or plastic buckets. "F-Style" rectangular cans, of the type in which turpentine, mineral spirits, and similar products are packaged, are also good candidates for this procedure.

¹Modification of a procedure in "Determining Tare in Net Weight Acceptance Sampling" by Robert S. Elder, <u>Journal of Quality Technology</u>, vol. 4, no. 3, July 1972, pp. 131-133.

It often will be necessary to follow the tare procedures below for checking random pack meat and poultry using wet tare determinations.

The total number of packages to be opened for tare is determined by first

- o selecting the appropriate number of packages according to Table 2-6 (page B-6) for the "initial tare sample",
- o determining their tare weights and net contents,
- o obtaining the ratio of the range of net contents to the range of tare weights, and
- o referring to Table 2-7 (pages B-7 and B-8), which shows the total number of containers to be opened.

The total number of packages to be opened for tare may or may not be greater than the initial tare sample size. The report form on page A-1 may be used for recording measurements for standard pack packages labeled by weight. (See Figure 2-2.) The detailed procedure is as follows:

- An "initial tare sample" (see Table 2-6, page B-6) is selected from the sample. (See Appendix E for a description of random sample selection.) The initial tare sample size is recorded in box 7 on the report form.
- (ii) The packages chosen for tare are gross weighed, and then emptied.¹ Glass packages may be opened; aerosol packages must not be opened. (See Section 3.11.4. for instructions on emptying aerosol packages.)
- (iii) The tare weight is determined and recorded for each package.
- (iv) The net weights for the initial tare sample are calculated and recorded.

Net Weight = Gross Weight - Tare Weight

¹For packages labeled in units other than weight, a determination is made of the suitability of using a weight value in place of the labeled measure. This determination is made by using the contents of the first two packages chosen for tare determination, and is described in Section 4.4. for packages labeled by volume, in Section 5.1.3. for packages labeled by count, and in Section 5.3.2. for packages labeled by linear or area measure. The alternative tare procedure is then followed for those packages that can be checked by weight. For packages that cannot be checked by weight, net contents must be measured directly for all the sample packages and there is no tare determination.

- (v) The "range of net weights" for the tare sample (R_c) is determined and recorded in box 9. (The range is the difference between the largest net weight value and the smallest. See Appendix H for more complete instructions on determining the range.)
- (vi) The "range of tare weights" (called R_t) is determined and recorded in box 10.
- (vii) The ratio R_c/R_t is computed and recorded in box 11. (R_c and R_t must both be in the same unit of measure or both in dimensionless units.)
- (viii) The total number of packages to be emptied for the tare determination, n_t , is read from Table 2-7 (pages B-7 and B-8) and recorded in box 12. In this look-up table, read down the first column (headed R_c/R_t) to find the range in which the computed R_c/R_t fits, then read across to the column headed with the appropriate sample size, n. If the number of packages to open, n_t , is equal to the number already opened, no additional packages need to be emptied.
- (ix) If n_t is greater than the number of packages already opened, compute the number of additional packages, equal to $(n_t \text{ minus the initial tare} \text{ sample size})$, which must be emptied.

For example, if R_c/R_t is 2.90 for a sample size of n = 30, 10 package tare weights are necessary to determine the average tare. In this example, if five packages have already been emptied, five more must be emptied to obtain an average tare value.

In another example, ten packages are randomly selected from an inspection lot of bottled herring labeled 4 oz. Their gross weights are:

0.406	1b*	0.400	lb
0.400	lb*	0.394	lb
0.404	lb	0.398	lb
0.398	lb	0.396	lb
0.408	lb	0.398	lb

The starred values are for the packages that were chosen for tare determination. The tare weights are: 0.146 lb for the first package and 0.150 lb for the second.

The range of tare weights, is $R_t = 0.150 - 0.146 = 0.004$ lb.

The package net weights for the two packages chosen for tare determination are:

0.406 lb - 0.146 lb = 0.260 lb0.400 lb - 0.150 lb = 0.250 lb

The range of net weights, $R_c = 0.260 - 0.250 = 0.010$ lb.

 $R_c/R_t = 0.010/0.004 = 2.5$. Consulting Table 2-7, for $R_c/R_t = 2.5$ and n = 10, $n_t = 4$; therefore, two more packages must be opened to determine the average tare.

- (x) Steps (ii), (iii), and (iv) are repeated for these additional packages.
- (xi) The average of all the tare weights is used together with the labeled quantity (in terms of weight) to represent the "nominal gross weight" (unless all the packages in the sample have been opened). The average tare weight is recorded in box 13 of the report form.

The actual package gross weights are compared with the nominal gross weight in box 14 to determine the package errors for all packages in the sample (see Chapters 3, 4, and 5).

If the number of packages required to be opened for tare is more than half of the total sample, the official has the option of opening all the packages in the sample. The tare values are not averaged in such instances. Instead, each tare weight is subtracted from the corresponding package gross weight to obtain the individual package net weight. It will be necessary to append worksheets to the report form if more than 5 packages must be opened.

Note: For foam product aerosols, a "test allowance" is applied to the tare determination to compensate for differences in product delivery between normal consumer usage and the test procedure. (See Section 3.11.6.) This test allowance (provided in Table 3-2, page B-17) is subtracted from the actual tare weight or the average tare weight. The test allowance is recorded in box 13a. See also Section 3.15. for corrections (box 13a) for canned coffee (vacuum pack). Moisture allowances can also be applied by means of a correction to the tare (and entered in box 13a).

2.12. MAV's

The limits of reasonable individual package variations are called "MAV's" in this handbook. The MAV applies only to individual packages subject to the average requirement. Pressed and blown glass tumblers and stemware given an "allowable difference" (see Section 5.7.) are not compared with the MAV.

In the past, limits of reasonable variation have been described as values limiting both positive and negative deviations from the label. The present handbook provides MAV's that are used to compare with minus package errors only¹. Positive deviations will in general be controlled by the competitive marketplace; this handbook, therefore, indicates MAV values that are intended to limit only negative deviations from the labeled quantity.

Tables 2-8 through 2-11, on pages B-9 through B-14, are separated according to the labeled unit of measure, for example, weight, volume, etc.

In each table, one column lists ranges of labeled quantities and another column lists the MAV for that range. For example, the MAV for a labeled weight of 5 lb can be found on page B-10. 5 lb is in the range "4.70+ to 5.80"; the MAV in decimal pounds is 0.14 and in ounces is 2 1/4.

When an MAV is listed as a percentage of the label, make the calculation and round down to the lower figure equivalent to the unit of measure.

The MAV's for packages labeled by weight are limits to be applied to packages when the principal declaration on the label is in terms of net weight (e.g., soap) or drained weight (e.g., mushrooms). The MAV for packages labeled by weight do not apply to supplemental weight statements, such as "fill weight".

When checking standard pack packages, the official should complete box 3 of the report form on page A-1 using that value from Table 2-8, 2-9, 2-10, or 2-11 corresponding to the labeled quantity.

The special report form developed for random packages on pages A-3 and A-4 provides space for recording the MAV for random pack package weights. (See Section 3.8. for application of the MAV to random pack package lots.) Special worksheets provide space for calculating the MAV in units of weight and in dimensionless units for those instances in which weighing will be used to check packages labeled in units other than weight.

¹Note exception in Section 2.13. for textiles.

2.13. EXCEPTIONS TO THE MAV's

When packaging practices or the nature of the product demands, MAV's exceeding those listed in Tables 2-8 through 2-11 are necessary.

Specific Product Exceptions to the MAV:

o Any individual thickness measurement of polyethylene sheeting may be as much as -20% below the labeled thickness (i.e., -20% of the labeled thickness).¹

The average thickness of a single package of polyethylene sheeting may be as much as -7% below the labeled thickness (i.e., -7% of the labeled thickness).² (See Section 5.4.3.)

o The National Conference on Weights and Measures Uniform Packaging and Labeling Regulation lists the MAV's for textiles³ as the following:

For those packages with no declared dimension less than 24 inches (60 cm):

A minus error may be no greater than -3% of a declared dimension;

A plus error may be no greater than +6% of a declared dimension.

For the packages with any declared dimension less than 24 inches (60 cm):

A minus error may be no greater than -6% of a declared dimension;

A plus error may be no greater than +12% of a declared dimension.

o The National Conference on Weights and Measures recommends the following MAV for bark mulch.⁴

A minus error may be no greater than -5% of the declared volume.

 2 1978 Communication from the National Flexible Packaging Association (now the Flexible Packaging Association.)

³Section 10.9.3. of the Uniform Packaging and Labeling Regulation, NBS Handbook 130, 1984, "Uniform Laws and Regulations."

⁴Section 10.11. of the Uniform Packaging and Labeling Regulation, NBS Handbook 130, 1984, "Uniform Laws and Regulations."

¹ASTM Standard D-4397-84, "Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications", 1984.

The Meat and Poultry Inspection Manual¹ of the U.S. Department of Agriculture (USDA) sets the lower limit for individual packages for meat and poultry that are produced under official USDA inspection. These are the limits applied by USDA inspectors at the production plant. These limits are defined according to the package's "group" and the scale division size being used by the packager. Table 2-12 on page B-15 defines the groups and the lower limits for individual packages. Only one in 40 packages is permitted to exceed the limits specified in Table 2-12 for groups A, 1, 2, 3, and 4. No package in a sample of 10 may exceed the limits specified for group 5.

2.14. MOISTURE ALLOWANCE

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In those cases requiring allowance for moisture loss, one possible procedure is to subtract an allowance value (converted to units of weight if necessary) from the nominal gross weight (see Section 2.11. and Section 3.5.) to obtain a "corrected nominal gross weight". The gross weight of each unopened package in the sample is then compared with the corrected nominal gross weight in order to determine individual package errors.

The report form on page A-1 provides space in box 13a to record a moisture allowance in order to determine a corrected nominal gross weight (box 14). (See Figure 2-2.) This handbook does not provide specific allowance values to be used for moisture loss.

Other procedures or approaches to moisture loss may be used.

¹See Appendix J for Subpart 18-K, "Net Weight", pp. 168-174, from the combined changes through December 1981, U.S. Department of Agriculture, Food Safety and Inspection Service, Meat and Poultry Inspection Program.

CHAPTER 3. METHODS OF TEST FOR PACKAGES LABELED BY WEIGHT

- 3.1. Weighing equipment
- 3.2. Preparation for testing
- 3.3. Recording package weights
- 3.4. Reading the package testing scale
- 3.5. Standard pack labeled by weight: CORE METHOD (dry tare)
- 3.6. Standard pack labeled by weight: wet tare
- 3.7. Standard pack labeled by weight: alternative tare
- 3.8. Random pack labeled by weight
- 3.9. Large packages and the substitution method
- 3.10. The determination of drained weight
- 3.11. Aerosol packages
- 3.12. Frozen food and other frozen products
- 3.13. Drained weight of frozen foods
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- 3.15. Canned coffee

CHAPTER 3. METHODS OF TEST FOR PACKAGES LABELED BY WEIGHT

This chapter describes weighing equipment and conventions in weighing. There follows a step-by-step description of the general method of test for packages labeled by weight (CORE METHOD) that will be referenced throughout the rest of the handbook. Variations on this core method are presented for wet tare, alternative tare, and random pack.

Methods of test for packages with large net weights, for specific types of commodities labeled by weight (drained weight, aerosols), and for other specific commodities (coffee, seafood) complete the chapter.

3.1. WEIGHING EQUIPMENT

Either mechanical or electronic digital scales may be used for checking packages labeled by weight. The mechanical equal-arm scales described below have been specially designed for package testing; available electronic equipment can equal or exceed the performance of these mechanical devices and is described in more general terms on page 3-3.

Equal-Arm Scale (for small weights in avoirdupois units) (Figure 3-1). - An equal-arm scale with approximately 5 pounds capacity and with center tower and poise beams is acceptable. The division size should not be greater than 1/16 oz on one face and 0.002 lb on the other face. There should be at least 10 divisions on each side of zero on both tower faces. The poise beams should have a zero notch in the center and notched divisions, each equal to or less than the tower capacity, on each side of zero with a span of at least 4 oz or 0.24 lb. For example, a scale with 20 divisions (of 0.002 lb each) on the tower face should have notched divisions of 0.04 lb intervals on the poise beams. (See the close up of a typical tower face in Figure 3-2.) The scale should be fitted with a locking device to hold the lever during transit, have a carrying handle, and should be provided with a protective cover or box. The sensitivity of this scale must meet section T.N.6.1.(b) of the Scale Code in NBS Handbook 44 (H-44). The accuracy should meet the acceptance tolerances given in H-44 Scale Code for Class II or Class III scales.

Equal-Arm Scale (for small weights in metric units).¹ - Similar in design to the avoirdupois weight scale, except that the maximum size of each tower division should be 1 g and the poise beam should be provided with at least a 200-g span with notched divisions each equal to or less than the tower capacity. The sensitivity of this scale must meet the requirements in T.N.6.1.(b) of the Scale Code, H-44. The scale accuracy should meet the acceptance tolerances given in H-44 Scale Code for Class II or Class III scales.

¹The markings specified for the equivalent metric scale may be incorporated into the present avoirdupois weight scales to eliminate the need for two scales.



Figure 3-1. Equal-arm package testing scale for small weights (avoirdupois units).



Figure 3-2. Mechanical package testing scale tower faces.

Equal-Arm Scale (for larger weights in avoirdupois units). - For checking relatively heavy packages, an equal-arm scale with center tower and poise beams and a capacity of approximately 20 pounds is acceptable. One face of the tower should have a maximum division size of 1/8 oz and the other face of the tower should show divisions not greater than 0.004 lb. There should be at least 10 divisions on each side of zero on both tower faces. The poise beams should have a zero notch in the center and notched divisions, each equal to or less than the tower capacity, on each side of zero. One beam should have at least a 12-oz span and the other side at least a 0.6-lb span. This scale, too, should be fitted with a locking device to hold the lever during transit, a handle for carrying, and should have a protective cover or box. The sensitivity must meet H-44 requirements (Section T.N.6.1.(b) of the Scale Code.) The accuracy should meet the acceptance tolerances for Class II or Class III scales.

Equal-Arm Scale (for larger weights in metric units).¹ - Similar in design to the 20 pound scale, except that the tower should have maximum divisions of 2 g and the poise beam should be provided with at least a 400-g span with notched divisions each equal to or less than the tower capacity. The sensitivity of this scale must meet H-44 requirements (Section T.N.6.1.(b) of the Scale Code.) The accuracy should meet the acceptance tolerances for a Class II or Class III scale.

<u>Electronic Digital Scale.</u> - Electronic digital scales appropriate for package testing are available with displays ranging from 0.0001 lb to 0.01 lb and capacities from 6 to 50 lb (or greater). The keys to selecting appropriate equipment for package testing purposes are:

- o The scale should be selected such that the division size should be no greater than MAV/6 for the size package being weighed.
- o The scale must meet all requirements of H-44 Scale Code.
 - The scale must meet the <u>acceptance</u> tolerances given in the Handbook for its class.
 - The scale must meet Section T.N.7.2., H-44, on discrimination.
- o The scale must be portable and rugged.
- o Slight out-of-level conditions should not introduce errors.
- o For the convenience of the inspector (although not mandatory), the scale should be battery powered.

¹The markings specified for the equivalent metric scale may be incorporated into the avoirdupois weight scales in order to eliminate the need for two scales.

<u>Commercial Scale</u> - If packages are heavier than the capacity of the equal-arm scale for larger weights, or if they cannot be accommodated on the platform of the equal-arm scale, it may be necessary to use an on-site device. Care must be exercised to ensure that the device meets, and is used in accordance with the criteria listed under the "substitution" method, discussed in Section 3.9.

<u>Analytical Balance</u> - Section 2.9.2. specifies the use of scales that can weigh accurately to 1/6 the MAV for an individual package. For example, the MAV for a 10-g package is 10% of 10 g or 1 g; therefore, the accuracy to be used in weighing is 1/6 g or 0.17 g, which cannot be attained by the small capacity equal-arm metric package scale. Electronic portable scales are capable of weighing to 0.1 g, but if they are not available to the inspector, very small packages must be weighed on an analytical balance. (This may require signing for and transporting packages to a laboratory.)

<u>Field Standard Weights¹</u> (Figure 3-3) - Two kits in avoirdupois units are adequate for checking small packages labeled in inch-pound units. One is a collection of 31 pounds of standard weights from 2 lb to 1/16 oz denominations, the second kit's weights range from 0.3 lb to 0.001 lb. An additional 25-lb and two 50-lb standard weights will suffice to weigh most large packages.

For weighing packages labeled in metric units, weights should total 15 kg in standard weights of various denominations ranging down to 0.5 g for checking small packages. In addition, two 10-kg and two 20-kg standard weights will be sufficient to weigh most large metric packages.



Figure 3-3. Test weight kit.

¹Tolerances for field standard weights (avoirdupois and metric) are given in Appendix I, Table I-1.

3.2. PREPARATION FOR TESTING

The principal requirement for a testing location is convenience to both the official and store, warehouse, or plant personnel. Any checking in the customer area of the store should be so located that it does not interfere with normal customer traffic.

Once the test area has been selected, provision should be made for a stable and level table or work area for the test equipment. (A bubble level may be used to verify level working surface.) The scale should be placed on a firm support and leveled. The official should

- o check the scale accuracy and repeatability at zero-load indication and at 1/2 and full capacity,
- o test the scale with small loads at zero and full capacity to determine the sensitivity of the indications (tower face, poise beam) or discrimination of the digital readout,
- o perform a "shift test"¹ at 1/2 capacity.

A commercial scale may be used only after determining that it has met H-44 requirements and is sufficiently sensitive to indicate changes in weight commensurate with MAV/6 (see Section 2.9.2.). If selected, the scale should not be released to commercial service until the testing has been completed.

3.3. RECORDING PACKAGE WEIGHTS

Table 3-1 (page B-16) lists the recommended maximum units of measure with which the official should record weights according to the labeled weight of the package. This table gives guidance on appropriate equipment for different labeled weight declarations.

3.4. READING THE PACKAGE TESTING SCALE

To obtain the greatest accuracy with an equal-arm package testing scale, rather than reading the tower face directly to determine the package errors, the scale should be used as a "null-indicator". In order to use the scale as a "null-indicator", field standard weights are placed on one weigh pan to exactly balance the other weigh pan supporting the item to be weighed. The package errors may then be determined exactly as the sum of the reference weights added or subtracted (rather than weight indications on the tower face).

¹For a discussion of the shift test, see pages 103-105 of NBS Handbook 94.

If an <u>exact</u> balance cannot be achieved when determining the gross or net weights and using the package checking scale as a "null indicator", the index of the indicator should point away from the product being weighed and toward material being weighed for tare.

If the package checking scale is read directly, it will frequently be necessary to round off the indication shown on the tower face to the nearest division (or to the nearest division corresponding to the increments in Table 3-1.). When the index of the package scale indicator is less than one half the distance between two divisions, the official should record the value corresponding to the lower division. Similarly, when greater than one half the distance, record the value corresponding to the next higher division. When the indicator is half way between two divisions, the official should record the value corresponding to the next higher division when record in the gross package weight, but should record the value corresponding to the next lower division when recording the tare.

Conventionally, neither packagers nor testing officials make air buoyancy corrections in the determination of package weights. For reasons of practicality, this handbook does not recommend or include air buoyancy corrections.

3.5. <u>STANDARD PACK LABELED BY WEIGHT: CORE METHOD (DRY</u> TARE)

The description below references numbered boxes on the report form on page A-1. (See Appendix A.) Other report forms and worksheets are provided in Appendix A for special procedures, to be discussed in later sections of this or other chapters, but are not mentioned in the description of the CORE METHOD.

An outline of the test procedure is provided in Figure 3-4.

The steps described in detail below should be followed when testing standard pack packages labeled by weight if dry tare is available:

- 1. Fill out the report form identifying the product, container description, location of test, and other pertinent data, including
 - the labeled weight (box 1),
 - the unit of measure¹ (box 2),
 - the MAV^2 corresponding to the labeled weight (box 3), and
 - the MAV converted to dimensionless units¹ (box 4). The value in box 4 is obtained by dividing the value in box 3 (the MAV in units of weight) by the value in box 2 (the unit of measure).

²Look up the MAV corresponding to the labeled weight in Table 2-8, pages B-9 and B-10.

¹The unit of measure most often chosen is the size of the scale division. See discussion in Sections 2.9.1. and 2.9.2. on the unit of measure and dimensionless units.
Determine the inspection lot size (box 5). Record the

- sample size (box 6),
- tare sample size (box 7), and
- the number of unreasonable errors (errors exceeding the MAV) allowed (box 8) following one of the sampling plans in Category A (page B-3) or Category B (page B-5).
- 2. Select a random sample from the inspection lot. (See Appendix E.)

Select a random tare sample from the lot or lots of tare materials.

- 3. Determine tare weights for the tare sample and record these values on the report form in the spaces provided beside box b.
- 4. Average the tare weights determined from the tare sample and record in box 13. If moisture loss is a permitted variation for the particular packages under test and a moisture loss allowance is assigned, record the allowance in box 13a.
- 5. Determine and record the nominal gross weight in box 14.

Nominal gross weight = labeled weight (box 1) + average tare weight (box 13) - tare correction (box 13a)

- 6. Compare the sample packages with the nominal gross weight.
 - Equal-arm device: Put field standard test weights equal to the nominal gross weight¹ on the left pan of the scale and put one sample package at a time on the right pan, recording each individual package error in the crosshatched area of report form. (See Section 2.9.3. on how to fill out this part of the report form.) Complete the first column with the first five package errors before proceeding with the next columns in sequence. (Do not fill out the form by going across the page.)
 - Electronic device: Put field standard test weights equal to the nominal gross weight¹ on the scale and "tare out" the nominal gross weight so that the digital display is "0". Remove weights, place sample packages on the scale one at a time, and record package errors in crosshatched area of report form.

¹When no variability is observed between individual tare weights, it is acceptable to put field test weights equivalent to the labeled weight (minus any corrections) plus an actual tare on the balance.

FIGURE 3-4.

OUTLINE OF PACKAGE TEST Standard Pack Packages Labeled by Weight

- 1. Fill in pertinent data on report form: what is being tested, UNIT OF MEASURE, MAV, INSPECTION LOT SIZE, SAMPLING PLAN information.
- 2. Select RANDOM SAMPLE and RANDOM TARE SAMPLE
- 3. Determine AVERAGE TARE WEIGHT
- 4. Determine NOMINAL GROSS WEIGHT (labeled weight + average tare weight)
- 5. Determine PACKAGE ERRORS by comparing sample packages with nominal gross weight
- 6. Determine UNREASONABLE ERRORS by comparing minus package errors with MAV

If number of unreasonable errors is greater than allowed by sampling plan, inspection lot fails test. No further testing is necessary.

7. Determine AVERAGE PACKAGE ERROR.

If average package error is zero or plus, inspection lot passes test. No further testing is necessary.

If CATEGORY B plan is being used, and average package error is a minus value, inspection of lot fails test. No further testing is necessary.

8. If a CATEGORY A plan is being used and average package error is minus, determine T.

If average minus package error is larger in magnitude (disregarding the sign) than T, inspection lot fails test. If average error is smaller, inspection lot passes.

- 7. Compare each minus package error to the MAV. Circle any minus package error that exceeds the MAV (i.e., an "unreasonable error"). Record the number of unreasonable errors in box 16.
- 8. Compare the number of unreasonable errors found in the sample (box 16) with the number of unreasonable errors allowed (recorded in box 8 according to the sampling plan being followed). If the number found is greater than the allowed number, the lot fails to comply with the test. No further testing is necessary. Record the results in box 17 (and box 28 if no further testing is performed).
- 9. If the number of unreasonable errors found is not greater than the allowed number, sum the individual package errors in the right hand portion of the crosshatched area, taking into account the plus errors and minus errors. Record the total error in box 15. If the total error (box 15) is zero or a positive number, the lot passes the test. Compute the average package error by dividing the total error in box 15 by the sample size recorded in box 6. Record the average package error in box 18. Compute the average error in terms of weight by multiplying the average error in dimensionless units (recorded in box 18) by the unit of measure (recorded in box 2). Record that value in box 19. When following a Category B sampling plan, if the total (and average) error are negative, the lot fails the test. Record results in box 20 and record the disposition of the lot in box 28.
- 10. When following a Category A sampling plan, if the total error is negative, "T" must be computed before a final decision on the lot can be made.

In order to compute "T":

- Record the range (R) of package errors of each group of five packages tested in the sample. Space is provided at the bottom of each column of five package errors to record the range. (See Figures 2-4 and 2-5.) See Appendix H on how to compute a "range".
- Average the group ranges and record the average range, \overline{R} , in box 21. (For a sample of 30, there will be 6 ranges to sum and divide by 6; for a sample of 50, sum 10 ranges and divide by 10.)

Determine "d":

d = Table 2-3, column 2 value multiplied by \overline{R} .

Look up the value in Table 2-3, column 2 (page B-3) corresponding to the sample size (already recorded in box 6) and record this value in box 22. Multiply the value in box 22 by the average range \overline{R} in box 21 and record d in box 23.

- Compute percentage of lot tested. This is equal to the value in box 6 divided by the value in box 5 and multiplied by 100. Record the value in box 24. (For a sample size of 30 and a lot size of 300, this value is 10%.)
- Look up "f" in Table 2-4 (page B-4) corresponding to the percentage of lot sampled that was recorded in box 24. Record this value in box 25. (For 10% of the lot tested, f = .95.)
- Compute "T":

T = d x f = the value in box 23 multiplied by the value in box 25.

Record T in box 26.

11. Compare the magnitude of T (box 26) with the magnitude of the average error (box 18) (disregarding the fact that box 18 is a minus value.) If the average error is larger than T, the lot fails to conform to the package requirements. If the average error is smaller than T, the lot conforms. Record the results in box 27 and box 28.

3.6. STANDARD PACK LABELED BY WEIGHT: WET TARE

The CORE METHOD is followed except:

- The random tare sample is selected from the random sample (in step 2).
- o Gross weights of tare sample packages are determined and recorded before opening (in step 3).
- Tare weights are determined by emptying, cleaning or wiping dry, then weighing all packaging materials from the tare sample (in step 3).
- Package errors are determined for the tare sample by subtraction, for the rest of the sample by comparison with the nominal gross weight.

The procedure is as follows. Differences from the CORE METHOD are underlined.

- 1. Fill out the report form identifying the product, container description, location of test, and other pertinent data, including
 - the labeled weight (box 1),
 - the unit of measure (box 2),
 - the MAV corresponding to the labeled weight (box 3), and
 - the MAV converted to dimensionless units (box 4). The value in box 4 is obtained by dividing the value in box 3 (the MAV in units of weight) by the value in box 2 (the unit of measure).

Determine the inspection lot size (record in box 5). Record - the sample size (box 6),

- tare sample size (box 7), and
- the number of unreasonable errors allowed (box 8) following one of the sampling plans in Category A (page B-3) or Category B (page B-5).
- 2. From the inspection lot, select the random sample, and from it the random tare sample. (See Appendix E for sample selection techniques.)
- 3. Determine and record individual package gross weights for tare sample. (See Figure 3-5.) Record in boxes labeled a. Open, empty, and clean tare sample packaging materials, determine and record tare weights in boxes labeled b.





- 4. Average the tare weights determined from the tare sample and record in box 13. If moisture loss is a permitted variation for the particular packages under test and a moisture loss allowance is assigned, record the allowance in box 13a.
- 5. Determine and record the nominal gross weight in box 14.

Nominal gross weight = labeled weight (box 1) + average tare weight (box 13) - tare correction (box 13a)

- 6. Compute and record package errors for tare sample:
 - (a) Package error in units of weight = Gross weight of package - nominal gross weight. This is the value in box a minus the value in box 14. Record the results in boxes labeled d.
 - (b) Convert package errors recorded in boxes d to dimensionless units (so that they can be recorded later in crosshatched area). Do this by dividing the package errors in units of weight (box d) by the unit of measure recorded in box 2. Record these values in the boxes labeled e.
 - (c) Transfer package errors for tare sample recorded in boxes e to the crosshatched area of report form.
- 7. Compare unopened sample packages with nominal gross weight.
 - Equal-arm device: Put field standard test weights equal to the nominal gross weight¹ on the left pan of the scale and put one sample package at a time on the right pan, recording each individual package error in the crosshatched area of report form. Fill in the first column with the first five package errors before proceeding with the next columns in sequence. (Do not fill out the form by going across the page.)
 - Electronic device: Put field standard test weights equal to the nominal gross weight¹ on the scale and "tare out" the nominal gross weight so that digital display is "0". Remove weights, place sample packages on the scale one at a time, and record package errors in crosshatched area of report form.
- 8. Compare each minus package error to the MAV. Circle any minus package error that exceeds the MAV (i.e., an "unreasonable error"). Record the number of unreasonable errors in box 16.

¹If no variability in the tare weights is observed in the tare sample, it is acceptable to put field test weights equivalent to the labeled weight (minus any corrections) plus an actual tare on the balance.

- 9. Compare the number of unreasonable errors found in the sample (box 16) with the number of unreasonable errors allowed (recorded in box 8 according to the sampling plan being followed). If the number of unreasonable errors found in the sample is greater than the allowed number, the lot fails to comply with the test. No further testing is necessary. Record the results in box 17 (and box 28 if no further testing is performed).
- 10. If the number of unreasonable errors found is not greater than the allowed number, sum the individual package errors in the right hand portion of the crosshatched area, taking into account the plus errors and minus errors. Record total error in box 15. If the total error (box 15) is zero or a positive number, the lot passes the test. Compute the average package error by dividing the total error in box 15 by the sample size recorded in box 6. Record the average package error in box 18. Compute the average error in terms of weight by multiplying the average error in dimensionless units (recorded in box 18) by the unit of measure (recorded in box 2). Record that value in box 19. When following a Category B sampling plan, if the total (and average) error is negative, the lot fails the test. Record results in box 20 and the disposition of the lot in box 28.
- 11. When following a Category A sampling plan, if the total error is negative, "T" must be computed before a final decision on the lot can be made.

In order to compute "T":

- Record the range (R) of package errors of each group of five packages tested in the sample. Space is provided at the bottom of each column of five package errors to record the range.
- Average the group ranges and record the average range, \overline{R} , in box 21. (For a sample of 30, there will be 6 ranges to sum and divide by 6; for a sample of 50, sum 10 ranges and divide by 10.)
- Determine "d":

d = Table 2-3, column 2 value multiplied by \overline{R}

Look up the value in Table 2-3, column 2 (page B-3) corresponding to the sample size (already recorded in box 6) and record this value in box 22. Multiply the value in box 22 by the average range in box 21 and record d in box 23.

- Compute the size of the sample as a percentage of the lot size. This is equal to the value in box 6 divided by the value in box 5 and multiplied by 100. Record the value in box 24. (For a sample size of 30 and a lot size of 300, this value is 10%.)
- Look up "f" in Table 2-4 (page B-4) corresponding to the percentage of lot sampled that was recorded in box 24. Record this value in box 25. (For 10% of the lot tested, f = .95.)
- Compute "T":

 $T = d \times f = the value in box 23$ multiplied by the value in box 25.

Record T in box 26.

12. Compare the magnitude of T (box 26) with the magnitude of the average error (box 18) (disregarding the fact that box 18 is a minus value). If the average error is larger than T, the lot fails to conform to the package requirements. If the average error is smaller than T, the lot conforms. Record the results in box 27 and box 28.

3.7. STANDARD PACK LABELED BY WEIGHT: ALTERNATIVE TARE

The CORE METHOD (page 3-6) is followed except:

- o The sample packages are kept in the order in which their corresponding random numbers were obtained.
- The random tare sample is the "initial tare sample" and is selected from the random sample.
- Tare weights are determined by emptying, cleaning, and weighing all packaging materials.
- o The range of tare weights (R_t) and range of net weights (R_c) is determined for the initial tare sample.
- o R_c/R_t is computed and this value is used to look up how many more packages (if any) must be opened to determine tare. Additional tare packages are measured as necessary.
- o Package errors are determined for the tare sample by subtraction, and for the rest of the sample by comparison with the nominal gross weight.

The procedure is as follows. Differences from the CORE METHOD are underlined.

- 1. Fill out the report form identifying the product, container description, location of test, and other pertinent data, including
 - the labeled weight (box 1),
 - the unit of measure (box 2),
 - the MAV corresponding to the labeled weight (box 3) and
 - the MAV converted to dimensionless units (box 4).

Determine the inspection lot size (record in box 5). Record - sample size 1 (box 6) and

- allowed number of unreasonable errors (box 8).

Determine and record initial tare size from Table 2-6 (page B-6) in box 7.

- 2. Select random sample from inspection lot <u>keeping sample</u> packages in the order in which their corresponding random numbers are obtained. This is the order in which packages will be opened for tare determination. (See Appendix E.6.1. for an example.)
- 3. Determine and record individual package gross weights (in boxes labeled a) for initial tare sample.
- 4. <u>Empty these packages, clean them, determine and record</u> tare weights (in boxes labeled b).
- 5. Determine the range of tare weights (R_t) . Record R_t in box 10. (See Appendix H on determining a "range.")
- 6. <u>Subtract each tare weight from the corresponding gross</u> weight to obtain the net weights for the initial tare sample. Record the net weights in the spaces labeled c.
- 7. Determine the range of net weights (R_c) . Record in box 9.
- 8. Divide R_c (box 9) by R_t (box 10) and record in box 11.
- 9. Find the value recorded in box 11 for R_c/R_t in the left column of Table 2-7 (pages B-7 and B-8). Then read across to the column headed with the appropriate sample size. This value, n_t , is the total number of packages to be emptied for tare determination. Record this value in box 12. If the number in box 12 is equal to or less than the initial sample size (recorded in box 7), there are enough packages to determine the average tare. However, if the number in box 12 is greater than the value in box 7, more

¹For Category A, see page B-3. For Category B, see page B-5.

packages must be opened to determine average tare. For example, if 2 packages were opened initially and, using Table 2-7, $n_t = 5$ (in box 12), then three more packages must be opened to obtain an average tare value. In some instances, all the packages in the sample must be opened an average tare is not appropriate. If more than 5 packages must be opened, the official will have to record the measurements on a worksheet.

10. Unless all packages in the sample have been opened, average the tare weights¹ and record in box 13. Go to step 11.

If all packages have been opened,² each package error (in units of weight) =

(gross weight) - (tare weight) - (labeled weight)

Follow steps 12(b) and (c) and then skip to step 14.

11. Determine and record the nominal gross weight in box 14.

Nominal gross weight = labeled weight (box 1) + average tare weight (box 13) - tare correction (box 13a)

- 12. Compute and record package errors for tare sample:
 - (a) Package error in units of weight = Gross weight of package - nominal gross weight. This is the value in box a minus the value in box 14. Record the results in boxes labeled d.
 - (b) Convert package errors recorded in boxes d to dimensionless units so that they can be recorded in crosshatched area. Do this by dividing the package errors in units of weight (box d) by the unit of measure recorded in box 2. Record these values in the boxes labeled e.
 - (c) <u>Transfer package errors for tare sample recorded in</u> boxes e to the crosshatched area of report form.

¹If moisture loss is a permitted variation for the particular packages under test and a moisture loss allowance is assigned, record allowance in box 13a.

 $^{^{2}}$ If all packages have been opened, then each package error must be corrected for moisture loss (if a moisture loss applies) before going to step 14.

- 13. Compare unopened sample packages with nominal gross weight.
 - Equal-arm device: Put field standard test weights equal to the nominal gross weight on the left pan of the scale and put one sample package at a time on the right pan, recording each individual package error in the crosshatched area of report form.
 - Electronic device: Put field standard test weights equal to the nominal gross weight on the scale and "tare out" the nominal gross weight so that the digital display is "0". Remove weights, place sample packages on the scale one at a time, record package errors in crosshatched area of report form.
- 14. Compare each minus package error to the MAV. Circle any minus package error that exceeds the MAV and record the number of "unreasonable errors" in box 16.
- 15. Compare the number of unreasonable errors found in the sample (box 16) with the number of unreasonable errors allowed (recorded in box 8 according to the sampling plan being followed). If the number of unreasonable errors found is greater than the allowed number, the lot fails to comply with the test. No further testing is necessary. Record the results in box 17 (and box 28 if no further testing is necessary).
- 16. If the number of unreasonable errors found is not greater than the allowed number, sum the individual package errors in the right hand portion of the crosshatched area, taking into account the plus errors and minus errors. Record total error in box 15. If the total error (box 15) is zero or a positive number, the lot passes the test. Compute the average package error by dividing the total error in box 15 by the sample size recorded in box 6. Record the average error in box 18. Compute the average error in terms of weight by multiplying the average error in dimensionless units (recorded in box 18) by the unit of measure (recorded in box 2). Record the value in box 19. When following a Category B sampling plan, if the total (and average) error is negative, the lot fails the test. Record results in box 20 and the final disposition of the lot in box 28.

17. When following a Category A sampling plan, if the total error is negative "T" must be computed before a final decision on the lot can be made.

In order to compute "T":

- Record the range (R) of package errors of each group of five packages tested in the sample. Space is provided at the bottom of each column of five package errors to record the range.
- Average the group ranges. Record the average range (\overline{R}) in box 21. (For a sample of 30, there will be 6 ranges to sum and divide by 6; for a sample of 50, sum 10 ranges and divide by 10.)
- Determine "d":

d = Table 2-3, column 2 value multiplied by \overline{R}

Look up the value in Table 2-3, column 2 (page B-3) corresponding to the sample size (already recorded in box 6) and record this value in box 22. Multiply the value in box 22 by the average range in box 21 and record d in box 23.

- Compute the size of the sample as a percentage of the lot size. This is equal to the value in box 6 divided by the value in box 5 and multiplied by 100. Record the value in box 24. (For a sample size of 30 and a lot size of 300, this value is 10%.)
- Look up "f" in Table 2-4 (page B-4) corresponding to the percentage of lot sampled that was recorded in box 24. Record this value in box 25. (For 10% of the lot tested, f = .95.)
- Compute "T":

 $T = d \times f =$ the value in box 23 multiplied by the value in box 25.

Record T in box 26.

18. Compare the magnitude of T (box 26) with the magnitude of the average error (box 18) (disregarding the fact that box 18 is a minus value). If the average error is larger than T, the lot fails to conform to the package requirements. If the average error is smaller than T, the lot conforms. Record the results in box 27 and box 28.

3.8. RANDOM PACK LABELED BY WEIGHT

Random pack packages are those whose contents are measured, packaged, and labeled individually. These packages do not generally occur in fixed or patterned quantities. They occur most frequently labeled by weight. They are tested most frequently where packaged, usually at the retail store or wholesale warehouse.

See Section 2.3.2. for the definition of a lot for random pack commodities.

Special report forms, such as the ones on page A-3 and A-4, will simplify recording additional information (such as the product identity, unit price, and labeled weight) that many jurisdictions desire when testing random pack packages.

The methods for checking random pack packages are derived from the standard pack CORE METHOD for dry tare, wet tare, or alternative tare.

Section 3.8.1. describes the most common test procedure for random pack, using dry tare and a Category B sampling plan. Section 3.8.2. describes variations using "page 2" (see page A-4) of the report form for Category A plans, or wet tare, or alternative tare.

These random pack methods will be described after discussing the choice of the MAV.

Selecting the MAV

Table 2-8, pages B-9 and B-10, lists MAV's that vary with the labeled weight.

Because random pack packages are individually weighed and marked after packing, an additional element of control is possible that is not available with standard pack packages. Consequently, the amount of variability found in the package errors for random pack packages is frequently less than in standard pack.

This handbook therefore, recommends for audit testing:

- o When testing inspection lots defined as a single size of tare (e.g., boat size "2S"), apply the MAV corresponding to the smallest labeled weight in the sample.
- o When testing inspection lots defined as the entire meat case, or entire store-packed produce counter, etc., <u>apply the MAV</u> corresponding to the average labeled weight in the sample.

When official tests are performed, identify the appropriate MAV for each package labeled weight. When using dry tare, it is convenient to reorder the sample from lightest to heaviest in labeled weight prior to testing. This facilitates selecting MAV's according to labeled weight ranges.

3.8.1. Random Pack, Dry Tare, Category B Sampling Plans

The CORE METHOD should be followed, except:

- o Labeled weight and MAV cannot be recorded until the sample has been selected.
- o After the sample has been selected, reorder packages from lightest to heaviest to facilitate building the nominal gross weight from standard test weights (against which the packages will be compared).
- o Variability of tare weights should be tested. However, the dry tare weight of many random pack packages varies less than the detection capability of the official's equipment. In these instances, a single dry tare, comprised of all the packaging materials (including the label), may be substituted for the field standard weights to represent the tare weight portion of the nominal gross weight.
- o Report form box numbers on pages A-3 and A-4 differ from the standard pack form box numbers (page A-1).

The procedure is as follows. (Boxes on the report form, page A-3, are identified.) Differences from the CORE METHOD are underlined.

- Begin to fill out the report form by identifying the location of test. Determine the size of the inspection lot to be tested (box 1). According to Table 2-5, page B-5, record the sample size (box 2), tare sample size (box 3) and number of unreasonable errors allowed (box 4). Record the unit of measure (box 5). Check the dry tare box under "Tare" on the right side of the report form.
- 2. Select random sample. (See Appendix E.) <u>Have tare made</u> up to represent tare sample. Note that when the tare is comprised of a foam or plastic boat, a fixed number of soaker pads, shrink wrap, and label, a single tare appropriate for each size of package can be the tare sample if no variation in tare weights is detected. If variability in tare weights is present, space is provided on the form for recording up to four different tare samples (corresponding, for example, to different tray sizes).

Reorder sample packages in the order of their labeled weights and record product identity, lot code, price per unit of weight, and labeled weight (boxes 7 and 8). For audit test, record MAV in box 10 corresponding to:

- <u>smallest labeled weight when lot is defined as a</u> <u>single product or consists of a single tray size for</u> <u>tare; or</u>
- average labeled weight when lot is defined as entire production of store department, e.g., meat department or produce department.

For official tests, record in box 10 the MAV corresponding to each package labeled weight.

Divide the MAV ($\underline{box 10}$) by the unit of measure ($\underline{box 5}$) to get the MAV in dimensionless units. Record this value in $\underline{box 11}$.

- 3. Compare first sample package with its nominal gross weight. Nominal gross weight for each package is individual package labeled weight (which will vary from package to package) plus unused empty package tare (which may vary depending upon how the inspection lot is defined).¹
 - Equal-arm device: Place empty dry tare package¹ plus field standard weights equal to the labeled weight marked on the first package on the left pan of the scale and place first sample package on the right pan. Record the package error (in dimensionless units) in the space provided in box 9, minus errors in column headed (-) and zero or plus errors in column headed (0/+).
 - Electronic device: Place actual dry tare¹ plus field standard weights equal to the labeled weight <u>marked</u> on the first package on the scale. "Tare out" this value so that the digital display is "0". Remove tare and weights. Place first sample package on the scale; record package error, as read, in space below box 9.
- 4. Compare remaining sample packages with their own nominal gross weights and record as described in step 3.
- 5. Circle minus package errors that are larger than the appropriate MAV recorded in box 11. Count circled (unreasonable) package errors. Record this number in box 13 at the bottom of the report form.

¹If variation in tare weights for a single tray size is noted, then nominal gross weight = (labeled weight) + (average tare weight).

6. If the number in box 13 is larger than zero (the number in box 4), check in box 14 that the lot fails and enter the final disposition of lot in box 18. No further testing is necessary.

If the number in box 13 is zero, continue.

- 7. Taking account of plus and minus errors, sum package errors and record total error in box 12. Record average error in box 15.
- 8. Convert average error in dimensionless units to units of weight and record in box 16.
- 9. If average error is zero or plus, check that the lot passes in box 17.
- 10. In box 18, record results from boxes 14 and 17, either lot approved or rejected.

3.8.2. Random Pack, Wet Tare or Alternative Tare Methods, or Category A Sampling Plans

The second page of the Random Pack Report Form on page A-4 is provided for the several calculations that must be performed with these methods.

If the inspection lot is defined as the entire meat department, etc., the <u>average</u> tare weight must be determined for each and every type and size of tare in the sample.

Unlike the procedure for random pack using dry tare, the official should not reorder the packages in the order of their labeled weights. This will preserve the random order for the tare sample and for the determination of the range of package errors.

When determining wet tare weights for random pack packages of meat, poultry, fish and similar products, the official may note large variations in tare weights stemming from, for example, different numbers of soaker pads in packages, or different amounts of absorbed liquid in the packaging materials. In such case, the alternative tare procedure of Section 2.11.4. will useful in be the determination of the average tare weight. Use of the alternative tare procedure is described in the method on the next page.

Summary of wet tare, alternative tare, and/or Category A methods

Follow Section 3.6. (standard pack, wet tare) or 3.7. (standard pack, alternative tare) except:

- Nominal gross weight for each package is the individual package labeled weight (which will vary from package to package) plus the average tare.
- o Report form box numbers differ from the standard pack form.

Procedure (alternative tare, Category A)

Although this procedure is based on the CORE METHOD, differences from the CORE METHOD are not underlined.

- 1. Select random sample and mark packages in the order in which the random numbers were obtained. This is the order in which the packages will be opened for tare and the order in which the package errors will be recorded. Record the package descriptions and labeled weights in this order in boxes 7 and 8 on "page 1" of the report form (shown on page A-3). Record the MAV corresponding to each labeled weight in box 10.
- 2. Determine and record in boxes labeled a and b on "page 2" (shown on page A-4) gross weights and tare weights of packages in the initial tare sample. (See Table 2-6, page B-6.) (For example, when the initial tare sample size is 5, packages marked "1" through "5" are gross weighed.)
- 3. Subtract each tare weight from its corresponding package gross weight to determine the net weights of the packages in the initial tare sample. Record in boxes labeled c on "page 2".
- 4. Determine and record the range of tare weights, R_t , for the initial tare sample and record this value in box 6b on page 2 of the report form. Determine and record the range of net weights, R_c , in box 6a. Compute R_c/R_t ; record in box 6c. Look up the value for n_t , the number of packages needed to determine the average tare, in Table 2-7, pages B-7 and B-8, and record in box 6d. Open additional packages (in the order marked), if necessary, and record their gross and tare weights.

5.

- Unless all packages in the sample have been opened. average the tare weights, and record average tare in box 6e. Compute package errors for the packages opened for tare and record these package errors in boxes labeled d and e. Transfer these package errors to page 1, box 9, of the report form. If at least half of the packages in the sample are needed to determine the tare, open and determine the net weight (gross weight minus tare weight) and package errors (net weight minus labeled weight) for all the packages in the sample. Additional worksheets will have to be appended to the report form to show all the calculations. When all packages have been opened, go to step 7 to complete the test.
- 6. Rearrange any remaining (unopened) packages in the sample from lightest to heaviest in order to facilitate subsequent measurements. Compare each unopened package with the nominal gross weight comprised of test weights representing the average tare weight plus the individual package labeled weight. Record the package errors in the spaces below box 9 on the first page of the report form corresponding to the package number marked on the package. (As an example, after five packages were opened for tare, the package with the lightest labeled weight may have been marked number 27. The package error is determined and recorded on the 27th line in box 9 of the report form beside the product description and labeled weight for this package, already recorded in boxes 7 and 8.)
- 7. Circle those minus package errors that exceed the MAV. Record in box 19 (on the second page of the report form) whether the number of unreasonable errors (box 4) exceeds the allowed number (box 13). If so, the lot fails and no further testing is necessary.
- 8. If the number of unreasonable errors is less than or equal to the allowed number, compute the total package error and record this value in box 12 (on the first page of the report form). If the total error is a plus value, the lot complies with the requirements. Complete boxes 20 and 21 on "page 2" and check that the lot is accepted (box 18 on "page 1").

9. If the total error is a minus value, compute the range of package errors for each group of five packages and record this in the spaces provided in box 23, "page 2". Compute the average range in box 24. Look up the value corresponding to the lot size in Table 2-3, column 2 (page B-3) and record this value in box 25. Compute and record d in box 26. Compute the percentage of the lot that the sample represents in box 27. Look up f in Table 2-4 (page B-4) and record it in box 28. Compute and record T in box 29. Compare the average error in box 20 with T in box 29. Record the final disposition of the lot in box 18 on the first page of the report form.

3.9. LARGE PACKAGES AND THE SUBSTITUTION METHOD

The substitution method may be used with any commercial scale for the checking of large packages (random or standard pack) if the size and/or weight exceed the capacity of the equal-arm (or equivalent) package-checking scales. The commercial scale should be used only as a substitution weigher or as a null indicator, not as a "direct reading" device, because possible scale error and between-division interpolation error contribute to the uncertainty of results. When using a commercial scale, each weighing, whether gross weight or tare weight, will require the following steps. (See example in Figure 3-6.)

- 1. Place package on commercial scale and record scale reading. Remove package.
- 2. Place standard weights equivalent to the scale indication in step 1 on the scale and add a small amount of additional weights (an additional 1 to 3%) to obtain an exact scale reading such that:
 - o If an analogue scale, the index of the indicator is coincident with a scale division.
 - o If a digital scale, a "break-point" is attained between two consecutive indications. Add a sufficient amount of small weights (in increments equal to 1/10 the value of the scale's minimum division)¹ to reach break point.

Record standard weights and scale reading on a worksheet.

3. Remove standard weights from the scale. Place the sample package on the commercial scale again.

¹For a discussion of error weights testing, see pages 120-122 of NBS Handbook 94.

Figure 3-6. Examples of substitution weighing.

Step		standard weights on pan	scale reading
	Determining Gross Weight or	(decimal g Tare Weights	oounds)
1.	After placing sample package on scale pan		101.1
2.	After placing standard weights on pan to give an exact reading equal to step 1 scale indication + approximately 1 percent	101.94	102.0
3.	After removing standard weights and replacing sample package		101.1
4.	After adding standard weights to duplicate step 2 scale indication	0.93	102.0
	Gross weight = (standard weights, step 2 - step 4) = 101.01 lb		
Determining Package Error When Tare Weight Is Known			
1b.	Scale reading with package on pan		101.1 lb
2b.	After placing standard weights on pan to give an exact reading equal to (tare wt + labeled wt + approximately 3% labeled wt	104 46 15	104 5 15
36	After removing standard weights equal	to	107.5 10
,0,	tare + labeled wt and adding sample package	3.11 lb	104.2 lb
46.	After adding or removing* standard weights to duplicate step 2b scale indication	3.43 lb	104.5 lb
	Package error = (standard weights, steps 3b - step 4b) = -0.32 lb		

 \ast With an electronic digital scale, see instructions in step 4, p.3-27.

- 4. Add or subtract weights until the scale reading recorded in step 2 is duplicated. With an electronic digital scale, if weights must be removed, remove enough weights so the readout of step 2 is duplicated by adding (rather than removing) weights in weight increments of 0.1 division. (That is, always approach the break-point from the minus side of the weight indication.) Record on the worksheet the standard weights on the scale. The gross weight of the package is equal to the total of standard weights recorded in step 2 minus the total of standard weights recorded in this step.
- 5. Repeat steps 1 through 4 to determine the tare weight of the package and to determine the gross weights and tare weights of the remaining tare sample packages.

In the second example (labeled b in Figure 3-6), a sample package is compared to the nominal gross weight to determine the package error. If weights are added in step 4b, this indicates a minus package error; if weights are removed, this is a plus package error.¹



Figure 3-7. Standard weights on pan of commercial scale.

¹If a moisture loss is to be applied, package error is equal to weights added or removed plus (+) moisture allowance (converted to units of weight). For example, if moisture allowance of 2 lb is applied to example b, a package error of 2.00 lb - 0.32 lb = +1.68 lb results.

3.10. 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 which is drained off, an "estimated 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 Food and Drug Administration.¹

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.

3.10.1. Equipment

<u>Scales and weights</u> recommended in Section 3.1. are suitable for determinations of drained weight.

Sieves

- o For drained weight of 3 lb (1.36 kg) or less, one 8-in (or 20-cm) No. 8 mesh U.S. Standard Sieve Series stainless steel sieve, receiving pan, and cover.
- o For drained weight greater than 3 lb (1.36 kg), one 12-in (or 30-cm) sieve, with same specification as above.

<u>Stopwatch</u> - mechanical or electronic, with a maximum error of 2 seconds in a 3-hour period.

3.10.2. Procedure

- 1. Fill out boxes 1 through 8 on the standard pack report form. 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 a 17-20° angle to facilitate drainage, and allow the product to drain into receiving pan for 2 minutes. (Do not shake or shift material on the sieve.) Remove sieve and product.

¹See Method 32.002 of the Official Methods of Analysis of the Association of Official Analytical Chemists.

Weigh the receiving pan, liquid, wet container, and any other tare material. (Do not include sieve and product.) (See Figure 3-8.) Record this weight as tare and receiving pan.

4.



Figure 3-8. The determination of tare for packages labeled by drained weight (example: olives).

- 5. Subtract the weight of the receiving pan, determined in step 1, from the weight obtained in step 4 to obtain the <u>tare weight</u> (which includes the weight of the liquid).
- 6. Subtract the tare weight, found in step 5, from the appropriate package gross weight determined in step 2 to obtain the drained weight of that package. Determine the package error (drained weight labeled 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 A-1.
- 9. Continue with steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

3.11. AEROSOL PACKAGES

The testing of aerosol packaged products is covered in the following sections. After a list of equipment (Section 3.11.1.) and a description of the assembly of a portable test stand used when emptying the containers (Section 3.11.2.), the details of the net contents determination are described in Sections 3.11.3. and 3.11.5. Methods for emptying the aerosol containers are given in Section 3.11.4. Test allowances to be applied to the average tare weight or individual tare weights of foam aerosols are given in Section 3.11.6.

3.11.1. Equipment

<u>Scales and weights</u> recommended in Section 3.1. are suitable for weight determinations.

<u>Portable test stand</u> with adjustable valve depressor; assembled from components available from a scientific supply company or hardware store. The components are:

- o support stand,
- o <u>utility clamp</u>,
- o gasoline can,
- o two dishpans, and
- $\frac{1/2-\text{inch carriage bolt}}{\text{long}} \text{ and nut.} (either 2 to 3 in or 5 to 7 cm}$

3.11.2. Preparation for Test

To assemble the stand for foam and most other aerosol packages, thread the carriage bolt into the nut and use the jaws of the utility clamp to grip the nut tightly. Mount the clamp on the rod of the support stand. (See Figure 3-9.)

Adjust the height of the clamp to the height of the container under test and thread the carriage bolt to depress the aerosol valve until maximum flow of product is obtained.

Use the dishpans to collect the expelled product.

Add the support plate and gasoline can to the stand for aerosol products such as paints and coatings (as shown in Figure 3-10). Adjust the support plate so that the orifice of the spray can is lined up with the intake of the gasoline can. Leave the vent on the gasoline can open and clear. The clamp and valve-depression adjustment is made in the same manner as with the other aerosol products.

Unlike conventional standard-pack packages, aerosol packages must not be opened. Instructions on the container specifically state:

Caution: Contents under pressure--do not puncture.

WARNING: The containers of packaged aerosol products are under pressure and should not be punctured, broken, or subjected to temperatures in excess of $120 \, {}^{\text{OF}}$. The fumes and suspension of finely divided product may be toxic, irritating, and flammable.

Therefore, the exhausting procedure described in Section 3.11.4. should be conducted in a well ventilated area, in an exhaust hood, or outdoors, at least 50 feet from any source of open flame or spark. No smoking should be permitted in the test area.



Figure 3-9. Portable test stand for all aerosol products except paints and coatings.



Figure 3-10. Portable test stand for aerosol paints and coatings.

Use the test stand equipped with the adjustable valve-button depressor for exhausting the container. Place the test stand in a plastic dishpan with another dishpan in an inverted position over the test stand to minimize pollution with the sprayed product during the exhausting procedure. Use the gasoline can as a receiving vessel for paint and coating products. (See Figure 3-10.)

3.11.3. The Determination of Net Contents: Part 1

All aerosol packaged products (except refrigerated products) should be checked at a product temperature of 68 °F (20 °C). All products that must be refrigerated to maintain quality should be checked at a product temperature of 40 °F (or 4 °C). Lower temperatures will require applications of a correction because less product will be expelled at lower temperatures. For practicality, testing at a 68 to 80 °F (or 20 to 27 °C) range is suggested for non-refrigerated products and 40 to 45 °F (or 4 to 7 °C) for refrigerated aerosols. These temperature ranges are representative of the temperatures at which the products are normally used.

Since it is not practicable to have a single test procedure covering every product or brand, the products are broken down into two general categories, each category having similar properties. The categories of aerosol packaged products are: (1) foam products and (2) other products. Examples of products in each of the two categories are listed in each section. A test allowance is added to the delivered weight when testing products in the foam products category only.¹ The allowance compensates for differences in delivery between normal consumer usage and the exhausting procedure for compliance testing. Within the foam category, however, some products will deliver more completely than others. Thus, it is conceivable that a foam aerosol packaged product could deliver the stated quantity within the limits of the test allowance, and yet be short filled on a dry tare basis. It is emphasized that the test allowance should not be used by the packager as justification for packing less than the stated quantity on a dry tare basis.

Regulations under the Fair Packaging and Labeling Act^2 require that, in the case of packages designed to deliver the product under pressure, "...the declaration shall state the net quantity of the contents that will be expelled when the instructions for use as shown on the container are followed."

The procedure presented below may be used for checking aerosol net contents when labeled by weight.

- 1. Fill out the heading of the standard pack report form (page A-1) and select the random sample. As explained in Appendix E.6.1., the random sample should be arranged in the order in which the random numbers were selected. This will be the order in which the packages will be opened for tare. Consult Table 2-6, page B-6, for the size of the initial tare sample.
- 2. Gross weigh each package in the initial tare sample and record this weight on the report form in the boxes labeled a. Follow Section 3.11.4. to empty the initial tare sample aerosol containers.

After following Sections 3.11.4., go on to Section 3.11.5. for instructions on completing the procedure.

¹In the testing procedure, the test allowance is subtracted from the nominal gross weight, the effect of which is the same as adding the test allowance to the delivered weight.

²Regulations under the Fair Packaging and Labeling Act (PL 89-755) include 16CFR\$500.22(a), 21CFR\$701.13(g)(1), 21CFR\$201.62(f), and 21CFR\$101.105(g). Also see parallel requirements recommended by the National Conference on Weights and Measures in its Uniform Packaging and Labeling Regulation (Section 10.3) in NBS Handbook 130. Quotations above from 21CFR\$101.105(g).

3.11.4. Exhausting the Aerosol Container

Follow the procedures below to empty aerosol containers and thereafter determine their tare.

Do not shake unless shaking is specified. If shaking is specified, shake according to directions on the container. If no directions are given as to how the can should be shaken, shake the container with a brisk wrist-twisting motion for one minute at the approximate rate of two wrist-twisting cycles per second. If the container has a ball agitator, continue shaking procedure for one minute after the ball has shaken loose.

a. Foam products:¹ Placing the selected container in the position specified in the instructions on the package, exhaust it by holding the valve wide open for 30 minutes. (See Figures 3-11 and 3-12.)



Figure 3-11. Portable test stand showing aerosol foam product ready to expel in upright position.

 $^{^1}$ A foam product is defined as a product that forms a foam at the container valve or on impingement with a surface and the foam volume is not substantially reduced for at least 20 seconds. Examples of foam products: shave creams, hand creams, facial foams, shampoos, oven cleaners, upholstery cleaners, foam degreasers, whipped toppings, frosted whips.



Figure 3-12. Portable test stand showing aerosol foam product ready to expel in inverted position.

b. Other products:¹ If shaking is specified in the instructions, shake at periodic intervals (at least two or three times during expulsion of the product). With the container in the position specified on the package, exhaust the sample container by depressing the valve-actuator until visible spray is interrupted. As soon as spray is interrupted release the actuator. (A change in sound usually accompanies spray interruption.) Allow the container to warm to 68 to 80 °F (20 to 27 °C) before concluding the evacuation.

¹ Examples of other products: Frostings, syrups, cheese spread, hair sprays, colognes, window cleaners, starches and fabric finishes, insecticides, room deodorants, personal deodorants, waterproofers, antiseptics and medicants, de-icers, ignition sprays, insect repellants, furniture polishes, dog and pet sprays, oil sprays, battery cleaners, shoe polishes and leather conditioners, wall cleaners, suntan lotions, spray-on bandages, run-stoppers, pre-shave lotions, nasal relief sprays, external analgesics, charcoal lighters, fire extinguishers, anti-static sprays, carburetor cleaners, plant foods, auto quick-start sprays, whitewall tire cleaners, paints, enamels, lacquers, acrylic coatings, varnishes, undercoatings.

Agitate the container with a swirling motion for 30 Hold the container at an angle of seconds. approximately 45 degrees from the upright position, with the valve-actuator depressed, and rotate the container to maintain a visible spray (again, note the sound change) as long as possible. (Rotating will ensure contact of the dip tube with any remaining product in Continue this procedure until no the container.) additional product or gas is expelled. Any undelivered product should be expelled as completely as possible by container the hand holding the in with the valve-actuator depressed and alternately inverting the container and then restoring to the original test position at approximately 10-second intervals until no additional product is delivered.

When exhausting containers with vapor tap valves (in which product continues to be expelled upon inversion of container), stop the exhausting procedure whenever the container becomes cold to the hand. Allow the container to return to test temperature of 68 to 80 $^{\circ}$ F (or 20 to 27 $^{\circ}$ C) before continuing the test.

A container with a metered valve cannot be emptied by holding the valve-actuator depressed since such a valve permits only a predetermined amount of product to be expelled each time the valve-actuator is depressed. Empty the container by alternately depressing and releasing the valve-actuator until no additional product or gas is expelled.

3.11.5. The Determination of Net Contents: Part 2.

The following steps complete the procedures begun in 3.11.3:

3. Rinse the outside of the containers with a suitable solvent and dry the exteriors of the containers. If the valve-actuators are removable, remove for cleaning and drying, and then replace. Determine and record on the report form in the boxes labeled b the tare weights of the initial tare sample. Calculate the net weights for the initial tare sample and record in boxes labeled c. For foam product aerosols, each package net weight is equal to the package gross weight minus the individual tare weight plus the test allowance. (See Section 3.11.6.)

For other aerosols, an individual package net weight is equal to the package gross weight minus the package tare weight.

4. Determine and record in box 9 on the report form the range of net weights, R_c .

- 5. Determine and record in box 10 the range of tare weights, R_{t} .
- 6. Compute R_c/R_t and record in box 11. From Table 2-7, pages B-7 and B-8, look up the total number of packages necessary for determining the tare; record n_t in box 12.
- 7. If n_t is larger than the initial tare sample, select additional tare sample packages, as necessary, from remaining packages arranged in the order in which the random numbers were obtained. It may be necessary to empty all the packages in the sample.
- 8. Gross weigh, empty, and determine the tare¹ for additional packages selected in step 7. Record these weights on a worksheet. If a foam product, record the test allowance in box 13a on the report form.
- 9. Follow steps 10-18 of Section 3.7. (page 3-16) to determine lot conformance.

3.11.6. Test Allowance for Foam Product Aerosols

Table 3-2 on page B-17 lists the test allowances to be subtracted from the average tare weight or individual package tare weight for foam product aerosols only. Record the test allowance in box 13a of the report form on page A-1. If all the sample packages have been exhausted for tare, note this on the report form and refer to a worksheet. When packages in the sample are exhausted for tare determination, the test allowance is subtracted from each individual tare before determination of the net weight of each package.

¹ Apply test allowance given in Section 3.11.6. if foam product aerosol is being tested.

3.12. FROZEN FOOD AND OTHER FROZEN PRODUCTS

Complications arise in tare determination and, in some instances, in net weight determination of products that must be maintained at low temperature in order to keep them frozen. This is because of difficulties in separating, while still frozen, the contents from the package, and also because of the presence of superfluous ice and frost. The gross weight and tare weight of many products can be determined in a frozen state by simply brushing frost and ice from the exterior of the package. This suffices for most frozen prepared vegetables, fruits, and many convenience items. Although surface defrosting of poultry has been practiced in order to remove the bird from its wrapping, and thus measure part of the tare,¹ this method should be used with great care since surface discoloration occurs upon refreezing. Therefore, such packages chosen for tare determination should be used or disposed of as other than fresh or frozen food. (From the viewpoint of health, the surface defrosting method is acceptable.) However, a U.S. Department of Agriculture seal must be removed if an opened package is repackaged.

Frost found inside frozen food packages is considered part of the net contents, not tare.

In general, procedures to be followed for frozen foods labeled by weight are those given in Sections 3.5. (standard pack, dry tare), 3.6. (wet tare), 3.7. (alternative tare), or 3.8. (random pack).

A regulatory agency may define the labeled weight of a particular frozen product as the weight of that solid or semisolid material determined after defrosting; in such case, the procedures in Section 3.13. are followed.

3.13. DRAINED WEIGHT OF FROZEN FOODS

The following technique is based upon, but not identical with, Method 22.005 of the Official Methods of Analysis of the Association of Official Analytical Chemists.

It is a "drained weight" procedure and, as such, does not derive a package error from the package gross weight minus the nominal gross weight. The actual weight of defrosted product is measured. The method therefore requires the defrosting of all packages comprising the sample. Since loss of quality, texture, and moisture will result should the product be refrozen, the packages in the sample are <u>not</u> to be refrozen after the test.

¹ Tare also includes inner wrappings, leg tags, pop-up thermometers, etc.

3.13.1. Equipment

Scales and weights recommended in Section 3.1.

Sieves

- o For labeled weight of 3 lb (1.36 kg) or less, one 8-in (or 20-cm) No. 8 mesh U.S. Standard Sieve Series stainless steel sieve and receiving pan.
- o For labeled weight greater than 3 lb (1.36 kg), one 12-in (or 30-cm) sieve, same specifications as above.

<u>Stopwatch</u> - mechanical or electronic, with a maximum error of 2 seconds in a 2-hour period.

<u>4-gallon or larger container</u> with bottom inlet for a hose attachment and either a screen-covered outlet on the upper part of the wall of the container or a wire mesh basket, which extends above the container.

Partial immersion thermometer with -30 to 120 °F (or -35 to +50 °C) range, 2 °F (or 1 °C) graduations, tolerance of +2 °F (or +1 °C).

3.13.2. Procedure

- 1. Fill out report form and select a random sample. A tare sample is not needed.
- 2. Weigh the sieve and receiving pan, recording weight on a worksheet as the "sieve weight".
- 3. If the sample packages are not water tight, the packages should each be placed in a plastic bag. Force excess air out of the bag by submerging it in water to a point above the location at which the bag is being tied off.

Submerge the bags completely in a container of water using clamps or weights to keep the bags submerged. Maintain the water at 68 + 4 °F (or 20 + 2 °C) by introducing water at this temperature at the bottom of the container at a flow rate of 1 to 3 gallons per minute. Avoid agitating the packages.

- 4. As soon as the product thaws, as determined by loss of rigidity, remove each bag from the bath and open it with a minimum of agitation. With screen tilted at about 20° from the horizontal and supported for drainage, distribute the package contents over the screen in one sweeping motion. Let the product drain into a waste receptacle or sink.
- 5. Two minutes from the time the product was placed on the sieve, place the product and sieve on receiving pan and weigh. Record this weight on the worksheet as the "sieve + product weight".
- 6. The weight determined in step 5 minus the "sieve weight" (step 2) is the drained weight of the product. The package error equals the drained weight minus the labeled weight. Record the package error on the worksheet and on the report form.
- 7. Clean and dry the sieve and receiving pan and repeat steps 4 through 6 for the remaining packages in the sample.
- 8. Follow steps 7-11 of Section 3.5. (CORE METHOD) for the determination of lot conformance or nonconformance.

3.14. GLAZED RAW SEAFOOD AND FISH

The National Marine Fisheries Service of the U.S. Department of Commerce recommends that Method 18.001 (a) of the Official Methods of Analysis of the Association of Official Analytical Chemists be used for glazed raw seafood and fish. This method requires removal of the glaze before the product is weighed.

The method may be used for any frozen glazed food product.

3.14.1. Equipment

For equipment requirements, see Section 3.13.1. except:

- o 8-in (or 20-cm) sieve is used for labeled weights of 2 lb (0.9 kg) or less.
- o 12-in (or 30-cm) sieve is used for labeled weights greater than 2 lb (0.9 kg).

3.14.2. Procedure

- 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. Agitate the product carefully so product is not broken. Continue the spray until all ice glaze that can be seen or felt is removed. The product should remain rigid.
- 4. Transfer the product to the weighed sieve. Without shifting product, incline the sieve to an angle of 17-20° to facilitate drainage and drain for exactly 2 minutes (into waste receptacle or sink).
- 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 pan plus sieve plus product (recorded in step 5) minus the "sieve weight" (recorded in step 2). The product net weight should be recorded on the worksheet. The package error is equal to the net weight of the product as measured minus the labeled weight. The package error should be recorded on the worksheet and transferred to the report form.
- 7. Repeat steps 3 through 6 for each package in the sample, cleaning and drying the sieve and receiving pan between package measurements.
- 8. Follow steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

3.15. CANNED COFFEE

The variation in weight of the metal can used to package ground coffee can be substantial in comparison with the weight variation of the coffee itself; therefore, the alternative tare procedure of Section 2.11.4. may be necessary.

The gross weight of vacuum packed coffee before breaking the vacuum seal will be less than the gross weight after the seal is broken and air enters the can. This difference in weight will be measurable using the recommended small capacity scale for 2- and 3-pound canned coffee. (The gross weight difference for 1 lb coffee is about 1/2 g.)

The checking procedure follows Section 3.7. (standard pack, alternative tare). In step 3 of Section 3.7., the official can correct the gross weight determined from unopened cans in the following way:

Using the initial tare sample packages, the official should 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. The nominal gross weight is equal to: the average tare weight minus the average difference in gross weights plus the labeled weight = box 13 - box 13a + box 1.

For example:

- A sample of 10 packages of 3-lb cans of coffee is selected; two packages are selected as the initial tare sample. The gross weight of the first unopened 3-lb can of coffee is 3.719 lb.
- (ii) The gross weight of this same 3-lb can of coffee when opened is 3.723 lb.

The difference between (i) and (ii) is 0.004 lb.

This difference and the determination of the gross weight difference for the second tare sample package are averaged; 0.004 lb is found as the average value.

Therefore, 0.004 lb is, in this example, recorded in box 13a.

Section 3.7., step 4 onward, is then followed.
CHAPTER 4. METHODS OF TEST FOR PACKAGES LABELED BY VOLUME

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- 4.2. Equipment for liquid volume determinations
- 4.3. Using liquid volumetric measures
- 4.4. Standard pack liquids labeled by liquid volume: General method, part 1, measuring the weight of a known volume
- 4.5. Standard pack liquids labeled by liquid volume: General method, part 2, using the weight of the labeled volume
- 4.6. Other methods of liquid volume measurement
- 4.7. Milk
- 4.8. Mayonnaise and salad dressing
- 4.9. Paint, varnish, and lacquers nonaerosol
- 4.10. Very viscous materials
- 4.11. Peat moss
- 4.12. Bark mulch
- 4.13. Solids or semisolids
- 4.14. Goods labeled by capacity

CHAPTER 4. METHODS OF TEST FOR PACKAGES LABELED BY VOLUME

This chapter first presents information on general problems and practices in measuring liquid volumes. Section 4.4. describes tests to check the suitability of weighing the net contents of packages labeled by volume. Section 4.5. describes a weighing method that references techniques already covered in Section 3.5. (CORE METHOD). Section 4.6. describes methods for use when weighing cannot be employed to check packages labeled by volume. Finally, methods for specific types of commodities are described in the remainder of the chapter. Packages labeled by dry volume or cubic measure are included in this category.

The procedures in this chapter return to the CORE METHOD of Section 3.5. for determination of lot conformance.

Determining the inspection lot, selecting the random sample and tare sample, and filling out the standard pack report form (page A-1) are not described in any detail in this chapter. The testing official is referred to Chapter 2, Appendix E, and Sections 3.5. through 3.7. for a more complete description of these procedures.

It should be noted that some packages labeled by volume utilize containers that are required by law or regulation to hold specified quantities (liquid or dry volume). These quantitative measuring containers include berry baskets and boxes, rigid dry measures, retail and prepackaged measure containers (such as ice cream containers), milk bottles, and lubricating oil bottles, and are covered by specific code requirements in NBS Handbook 44. Handbook 133 does not describe the testing of the capacities of these containers. Containers for such products as cottage cheese, sour cream, and yogurt may be tested by using the techniques of Section 4.14.

4.1. MEASURING LIQUID VOLUMES

The volume that is occupied by any kind of packaged product varies with the temperature of the product. This must be kept in mind when checking products labeled by liquid volume but can be ignored when checking products labeled by dry volume. For example, the volume of a liquid cosmetic product is 500 mL at 20 °C (68 °F) and 503 mL at 25 °C (77 °F). Therefore, a reference temperature is usually specified in regulations for products sold by liquid volume. The labeled volume is required to comply with the regulation at the reference temperature.

In general, the reference temperature is the temperature at which the product is customarily sold. For frozen foods labeled by liquid volume (e.g., fruit juices, batters, etc.), packagers routinely recommend a maximum storage temperature of 0 °F (-17.8 °C).¹ For foods that must be refrigerated to maintain quality, the reference temperature is 40 °F (4.4 °C).² The reference temperature for all petroleum products is 60 °F (15 °C).³ For products sold unrefrigerated, the reference temperature is generally accepted as 68 °F (20 °C).⁴ The reference temperature for beer is 39.1 °F.⁵ The reference temperature for distilled spirits and wine is 60 °F.6

The following discussion applies to packaged products that are liquids at their reference temperature.

Whenever the liquid volume of a product is measured, the product temperature must be controlled and measured.

Since many liquid products have a high water content, the following information on water will guide the testing official as to the approximate errors that can arise from variations in temperature, and the effect of temperature on volume or on the weight of a known volume. For example,

1 gallon of water at 40 °F (4.4 °C) occupies:

1 gal + 0.28 fl dr at 50 °F (10 °C),

(this corresponds to about 1/4 to 1/3 of a graduation on the neck of a one-gallon glass volumetric container);

1 gal + 0.9 fl dr at 60 °F (15.6 °C); 1 gal + 1.25 fl dr at 70 °F (21.1 °C).

¹Frozen products labeled by liquid volume should be checked at the packaging plant. Those products with a high water content have a minimum volume at about 40 $^{\circ}$ F (4 $^{\circ}$ C) and a larger volume at 0 $^{\circ}$ F (-18 $^{\circ}$ C) than their volume at 40 $^{\circ}$ F (4 $^{\circ}$ C).

²21CFR§101.105(b) (ii).

³16CFR§500.8(b).

⁴16CFR\$500.8(b); 21CFR\$101.105(b)(iii); 40CFR\$162.10(2); 21CFR\$201.62(b); 21CFR\$701.13(b).

⁵27CFR§7.10

⁶27CFR§5.11 and 27CFR§4.10.

In the same way, 1 gallon of water would weigh¹ about

8.336 lb at 40 °F (4.4 °C), 8.334 lb at 50 °F (10 °C), 8.328 lb at 60 °F (15.6 °C), and 8.320 lb at 70 °F (21.1 °C).

These variations, although small, are detectable with the equipment recommended in this handbook. It is important to maintain only the packaged goods that will be opened for volumetric measurements at the same temperature. As will be described in Section 4.4., the testing official will deliver a known volume of product from one package and weigh it. Having repeated this procedure on a second package, the official will compare the weights of the two volumes in order to determine whether the rest of the packages in the sample can be weighed without opening those packages. Since the weight of a fixed volume of liquid will vary with the temperature, the official must determine the weights of the two volumes at the same temperature.²

Using the example of water, 1 gallon of water at 68 $^{\circ}$ F weighs 8.322 lb, but weighs 8.320 lb at 70 $^{\circ}$ F. As described in Section 4.4., if a difference of more than 0.004 lb is found between the weights of a known volume from two packages (using the equal arm scale for larger weights), weighing cannot be used to check the package net contents. For the example of water, the 2 $^{\circ}$ F difference in product temperature is enough to account for a 0.002 lb difference in the weight of one gallon.

In order to make package volume measurements on a refrigerated product without the product rapidly warming, it is good practice to equilibrate the volumetric glassware to the same temperature as the liquid product. For example, the official may put the flask to be used for checking milk in the cooler with the milk for about a half hour before checking the packages.

If volumes are determined on products at temperatures higher than their reference temperature of 60 or 68 $^{\rm O}$ F, the measured volumes will be greater than at the reference temperature. By testing such products at or above the reference temperature, the official will always give the benefit of temperature errors to the packager.

Measurements of product volumes at lower than the reference temperatures of 60 or 68 °F normally will require the application of a density correction. Volumes of refrigerated food products determined at temperatures higher or lower than the 40 °F reference temperature will be larger than the volume determined at 40 °F because the maximum density of water (a principal component of most foods) occurs at 40 °F.³

¹Weighed in air.

 $^{^2}$ Alternatively, an agency may develop (or obtain from the packager) tables or formulae of volume/temperature variations which can be used to correct individual measurements to volume at the same temperature.

4.2. EQUIPMENT FOR LIQUID VOLUME DETERMINATIONS

<u>Scales and weights</u> recommended in Section 3.1. are suitable for the determination of the weight of a known volume.

<u>Volumetric Measures</u> - Measures specifically designed for package checking purposes may be used in making fluid volumetric determinations. (See Figure 4-1.) Standard measuring flasks and graduates recommended for use with packages labeled in inch-pound units are the gill, half pint, pint, quart, half gallon, and gallon. In addition, a 2-fluid-ounce cylindrical graduate, graduated to 1/2 fluid-dram is recommended. When checking packages labeled in metric units, flask sizes of 100 milliliters, 200 milliliters, 4 500 milliliters, 1000 milliliters, 2000 milliliters, and 5000 milliliters and a 50-milliliter cylindrical graduate, graduated to 1 milliliter should be used.

Tolerances for inch-pound and metric field standard flasks and cylinders are given in Appendix I.5



Figure 4-1. Standard measuring flask and graduate for testing packages labeled in metric units of volume.

 3 This is also true for malt beverages (e.g. beer).

⁴250-milliliter flasks may also be used.

⁵Flask manufacturers can supply standard measuring flasks with extended graduations on their necks (rather than those listed in Appendix I, Table I-2). These graduations can extend to the MAV for packages labeled by volume (e.g., for the half pint, graduations down to 3 drams below the half-pint mark may be specified for purchase).

A separate set of volumetric measures should be clearly marked and reserved for any testing of pesticides, herbicides, or similar products. Detergent washing of each set of volumetric measures between tests will then be adequate for field care and use. Volumetric measures suspected of contamination can be cleaned with a solution of potassium dichromate and sulfuric acid in a laboratory, not in the field.

<u>Partial immersion thermometer</u> with a range of -30 to 120 °F (or -35 to +50 °C), at least 1 °F (or 1 °C) graduations, and with a tolerance of +2 °F (or +1 °C).

<u>Defoaming agents</u> may be necessary for checking liquid commodities that effervesce or are carbonated, such as beer and soft drinks. Three such products are:

- o Hexanol
- o Octanol, (Capryl Alcohol), purified
- o Antifoam B¹ Dow-Corning Corporation Midland, Michigan

The use of these defoaming agents renders the liquid commodities unfit for human consumption.

Bubble level.

4.3. USING LIQUID VOLUMETRIC MEASURES

Volumetric flasks are used in two ways for testing liquid products.

- (i) <u>Gravimetric measurement</u>. An amount of product (not the entire package contents) is poured into a flask exactly to a specified mark on the neck of the flask and weighed. For example, the weight of the contents of a package labeled as 32 fluid ounces may be determined by weighing the contents of a pint flask filled with liquid product, then multiplying the result by two.
- (ii) <u>Volumetric measurement</u>. The entire package contents are poured into one or more flasks. The liquid volume is determined by comparing the liquid level with the graduations on the neck.

¹The use of trade or brand names does not imply that they are endorsed or recommended by the Department of Commerce over similar products commercially available from other manufacturers.

Selecting the Flask

For fluid volume measurements, the choice of the volumetric flask to be used in any determination will depend on the labeled volume of the package. Even though packages may be labeled with a volume identical to the testing official's flask capacity, the amount contained in or delivered from any individual package may be less than the minimum mark inscribed on the inspector's flask. The lot codes on packaged liquids do not always correspond to single homogeneous batches of the liquid when being filled. Therefore, it is important to never mix liquids from two different packages (except for milk - see Section 4.7.). For this reasons, the official should use the flask sized closest to, but smaller than, the labeled volume for the determination of the weight of a known volume.¹

Preparing the Flask

Because flasks are ordinarily calibrated on a "to deliver" basis, they must be "wet down" before using. Immediately prior to use, the volumetric flask(s) or graduate should be filled with water² to a point slightly below the top graduation on the neck. The flask should be emptied in 30 seconds (+5 seconds), tilting the flask gradually so that the flask walls are splashed as little as possible. When the main flow has ceased, the flask should be nearly inverted. Hold the flask in this position 10 seconds more and touch off the drop of water that adheres to the tip. The flask or graduate is then ready to accept product liquid from a package. This is called the "wet-down" condition.

Reading the Liquid Level

When reading or setting the liquid level in a flask or graduate, the official's eye should be at the same level as the liquid surface.

Due to surface tension, the liquid surface is curved near the junction of glass and liquid. Therefore, when reading or setting the liquid level, the center of the liquid level is to be compared with the graduation marks. For clear liquids, the bottom of the liquid surface (which will appear to have some thickness) is matched to or compared with a graduation mark; for opaque liquids, the center of the top rim of the liquid surface is the point to be set or to which comparison is made. (See Figure 4-2.) Of course, the flasks should be read on a level surface. (A bubble level may be used to ascertain the level condition.)

 2 The water should be at the temperature of the product.

¹The minimum mark on the graduated neck of standard flasks currently in use for package checking does not extend to the MAV limits described in Table 2-9. Therefore, it may be necessary for the official to use smaller flasks in combination with a cylinder to determine a package volume directly, that is, by delivering the contents into volumetric containers (method ii of this section).



Figure 4-2. Reading the liquid level on the neck of a flask.

Using the Flask and Thermometer

Normal expansion or contraction of the glassware is relatively small and may be ignored. However, the testing official must never expose the glassware to a direct source of heat, such as a flame.

The flask should be washed (with detergent if necessary) and rinsed with water between deliveries of liquid product from different packages. The flask must be wet with water and drained as described for a "wet-down" each time it is to be used.

Immerse the thermometer (see equipment section) only 76 mm (or 3 in) into the liquid product. Measure the product temperature immediately after weighing the flask and product.

4.4. STANDARD PACK LIQUIDS LABELED BY LIQUID VOLUME: GENERAL METHOD, PART 1, MEASURING THE WEIGHT OF A KNOWN VOLUME

In order to avoid opening all of the packages comprising the sample and because measurements of volume are generally less precise than measurements of weight, the preferred method (described in this section and in 4.5.) is to determine the weight of the labeled volume. The weight of the labeled volume plus the tare weight is the nominal gross weight, to be used when comparing the gross weight of each unopened package. The procedure is divided into two sections. This section describes a check for the variability of the weight of a known volume to decide whether a weighing procedure is suitable. If a weighing procedure can be used, consult the next section (4.5.) for a description of the use of a weight value for a known volume of product to determine package errors.

Section 2.10. gave the criteria for weighing packages not labeled by weight. Most common consumer products labeled by liquid volume (food, cosmetics, cleaning fluids, and over-the-counter drugs) weigh from about 0.05 lb per fl oz (0.8 g per mL) to about 0.07 lb per fl oz (1.1 g per mL). This permits the testing official to refer to a list of appropriate weighing devices to use to check these products and to skip the test that determines whether the scale can detect weights equivalent to MAV/6.

The measurement of the weight of a known volume can be combined with the determination of tare and, therefore, will not require more packages to be opened than the number designated in column 3 of Tables 2-2, page B-3, or 2-5, page B-5.

If the inspection lot is composed of packages from different lots, they will have different lot symbols or codes on the package: it is extremely important to check the weight of a known volume from each lot. The official may find that inspection lots of packages labeled by liquid volume must be sorted according to the manufacturer's lot code before sampling in order to check such packages by weighing.

Since many products labeled by liquid volume are packaged in glass containers, the official should become familiar with the alternative tare procedures of Section 2.11.4. as applied to liquids.

The general report form on page A-1 is designed for packages labeled by volume, length, count, etc. In addition, a two-page worksheet has been designed to lead the official through the entire procedure. The worksheets on pages A-5 and A-6 are referenced in the method below.

To minimize round-off errors, carry along at least two extra decimal places in any calculation until the final weight of the labeled volume is obtained.

The general method for checking packages labeled by liquid volume starts with measuring the weight of a known volume of the product.

1. Fill out the report form heading (page A-1) and select the random sample and random tare sample according to the lot size and sampling plan. (See Table 2-5, page B-5 for Category B plans and Table 2-2, page B-3 for Category A plans.) Record the labeled volume in box 1 as <u>fluid ounces</u> (if labeled in inch-pound units).

Refer to Table 4-1, page B-18, for the appropriate weighing device¹ and Table 4-2, page B-19, for maximum units of measure. Record the unit of measure in box 2 on the report form.

2. Gross weigh individual packages in the tare sample. Record these weights on the worksheet (page A-5) in item 1. Select a flask one size smaller than the labeled volume and weigh the flask in the "wet down" condition described in Section 4.3. Record in item 4 on the worksheet.

If the liquid product requires mixing for uniformity, this should be done before opening each package. If the product is of a type that effervesces or foams when opened or poured (such as beer or carbonated beverages), add two drops of a defoaming agent to the bottom of the wetted flask before pouring.

Open the first package selected for tare and fill the flask to the volume indication line.

Calculate the weight of the volume that corresponds to MAV/6.

See worksheet for packages labeled by count (pages A-9 and A-10) for details in performing this calculation.

The weight of MAV/6 must be at least as large as 1/2 the size of the smallest division on any mechanical scale used to weigh the product (or at least as large as the smallest increment in the readout if a digital scale is being used).

If the weight difference is less than 1/2 the smallest scale division, all the packages will have to be opened and volumetric method A employed. (See Section 4.6.)

For example, packages labeled "1 quart" have an MAV of 8 fl dr (1 fl oz). The weight of the liquid is determined to be 0.770 lb for 16 fl oz., thus MAV/6 in weight units is:

$$\frac{1 \text{ fl oz}}{6} \times \frac{0.770 \text{ lb}}{16 \text{ fl oz}} = 0.008 \text{ lb}$$

In this example, assuming that the official has used a small-capacity equal-arm mechanical scale, MAV/6 is larger than the smallest scale division, so that the next step in the gravimetric procedure may be followed.

¹If the weight of a given volume of liquid product is less than 0.05 lb per fl oz (0.8 g per mL) or if recommended weighing equipment is not available, the following procedure should be followed in order to determine whether the scale is sensitive enough to detect individual package errors.

3.

Weigh the flask filled with product (recording this weight in item 3 on the worksheet). (See Figure 4-3.) Then subtract the weight of the flask to obtain the weight of the product (item 5). Record the flask volume and product temperature for the first package in items 6 and 7 on the worksheet.



Figure 4-3. Weighing a known volume of liquid.

- 4. Empty, clean, and dry the package container. Weigh the package container and record this weight in item 2 of the worksheet.
- 5. Clean the flask and repeat steps 2, 3, and 4 on the second package chosen for tare determination. Only two packages are used to determine the weight of the known volume. (Even if more than 2 packages are required to determine tare, do not weigh their liquid contents.) Record the weight of the liquid volume from the second package, the flask volume, and the product temperature in items 5, 6, and 7 on the worksheet.
- 6. Determine tare for the rest of the tare sample. (There are spaces provided on the worksheet for five packages.)
- 7. When using any given scale to weigh packages labeled by volume, the two values for the weight of a known volume should not differ by more than the amount given in Table 4-3 (page B-20).

If the weights of the two packages meet the above criterion, then the average of the weights of the labeled volume may be used in testing the packages comprising the sample and Section 4.5. may be followed. Fill in item 8 of the worksheet. Go on to step 8.

If the weights differ by more than the value given in Table 4-3, page B-20, then volumetric measurements must be made on all the packages in the sample following one of the procedures given in Section 4.6.

Example: Two packages are chosen from a sample of ten packages labeled "1/2 gallon" for determination of the tare and of the weight of a known volume. The weight of a 1-quart flask plus 32 fl oz of the packaged liquid from the first package is 3.050 lb. The weight of 32 fl oz of the liquid is 2.048 lb. If using a small capacity package testing scale, the weight of 32 fl oz of the liquid from the second package may not differ from 2.048 lb by more than 0.002 lb (that is, it may weigh from 2.046 to 2.050 lb) if a weighing procedure is to be employed.

4.5. <u>STANDARD PACK LIQUIDS LABELED BY LIQUID VOLUME:</u> <u>GENERAL METHOD, PART 2, USING THE WEIGHT OF THE</u> <u>LABELED VOLUME</u>

After confirming that packages labeled by volume can be checked by weighing (as described in the previous section), the official should complete the checking procedure on the sample as described below. The following steps are intended to lead into Section 3.5., the CORE METHOD for packages labeled by weight.

8. Compute the average weight of the labeled volume of the product.

The average weight of the labeled volume =

average weight of known volume x labeled volume known volume

The average weight of the labeled volume may be obtained by first determining the average of the two values in item 5 on the worksheet. Record in item 9 on the worksheet. Then follow the instructions in item 10 on the worksheet.

- 9. In steps 4 and 6 of Section 4.4. the tare weights of the individual packages in the tare sample were determined. If additional tare sample packages are indicated (using the method of Section 2.11.4.), select, gross weigh, open, clean, and weigh the containers. Average the tare weights determined from all opened containers (unless the entire sample has been opened). Record average tare weight in item 12 on the worksheet and box 13 on the report form.
- 10. The average tare plus the weight of the labeled volume of the product is the "nominal gross weight". Record nominal gross weight in step 13 of the worksheet and in box 14 of the report form.

Items 14 and 15 of the worksheet provide space for recording package errors for the first five packages opened for tare.

11. Look up the MAV for the labeled volume in Table 2-9, pages B-11 and B-12 and record it in box 3 on the report form and item 16 on the worksheet. Convert the MAV in units of volume to units of weight:

MAV (weight) =

MAV (volume) x <u>average weight of labeled volume</u> labeled volume

To convert, multiply the value recorded in item 16 on the worksheet by the value recorded in item 10 and divide by the labeled volume recorded in box 1 on the report form. Record this value in item 17 on the worksheet.

Convert the MAV to dimensionless units as described in item 18 on the worksheet and transfer this value to box 4 on the report form. With all measurements converted to weight and dimensionless units, determine package errors and lot conformance for unopened packages by following the CORE METHOD in Section 3.5., step 6 onward.

Convert the average error back to units of volume following the arithmetic in item 19 on the worksheet when completing the report form.

4.6. OTHER METHODS OF LIQUID VOLUME MEASUREMENT

If the packaged product fails either criterion in Section 4.4. (step 1 footnote or step 7), the official should use one of the methods of liquid volume measurement described in this section.

All three of these methods of determining an individual package error require opening all sample packages. After the errors have been determined for all packages, the CORE METHOD in Section 3.5. (step 7 onward) is followed to determine conformance of the lot with the package requirements.

Method A is used if the scale cannot detect differences in weight equivalent to MAV/6 and may be used as an alternative to any other fluid measurement given here.

Method B is suitable for liquids that are homogeneous.

Method C is suitable for liquids that are not homogeneous, but may also be used for homogeneous liquids.

4.6.1. <u>Method A: Determining the Volume at the Liquid Level of</u> Fill. (Depth Gage Method)

When the test in step 1, footnote, Section 4.4., indicates that the scale is not sensitive enough to detect individual package errors, the following method must be used. It is a laboratory procedure. In order to determine the volume of liquid in each package in the sample, the level of fill of each package is duplicated with water (from pipets and a buret).

Equipment

<u>Micrometer depth gage</u> (ends of rods fully rounded)¹ 0-9 in or 0-225 mm.

Bubble level at least 10 in or 25 cm in length.

Laboratory pipets and/or buret:

Buret meeting type 1, style 1, class A, Fed Spec NNN-B-782. Pipets meeting type 1, style 1, class A, Fed Spec NNN-P-395, calibrated "to deliver."

Procedure

- 1. If following this section after Section 4.4., select one or more packages to replace the package(s) opened in Section 4.4. If this is the method of choice, select a random sample. Fill out the report form heading (page A-1).
- 2. Open the first package in the sample on a level surface. Use the depth gage to determine the level of fill of the package before product is removed.

Record the depth gage reading on a worksheet.

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

 $^{^{1}\}mathrm{The}$ rods will have to be custom ground.

- 4. Duplicate the level of fill determined in step 2 above with distilled water delivered from pipets or buret. Record the resulting water volume as the packaged goods volume on the worksheet.
- 5. Subtract the labeled volume from the actual package volume (recorded in step 4) to arrive at the individual package error. Record the package error on the worksheet and convert it to dimensionless units in order to transfer to the report form.
- 6. Repeat steps 2 through 5 for each package in the sample. Follow steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

4.6.2. <u>Method B: Measuring the Weight of a Known Volume for</u> Every Package

The following method is suitable for liquids that are homogeneous (or can be mixed until they are homogeneous) and do not separate quickly. Taking advantage of product homogeneity, this method uses the weight of a known volume to calculate the weight of the labeled volume. Since weighing is used to determine errors in volume, the scale must be capable of distinguishing volumes equivalent to MAV/6 (See Section 4.4., step 1, footnote.)

Equipment is the same as that listed in Section 4.2.

Summary

Section 4.4. describes the determination of the weight of a known volume of product from two packages. When the range of weights from two packages exceeds the Table 4-3 value, the method of Sections 4.4. and 4.5. may still be used as long as the weight of a known volume is determined for each and every package in the sample.

The net weight of each container is measured. The weight per unit volume of each container is measured, as well. The net weight of each container is multiplied by its weight per unit volume to calculate the contained volume.

Procedure

The numbered steps follow step 7 in Section 4.4.

8. Compute the weight of the labeled volume for the first package opened from the tare sample.

The weight of the labeled volume for package 1 =

weight of known volume (from package 1) x labeled volume known volume

Record this weight on a worksheet. Repeat this calculation to obtain the weight of the labeled volume for the second package from the tare sample. Record this weight on the worksheet. Do not average the weights of the labeled volumes for the two packages.

9. Subtract the sum of the actual tare weight plus the weight of the labeled volume computed in step 8 (above) from the package gross weight to arrive at the individual package errors (in terms of weight) for the first two packages opened for tare in Section 4.4.

Package error (in units of weight) =

(gross weight) - (tare weight + weight of labeled volume)

The package error in units of weight should be recorded on a worksheet.

Calculate the package error in units of volume:

Package error (in units of volume) =

(package error in units of weight) x

labeled volume weight of labeled volume

For example, the tare weight of package 1 is 0.075 lb and the weight of the labeled volume (32 fl oz) for package 1 is 2.156 lb. The gross weight of package 1 is 2.245 lb. The package error in units of weight is therefore: (2.245 lb) - (0.075 lb + 2.156 lb) =+0.014 lb. In units of volume, the package error is (+0.014 lb) x (32 fl oz)/(2.156 lb) = +0.21 fl oz.

- 10. Gross weigh the remaining packages in the sample. (Only the tare sample packages were weighed in Section 4.4.)
- 11. Determine the weight of a known volume for each package in the sample. (See steps 2 and 3 of Section 4.4.)
- 12. Clean, dry, and weigh each package container (to determine each tare weight).
- 13. Repeat steps 8 and 9 above for each package in the sample.

14. Transfer package errors to the standard pack report form on page A-1 (using an appropriate unit of measure in terms of volume).

Follow steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

4.6.3. <u>Method C: Measuring the Volume Delivered from the</u> Package

The product does not have to be homogeneous to use this method, but the product should be mixed before opening even if its components separate quickly. Oil and vinegar salad dressings are good examples of the type of product for which this method can be used. Unlike Method B, this method uses the weight of a known volume only to calculate the volume remaining in an emptied container so that any inhomogeneity of the product will not greatly affect the calculated net contents.

In steps 3 and 5 of Section 4.4., the weight of a known volume of liquid is determined for each of two packages in the sample. When it is found in step 7 that these weights differ too much from each other, the following method may be followed to determine package errors.

It is possible to use an average weight of a known volume to determine the amount of liquid remaining in a package after delivery of the main body of liquid to volumetric flask(s) as long as the two weights determined in steps 3 and 5 of Section 4.4. do not differ by more than 5%. (See calculation in step 8 on page 4-17.) For example, if the weights of 8 fl oz of product were determined to be 0.496 lb for the first package and 0.484 lb for the second package, the difference, 0.012 lb, is less than 5% of the average weight, 0.490 lb. Therefore, 0.490 lb for 8 fl oz may be used to calculate the liquid volume remaining in the packages.

If the weights determined in steps 3 and 5 of Section 4.4. differ by more than 5%, a method such as 4.6.2., (Method B) must be used. This method will require both the determination of the weight of a known volume and a direct measurement of product volume delivered from the package for every package. (In this instance, the results of steps 3 and 5 of Section 4.4. may be used only for the weights of a known volume for the first two packages opened for tare. The weight of a known volume will have to be determined for each package in the sample.)

The equipment is the same as that listed in Section 4.2.

Summary

The contents are emptied into a flask and measured volumetrically. The volume of product remaining in the emptied container is obtained by determining the weight difference between the wet container and the container after drying. This weight is converted to volume:

(wet container - dried container weight) x known volume weight of known volume

This resultant volume is then added to the volume of product delivered from the package to obtain the total product volume.

Procedure

The numbered steps below follow step 7 in Section 4.4.

- 8. Calculate the average weight of the labeled volume as described in step 8 of Section 4.5. Divide the difference in weights for the first two package volumes by the average weight of the labeled volume. If this ratio is 0.05 or smaller, use the average weight of the labeled volume to compute the amount of liquid remaining in the package in step 13. If the ratio is greater than 0.05, separate values for the weight of a given volume must be determined for each package in the sample to be used in step 13.
- 9. Returning to the first package opened in step 2, Section 4.4., deliver the rest of the package contents into graduated flask(s) and/or a graduate and record the total delivered volume on a worksheet.

The volume of product still left in the package must now be determined.

- 10. Weigh the empty (but wet) package container.
- 11. Clean, dry, and weigh the package container.
- 12. Record the difference in weight between wet and dried tare on the worksheet.

13. Calculate the volume of liquid left in the package. If the ratio calculated in step 8 above is 0.05 or smaller, the remaining volume of liquid in the package is calculated to be:

> weight difference (step 12) x labeled volume average weight of labeled volume (step 8)

If the ratio is greater than 0.05 in step 8, the remaining volume of liquid is:

weight difference (step 12) x labeled volume weight of labeled volume for each package

(Or Method B, Section 4.6.2., may be followed.)

Record remaining volume in the package on the worksheet.

14. Add the volume remaining in the package as determined in step 13 to the volume poured from the package (determined in step 9 and recorded on the worksheet) to arrive at the total volume.

Total product volume =

volume delivered into flasks or graduates +

volume remaining in package

15. Subtract the labeled volume from the total package volume determined in step 14 to arrive at the individual package error.

Package error (units of volume) =

(total product volume) - (labeled volume)

Record package error on the worksheet and in the crosshatched area of the worksheet (identifying an appropriate unit of measure in box 2).

16. Repeat steps 9 through 15 above for the second package opened. If the ratio calculated in step 8 is 0.05 or smaller, the average weight of the labeled volume may be used (already calculated in step 8).

If the ratio calculated in step 8 is greater than 0.05, the weight of a known volume of product from this package would already have been determined in Step 5 of Section 4.4. This weight of a known volume can be used in step 13 above for this package only.

17. If the ratio calculated in step 8 is 0.05 or smaller, open each package in the sample, deliver its contents into flask(s) and a graduate as described in step 9 above, and repeat steps 10 through 15 using the average weight of the labeled volume already determined in step 8. Repeat for every package in the sample.

If the ratio calculated in step 8 above is greater than 0.05, determine the weight of a known volume as described in Section 4.4. for each of the remaining packages in the sample following each determination with steps 9 through 15 above.

After package errors for sample have been determined, follow steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

Example

From a sample labeled "40 fl oz" the first package was opened and part of the product was poured into a 1-qt flask to the 1-qt mark.

The remaining product was then poured into a 1/2-pt flask and was found to fill the flask to 1/2 fl dr below the 8-fl oz mark.

Therefore, the volume delivered from the package is = 32 fl oz + 8 fl oz - 1/16 fl oz = 39.9375 fl oz delivered.

The weight of the wet package container is 1.012 lb and after air drying, 1.000 lb. According to procedures followed in steps 3 and 5 of Section 4.4., it was found for the two tare sample packages that 32 fl oz weighs 2.123 lb (average weight).

Thus,

$$\frac{(1.012 \text{ lb} - 1.000 \text{ lb}) \times 32 \text{ fl oz}}{2.123 \text{ lb}} = 0.18 \text{ fl oz}$$

This is the volume of product remaining in the package.

The total product volume is therefore: 39.94 fl oz + 0.18 fl oz = 40.12 fl ozThe package error is

40.12 fl oz - 40.00 fl oz = +0.12 fl oz

4.7. MILK

Because of the homogeneity of milk within a production lot, some steps in Section 4.4. are eliminated if the inspector is careful to define the inspection lot as that product from a single production lot code.

Equipment is the same as described in Section 4.2. <u>except that the</u> selected flask may be equal in volume to that declared on the milk container.

Summary

Sections 4.4. and 4.5. are followed except:

- o In step 2 of Section 4.4., if product delivered from the first container does not fill the flask to a graduation line, milk from a second package may be added to bring the liquid level up to the graduation.
- o Steps 5, 6, and 7 of Section 4.4. may be skipped. As a result, only one package is used to determine the weight of the labeled volume of the product in step 8 of Section 4.5.

Procedure

The method is as follows. Deviations from Sections 4.4. and 4.5. are underlined.

- 1. Fill out report form heading (page A-1) and <u>define the</u> inspection lot as packages with a single lot code. Record the labeled net contents (box 1), unit of measure (box 2), the lot size (box 5), sample size (box 6), tare sample size (box 7), and allowed number of unreasonable errors (box 8). (For Category A, see page B-3; Category B, page B-5.) Select the random sample and random tare sample.
- 2. <u>Keep temperature of tare sample and flasks as close as</u> <u>possible to 40 °F</u>. Gross weigh tare sample packages and record on worksheet in item 1 (page A-5).

Select flask of same size as labeled volume. Wet down flask. Weigh flask and record weight on worksheet (item 4).

Open first tare sample package and fill flask to the flask volume indication line. <u>Open second package and add milk if</u> there is insufficient milk in the first package to fill to the line.

- 3. Weigh flask and milk and record weight in item 3 of worksheet. Subtract flask weight to determine the weight of the milk; record in item 5 of the worksheet. Take temperature of milk in flask. Record flask volume and temperature in items 6 and 7 on worksheet.
- 4. Empty tare sample packages, clean and dry the containers. Weigh containers and record in item 2 of worksheet.
- 5. Skip item 8 on the worksheet. Items 9 and 10 (assuming that the flask volume equals package labeled volume) are the same value as recorded in item 5. Compute the average tare weight for the tare sample (individual weights recorded in item 2) and record in item 12 on the worksheet and in box 13 on the report form.
- Compute the nominal gross weight by adding the average tare weight (item 12) to the weight of the labeled volume (item 5). Record in item 13 on the worksheet.
- 7. Compute the package errors for the tare sample packages.

Package error = gross weight for each package - nominal gross weight

On the worksheet: item 14 = item 1 - item 13

8. Convert package errors in weight units to dimensionless units.

On the worksheet: item 15 = item 14 : unit of measure (box 2 of report form)

Record package errors for tare sample on report form.

- 9. Find the MAV in Table 2-9, page B-11 or B-12 and record it in box 3 on the report form. Convert MAV from units of volume to units of weight as described on the worksheet in item 17.
- 10. Convert the MAV to dimensionless units as described on the worksheet in item 18.
- 11. Compare unopened sample packages with the nominal gross weight as described in the CORE METHOD, Section 3.5., step 6 onward, and determine lot conformance.
- 12. Convert average package error back to units of volume as described in item 19 on the worksheet.

Record this value in box 19 of the report form.

4.8. MAYONNAISE AND SALAD DRESSING

The following method is also suitable for other water-immiscible products without a level liquid surface. This method is provided for mayonnaise and salad dressing because the volume of such products is changed by scooping or stirring the product.

The method determines the amount of air space above the product in the package, and then the total container volume. Subtracting the airspace volume from the total container volume gives the product volume.

4.8.1. Equipment

Volumetric measures recommended in Section 4.2.

<u>Plastic disks</u> (to be used with the procedure of fill described in Section 4.14.)

4.8.2. Procedure

- 1. Fill out the report form heading and select a random sample. A random tare sample is not needed.
- 2. Open the first package and place a disk larger than the package container opening over the opening. Deliver water from a graduate through the central hole in the disk onto the top of the product until the container is filled (as described in step 3 of Section 4.14.2. on the use of the plastic disks). Record the volume of water as "headspace" on a worksheet.
- 3. Empty, clean, and dry the package container.
- 4. With the disk over the opening, fill the package container with water from flask(s) and graduate(s). Record the amount of water as "container volume" on the worksheet.
- 5. Subtract the volume recorded in step 2 from the volume recorded in step 4. This is the volume of product in this individual package.
- 6. Subtract the labeled volume from the package volume determined in step 5 to arrive at the individual package error in units of volume. Record package error in the crosshatched area of the report form using an appropriate unit of measure in box 2.
- 7. Repeat steps 2 through 6 for the remaining packages in the sample.

Follow steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

4.9. PAINT, VARNISH, AND LACQUERS - NONAEROSOL

This section describes three different test methods that may be employed depending upon the required degree of accuracy and the location of the check. The procedures are: a field auditing method, usually conducted on the premises of the vendor; an in-plant auditing method; and a "possible violation" method which is designed for laboratory or in-plant use because of clean-up and product collection requirements.

Although the procedures are suitable for use with products labeled by volume and packaged in cylindrical containers with separate lids which can be resealed, the various steps have been set forth using paint as the example. A worksheet for audit or possible violation (page A-7) is also included.

4.9.1. Equipment

Scales and weights recommended in Section 3.1.

Volumetric measures recommended in Section 4.2.

<u>Micrometer depth gage</u> (ends of rods fully rounded)¹, 0 to 9 in (0 to 225 mm).

Diameter tape measure, 2 to 12 in or 5 to 30 cm.

Spanning bar, 1 by 1 by 12 in or 2.5 by 2.5 by 30 cm.

<u>Paint solvent</u> or other solvent suitable for the product being tested.

Rule, 12 in or 30 cm.

Cloth, 12 in or 25 cm square.

Wood, 12 in or 25 cm long, 2- by 6-in.

Rubber mallet.

<u>Circular metal disc</u>, 1/4 in or 0.65 cm thick and slightly smaller than the diameter of package container bottom.

Rubber spatula.

Bubble level.

Optional: Micrometer.

¹The rods will need to be custom ground.

4.9.2. Field Auditing Procedure

The following procedure is suitable only for use in checking products put up in cylindrical containers up to 1 gal or 4 L in capacity. Step 2a can be used with any sized containers and 2b with 1-gallon or 4-L containers only. The method determines by calculation the volume of a single can in the sample, selected as most likely to contain the smallest volume of product. It does not require emptying any containers, only measuring critical dimensions of the container.

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 percent in this auditing procedure. This method is therefore recommended solely to eliminate from more rigorous testing those packaged products that appear to be full measure. Section 4.9.4. is recommended when the volume determined in step 9 of this section is less than the labeled volume or in any case where short measure is suspected.

- 1. Fill out the report form heading and select a random sample. A tare sample is not needed.
- 2. a. Any container up to 1 gal or 4 L:

Measure the outside diameter of each container near its middle (as shown in Figure 4-4) to the closest 0.001 in (or 0.02 mm), using a direct reading diameter tape measure. Record readings in column 3 of the Worksheet for Checking Paint (page A-7) in the audit section.

Set the containers on a level surface and record their heights on the worksheet under column 1 in the audit section. If the range of outside diameters exceeds 0.005 in (or 0.125 mm) or the range in heights exceeds 0.0625 in (or 1.58 mm), this procedure cannot be used. If the ranges are within the specified limits, open all cans in the sample and select the container with the greatest headspace as determined by visual inspection or with the use of the micrometer depth gage. Replace all lids except that of the selected container and reseal the lids by placing a cloth and then a section of wood on lid and hammering on the wood with a rubber mallet. Tip the cans upside down momentarily to complete the resealing operation. Continue with step 3 below.

2.

b. 1-gal or 4-L cans:

This test is appropriate when the weight of the paint is much greater than the weight of the can and is, therefore, applicable for 1-gal or 4-L sizes only.

Gross weigh each package in the sample. Select the package from the sample with the lightest gross weight. Carefully remove the lid of this can.

3. Measure the outside diameter of the selected container near its top, middle (already measured if step 2a was used), and bottom, to the closest 0.001 in (or 0.02 mm), using a direct reading diameter tape measure. Record these measurements in columns 2, 3, and 4 on the paint worksheet in the audit section.



Figure 4-4. Measuring the diameter of a paint can.

Sum the three diameter values and divide by three to obtain the average diameter. Record the average diameter in column 5 of the paint worksheet.

4. 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 4-4, page B-21.

Subtract twice the wall and paper label (if any) thickness from the average can diameter (step 3) to obtain the average liquid diameter. Record the liquid diameter in column 6 of the paint worksheet.

5.

On a level working surface, place the container of paint on the circular metal disc slightly smaller in diameter than the bottom rim of the can so the bottom of the container nests on the disc as shown in Figure 4-5. This eliminates the "sag" in the base of the paint container.



Figure 4-5. Measuring the distance to the liquid level.

6. Place the spanning bar and depth gage across the top of the paint can as shown in Figure 4-5. Mark the location of spanning bar on rim of paint container. Measure the distance to the liquid level to the nearest 0.001 in (or 0.02 mm) at three points in a straight line, at points approximately 3/8 in from the inner rim for cans 5 in in diameter or less (1/2) in from the rim for can diameters exceeding 5 in), and at the center of the can as shown in Figure 4-6. If working in metric units, measure at 1 cm from the rim for cans with diameters of 15 cm or less and 1.5 cm from the rim for can diameters exceeding 15 cm. Sum 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 of the audit section on the paint worksheet.



- Figure 4-6. Top view of paint can showing locations at which depth measurements are made.
 - 7. Measure the distance to the bottom of the container (Figure 4-7) at three points in a straight line in the same manner as outlined in step 6. Sum the three readings and divide by three to obtain the average height of the container and record it in column 8 of the paint worksheet in the audit section.



Figure 4-7. Measuring the distance to the bottom of a container.

- 8. 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 of the paint worksheet.
- 9. Determine the volume of paint in the container by using the following formula:

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

= 0.7854 x D x D x H

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

Record this volume in column 10 of the paint worksheet.

If this calculated volume is less than the labeled volume, go on to Section 4.9.4.

4.9.3. In-Plant Auditing Procedure

This method is applied to a container that is likely to contain the smallest volume of product. The level of fill is duplicated with water in a can of the same dimensions as the one under test. The method can be used to check any size of package provided that the liquid level is within 9 inches of the top of the container.

Follow steps 1 through 5 of Section 4.9.2. If any paint is found clinging to the side walls or lid, carefully scrape the paint into the container with a rubber spatula.

- 6. Place the spanning bar and depth gage across the top of the paint can. Measure the distance to the liquid level at the center of the surface and record the level in the audit section of the paint worksheet in column 7. (See page A-6.)
- 7. Select an empty can with the same bottom configuration as, and with diameter and height within +0.001 in (or +0.025 mm) for 1-pt (or 500 mL) cans, +0.002 in (or +0.05 mm) for 1-qt (or 1-L) cans, ± 0.003 in (or ± 0.075 mm) for 1/2-gal (or 2-L) cans, and +0.004 in (or +0.1 mm) for 1-gal (or 4-L) cans, of the container under test. Set the empty can on a level work surface with a circular metal disc slightly smaller in diameter than the bottom can rim underneath the can to eliminate sag. (See Figure 4-5.) Set up spanning bar and depth gage as in step 6 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 6. If this distance is equal to or greater than the distance determined in step 6, assume that the package is satisfactory. If the distance is less than the distance determined in step 6, short measure may be suspected. Use the possible violation procedure given in the next section when short measure is suspected.

4.9.4. Possible Violation Procedure

The following method may be used provided that the liquid level is within 9 inches of the top of the container. The steps noted with an (a) are required if paint is found adhering to the lid and cannot be removed by scraping into the can.

It may be necessary to use the alternative tare procedure of Section 2.11.4., although the following steps do not specifically include that technique.

- 1. Fill out the standard pack report form (page A-1), select the random sample and random tare sample.
- 2. Do not shake or invert the containers selected as the sample. Determine the gross weight of these packages and record in the lower section of the paint worksheet headed "Possible Violation" (page A-7). Also record the labeled volume in column 1 of this worksheet. Select first tare sample package. Use circular metal disc to eliminate can sag as shown in Figure 4-5 and described in step 5, Section 4.9.2. Remove the lid. If paint is clinging to the side walls, scrape it down into the can with the spatula.
- 2a. If paint adhering to the lid cannot be removed completely by scraping the paint into the can, determine the weight of the lid plus any adhering paint. Clean the lid of paint 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 of the paint worksheet.
- 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 0.001 in (0.02 mm). Record the distance in column 4 of the paint worksheet.

- 4. Empty and clean the sample container and lid with a suitable 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 2 above.
- 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 amounts¹ until the water reaches the same level occupied by the paint as indicated by the depth gage. Record this volume of water (in fl oz or mL) in column 6 of the paint worksheet. This is the volume occupied by the paint in the container. Follow steps 7a, 8a, and 9a if paint could not be removed from lid by scraping. Follow steps 7, 8, and 9 otherwise.
- 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 on the paint 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.
- 8. Calculate the weight of the labeled volume of paint =

net weight (col. 7) x labeled volume (col. 1) volume of paint in can (column 6)

Record this value in column 8 of the worksheet.

8a. Calculate the package volume =

volume in can (col. 6) +

lid paint weight (col. 3) x <u>can volume (col.6)</u> net weight (col.7)

Record it in column 9 of the worksheet.

¹One method of measuring water delivered into the container is to use a volumetric measure of the same size as the labeled quantity of paint. Fill the measure to the mark with water and pour the water into the package container. Add or subtract the water necessary to reach the same level occupied by the paint with the aid of a syringe dropper and small graduate. The volume occupied by the paint is the volume of the test measure plus the additional water added or minus the water removed from the package container.

9. Calculate package error.

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

- 9a. Package error = (column 9 value) (labeled volume)
- 10. Repeat steps 2 through 9a (above) for the second package chosen for tare.

In order to use weighing to check the sample, the weights of the labeled volume for the first two packages (recorded in column 8) should not differ from each other by more than the value given in Table 4-3 (page B-20). If this criterion is met, the rest of the sample may be checked by weighing. The nominal gross weight is equal to the sum of the average weight of the labeled volume plus the average tare. Go to step 6 of the CORE METHOD described in Section 3.5. to complete the test.

It should be noted 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. In such instances, the criterion of Table 4-3 will not be met. Follow steps 2 through 9a but skip steps 7, 8, and 9, if paint is adhering to the lid (or steps 2 through 6 if paint is not adhering to the lid) for all the packages in the sample. When package errors have been determined in this manner, go to Steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

4.10. VERY VISCOUS MATERIALS¹

The following method can be used for any package labeled by volume, but is especially suitable for very viscous materials such as cartridge-packed caulking compounds, glues, pastes, and the like, often packed in tubes. This is most suitable as a laboratory procedure using a hood to ventilate solvent fumes, if necessary. If used in the field, a well-ventilated area should be chosen to conduct the test if solvents other than soap and water must be used.

Except for the special measurement procedures to determine the weight of the labeled volume, this procedure follows Sections 4.4. and 4.5. for standard pack liquids labeled by volume. For each weight of a known volume determination, a portion of the packaged product is packed into a preweighed cup of known volume (called a density cup or pycnometer) and weighed. From the weight of the known volume, the weight of the labeled volume can be determined. This weight (plus the tare) can then be compared with the actual net weight to determine the package error.

¹Based on a method devised by Mr. James Little, NBS.

4.10.1. Equipment

Small-capacity scale and weights recommended in Section 3.1.

<u>Pycnometer</u>, a vessel of known volume for weighing semifluids. The pycnometer can be purchased or constructed. If constructed, it will be referred to 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. (See Figure 4-8.) The slicker plate can be purchased commercially.

<u>Appropriate solvents</u> (water, Stoddard solvent, kerosene, alcohol, etc.).

Caulking gun (for cartridge-packed products).

4.10.2. Preparation for Test

Weigh and calibrate pycnometer or the complete density cup unit (cup and slicker plate) with respect to volume (mL or fl oz) prior to use. Calibrate the density cup gravimetrically with respect to the contained volume using the procedure given in NBS IR 74-461, "The Calibration of Small Volumetric Glassware". Special instructions furnished by the manufacturer may be necessary in order to calibrate a pycnometer not already calibrated. It is not necessary to reweigh or recalibrate for each test; however, the pieces of each unit should be marked to prevent interchange of cups and slicker plates.



Figure 4-8. Empty density cup and slicker plate.

4.10.3. Procedure

- 1. Determine inspection lot, fill out the report form heading (page A-1) and select the random sample and tare sample.
- 2. Weigh a calibrated pycnometer or density cup and slicker plate and record on the worksheet on pages A-5 and A-6 as "pycnometer weight" or "cup and plate weight" in place of "flask weight" in item 4. Also record the pycnometer or cup volume (item 6 on this worksheet).
- 3. Gross weigh and then open the first package in the tare sample. Record the package gross weight on the worksheet in item 1. Transfer the product to the pycnometer or density cup, filling the pycnometer or cup to excess. Use a caulking gun for transferring product from caulking cartridges. Remove the product as completely as possible from the package container, clean package container with solvent, dry and weigh it. (Record this weight as "tare weight" in item 2 on the worksheet.)
- 4. If pycnometer is used, cover with lid and screw cap down tightly. Excess material will be forced out through hole in lid. Clean exterior surfaces.

If using density cup, place the slicker plate over 3/4 of the cup mouth (see Figure 4-9), press down, and slowly move the plate across the remainder of the opening. With the slicker plate kept in place, clean all exterior surfaces with solvent and dry them.



Figure 4-9. Density cup filled with product.

- 5. Weigh filled pycnometer or filled density cup with slicker plate to at least the nearest 0.002 pound or nearest gram. Record this weight in item 3 on the worksheet. Subtract the weight of the empty pycnometer or cup and plate (item 4 on worksheet) from the filled weight to arrive at the weight of the product contained in the pycnometer or density cup. Record this weight on the worksheet in item 5.
- 6. Clean the pycnometer or density cup and repeat steps 3, 4, and 5 for the second package in the tare sample.

If the weights recorded in item 5 on the workshet differ from each other by more than the value in Table 4-3, page B-20, then all the packages will have to be opened to determine their package errors. Go to step 8 in this event.

7. Calculate the weight of product corresponding to the labeled volume of product =

product weight in cup x labeled volume density cup volume

If using pycnometer, substitute product weight in pycnometer and pycnometer volume in above equation. (See items 9 and 10 on the worksheet.) Continue to follow the instructions on the worksheet to determine lot conformance.

8. If an average weight of the labeled volume cannot be used to determine the nominal gross weight, that is, if the "yes" box is checked in item 8 on the worksheet, the gross weight of each package minus its tare weight is the actual weight of product in each individual package being measured. Record this as the "net weight" on another worksheet. Subtract the weight of the labeled volume (determined for each package as given in Step 7) from the net weight of product to arrive at each individual package error in units of weight.

Convert the package errors to units of volume.

Package error (volume) =

Package error (weight) x cup volume weight of product in cup

(If using pycnometer, substitute pycnometer volume for cup volume and weight of product in pycnometer for weight of product in cup in above equation.)
Record the package errors on the standard pack report form on page A-1 using an appropriate unit of measure.

Follow Steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

4.11. PEAT MOSS

Peat and peat moss are labeled by weight, by "compressed volume," and by volume. The following method is for use in testing the volume declaration, including the volume that can be recovered from the compressed state.¹ ASTM D 2978-71, "Standard Method of Test for Volume of Peat Materials", is the reference standard for the procedure.

Every package in the sample is opened.

This method is suitable 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 specified below 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 test measure (see step 2 below).

4.11.1. Equipment

12.5-mm (or 1/2-in) sieve.

Wooden or metal container, with inside dimensions of 12 by 12 by 12 in marked off in 1-in horizontal lines on the inside (1-cu ft container) or of 50 by 50 by 40 cm marked off in 5-cm horizontal lines ($0.1-m^3$ container). This container is not commercially available, but has to be constructed.

Straight edge, 20 in (50 cm) in length.

Sheet for catching overflow of material.

Bubble level.

4.11.2. Procedure

- 1. Determine inspection lot, fill out the report form heading, and select the random sample. No tare sample is needed.
- 2. Open each package in turn, removing the contents and passing them through the sieve directly into the measuring container (overfilling it). Shake the measuring container with a rotary motion at one rotation per second for 5 seconds. Do not lift the measuring

¹The compressed volume declaration can only be checked by measuring the package dimensions or by liquid displacement (see Section 4.13.).

container when rotating it. If package contents are greater than the measuring container capacity, level the measuring container with a straight edge using a zig-zag 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 amount of material on a worksheet.¹

3. Compute each package error (= actual measurement minus the labeled measurement) and record it on the worksheet. Transfer the package errors to the report form using an appropriate unit of measure in box 2 of the report form. Follow steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

4.12. BARK MULCH

The National Conference on Weights and Measures recommended the following method for bark mulch. 2

4.12.1. Equipment

Construct test measure of materials (for example, 1/2-inch plywood) that will not bulge when filled with mulch. Interior dimensions should be 9 inches by 16 inches by 48 inches high, with 2 opposite inside walls of the measure marked or scribed intervals. at 1/2-inch Other interior dimensions are acceptable as long as the container approximates the configuration of the package under test (e.g., 12- by 12-inch cross section). Container height may also be reduced from 48 inches, but this will restrict the maximum size of package that can be tested. A lexan or plexiglass side wall is useful for determining the level of fill, but may need to be reinforced.

Each half inch of depth of the test measure is equivalent to 72 cubic inches of volume in the 9- by 16-in or 12- by 12-in configurations.

4.12.2. Procedure

1. Determine inspection lot, fill out report form heading, and select the random sample. No tare sample is needed. A special MAV of 5% of the declared volume is applied for bark mulch.

¹Use conversion factors (such as "Factors for High Precision Conversion", NBS Letter Circular 1071, July 1976) to convert from cubic measure to dry volume, if necessary.

²Report of the 68th National Conference on Weights and Measures, 1983, NBS Special Publication 663.

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

Record each package error. Package error = (package net volume) - (labeled volume)

3. After package errors for the entire sample have been recorded, follow steps 7-11 of the CORE METHOD in Section 3.5. to determine lot conformance.

4.13. SOLIDS OR SEMISOLIDS

The following procedure can only 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, frozen desserts labeled by liquid volume are tested using kerosene as the immersion fluid.

Every package must be opened. The product is removed from its package and completely submerged in water or other fluid in a container. The volume of the product may be determined either (a) by noting the difference in volume registered by comparison with graduated markings on the container or (b) by measuring the volume of water or fluid overflowing from a container previously filled to overflow capacity.

4.13.1. Equipment

Either of the following:

- o <u>Graduate or volumetric flask</u> of capacity larger than the labeled volume of package being tested.
- o <u>Container with overflow spout</u> of physical dimensions large enough to contain commodity, plus graduate or volumetric flask equivalent to labeled volume.

Thin wire.

<u>Water or other fluid</u> that will not dissolve or mix with package contents.

Bubble level.

4.13.2. Procedure

- 1. Determine inspection lot, fill out the standard pack report form heading, page A-1, and select the random sample. A tare sample is not needed.
- 2. On a level surface, follow either (a) or (b) below.
 - a. Select a graduate of larger capacity than the labeled volume of the package. Partially fill it with water or other liquid to a volume which will still allow the packaged product to be added to the graduate without exceeding the graduated portion of the graduate. Record this volume on a worksheet.

Open the first package and submerge the product by pushing the product into the liquid with the wire. Record the resulting volume as "fluid and product" on the worksheet.

The volume of the product is the difference between liquid levels, "after" minus "before" adding the product to the graduate. Record it as "net volume of product" on the worksheet.

- b. Select container with overflow spout and fill it to overflowing with water or other liquid; allow to sit until dripping stops. Place a graduate or other volumetric container of a capacity large enough to contain the package volume at the Open the first package and carefully spout. submerge the product using the thin wire to push the entire product below the liquid level. The volume of liquid displaced by the product (including the final dripping of liquid into the container or graduate) is the volume of the product. Record this volume as the "net volume of product" on a worksheet.
- 3. The volume of the product (as determined by 2a or 2b above) minus the labeled volume is the individual package error. Record the package error on the worksheet and transfer to the report form using an appropriate unit of measure. Repeat steps 2 and 3 (as appropriate) with the remainder of the packages in the sample. Follow steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

4.14. GOODS LABELED BY CAPACITY

The capacity of packaged products such as bowls, pots, glasses, cups, etc. is labeled in terms of liquid volume and is defined as the brim-full or level-full capacity unless there are markings of capacity on a side wall of the product, or a ridge capable of accepting a lid. (In the former instance, the capacity is defined as the capacity at the designated mark. In the latter instance, the capacity is defined as the capacity at the level of the ridge or "seat".) The procedures presented below are for determining the brim-full, marked or seated capacity of a container.

4.14.1. Equipment

Volumetric Flasks and graduate as described in Section 4.2.

500-milliliter buret meeting Type 1, Style 1, Class A requirements of Fed Spec NNN-B-782.

Rubber bulb syringe.

<u>Plastic Disks.</u> 1/8-in or 3-mm thick disks with diameters to correspond to seat diameter or larger than brim diameter of each container tested. Diameter tolerance is ± 0.002 in or ± 0.05 mm. The outer edge should be beveled at a 30-degree angle with the horizontal to 1/32 in or 0.8 mm thick at the edge. There should be a 3/4-in or 20-mm diameter hole through the center of the disk and a series of 1/16-in or 1.5-mm diameter holes 1 in or 25 mm apart around the periphery of the disk and 1/8 in or 3 mm in from the outer edge. All edges should be smooth. (See Figure 4-10.)

Bubble level.



Figure 4-10. Plastic disk (beveled edge upward) inserted in the seat of a container to be tested.

4.14.2. Procedure¹

The following procedures are divided into (a) determination of flush fill to brim or (b) determination of capacity to seat. The working surface must be level for all test procedures. After describing the procedure, information is presented on testing a container to a marked capacity not using the plastic disks.

- 1. Determine inspection lot, fill out the standard pack report form heading (page A-1), and select the random sample. A tare sample is not needed.
- 2. a. Select a plastic disk with a diameter larger than the outside brim diameter of the container to be tested. Place the disk with the beveled edge upward on the container. Center the disk on the container. (See Figure 4-11.)



Figure 4-11. Disk in place for flush fill (or brim-full) capacity determination.

2. b. Select a disk with a diameter equal to the seat diameter of the container being tested. Insert the plastic disk on the seat of the container with the beveled edge upward. (See Figure 4-10.)

¹Plastic disk procedure provided by the American Can Co., Neenah, Wisconsin.

3. 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 the filling procedure 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.

> Do not add additional water after the level of the water dome has dropped.

- 4. Record on a worksheet the amount of water used to fill container and subtract 0.03 fl oz (1 mL) (corresponding to the amount of water in the disk hole) to obtain the container capacity. Record the container capacity as "net capacity" on the worksheet.
- 5. Compute the package error (= net capacity minus the labeled capacity), record it on the worksheet, and transfer it to the report form using an appropriate unit of measure.

Repeat this procedure on the remaining packages in the sample. Follow steps 7-11 of Section 3.5. (CORE METHOD) to determine lot conformance.

When testing containers with markings of capacity on the side wall of the container, water from a buret, flask, or graduate should be added to each container to obtain a level of fill corresponding to the markings. The official should record the amount of water used to reach the mark (similar to filling a volumetric flask to a mark if the container walls are transparent) as the container capacity. Then follow step 5 above to complete the test.

CHAPTER 5. METHODS OF TEST FOR PACKAGES LABELED BY COUNT, LENGTH, AREA, THICKNESS, OR COMBINATIONS OF QUANTITIES

- 5.1. Packages labeled by count when the labeled count is 51 or more units per package
- 5.2. Packages labeled by count when the labeled count is 50 or fewer units per package
- 5.3. Packages labeled by linear or square (area) measure
- 5.4. Polyethylene sheeting
- 5.5. Paper plates
- 5.6. Sanitary paper products
- 5.7. Pressed and blown glass tumblers and stemware

CHAPTER 5. METHODS OF TEST FOR PACKAGES LABELED BY COUNT, LENGTH, AREA, THICKNESS, OR COMBINATIONS OF QUANTITIES

Many commodities and manufactured products are sold in units of quantity other than weight or liquid or dry volume. For example, food wrap is sold by length, width, and area. Polyethylene sheeting is sold by length, width, area and thickness. Disposable paper plates are sold by the number in the package and by their diameter.

This chapter provides general procedures for packages labeled by count or length and procedures for specific commodities such as polyethylene sheeting.

When packaged goods are labeled by two or more units (for example, count and dimension, or capacity, etc.), each labeled quantity must meet the average requirements unless other requirements pertain.

The National Conference on Weights and Measures (NCWM) Uniform Method of Sale of Commodities Regulation $(MoS)^1$ has provided an exception to the average requirements: pressed and blown glass tumblers and stemware are given tolerances; the average requirement does not apply. A special sampling plan and test procedure are provided for pressed and blown tumblers and stemware (Section 5.7.).

For statistical reasons, an exception to the average requirement applies to packages labeled by low count (less than 51 units per package). This chapter provides a set of sampling plans to be used in such instances (Section 5.2.).

5.1. PACKAGES LABELED BY COUNT WHEN THE LABELED COUNT IS 51 OR MORE UNITS PER PACKAGE

Two methods are presented here for determining count without opening all packages in the sample. Both use the weight of a counted number of packaged units or items. One of these methods is intended as an audit procedure only. Of course, if the weight of discrete units or numbers of units is found to be too variable, the official must count packaged units rather than weigh them.

5.1.1. Equipment

Scales and weights recommended in Section 3.1.

¹The NCWM MoS appears in NBS Handbook 130 and is a standard for State regulatory use that is periodically revised by State agency representatives. Not all 50 States have regulations based on this model.

5.1.2. Audit Procedure

Since the precision of the method is only ± 1 percent, determination of lot conformance and further action based on shortages of count must rely either on actual count or Section 5.1.3.. However, this method is useful for auditing packages labeled by high unit counts (in excess of 100).

- 1. Determine inspection lot, fill out the standard pack report form heading (page A-1), and select the random sample and random tare sample.
- 2. Gross weigh the first package in the tare sample. Record this weight on a worksheet.
- 3. Select the number of items, either (a) or (b), from the first tare package that weighs the greater:
 - a. 10 percent of the labeled count,
 - b. a quantity sufficient to indicate at least 50 minimum divisions on the package checking scale. For example, using the package checking scale with 1/16-oz divisions, the selected count must weigh at least 3 1/8 oz. For the package checking scale with 1-g divisions, the selected count must weigh at least 50 g. Record the count and weight on the worksheet.
- 4. Calculate the weight of the labeled count

Record the result on the worksheet as "labeled count weight".

- 5. Gross weigh the rest of the tare sample and keep contents of opened packages separated in case Section 5.1.3. must be followed. Determine the tare weights of the tare sample and record these on the worksheet.
- 6. The weight of the labeled count plus the tare weight represents the "nominal gross weight".

Package error (weight) =

(actual package gross weight) - (nominal gross weight)

Compare the unopened packages with the nominal gross weight and record the package errors on the worksheet.

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

Package error (count)

= <u>Package error (weight) x labeled count</u> labeled count weight (step 4)

Round any fractional counts computed in this manner to whole units in favor of the packager. Record the package error in units of count in the crosshatched area of the report form. Compute the average error. If the average error is minus, follow Section 5.1.3. to determine lot conformance. If the average error is equal to zero or positive, the lot is presumed to conform to the package requirements.

5.1.3. Possible-Violation Procedure

Special worksheets have been developed to accompany the report form. The worksheets on pages A-9 and A-10 guide the inspector through the procedure.

The measurement of the weight of the number of units in the package is combined with the determination of tare and, therefore, will not require opening more packages than the tare sample.

If the procedure in Section 5.1.2. has been used, procedure 5.1.3. can be followed with the same sample if package contents have been kept separate and can still be counted.

- 1. Determine inspection lot, fill out the report form heading (page A-1), and select the random sample and random tare sample. Record the labeled count in box 1 on the report form.
- 2. Gross weigh the packages selected for tare determination and record their gross weights in item 1 of the worksheet. Open these packages.
- 3. Determine and record the net package contents weight and the <u>exact number of items</u> in the first opened package.

Record the weight in item 4 and the count in item 3 on the worksheet.

4. Record the MAV from Table 2-10 (page B-13) in units of count in box 3 on the report form and in item 6 on the worksheet.

In order to determine whether the scale used to weigh the packages is able to discriminate differences in count, calculate the weight equivalent to MAV/6. MAV/6 must be at least as large as 1/2 the size of the smallest mechanical scale division (or at least as large as the smallest increment in the readout on a digital scale). (See items 7 and 8 on worksheet.)

For example, from Table 2-10 the MAV is 7 units for a package labeled with a count of 250 units. The scale should be capable of discriminating differences corresponding to MAV/6 or, in this example, one unit.

If the criterion above is not met, count the package contents in each package in the sample; if met, go on to step 5.

- 5. Determine and record on the worksheet in item 2 the tare weight of the first package opened.
- 6. Determine and record the weight and the count of the package contents in the second package opened for tare (items 3 and 4 on the worksheet).
- 7. Calculate the weights of the labeled counts for the first two packages.

Weight of labeled count

= labeled count x <u>contents weight</u> contents count

Record these weights in item 5 of the worksheet.

To avoid round-off errors, carry over at least two extra decimal places in the calculation until the weight of the labeled count is obtained.

The difference in weights of the labeled counts of the two packages must not exceed the value given in Table 4-3 (page B-20). Fill in item 9 on worksheet.

If the difference in weights does not meet this criterion, determine the actual count per package for every package in the sample. If the difference meets this criterion, average the weights of the labeled count and go on to step 8.

- 8. Determine the tare for the rest of the tare sample if any additional tare sample packages remain. Record the tare values on the worksheet. Average the tare weights (record in item 10 on the worksheet and box 13 on the report form).
- 9. The average weight of the labeled number of items in the package (step 7) plus the average tare weight (step 8) equals the "nominal gross weight". Record the nominal gross weight in item 11 on the worksheet and in box 14 on the report form.

Package error (weight) =

(actual package gross weight) - (nominal gross weight)

Record package errors for the tare sample packages (items 12 and 13 on the worksheet).

10. Convert the MAV to units of weight:

MAV (weight) = MAV (count) x

average weight of labeled count labeled count

See item 14 on worksheet for calculation.

Convert the MAV to dimensionless units and record in item 15 on the worksheet and box 4 on the report form.

With all measurements converted to weight and dimensionless units, go to Step 6-11 of Section 3.5. (CORE METHOD) to determine lot conformance. Convert back to count when completing box 19 of the report form by following the calculation in item 16 on the worksheet.

5.2. PACKAGES LABELED BY COUNT WHEN THE LABELED COUNT IS 50 OR FEWER UNITS PER PACKAGE

A special sampling plan is provided for packages labeled by count when the number of units per package is 50 or fewer. The sampling procedure requires counting the number of units in each package in the sample and noting the number of those packages that contain less than the labeled count. The MAV is not used directly in the sampling plan. The required number of packages for the sample, tare sample, and the allowed number of undercount packages are given in Table 5-1 (page B-22). Average count does not apply.

Procedure

1. Determine inspection lot, fill out report form heading. Sample size and tare sample size are found in Table 5-1, page B-22. Record the column 4 value from Table 5-1 (the number of packages that are permitted to contain fewer than the labeled count) in box 8 of the report form.

The MAV in units of count is found in Table 2-10 (page B-13) and recorded in box 3 on the report form.

2. Follow steps 2 through 9 of Section 5.1.3.

If it is possible to determine count by weighing, compare the gross weight of the unopened packages in the sample with the nominal gross weight. Individual package errors are equal to the actual gross weights minus the nominal gross weight.

If it is necessary to open every package in the sample and count the contents, the package error is equal to the actual count minus the labeled count. Record the package errors.

3. Circle and count the number of minus package errors of any size. If this number is larger than the number in box 8 of the report form, the lot fails to comply with the package requirements. If the number of minus package errors is less than or equal to the number recorded in box 8 of the report form, the lot complies.

The MAV's listed in Table 2-10 for packages labeled by count and fewer than 51 units per package define the limits of reasonable variation for an individual package even though the MAV is not used directly in the sampling plan. Individual packages that are undercount from the labeled count by more than the MAV are, however, considered defective (even if the lot as a whole passes inspection); they should be repacked, relabeled, or otherwise handled.

Example

An official must test a lot of 360 packages of cotton balls labeled "50 cotton balls". A random sample of 10 packages is chosen from the lot. Because his scale cannot discriminate differences in count, the inspector opens every package and counts the balls. The 10 package counts are: 50, 52, 50, 50, 51, 53, 52, 50, 47, 50.

Referring to Table 5-1, since only one package contains fewer than 50 balls, the inspector declares the lot to have passed the test. The package containing 47 balls should not be introduced into commerce even though the lot complies with the package requirements.

5.3. PACKAGES LABELED BY LINEAR OR SQUARE (AREA) MEASURE

The weight of the labeled linear or area measure may be used together with the tare weight as the nominal gross weight, as long as the scale used to weigh the packages can discriminate the weight equivalent to MAV/6 and the weight of the labeled measure does not vary outside the ranges permitted in Table 4-3 (page B-20). Worksheets similar to the one provided for count (pages A-9 and A-10) should be devised and used for length or area measurements.

Products labeled by length or area often require the application of tension to the ends of the product before measurement in order to straighten the product. Tension must be applied to woven or twisted fiber products such as thread, yarn, rope, cording, twine, etc. Because of the specialized equipment required for these products (and because such equipment is not readily available outside the packaging plant), the official is referred to the following standards suitable for in-plant inspection together with sampling plans described in this handbook. These standards are: "Standard Method of Test for Yarn Number by the Skein Method", ASTM D1907-75, for thread and yarn; "Standard Methods of Testing Twine Made from Bast and Leaf Fibers", ASTM D1233-73, and "Standard Tolerances for and Methods of Testing Single Jute Yarn", ASTM D541-71.

Textiles labeled by length should be inspected using textile measuring devices that have been found to conform with the tolerances of NBS Handbook 44.

5.3.1. Equipment

Scales and weights as recommended in Section 3.1.

T-square.

Steel tapes and rules:

Inch-pound:

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

For labeled dimensions greater than 25 in, 100-ft tape with 1/16-in divisions, overall length tolerance of 0.1 in.

Metric:

For labeled dimensions 40 cm or less, 1-m rule with 1/2-mm divisions, overall length tolerance of 0.4 mm.

For labeled dimensions greater than 40 cm, 30-m tape¹ with 1 mm divisions, overall length tolerance of 2.5 mm.

¹The markings specified for the equivalent metric rule and tape may be incorporated in the inch-pound rule and tape.

5.3.2. Procedure

- 1. Determine inspection lot, fill out the standard pack report form on page A-1, and select the random sample and tare sample. Separate report forms and worksheets (replacing all "count" terms with "dimensions" on page A-9 and A-10) should be filled out for packages labeled by separate dimensions and/or area.
- 2. Gross weigh and open the packages selected for tare determination. Record on the worksheet in item 1.
- 3. Determine 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.

Record the weight and measure on the worksheet in items 4 and 3. Calculate the weight of the labeled measurement on the worksheet following item 5.

Weight of the labeled measurement =

labeled measurement x <u>contents weight</u> contents measurement

Record the MAV in units of length or area measure (given in Table 2-11, page B-14) in box 3 of the report form and on the worksheet in item 6.

4. Calculate the length or area of packaged product corresponding to MAV/6. Convert the MAV/6 to units of weight (in item 7) of the worksheet. MAV/6 in units of weight must be at least as large as 1/2 of the smallest division on a mechanical scale used to weigh the product (or at least as large as the smallest increment in the readout, if a digital scale is being used). (See item 8 on the worksheet.)

> For example, an inspector finds that 200 sq ft of product weights 2.000 lb; 1 sq ft must therefore weigh 0.010 lb. For the small capacity scale, this is 5 times the usual minimum scale division (0.002 lb); therefore, the first criterion is met.

> If this criterion is met, go on to the next step. If not, all packages in the sample must be opened in order to measure the contents.

- 5. Determine and record in item 2 on the worksheet the tare weight of the first package opened.
- 6. Determine the measurements of the product in the second package chosen for tare determination (item 3). Determine the tare weight of this package and record on the worksheet (item 2). Calculate and record the weight of the labeled measurement for the second package (item 5).
- 7. The weights of the labeled measurement for two packages must not differ by more than the value given in Table 4-3 (page B-20). If they do, all packages in the sample must be opened, measured individually, and compared against the labeled measure to determine the package errors. (See item 9 on the worksheet.) If Table 4-3 criterion is met, go on to step 8.
- 8. Calculate the average weight of the labeled measurement and record it on the worksheet in item 9.
- 9. Determine the tare weights of the rest (if any) of the tare sample. Record on the worksheet and average the tare weights (item 10 on the worksheet).
- 10. The average weight of the labeled measurements (item 9 on the worksheet) plus the average tare weight (item 10 on the worksheet) equals the nominal gross weight. Record the nominal gross weight on the worksheet in item 11 and in box 14 on the report form.

Package error (weight) =

(actual package gross weight) - (nominal gross weight)

11. Determine the package errors for the tare sample following the arithmetic in items 12 and 13 on the worksheet and transfer these values to the crosshatched area of the report form.

12. Convert the MAV to units of weight.

MAV (weight)

= avg. wt. of label measurements x MAV (length) labeled measurements

Record MAV in units of weight on the worksheet in item 14.

Convert the MAV to dimensionless units as shown in item 15 on the worksheet. With all measurements converted to weight, follow steps 6-11 of Section 3.5. to determine lot conformance. Convert package errors in weight to length (or area) when completing the report form using the formula in step 16 on the worksheet.

5.4. POLYETHYLENE SHEETING

Polyethylene sheeting is sold not only by its linear or area measurement and net weight, but also by its thickness. The procedure to check thickness is based on ASTM D374 "Standard Test Methods for Thickness of Solid Electrical Insulation".

First the net weight of the product and dimensions of the sheeting are checked. If the net weight and dimensions conform to the package requirements, the thickness of the sheeting is then checked. All the sample packages are opened for thickness measurements.

A worksheet is provided to record length, width and thickness measurements for polyethylene sheeting on page A-11.

5.4.1. Equipment

Scales and weights recommended in Section 3.1.

Micrometer:

A deadweight dial micrometer (see Figure 5-1) equipped with a flat anvil, 1/4-in (or 6-mm) diameter or larger, and a 3/16-in (or 4.5-mm) diameter flat surface on the head of the spindle. The anvil and spindle head surfaces should be ground and lapped, parallel to within 0.0001 in (or 0.002 mm), and should move on an axis perpendicular to their surfaces. The dial spindle should be vertical and the dial should be at least 2 in (or 50 mm) in diameter. The dial indicator should be continuously graduated to read directly to 0.0001 in (or 0.002 mm). If 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 3 lbf (or 13 N) 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 0.001 in (or 0.02 mm).

The indicator reading must be repeatable to 0.00005 in (or 0.0012 mm) at zero setting.

Weight on probe head (total of anvil, weight, spindle, etc.) must be 4 oz (113.6 g).

o Electronic or motor-driven comparator with same specifications as above.

Steel tape rules recommended in Section 5.3.1.

T-square.

5.4.2. Preparation for Test

Gage blocks covering the range of thicknesses to be tested should be used to check the accuracy of either the micrometer or the comparator and should be maintained without rust, tarnish, or scratches. The micrometer or comparator should be operated in an atmosphere free from drafts and fluctuating temperature and should be allowed to stabilize at ambient room temperature before use.

Place the deadweight dial micrometer or comparator on a solid, level table, free from excessive vibration. Check the weight of the deadweight used with the spindle head. It should have a weight of about 3.6 oz.

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. The accuracy of the micrometer or comparator should be checked with appropriate thickness gages whenever the device is moved to a different location and at the beginning of each day's use of the device.



Figure 5-1. Deadweight dial micrometer.

5.4.3. Procedure

Steps 6a and 8a below apply to rolled product, 6b and 8b to folded product. Steps 10a and b apply to a two-stage MAV and, therefore, both steps 10a and 10b are followed for any single product test.

1. Determine inspection lot, fill out the standard pack report form heading (page A-1), and select the random sample and random tare sample.

Check the label declaration to make sure that all the declared dimensions are consistent with one another:

 $W = T \times A \times 0.03613$, where

- W = net weight in pounds
- T = nominal thickness in inches
- A = nominal area; that is nominal length in inches times nominal width in inches
- D = density in grams per cubic centimeter as determined by ASTM Standard D1505-68
 "Standard method of Test for Density of Plastics by the Density Gradient Technique" (or latest issue).

0.03613 is a factor for converting g/cm³ to lb/in³.

Assume a minimum density of 0.914 g/cm^3 .

For example, if the label reads:

i	6 ft wide x 100 ft long		
	4 MIL		
	net weight 11.5 lb		
=	(.004 in) x (100 ft x 12 <u>in</u>) ft		
	x (6 ft x 12 in) x 0.03613 ft	x	.914

= 11.4 lb net weight

W

Therefore, a declaration of 11.5 lb indicates that the label is in compliance.

Separate report forms for weight, length, width, and thickness should be attached to one another. The MAV for length and width dimensions is found in Table 2-11, page B-14. The MAV's for thickness are listed in Section 2.13. and in step 10a and b below. (If the actual length and width are correct, the area declaration is assumed correct.)

- 2. Gross weigh the packages chosen for tare, open them, and record the gross weights on the report form.
- 3. Weigh the first package tare (include core if any) and record on report form. Extend the first package to its full dimensions, and remove by hand all creases and folds as far as possible.

Measure the length and width of the product to the closest 1/8 in (3 mm). Make all measurements at intervals uniformly distributed along the length and width of the product. Record the individual measurements on the worksheet for polyethylene (page A-11). Compute the average length and width and record on the worksheet.

- a. With rolls of product, make three length measurements along the width of the roll and at least ten width measurements along the length of the product.
- b. 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.

- 4. Follow Section 3.6. for determining conformance of the lot with net weight labeling requirements. If the lots fail to conform with net weight requirements, no further measurements are necessary.
- 5. Follow steps 4 through 12 of Section 5.3.2. to determine whether the inspection lot conforms with the package requirements on length and width. If the lot fails to conform, thickness need not be checked.
- 6. Measure the thickness of the plastic sheet with a micrometer or comparator at:
 - a. five uniformly distributed locations across the width at each end and 5 locations along each side of each roll in the sample, or;
 - b. five uniformly distributed locations across the width at one end and along the length at one side of folded product for each package in the sample.

When measuring the thickness, place the sample between the micrometer or comparator 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 0.0003 to 0.0004 in (or 0.008 to 0.01 mm) and move the sheet to the measurement position. Drop the spindle head onto the test area of the sheet. Read the dial thickness 2 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 or probe 0.0003 to 0.0004 in (or 0.008 to 0.01 mm) above the rest position on the test surface, move to the next measurement location, and drop the spindle head onto the test area. Take care to raise the spindle head or probe no more than 0.0004 in (or 0.01 mm) above its rest position on the test area. Any part of the test area in contact with the spindle head or probe during measurement must be at least 1/4 in (or 6 mm) from the edge of the sheet.

Record all thickness measurements on the worksheet. Compute and record the average thickness for the individual package.

- 7. Repeat step 6 on the remaining packages in the sample.
- 8. In Section 2.13., the MAV for polyethylene was described to apply in two stages. Follow both a and b below.
 - a. Measured thickness should not be less than 80% of the labeled thickness.

Circle any value in the thickness columns of the worksheet that is smaller than (0.8 x labeled thickness). If the number of values circled exceeds the number recorded in box 8 of the report form, the lot fails to conform to requirements No further testing of the lot is necessary.

If the number of circled thickness measurements is less than or equal to the box 8 value, go on to step 8b.

b. The average thickness for any single package should be at least 93% of the labeled thickness.

Circle any package average thickness value that is smaller than $(0.93 \times \text{labeled thickness})$.

If the number of package average thicknesses circled¹ exceeds the number recorded in box 8 of the report form, the lot fails to conform to requirements. No further testing of the lot is necessary. If the number of circled package average thicknesses is less than or equal to the box 8 value, follow step 8-11 of Section 3.5. (CORE METHOD) to determine lot conformance with respect to average thickness.

¹Count circled average thicknesses only; do not include circled individual thicknesses in this count.

5.5. PAPER PLATES¹

The plate count is first checked against requirements for the average, then the plate size is checked.

5.5.1. Equipment

Scales and weights recommended in Section 3.1.

<u>Measuring base</u> of any flat, sturdy material approximately 15 in (or 40 cm) square. Two vertical side pieces approximately 1 in (or 3 cm) 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.

<u>Graph paper</u>, 20 divisions per inch (or 10 divisions per centimeter).

5.5.2. Preparation for Test

Trim all white borders from 2 or more sheets of graph paper. 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 the plates to be measured; these sheets are also taped to the measuring base. Number each inch (or centimeter) line from the top and left side of base plates: 1,2,3, etc.

5.5.3. Procedure

- 1. Determine inspection lot, fill out standard pack report forms (one for each labeled unit), and select random sample and random tare sample.
- 2. Follow the procedures in Section 5.1. or 5.2. (depending on the labeled count) to determine lot conformance with respect to count. If the lot conforms, go on to step 3 below.
- 3. The sample selected for determining lot conformance with respect to count may be used to determine conformance with respect to dimensions; however, the inspector may have to select additional packages for the sample. For example, if the lot size is between 251 and 500 packages, Table 5-1 (page B-22) permits a sample size of 10 packages for packages labeled by low count, but Table 2-5 requires a sample size of 30 packages for this lot size for checking dimensions.

¹Equipment and method derived from those provided by Mr. William Marks, American Can Co., 333 No. Commercial St., Neenah, WI 54956.

For low count packages, check sample size required according to Table 2-2 (page B-3) or 2-5 (page B-5) and, if necessary, select additional packages for the sample. A tare sample is not needed in this part of the procedure.

Select one plate from each package to represent that $package^1$.

4. Place each plate to be measured on the measuring base plate, eating surface down, so that two sides of the plate are touching the two vertical side pieces (See Figure 5-2.)

Rest the palm of your hand on the plate to ensure that plate is flat and, referring to the numbered lines on the graph paper, read the plate diameter. If the plate is circular, read the smallest diameter if the numbers in the two directions differ. If the plate is oblong, read the plate size in major and minor directions.

- 5. The package error is equal to the plate diameter minus the labeled diameter. Record the package error on a worksheet and, using an appropriate unit of measure, transfer to a report form (separate from the form used to record count).
- 6. Repeat steps 4 and 5 for all packages in the sample. Follow steps 7-11 of section 3.5. (CORE METHOD) to determine lot conformance.

¹Some packages of plates contain a combination of plates of differing sizes. In this instance, a plate of each declared size is taken from the package to represent all the plates of that size in the package. For example, if three sizes are declared, three plates are selected from each package. Upon occasion, packages of plates declared to be of one size may contain plates which can be seen by inspection to be of different sizes in the same package. In this instance, select the smallest plate and using the methods above, determine the package error for the smallest. If the smallest plate is not short measure by more than the MAV, each size of plate in the package will have to be checked and the average dimensions of the package calculated. For example, if 5 plates measure 8 7/16 in and 15 measure 8 9/16 in, the average dimension for this package of 20 plates is 8.53 in.



Figure 5-2. Preparing to measure the dimensions of a paper plate.

5.6. SANITARY PAPER PRODUCTS¹

The labeled count is first checked, followed by a check on the linear measurements.

The count of sanitary paper products cannot be determined adequately by weighing. Variability in sheet weight and core weight requires that official tests be conducted by actual count. Weighing can be a useful audit method, however.

These products often declare total area as well as unit count and sheet size declarations. If the actual sheet size measurements and the actual count comply with the average requirements, the total area declaration is assumed to be correct.

5.6.1. Equipment

<u>Plastic plate</u>, 1/8 to 1/2 in (or 0.3 to 2 cm) thick, 20 by 20 in (or 50 by 50 cm).

Rule, 12 in (or 30 cm) in length, 0.02 in (or 1 mm) divisions.

It is easier to make the measurements if two rules are inlaid perpendicular to each other and flush with a working surface.

¹Derived from apparatus and method by Mr. William Marks, American Can Co., Neenah, WI 54956.

5.6.2. Procedure

- 1. Determine inspection lot, fill out separate forms for length, count, and width. Follow the procedures in Section 5.1. or 5.2. to determine lot conformance with count requirements.
- If necessary, select additional packages for the sample to be checked for dimensions (as in Section 5.5.3., step 2). A tare sample is not necessary.
- 3. Select one sheet, napkin, etc. from each package. Then, (removing creases if necessary), place the product between the working surface and the plastic plate and measure and record the product's dimensions.
- 4. The package error is equal to the actual dimension minus the labeled dimension. Record the package errors on a worksheet and, using an appropriate unit of measure, transfer them to a different report form than used to record count.
- 5. Repeat steps 3 and 4 for all the packages in the sample. Go to step 7 of Section 3.5. (CORE METHOD) to determine lot conformance.
- 6. Individual sheets within a package or roll may differ from one another. If the above procedure indicates lot non-conformance, measure at least 10 sheets selected randomly from each package. Average these to determine dimensions and use these average dimensions in steps 4 and 5 above.

5.7. PRESSED AND BLOWN GLASS TUMBLERS AND STEMWARE

The package requirement that the <u>average</u> quantity of a lot (shipment or delivery) meet or exceed the labeled quantity is not applied to the capacity of pressed and blown tumblers and stemware¹. When a tolerance is provided in a regulation, a minimum net quantity is defined for the packages in the lot. If any and all packages in a lot are allowed to be less than the declared quantity by a specified amount, then the average net quantity of those packages cannot be expected to meet some higher value.

The sampling plans in Table 5-2 (page B-23) are provided for pressed and blown glass tumblers and stemware.

To use the sampling plans in Table 5-2 the inspection lot is identified and a random sample (following Appendix E methods) is selected according to the size of the lot.

The capacity of the items in the sample are measured following Section 5.7.1. Each package error is compared with the applicable allowable difference. The number of packages with package errors greater than the allowable difference is counted and compared with the number given in column 4 of Table 5-2. If the number in column 4 is exceeded, the lot fails to conform with the package requirements. If the number of packages with errors exceeding the allowable difference is less than or equal to the number in column 4, the lot conforms. The average package error is not calculated. The lot conforms or fails based on the individual package errors only. Individual packages containing items exceeding the allowable difference are acted upon individually even though the requirements for the lot may be met.

Reference to

Product	Allowable difference	MoS
pressed and blown tumblers and stemware labeled by count and capacity	<pre>inch-pound: + 1/4 oz for items less than or equal to 5 oz; + 5% for items greater than 5 oz. metric: + 10 mL for items less than or equal to 200 mL; + 5% for items greater than 200 mL.</pre>	Section 3.2.1.

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¹The National Conference on Weights and Measures (NCWM) Uniform Method of Sale of Commodities Regulation (MoS) is a standard for State regulatory use which is periodically updated by State agency representatives. The 1983 edition of NBS Handbook 130, which contains the current NCWM uniform regulations, lists the following "allowable differences" or tolerances. Individual State regulations may or may not permit the following or other allowable differences.

5.7.1. Procedure

This section describes how to test tumblers and stemware which are labeled by count and capacity. The package count must meet the requirements for the average. The individual units (tumblers, stemware) must meet the requirements for capacity, which for pressed and blown products is an "allowable difference" requirement. Equipment is the same as recommended in Section 4.14.1.

1. Determine inspection lot, and follow the procedures in Section 5.1. or 5.2. (depending on the labeled count) to determine conformance of the lot with respect to count.

If the lot conforms to requirements for count, go on to step 2 below.

2. The packages selected for the sample to be tested for count may also be used to test for capacity. Since a different sampling plan will be used, a different sample size may be needed.

For example, an inspection lot of 7 oz, 12 count, glass tumblers is composed of 500 packages. Referring to Table 5-1 (page B-22), a sample size of 10 is selected to be checked for count. The lot is found to conform to the average requirements for count. Referring to Table 5-2 (page B-23), a sample size of 10 is adequate for checking the labeled capacity. Therefore, the same 10 packages are checked for capacity.

Every package is checked. (No tare sample is needed.)

The capacity of each container in the package is determined.

- 3. Follow Section 4.14.2., steps 2, 3, and 4 on each item to be checked. Use separate worksheets amd report form from those used to record labeled count.
- 4. The tumbler error is equal to the measured volume capacity minus the labeled capacity. Note on the report form to refer to the worksheet(s) for the appropriate individual tumbler error.
- 5. Compare each tumbler/stemware error with the allowable difference. Circle any error that exceeds the allowable difference (either positive or negative error).

6. Compare the total number of circled errors with Table 5-2, column 4 value, corresponding to the sample size.

For example, if the sample size is 30, only one tumbler/stemware error in the sample may exceed the allowable difference.

If the number of circled errors is more than the column 4 value of Table 5-2, the lot fails to conform to the package requirements. If the number of circled errors is less than or equal to the value in Column 4 of Table 5-2, the lot conforms with the package requirements.

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DATE			STAN	DARD PAC	K REPORT	FORM		REF	REPORT NUMBER		
Location of TEST (Name	e, Address)	Retailer Wholesaler Packager	PRODUCT I	DENTITY	BRAND		LOT CODE(S)		CONTAINER	DESCRIPTION	
			1 LABELE	D CONTENTS	2 UNIT OF	MEASURE	3 MAV (sam units as li	ne abel)	4 MAV (dir	nensionless units)	
5 LOT SIZE (N)	a GROSS WEIGHT										
6 SAMPLE SIZE (n)	b TARE WEIGHT										
□ A (p. B-3) □ B (p B-5)	C NET WEIGHT			<u> </u>							
7 TARE SAMPLE SIZE Alternative (p B-6)	d PACKAGE ERROR a - 14								-		
8 Allowed Number UNREASONABLE ERRORS	e PACKAGE ERROR (dimensionless units) d + 2			······							
9 R _C (see C) Range of Net Weights	10 RT (see b Range of TARE Weights) 11 $R_{C} \div R_{T} =$ 9 \div 10 =	12 n _t (Tat p. B-78	ole 2-7, 13 AVE \$8)	RAGE TARE dry wet altern	13a TAR	E CORRECTION Moisture Foam (p E Vacuum P	N 14 NC WE 3-17) ack 1 +	MINAL GROSS GHT 13 + 13a =	3	
				PACKAGE	ERRORS				TO ⁻	(0/ +)	
-								$\overline{\ }$			
								$\overline{\ }$			
				$\sum_{i=1}^{n}$	$\overline{\ }$						
RANGES					`				15 TOTAL E	ROR	
16 NO. UNREASONABLE 17 IS 16 Greater than B MINUS ERRORS VES: LOT FAILS NO-CONTINUE			I8 AVERAGE (Dimensio 15 ÷ 6 =	ERROR niess Units)	19 AVERAGE (labeled u	ERROR nits)	20 IS 18 Z □ NO → 0 Q □ YES → LO	ERO OR PLU Cat. B, Lot Fa DT PASSES	S? ils □ Cat. A, g	o to 21	
21 AVERAGE RANGE	22 Use 6 In Table 2	to look up value -3, Col 2 (p. B-3)	$d = 21 \times d$	22 =	24 (n/N)×10	0 = < 100 =	25 Use 24 to look up f in Table 2-4 (p B-4) f =		26 T = 2	26 T = 23 × 25 =	
27 Disregarding the si	gns, is 18 large	r than 26 ? 🗆 Yes- 🗆 No -	►lot fails ►lot passes								
28 DISPOSITION OF LOT:	 Approve Rejected 	d Comments:									

Official

DATE	F	RANDOM F (F	PACK RE Page 1 of	PORT FORM	REPORT NUMBER											
LOCATION OF TEST (Name, Address)	 Retailer Wholesaler Packager 		1 LOT S	SIZE (N) 2 SAMPLE SIZE (n) 3 TAF A (p B-3) B (p B-5)				SAMPLE SIZE alternative (p 8-6)	4 ALLOWE UNREAS	ED NUMBER OF SONABLE ERRORS						
		5 UNIT OI (size of		OF MEASURE of scale div.)			lb UZ	TARE	DRY WET (page 2	for alternative)						
7 PRODUCT DESCRIPTION, LOT CO	ODE 8 LAE		BELED 9 PACKAG		9 PACKAGE ERROR		11 MAV (Scale	/////////	ACKAGE 1	PACKAGE 2						
										(p B-9410)		TARE 1	TARE 1			
	· <u> </u>							6 AVERAGE	TARE							
								TARE 3								
	. <u> </u>							6 AVERAGE	TARE							
		<u> </u>						TARE 4								
								6 AVERAGE	TARE							
								(B c	LOT DISPOSIT	ION 2 for A)						
			-				14 IS 13 GREATER THAN ZERO? YES→LOT FAILS NO→ CONTINUE									
								15 AVERAGE ERROR	$= \frac{\text{TOTAL}}{\text{ERROR}} \div$ $= 12 \div$	NO. OF PACKAGES						
								16 AVERAGE ERROR In units of weig	= AVERAC ERROR ght Scale d	GE UNIT OF IN MEASURE						
									= 15 × 5							
	<u></u>							17 IS AVERA YES	GE ERROR 0/ + LOT PASSES LOT FAILS	- ? S						
									CEPTED	LOT REJECTED						
								COMMENTS.								
								1								
				12 TOTAL	ERROR	13 NUMBER OF	MINUS									
						EXCEEDING	MAV									

Official

RANDOM PACK REPORT FORM Page 2 of 2

1	REPORT	NUMBEF

							l_		
									7
GROSS WEIGHT									
D TARE WEIGHT									BD HT =
		-	······						6a R _c =
d PACKAGE ERROR a - 6e - 8									$\begin{array}{c} 6c \\ B_C \div B_T = \\ \hline 6b \div 6a \end{array}$
e PACKAGE ERROR (in scale div) d ÷ 5						- · .			6d n _t (Table 2-7 p B-788
Additional GROSS WT Tare weights:									6e AVERAGE TARE
TARE WT									
NOTE: PACKAGES SHOL	LOT JLD NOT BE A		SPOSITION C	ATEG	ORY A ST TO HEA	VIEST	WHEN FOLLOV	VING A	
19		20	AVERAGE	=	TOTAL	÷	NO. OF PACKAGES		
ON PAGE 1,			(Scale div)	=	12	÷	2		
THE NUMBER OF MINUS PACKAGE ERRORS EXCEEDING THE MAV				=					
IS RECORDED IN BOX 13		21	AVERAGE	=	AVERAGE ERROR	×	UNIT OF MEASURE		
BOX 4 CONTAINS THE ALLOWED NUMBER.		i	n units of weight		in no. of scale div.				
IS 13 Greater than 4 ?				=	20	×	5		
L: YES → LOT FAILS L: NO → GO TO 20		0.01		=			LOT DACCEC		
		$\begin{array}{c} \text{``IS 20 MINUS? } \\ \text{``YES} \rightarrow \text{GO TO 23} \\ \end{array}$					GO TO 23		
23 BANGE OF PACKAGE		25	TABLE 2-3 Col. 2 value (page	B-3)	26 d	= 24 ×	25	27 (n	/N)× 100 =
ERRORS FOR EACH GROUP OF 5 PACKAGES				,		=			$2 \div 1$)×100=
2		28				29	T - 26 - 28		
4			look up f in Table :	2-4 (pag	ie B-4) f =		=		
5									
6									
7									
8		DIS	REGARDING THE	SIGN	6,				
9		13	☐ Yes → Lot Fa ☐ No → Lot Pa	ails sses					
10									
AVERAGE = SUM OF ÷ NO. OF GROUPS									
n n R≃	r						· · · · · · · · · · · · · · · · · · ·		
., -		R	ecord final lot disp	osition	on page 1 ir	box 18]		

WORKSHEET FOR PACKAGES LABELED BY LIQUID VOLUME

NUMBERS WITH BOXES (e.g. 3)) REFER TO REPORT FORM (page A-1) STEP NUMBERS (e.g. STEP 5) REFER TO WORKSHEET

Fill out report form up through box $\boxed{8}$, skip boxes $\boxed{3}$ and $\boxed{4}$

-

.

8

	_	(1st Pkg)	(2nd Pkg)	(3rd)	(4th)	(5th)					
1. Gross Weight											
2. Tare Weight	* R _C =										
Net Weight	*R _T =										
3. Flask Weight (full)											
4. Flask Weight (empty,	wetted)										
5. Weight of Liquid (Ste	p 3-Step 4)										
6. Volume of Flask											
7. Temperature of Liquid	d l										
8. Do the weights recorded in Step 5 differ from each other by more than the value in Table 4-3 (page B-20)?											
	YES 🗆 If this packa	box is checked, op ge error by volume	pen all packages in (see Section 4.6.).	sample and determine	ne each						
	NO 🗆 If this	box is checked, co	ontinue below.			1					
9. AVERAGE WEIGHT (OF LIQUID IN FLASK	= AVERAGE OF	STEP 5 =								
10. AVERAGE WEIGHT OF LABELED VOLUM	10. AVERAGE WEIGHT OF LABELED VOLUME = $\frac{\text{LABELED VOLUME}}{\text{FLASK VOLUME}} \times \text{AVG. WEIGHT OF LIQUID IN FLASK}$ $= \frac{\text{box } 1}{\text{Step 6}} \times \text{Step 9} =$										
*11. (R _C /R _T =	11. $(R_C/R_T =) (n_t =)^{\ddagger}$										
12. AVERAGE TARE =	AVERAGE OF STEF	2 (or average of S	Step 2 and additior	nal tares)*							
	=		Re	ecord in box 13 on	report form						

*Alternative Tare procedure for liquids packed in glass.

‡If additional packages are opened for tare, provision should be made for recording all pertinent data.

13. NOMINAL GROSS WEIGHT = AVERAGE + AVERAGE WEIGHT TARE OF LABELED VOLUME
= Step 12 + Step 10 =
Record in box 14 on report form
14. For packages opened for Tare:
PACKAGE ERROR = GROSS WEIGHT - NOMINAL GROSS WEIGHT (weight)
= Step 1 - Step 13
15. PACKAGE ERROR = PACKAGE ERROR ÷ UNIT OF MEASURE (dimensionless units) (weight)
= Step 14 + box 2
Record package errors on report form in crosshatched area.
16. MAV from Table 2-9 = Record in box 3 on report form.
17. MAV (weight) = MAV (volume) × AVERAGE WEIGHT OF LABELED VOLUME LABELED VOLUME
= Step 16 \times $\frac{\text{Step 10}}{\text{box 1}}$ =
18. MAV = MAV ÷ UNIT OF MEASURE (dimensionless (weight) units)
- Step 17 \div box 2 - Becard in box 4 on report form
19. Compare unopened packages with nominal gross weight (Step 13, box 14).
Record package errors for remaining packages in sample directly on report form in crosshatched area.
Compare minus package errors with MAV (Step 18, box 4).
Average package errors (box 18). Convert back to units of volume as given below:
AVERAGE PACKAGE ERROR = AVG. PACKAGE ERROR × UNIT OF × LABELED VOLUME (dimensionless units) × MEASURE × LABELED VOLUME AVG. WEIGHT OF LABELED VOLUME
$= box 18 \times box 2 \times \frac{box 1}{5 \text{ Step 10}}$
= Record in box 19 on report form
(Deven shows with 1011 1411 1511 is correct out for laters for complexings)

(Boxes above with "3", "4", "5" in corners are for larger tare sample sizes.)

WORKSHEET FOR CHECKING PAINT

Audit

		C	an Diameter		6	6 7	8	9	10
Can Heig	ht (2 3 Midd	le <u>4</u> Bottom	45BottomAverage		Average Liquid Level	Average Container Depth	Average Liquid Depth	Volume
u. in. = 0.0	04329 gal.	Volum	10 = 0.785	54 x 6 x 6)×(9)]			
m ³ = 0.00	ΙL	lf volu	me in (10) is le	ess than labeled	i volume, use po	ossible violatio	on procedures	(Section 4.9	.4.)
				Possible Vi	olation				
1 Label	2 Gross Weight	3 Lid Weight Wet (-) Dry	4 Liquid Level	5 Tare	6 Water Volume	7 Net Weigh $= 2 - 5$	8 Weight Label Vo	t of Pa	9 ackage Volume
_							= (6)+(

WORKSHEET	FOR	PACKAGES	LABELED	ΒY	COUNT
-----------	-----	----------	---------	----	-------

NUMBERS WITH BOXES STEP NUMBERS (e.g. "St	(e.g. <u>[3]</u>) REFER T(ep 5'') REFER TO W) REPORT FOR ORKSHEET	M (page A-1)			
Fill out report form throug	gh box 8 , skip bo	exes 3 and [4			
	(1st Pkg)	(2nd Pkg) (3	3rd)	(4th)	(5th)
1. Gross Weight						
2 Tare Meight						
2. Tare Weight						
3. Count in Each Package						
4. Weight of Counted Items	 					
5. Weight of Labeled						
$= \frac{\text{Labeled}}{\text{Count}} \times \frac{\text{Step 4}}{\text{Step 3}} =$						
6. MAV from Table 2-1((count) (page B-13)) =			Record ir	n box 3 on the rep	ort form
7. MAV/6 = MA (weight) (cod	V/6 × WEIG	HT OF COUNTE COUNT IN PACK	ED ITEMS (AGE			
= Ste	$\frac{p \ 6}{5} \times \frac{Ste}{Ste}$	p 4 (for first pa p 3 (for first pa	ckage) =			
8. If using an equal-arm p	backage checking so	a <i>l</i> e, is value cal	culated in Step	7 equal to	or larger than ½ the	smallest graduation?
lf using an electronic p	ackage checking sc	ale, is value cal	culated in Step	7 at least	as large as the smalle	est increment?
	NO 🗆 If this packa each packag	ge is checked, e e error by actua	open all packag ally counting the	es in sampl e items insi	e and determine de the packages.	
	YES 🗆 If this box is	checked, cont	inue below.			
9. Do the weights recorde	d in Step 5 above di	fer from each o	ther by more tha	an the value	in Table 4-3 (page B-	20)?
`	YES 🗆 If this box is package erro	checked, open r by counting ite	all packages in ems inside pact	sample and ages.	I determine each	
	NO 🗔 Average Wei	ght of Labeled (Count = averag	e of Step 5	=	
10. AVERAGE TARE = A	/ERAGE OF STEP 2	=			Record in box	13 on report form.
11. NOMINAL GROSS WE	EIGHT = AVER TA	RAGE + RE (AVERAGE WEI	GHT OUNT		
	= Ste	p 10 +	Step 9 =	Record in	box [14] on report fc	Jorm.

12. For packages opened for Tare:





box [18]

box 2

×

Step 9

Record in box 19 on report form.

×

WORKSHEET FOR CHECKING POLYETHYLENE SHEETING

Labeled Length	
Labeled Width	
Labeled Thickness	

0.8 imes Labeled Thickness 0.93 imes Labeled Thickness

Compare with All Thickness Measurements Compare with Average Package Thickness

Pac kage	Length	Width	Thic	kness	Package	Length	Wie	dth	Thickness		ness	
Package Average												
			<u> </u>		_							
			<u> </u>									
					_							
Package Average						·····						
Package			<u> </u>									
Average			 									
-												
Package Average												
-												
Package Average												
Sample Average												

APPENDIX B. TABLES

Table	1-1	Agencies responsible for prokage	Page
Table	1 1	regulations	B - 1
Table	2-1	Guide to locations on the report form for standard pack packages on page A-1	В-2
Table	2-2	Sampling plans of category A	B-3
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Table	5-2	Sampling plans for packages given tolerances	B-23

Page

Table 1-1. Agencies responsible for package regulation	ons.
--	------

Agency	Product
U.S. Department of Agriculture, Food Safety and Quality Service	meat and poultry
U.S. Department of Health and and Human Services, Food and Drug Administration	food, drugs, cosmetics, and medical devices
U.S. Federal Trade Commission	household or consumer commodities that are not food, drugs, medical devices, or cosmetics
U.S. Environmental Protection Agency	pesticides
U.S. Department of the Treasury, Bureau of Alcohol, Tobacco, and Firearms	alcohol and tobacco products
State Weights and Measures Offices	all packaged products

*See Appendix D for specific regulations.

			and the second
Box	Subject	Section	Page
1	Labeled Contents	2 2 1	2-2
2	Unit of Measure	2 9 1	2-16
3	Maximum Allowable Variation (MAV)	2.12	2-27 & $B=0$
5			$t_0 R = 15$
4	MAV (dimensionless units)	2.9.1.	2-16
5	Lot Size (N)	2.3.3	2-8
6	Sample Size (n)	2.6., 2.7.	2-9, 2-14
7	Tare Sample Size (n _t)	2.6., 2.7., 2.11.4.	2-9, 2-14.
			2-23
8	Allowed Number of Unreasonable Errors	2.6.1., 2.7.1.	2-10, 2-14
9	Range of Net Weights (R _c)	2.11.4.	2-25
10	Range of Tare Weights (R _t)	2.11.4.	2-25
11	R _c : R _t	2.11.4.	2-25
12	n _t from Table 2-7	2.11.4.	2-25
13	Average Tare	2.11., 2.11.3.,	2-20, 2-23
10		2.11.4	2-26
13a	Tare Correction	moisture 2.14.,	2-29
		foam 3.11.6.,	3-37
1)(Nominal Croca Haight	vacuum pack 3.15.	3-42
15	Total Package Ennen	3.5.	3-7
15	Actual Number of Unreageneble Error	2.9.3.	2-18
17	Decision on Unreasonables	2.0.1., 2.7.1	2-10, 2-14
18	Average Frror (dimensionless units)	2.0.1., 2.7.1.	2-10, 2-14
19	Average Error (labeled units)	262 272	$2^{-11}, 2^{-15}$
20	Decision on Average	262 272	$2^{-11}, 2^{-15}$
21	Average Range	2.0.2., 2.7.2.	$2 11, 2^{-1}$
22	Value from Table 2-3, column 2	2.6.2	2 - 12, 11 - 12
23	d	2.6.2.	2-12
24	(n/N) x 100	2.6.2.	2-13
25	f	2.6.2.	2-13. B-4
26	Т	2.6.2.	2-13
27	Decision on Average (for Cat. A only)	2.6.2.	2-14
28	Disposition of Lot	Summary of boxes	2-4
		17, 20, 27	

Table 2-1. Guide to locations on the report form for standard pack packages on page A-1.

Table	2-2.	Sampling	plans	of	Category	Α.
-------	------	----------	-------	----	----------	----

1	2	3	4
Lot size	Sample size	Tare sample size ^a	Number of minus
(number of packages	(number of packages	(number of packages	package errors
in lot)	in sample)	chosen for tare	allowed to exceed
		determination)	the MAV ^D
N	n	nt	
30 or less	all	2	0
31-800	30	2	1
801-2,000	50	5	2
2,001-5,000	80	5	3
5,001-15,000	125	5	5
15,001 and greater	200	10	7

^aSpecial rules for tare sampling apply when Section 2.11.4. is followed (this is the tare procedure for variable tare and must be used for glass or aerosol packages).

 $^{\rm b}{\rm See}$ Tables 2-8 through 2-11 (pages B-9 to B-14), and Sections 2.12. and 2.13.

1	2	3
n sample size	$\frac{0.8598}{\sqrt{n}}$ used only when \overline{R} is calculated	$\frac{2}{\sqrt{n}}$ used only when s is calculated
30 50 80 125 200	0.1570 0.1216 0.09613 0.07691 0.06080	0.3652 0.2828 0.2236 0.1789 0.1414

Table 2-3. Values of $\frac{0.8598}{\sqrt{n}}$ and $\frac{2}{\sqrt{n}}$ for sample size n.

Percent of lot sampled	f	Percent of lot sampled	f	Percent of lot sampled	f
1	.99	36	.80	71	•54
2	.99	37	.79	72	•53
3	.98	38	.79	73	•52
4	.98	39	.78	74	•51
5	.97	40	.77	75	•50
6	.97	41	.77	76	.49
7	.96	42	.76	77	.48
8	.96	43	.75	78	.47
9	.95	44	.75	79	.46
10	.95	45	.74	80	.45
11	.94	46	.73	81	.44
12	.94	47	.73	82	.42
13	.93	48	.72	83	.41
14	.93	49	.71	84	.40
15	.92	50	.71	85	.39
16	.92	51	.70	86	•37
17	.91	52	.69	87	•36
18	.91	53	.69	88	•35
19	.90	54	.68	89	•33
20	.89	55	.67	90	•32
21	.89	56	.66	91	.30
22	.88	57	.66	92	.28
23	.88	58	.65	93	.26
24	.87	59	.64	94	.24
25	.87	60	.63	95	.22
26	.86	61	.62	96	.20
27	.85	62	.62	97	.17
28	.85	63	.61	98	.14
29	.84	64	.60	99	.10
30	.84	65	.59	100	0
31 32 33 34 35	.83 .82 .82 .81 .81	66 67 68 69 70	•58 •57 •57 •56 •55		

Table 2-4. Values of f for percent of lot sampled *

*Percent of lot sampled = $\frac{\text{sample size}}{\text{lot size}} \times 100 = \frac{n}{N} \times 100$

1

Table 2-5. Sampling plans of Category B.

1 Lot size	2 Sample size	3 Tare sample size ^a	4
(number of packages in lot)	(number of packages in sample)	(number of packages chosen for tare determination)	Number of minus package errors allowed to ex- ceed the MAV ^b
N	n	nt	
Up to and including 250	10	2	0
251 and greater	30	2	0

^aSpecial rules for tare sampling apply when Section 2.11.4. is used (glass or aerosol packages).

^bSee Tables 2-8 through 2-11 (pages B-9 to B-14), Sections 2.12. and 2.13.

Sampling plan Category	Lot size	Initial tare sample size
А	all	5 packages
В	equal to or less than 250 packages	2 packages
	greater than 250 packages	5 packages

Table 2-6. Initial tare sample size for alternative tare procedures.

determination.
tare
for
opened
þe
to
(n_{t})
packages
of
number*
Total
Table 2-7.

	n=200	nt	200 193 173 160	148 135 111 100	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	4 4 2 2 7 4 4 2 2 7 4 0 1	5 3 5 5 3 3 3 3 3 3 3 3 5 5 5 5 5 5 5 5	5 5 3 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
	n=125	nt	125 121 115 108	6 9 7 3 9 2 9 3	3 F F 2 2 2 3 7 3 7 3 7 3 7 3 7 3 7 3 7 3 7 3	52 88 33 39 89 53 33 39 89		
a	n=80	nt	80 77 69 64	7 7 7 0 7 7 0 0 0 0 0 0 0	25 8 29 33 29 25	2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	5 2 2 0 0 0 0 2 7 0 0 0 0	
ckages in sampl	n=50	nt	50 70 70 70 70 70 70 70 70 70 70 70 70 70	25 83 34 25 83 33 33 33 33 33 33 33 33 33 33 33 33	23 21 16 17	б б б б б б б б б б б б б б б б б б б	00000	20004
number of pa	n=30	nt	28 58 58 50 50 50 50 50 50 50 50 50 50 50 50 50	23 21 17 15	4 0 0 C C C	o ∞ ∞ ∽ ∽	ດດບບບ	コ ユ コ ユ M
	n=10	nt	000°∞	00770	다 다 그 그 그	$m m m m \omega$	~~~~~	~~~~~~
	Ratio	R_{c}/R_{t}	0.2 OR LESS 0.21 - 0.40 0.41 - 0.60 0.61 - 0.80 0.81 - 1.00	1.01 - 1.20 1.21 - 1.40 1.41 - 1.60 1.61 - 1.80 1.81 - 2.00	2.01 - 2.20 2.21 - 2.40 2.41 - 2.60 2.61 - 2.80 2.81 - 3.00	3.01 - 3.20 3.21 - 3.40 3.41 - 3.60 3.61 - 3.80 3.81 - 4.00	4.01 - 4.20 4.21 - 4.40 4.41 - 4.60 4.62 - 4.80 4.81 - 5.00	5.01 - 5.20 5.21 - 5.40 5.41 - 5.60 5.81 - 5.80 5.81 - 6.00

* Including those already opened for initial tare determination.

• 110 12		n=200	nt	19 17 16	04000 040000	22200	000000	00000	10
		n=125	n_{t}	12 12 10	000000 0000000000000000000000000000000	87779	ທູດເບັບ	ገ ግ ግ ግ ግ	ي. ا
	ple	n=80	nt	88777	າມ໙୰୰	ហហហហ	ው ው ው ው ው	ጣ ጣ ጣ ጣ ጣ	ſ
have a line and a man	packages in sam	n=50	nt	ហហហហ	ው ው ው ው ው	ហហហហ	ሰ ባ ባ ባ	ር ር ር ር ር ር ር ር ር ር ር ር ር ር ር ር ር ር	5 determination
	number of	n=30	nt	ოოოო	m m N N N	~~~~~	0 0 0 0 0	~~~~~	2 for initial tar
		n=10	nt	งงงงง	0 0 0 0 0	~~~~~	~~~~~	~~~~~	2 2 Constrained
		о с	Rc/Rt	6.01 - 6.20 6.21 - 6.40 6.41 - 6.60 6.61 - 6.80 6.81 - 7.00	7.01 - 7.20 7.21 - 7.40 7.41 - 7.60 7.61 - 7.80 7.81 - 8.00	8.01 - 8.20 8.21 - 8.40 8.41 - 8.60 8.61 - 8.80 8.81 - 9.00	9.01 - 9.20 9.21 - 9.40 9.41 - 9.60 9.61 - 9.80 9.81 - 10.00	10.01 - 10.20 10.21 - 10.40 10.41 - 10.60 10.61 - 10.80 10.81 - 11.00	* Including those

Total number^{*} of packages (n+) to be opened for tare determination. Table 2-7 (continued).

Table 2-8. MAV's for an individual	package	labeled	by	weight ^a .
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upois units		Metric units		
MA	۷V	Labeled weight	MAV	
Decimal pounds	Fractional ounces	Grams	Grams	
10% labeled	of Weight	up to and including 36	10% of labeled weight	
0.008	1/8	36+ to 54	Ц	
0.012	3/16	54+ to 82	5	
0.016	1/4	82+ to 118	7	
0.020	5/16	118+ to 154	9	
0.024	3/8	154+ to 209	11	
0.028	7/16	209+ to 263	13	
0.032	1/2	263+ to 318	15	
0.036	9/16	318+ to 381	16	
0.040	5/8	381+ to 426	18	
0.044	11/16	426+ to 490	20	
0.048	3/4	490+ to 572	22	
0.052	13/16	572+ to 635	24	
0.056	7/8	635+ to 698	25	
0.060	15/16	698+ to 771	27	
	upois units MA Decimal pounds 10% labeled 0.008 0.012 0.016 0.020 0.024 0.020 0.024 0.028 0.028 0.028 0.028 0.028 0.032 0.036 0.036 0.040 0.040 0.044 0.048 0.052 0.056 0.060	MAV MAV Decimal pounds Fractional ounces 10% of labeled weight 0.008 1/8 0.012 3/16 0.016 1/4 0.020 5/16 0.024 3/8 0.023 1/2 0.032 1/2 0.036 9/16 0.040 5/8 0.040 5/8 0.052 13/16 0.052 13/16 0.055 7/8 0.060 15/16	Metric units MAV Labeled weight Decimal pounds Fractional ounces Grams I0% of labeled weight up to and including 36 0.008 1/8 36+ to 54 0.012 3/16 54+ to 82 0.016 1/4 82+ to 118 0.020 5/16 118+ to 154 0.024 3/8 154+ to 209 0.028 7/16 209+ to 263 0.032 1/2 263+ to 318 0.036 9/16 318+ to 381 0.040 5/8 361+ to 426 0.041 11/16 426+ to 490 0.048 3/4 490+ to 572 0.052 13/16 572+ to 635 0.056 7/8 635+ to 698 0.060 15/16 698+ to 771	

aApplies only to shortages in package weight (that is, the MAV is compared with minus package errors only) b0.08+ means "greater than 0.08" C"to" means "to and including"

Avoi	irdupois units		Metric units			
Labeled weight	М	IAV	Labeled weight	MAV		
Pounds	Decimal pounds	Fractional ounces	Grams or kilograms	Grams		
1.70+ to 1.88	0.064	1	771+ to 852	29		
1.88+ to 2.14	0.070	1 1/8	852+ to 971	32		
2.14+ to 2.48	0.078	1 1/4	971+ to 1.125	35		
2.48+ to 2.76	0.086	1 3/8	1.125+ to 1.350	40		
2.76+ to 3.20	0.094	1 1/2	1.350+ to 1.600	45		
3.20+ to 3.90	0.11	1 3/4	1.600+ to 1.800	50		
3.90+ to 4.70	0.12	2	1.800+ to 2.100	55		
4.70+ to 5.80	O.14	2 1/4	2.100+ to 2.640	65		
5.80+ to 6.80	0.15	2 1/2	2.640+ to 3.080	70		
6.80+ to 7.90	0.17	2 3/4	3.080+ to 3.800	80		
7.90+ to 9.40	0.19	3	3.800+ to 4.400	85		
9.40+ to 11.70	0.22	3 1/2	4.400+ to 5.200	100		
11.70+ to 14.30	0.25	4	5.200+ to 6.800	115		
14.30+ to 17.70	0.28	4 1/2	6.800+ to 8.20	130		
17.70+ to 23.20	0.31	5	8.20+ to 10.60	145		
23.20+ to 31.60	0.37	6	10.60+ to 14.30	170		
31.60+ to 42.40	0.44	7	14.30+ to 19.25	200		
42.40+ to 54.40	0.50	8	19.25+ to 24.70	230		
54.40+	2% of : we	labeled ight	24.70+	2% of labeled weight		

Table 2-8. (continued) MAV's for an individual package labeled by weight.

Table 2-9. MAV's for an individual package labeled by volume - liquid or dry^a.

	Inch-Pound			Metric	
Labeled quantity	Liquid MAV (fl oz)	Labeled quantity	Dry MAV (cu in)	Labeled quantity	Liquid and dry MAV (mL)
up to and including 0.50 fl oz	م	up to and including 0.18 cu in	0.03	up to and includ- ing 3 mL	0.50
		0.18+ to 0.49 cu in	0.06	3+ to 8 mL	1.00
		0.49+ to 0.92 cu in	60.0	8+ to 15 mL	1.50
0.50+ ^d to ^e 0.75 fl oz	0.06	0.92+ to 1.35 cu in	0.11	15+ to 22 mL	2.0
0.75+ to 2.25 fl oz	0.13	1.35+ to 4.06 cu in	0.23	22+ to 67 mL	ю. М
2.25+ to 4.25 fl oz	0.19	№.06+ to 7.67 cu in	0•3ħ	67+ to 126 mL	5.5
4.25+ to 5.75 fl oz	0.25	7.67+ to 10.38 cu in	0.45	126+ to 170 mL	7.5
5.75+ to 7.50 fl oz	0.31	10.38+ to 13.54 cu in	0.56	170+ to 222 mL	6
7.50+ to 11.75 fl oz	0.38	13.54+ to 21.21 cu in	0.68	222+ to 347 mL	[
11.75+ to 17.00 fl oz	0.50	21.21+ to 30.68 cu in	06.0	347+ to 503 mL	15
17.00+ to 21.00 fl oz	0.63	30.68+ to 37.90 cu in	1.13	503+ to 621 mL	18
21.00+ to 27.00 fl oz	0.75	37.90+ to 48.73 cu in	1.35	621+ to 798 mL	53
Liquid Measure Equivalents 1 pint = 16 fl oz 1 quart = 32 fl oz 1 gallon = 128 fl oz					

CUse laboratory glassware. d0.50+ means "greater than 0.50." e"to" means "to and including." Table 2-9 (continued). MAV's for an individual package labeled by volume - liquid or dry.

	Inch-Pound			Metric	
Labeled quantity	Liquid MAV (fl oz)	Labeled quantity	Dry MAV (cu in)	Labeled quantity	Liquid and dry (MLV)
27.00+ to 31.00 fl oz	0 .88	48.73+ to 55.95 cu in	1.58	798+ to 917 mL	26
31.00+ to 39.00 fl oz	1.00	55.95+ to 70.38 cu in	1.80	917+ mL to 1.153 L	30
39.00+ to 55.00 fl oz	1.25	70.38+ to 99.26 cu in	2.26	1.153+ to 1.627 L	37
55.00+ to 69.00 fl oz	2.50	99.26+ to 124.5 cu in	2.71	1.627+ to 2.041 L	<i>1</i> 11
69.00+ to 85.00 fl oz	1.75	124.5. to 153.4 cu in	3.2	2.041+ to 2.514 L	52
85.00+ to 103.00 fl oz	2.0	153.4+ to 185.9 cu in	3.6	2.514+ to 3.046 L	59
103.00+ to 160 fl oz (1.25 gal)	2.5	185.9+ to 288.8 cu in	4.5	3.046+ to 4.732 L	ħ Z
160+ to 185.6 fl oz	3.0	286.8+ to 335.0 cu in	ت. س	4.732+ to 5.489 L	68
185.6+ to 240 fl oz	3.5	335.0+ to 433.1 cu in	6.3	5.489+ to 7.098 L	104
240+ to 272 fl oz	4.0	433.1+ to 490.9 cu in	7.2	7.098+ to 8.044 L	118
272+ to 344 fl oz	4.5	490.9+ to 620.8 cu in	8.1	8.044+ to 10.173	133
344+ to 392 fl oz	5.0	620.8+ to 707.4 cu in	0.6	10.173+ to 11.593	148
392+ to 560 fl oz	6.0	707.4+ to 1011 cu in	10.8	11.593+ to 16.561	177
560+ to 640 fl oz	7.0	1011+ to 1155 cu in	12.6	16.561+ to 18.927	207
640+ to 800 fl oz	8.0	1155+ to 1444 cu in	14.4	18.927+ to 23.659	237
800+ to 904 fl oz	0.6	1444+ to 1631 cu in	16.2	23.659+ to 26.734	266
Over 904 fl oz	1% of labeled volume	Over 1631 cu in	1% of labeled volume	0ver 26.734 L	1% of labeled volume
See Section 2-13 for exception: t	oark mulch	Dry 1 Dry Pint = 33.600312 1 Dry Quart = 67.20062	Measure Equivale 5 cu in 1 Bush 5 cu in 1 cu f	nt el = 2150.42 cu in t = 1728 cu in	

rando units makes and another

Labeled count	MAV
up to and including 17 ^b	0
18-50 ^b	1
51-83	2
84-116	3
117-150	Ц
151-200	5
201-240	6
241-290	7
291-345	8
346-400	9
401-465	10
466-540	11
541-625	12
626-725	13
726-815	1 4
816-900	15
901-990	16
991-1075	17
1076-1165	18
1166-1250	19
1251-1333	20
1334 and over	1.5% of labeled count rounded off to the nearest whole number

Table 2-10. MAV's for an individual package labeled by count^a.

1 L

^aApplies only to shortages in package count (that is, minus package errors). ^bSee Section 5.2. for sampling plans to be used with these package sizes.

h) or by area ^a		Metric	Labeled length meters	Up to and including 1	1+ to 40	40+ to 85	85+ to 140	140+ to 300	300+ to 1000	1000+		the labeled area.
labeled by length (widt)	Length	MAV	(expressed as a percentage of the labeled length)	34	1.5%	29	2.5%	હ	۲ <i>%</i>	e L	Area	for packages labeled by area is 3% of
		Inch-Pound	Labeled Length yards	Up to and including 1	1+b toc 48	48+ to 96	96+ to 154	154+ to 330	330+ to 1100	1100+		The MAV

Table 2.11. MAV's for an individual package

 $^{\rm a}{\rm Applies}$ only to shortages in package measure (that is, minus package errors).

b1+ means greater than 1

C"to" means "to and including"

textiles, polyethylene sheeting. See Section 2.13. for exceptions:

Group Name	Definition Group (numbe labeled weight i Homogeneous, Fluid When Filled	of rs are n ounces) All Other Products	Lower Limit for Individual Weights
А	less than 3		10 % of labeled weight
1	3-16	-	7.1 g 0.25 oz 8/32 oz 4/16 oz 2/10 oz 2/8 oz 1/4 oz
2	over 16	3-7	14.2 g 0.50 oz 16/32 oz 8/16 oz 5/10 oz 4/8 oz 2/4 oz
3	-	over 7 to 48	28.3 g 1 oz
4	_	over 48 to 160	42.5 g 1.50 oz 1 16/32 oz 1 8/16 oz 1 5/10 oz 1 4/8 oz 1 2/4 oz
5	1	over 160	2 oz 1/4 lb

Table 2-12. U.S. Department of Agriculture, Meat and Poultry, Groups and Lower Limits for individual packages^{*}

*See also Appendix J.

1										
units	Units of measure (kg)	σ	0.001b	0.002	0.005	0.01	0.05	0.1		
Metric	Labeled weight	Up to and including 82 g	Greater than 82 g to and including 250 g	Greater than 250 g to and including 900 g	Greater than 900 g to and including 2.5 kg	Greater than 2.5 kg to and including 30 kg	Greater than 30 kg to and including 60 kg	Greater than 60 kg		
	neasure (1b)	IJ	0.002 ^b	0.004	0.008	0.02	0.03	0.05	0.01	0.2
is	Units of r (oz avoir)	IJ	1/32b	1/16	1/8	1/4	1/2	-	0	ц
Avoirdupo	Labeled weight	Up to and including 1.92 oz (0.12 lb)	Greater than 1.92 oz (0.12 lb) to and including 5.44 oz (0.34 lb)	Greater than 5.44 oz (0.34 lb) to and including 20 oz (1.25 lb)	Greater than 1.25 lb to and including 4 lb	Greater than 4 lb to and including 8 lb	Greater than 8 lb to and including 25 lb	Greater than 25 lb to and including 75 lb	Greater than 75 lb to and including 150 lb	Greater than 150 lb

Recommended maximum units of measure to be used in recording package weights. Table 3-1.

^aAn analytical or other high accuracy balance will be necessary for weighing packages in this category.

^bThe equal-arm package scale must be used as null-indicator for packages labeled from 1.92 to 5.44 oz or 82 to 250 g to eliminate effects of possible tower errors.

Avoirdupois:	Test allowance
Dabered weight of package	Ounce Pound
0 to less than 1 1/2 oz 1 1/2 oz to less than 5 oz 5 oz to less than 8 oz 8 oz to less than 11 oz 11 oz to less than 14 oz 14 oz to less than 1 lb 1 oz 1 lb 1 oz or more	0 0 1/16 0.004 1/8 0.008 3/16 0.012 1/4 0.016 5/16 0.020 3/8 0.023
Metric: Labeled weight of package	Test allowance Grams
0 to less than 50 g 50 g to less than 100 g	0

Table 3-2. Test allowances for foam aerosol products

Labeled volume (inch-pound)	Device	Labeled volume (metric)
Up to and including 4.25 fl oz	analytical or other high accuracy balance	Up to and including 126 mL
Greater than 4.25 fl oz to and including 32 fl oz	small capacity equal-arm scale or equivalent	Greater than 126 mL to and including 1 L
Greater than 32 fl oz to and including 3 gal	large capacity equal-arm scale or equivalent	Greater than 1 L to and including 12 L
Greater than 3 gal	commercial scale and substitution weighing	Greater than 12 L

Table 4-1. Weighing devices appropriate to use to check common consumer products labeled by liquid volume.

Table 4-2.	Recommended maximum units of measure to be used for record	ing the
	weights of packaged goods labeled by liquid volume.	0

Inch-Pound			Metric	
Labeled volume	Units of me (oz avoir)	easure (lb)	Labeled volume	Units of measure (g)
Up to and including 4.25 fl oz	а	а	Up to and including 3 mL	0.01a
			Greater than 3 mL to and including 126 mL	0.1 ^a
Greater than 4.25 fl oz to and including 17.00 fl oz	1/32 ^b	0.002 ^b	Greater than 126 mL to and including 503 mL	1.0 ^b
Greater than 17.00 fl oz to and including 55.00 fl oz	1/16	0.004	Greater than 503 mL to and including 2.041 L	2.0
Greater than 55.00 fl oz to and including 1.25 gal	1/8	0.01	Greater than 2.041 L to and including 5.489 L	5.0
Greater than 1.25 gal to and including 1.875 gal	1/4	0.02	Greater than 5.489 L to and including 37.5 L	10.0
Greater than 1.875 gal to and including 4.375 gal	1/2	0.03		
Greater than 4.375 gal to and including 9 gal	1	0.05		
Greater than 9 gal to and including 18 gal	2	0.1		

^aUse analytical or other high accuracy balance.

^bUse package checking scale as null indicator.

Table 4-3. Maximum permitted difference in weights of two equal quantities according to the type of scale used to weigh.

Type of Scale	Pounds	Grams	
Applytical on other high accuracy balance	0.0001	0.05	
Analytical of other high accuracy balance	0.0001	0.05	
Small capacity equal-arm scale or equivalent	0.002	1.0	
Large capacity equal-arm scale or equivalent	0.004	2.0	
Commercial scale up to and including 30 lb (14 kg)	0.01	5.0	
Commercial scale above 30 lb (14 kg) up to and including 100 lb	0.02	9.0	
Wall thickness			
---	----------------------------------	---------------------------------------	--
Inch-pound		Metric	
can size	in	can size	mm
1 gal 1/2 gal 1 qt 1 pt	0.010 0.010 0.009 0.008	4 L 2 L 1 L 500 mL 250 mL	0.25 0.25 0.23 0.23 0.23 0.20
Label thickness (paper) ^a (all can sizes)			
	Inch-pound	Metric	
	0.004 in	0.10 mm	

Table 4-4. Thickness of paint can walls and labels.

 $^{\rm a}{\rm The}$ thickness of labels lithographed directly onto the container may be ignored.

1 2 3 4 Number of packages Lot size Sample size Tare sample size (number of (number of packages allowed to contain (number of packages in lot) packages in chosen for tare fewer than the sample) determination) labeled count. Ν n nt

2

2

5

1

2

3

Table 5-1. Sampling plans for packages labeled by low count^a

^aLabeled count is 50 or fewer units.

10

30

50

Up to and including 500

501-5000

5001 and greater

Table 5-2. Sampling plans for packages given tolerances.

-

1 5

1	2	3	4
Lot size N	Sample size n	Tare sample size n _t	Number of package errors which may exceed allowable difference
Up to and including 500 501-5,000 5,0001 and over	10 30 50	2 2 5	0 1 2

APPENDIX C. GLOSSARY

ACCEPTANCE TOLERANCE.¹ The limit of inaccuracy for new, newly reconditioned, or adjusted equipment. (See Section 3.1.)

ALLOWABLE DIFFERENCE. The amount by which the actual quantity in the package may differ from the declared quantity. Pressed and blown tumblers and stemware labeled by count and capacity are assigned an allowable difference in capacity. (See Section 5.7.) Also termed Tolerance.

ANALOGUE SCALE. A weighing device in which weight values are indicated by means of "a series of graduations in combination with an indicator, or in which the most sensitive element of an indicating system moves continuously during the operation of the device."¹ (See Section 3.9.)

AUDIT TESTING. Preliminary tests designed to quickly identify potential noncompliance. (See Section 1.5.)

AVERAGE. The sum of a number of individual measurement values divided by the number of values. For example, the sum of the individual weights of 12 packages divided by 12 would be the average weight of those packages.

AVERAGE ERROR. The sum of the individual package errors (defined) (considering their arithmetic sign) divided by the number of packages comprising the sample. (See Section 2.6.2.)

AVERAGE REQUIREMENT. (See Section 1.2.1.)

AVERAGE TARE. The sum of the weights of individual package containers (or wrappers, etc.) divided by the number of containers or wrappers weighed.

AVOIRDUPOIS UNITS. The inch-pound unit (defined) for weight commonly used in the United States of America, based on the pound of 16 ounces and the ounce of 16 drams.

BERRY BASKETS AND BOXES.¹ Disposable containers in capacities of 1 dry quart or less for berries and small fruits.

BREAK POINT. That point at which a digital indicator changes its indication from one value to an adjacent value. (This is determined by adding test weights 0.1 of the value of the smallest indication until the break point is reached.) (See Section 3.9.)

^{1&}lt;sub>NBS</sub> Handbook 44.

CATEGORY A (CATEGORY B). A set of sampling plans provided in this handbook for use in checking packages that must meet the average requirement (defined). (See Section 2.6. for Category A, and Section 2.7. for Category B.)

CHECKWEIGHER. A weighing device often used in packaging operations. It separates packages into weight groups according to the amount their actual weights differ (over or under) from the target or nominal weight.

COMBINATION QUANTITY DECLARATIONS.¹ A package label that contains the count of items in the package as well as one or more of the following: weight, measure, or size.

COMPLIANCE TESTING. The determination of conformance of packages with specified legal requirements.

CORRECTED AVERAGE TARE. For foam product aerosols (defined), this is the average tare (defined) as measured minus the test allowance (defined). (See Section 3.11.6. and Table 3-2.)

DECISION CRITERIA. The rules for deciding whether or not a lot is in conformance with package requirements based on the results of checking the packages in the sample. (See Sections 2.6.1., 2.6.2., 2.7.1., and 2.7.2.)

DELIVERY. A quantity of identically labeled product received at one time by a buyer.

DIMENSIONLESS UNITS. The integers in terms of which the official records package errors. The dimensionless units must be multiplied by the unit of measure (defined) to obtain package errors in terms of weight, length, etc. (See Section 2.9.1.)

DISPOSABLE CONTAINERS. A package container designed to be used only once.

 $DIVISION^2$ (on a scale). For a mechanical scale: the smallest subdivision of the scale. For a digital (electronic) scale: the difference between two consecutively indicated values.

DRAINED WEIGHT. The weight of solid or semisolid product representing the contents of a package obtained after a prescribed method for removal of the liquid has been employed. (See Section 3.10 and 3.13.)

DRY MEASURE.² Rigid containers designed for general and repeated use in the volume measurement of particulate solids.

¹NBS Handbook 130, Uniform Method of Sale of Commodities Regulation.

²NBS Handbook 44.

DRY TARE. All packaging materials (including glue, labels, ties, etc.) that will contain or enclose the product, but before the product is introduced into the container. Prizes, gifts, coupons, or decorations that are not part of the product are defined as part of the tare also. (See Section 2.11.)

ERROR. See PACKAGE ERROR.

FILL WEIGHT. A supplemental statement of the weight of solids put into the package (usually canned food) but before further processing. It is not the same as a drained weight statement.

FOAM PRODUCT AEROSOL. A product that forms a foam at the container valve or on impingement with a surface, the foam volume not being substantially reduced for at least 20 seconds.

FLUSH FILL CAPACITY. The capacity of a cup or container as defined by the volume contained by it when a flat plate (such as a slicker plate (defined)) rests on its rim.

GROSS WEIGHT. The weight of the package including contents, packing material, labels, etc.

HEADSPACE. The container volume not occupied by product.

INDEX OF AN INDICATOR. That particular portion of an indicator (as, for example, on a weighing scale) that is directly utilized in making a reading (e.g., the tip of a movable pointer on a dial) (See Section 3.4.)

INCH-POUND UNITS. Units based upon the yard, gallon, and the pound commonly used in the United States of America. Some of these units have the same name as similar units in the United Kingdom (British, English, or UK units), but are not necessarily equal to them.

INITIAL TARE SAMPLE. The first packages (either two or five) selected from the sample to be opened for tare determination in the alternative tare procedure. Depending upon the variability of these individual tare weights as compared with the variability of the net contents, this initial tare sample may be sufficient or more packages may be needed to determine the tare. (See Section 2.11.4. and Table 2-6.)

INSPECTION LOT. The collection of identically labeled (except for actual quantity in the case of random pack) packages available for inspection at one time. This collection will pass or fail as a whole based on the results of tests on a sample drawn from this collection. (See Section 2.3.)

LABEL.¹ "Any written, printed, or graphic matter affixed to, applied to, attached to, blown into, formed, molded into, embossed on, or appearing upon or adjacent to a consumer commodity or a package containing any consumer commodity, for purposes of branding, identifying, or giving any information with respect to the commodity or to the contents of the package, except that an inspector's tag or other nonpromotional matter affixed to or appearing upon a consumer commodity...(is)...not...a label."

LOCATION OF TEST. The place where the package will be examined. Broadly defined as one of three general locations: (1) where the commodity was packaged, (2) a warehouse or storage location; or (3) a retail outlet.

LOT. See INSPECTION LOT.

LOT CODE. A series of identifying numbers and/or letters on the outside of a package designed to provide information such as the date and location of packaging, the expiration date, and so on.

LOT SIZE. The number of packages in the inspection lot (defined). See Section 2.3.3.

LUBRICATING OIL BOTTLES.² A rigid (inflexible) measure container (defined) for repeated use in "measurement of lubricating oil for direct delivery to the crankcase of a motor vehicle, whether or not the bottle is sealed with a cap or some other device."

MAV (MAXIMUM ALLOWABLE VARIATION). A deficiency in the weight, measure or count of an individual package beyond which the deficiency is considered to be an unreasonable error (defined). The number of packages with deficiencies greater than the MAV is controlled by the sampling procedure. (See Section 2.12.)

MEAN OR ARITHMETIC MEAN. See AVERAGE.

MEASURE CONTAINERS.² Containers whose capacities are used to determine quantity. They are of two basic types: (a) retail and (b) prepackaged. Retail containers are packaged at the time of retail sale and prepackaged containers are packaged in advance of sale. An example of a prepackaged measure container is an ice cream package.

METERED VALVE. A push-button operated aerosol delivery device that meters a pre-determined quantity of product when depressed and then shuts off automatically. No additional product will be expelled until the push button is released and depressed again to repeat the procedure.

¹NBS Handbook 130, Uniform Packaging and Labeling Regulation.

²NBS Handbook 44.

MILK BOTTLES.¹ A container that is designed as a measure container (defined) for repeated use in the measurement and delivery of milk and other fluid dairy products at retail.

MINUS OR PLUS ERRORS. Negative or positive deviations from the labeled quantity of the actual package quantities as measured. (See PACKAGE ERRORS.)

MOISTURE ALLOWANCE. That variation in weight of a packaged product permitted in order to account for loss of weight due to loss of moisture during good package-distribution practices. (See Sections 1.9., 2.14., Step 4 of Section 3.5.)

NET QUANTITY OR NET CONTENTS. That quantity of packaged product remaining after all necessary deductions for tare (defined) have been made.

NOMINAL.¹ "Refers to 'intended' ... as opposed to 'actual'."

NOMINAL GROSS WEIGHT. The sum of the nominal tare weight (defined) plus the declared or labeled weight (or other labeled quantity converted to a weight basis). (See Section 2.11. and step 5 of Section 3.5.)

NOMINAL TARE WEIGHT. The quantity designated as tare (defined) and used in the determination of the nominal gross weight. It may be an average tare value or a corrected average tare value.

NULL INDICATOR. A device or portion of device used to indicate a "zero" or load-balanced condition.

OBSERVED VALUE. A particular quantity determined as the result of an observation, test, or measurement.

PACKAGED GOODS.² "Product or commodity put up in any manner in advance of sale suitable for either wholesale or retail sale."

PACKAGE ERROR. The difference between the actual net contents of an individual package as measured and the declared net contents on the package label; (-) minus for less than the label and (+) plus for more than the label. (See Section 2.9.)

POISE.¹ "A movable weight mounted upon or suspended from a weighbeam bar and used in combination with graduations, and frequently with notches, on the bar to indicate weight values."

PLUS ERRORS. See MINUS OR PLUS ERRORS.

¹NBS Handbook 44.

²¹⁶ CFR §500.2(h).

PRINCIPAL DISPLAY PANEL.¹ "The term 'principal display panel or panels' shall be construed to mean that part, or those parts, of a label that is, or are, so designed as to most likely be displayed, presented, shown, or examined under normal and customary conditions of display and purchase. Wherever a principal display panel appears more than once on a package, all requirements pertaining to the 'principal display panel' shall pertain to all such 'principal display panels'."

PRODUCTION LOT. The total collection of packages defined by the packager, usually consisting of those packages produced within a given unit of time and coded identically.

PYCNOMETER. A container of known volume used to contain material for weighing so that the weight of a known volume may be determined for the material. (See Section 4.10.)

RANDOM PACK.² "The term 'random package' shall be construed to mean a package that is one of a lot, shipment, or delivery of packages of the same consumer commodity with varying weights; that is, packages of the same consumer commodity with no fixed pattern of weight."

RANDOM SAMPLING. The process of selecting sample packages such that all packages under consideration have the same probability of being selected. An acceptable method of random selection is to use a table of random numbers. (See Appendices E, F and G.)

RANGE. The difference between the largest and the smallest of a set of measured values. (See Appendix H.)

REASONABLE VARIATION. An amount by which individual package net contents are allowed to vary from the labeled net contents. This term is found in most Federal and State laws and regulations governing packaged goods. (See Appendix D.) This handbook defines the limits of reasonable variation only in terms of negative deviations from the label, referred to as "MAV" (defined).

¹NBS Handbook 130, Uniform Packaging and Labeling Regulation.

²NBS Handbook 130, Uniform Packaging and Labeling Regulation.

ROUNDING. The process of omitting some of the end digits of a numerical value and adjusting the last retained digit so that the resulting number is as near as possible to the original number. (See Section 3.4.)

SAMPLE. A group of packages taken from a larger collection of packages and providing information that can be used as a basis for making a decision concerning the larger collection of packages or of the package production process. A sample provides a valid basis for decision only when it is a random sample (defined). (See Appendix E.)

SAMPLE SIZE. The number of packages in a sample.

SAMPLING PLAN. A specific plan that states the number of packages to be checked and the associated decision criteria. (See Section 1.4.)

SCALE TOLERANCE. The official value fixing the limit of allowable error for commerical weighing equipment as defined in NBS Handbook 44.

SEAT (as in "seat diameter" or "seated capacity"). The projection or shoulder near the upper rim of a cup or container that is designed to serve as the support for a lid or cover.

SEATED CAPACITY. The capacity of a cup, container, or bottle, as defined by the volume contained by them when the lid or a flat disc is inserted in the lid groove located inside and near the upper rim of the cup, container, or bottle. (See Section 4.14.)

SENSITIVITY¹ (of a weighing device). The minimum change in the position of rest of the indicating element of the scale in response to an increase or decrease of the test-weight load on the scale. (See Section 3.1.)

SHIPMENT. A quantity of identically labeled product (except for lot code) sent at one time to a single location.

SLICKER PLATE. A flat plate, usually of glass or clear plastic composition used to determine the "level full" condition of a capacity (volumetric) measure. (See Section 4.10. and 4.14.)

STANDARD DEVIATION. A measure to describe the scatter of the individual package contents around the mean contents. (See Section 2.6.2.)

STANDARD PACK. That type of package in which a commodity is put up with identical labels and only in certain specific quantity sizes. Examples of goods so packed are canned, boxed, bottled and bagged foods, and over-the-counter drugs.

SUBSTITUTION WEIGHING. The use of a commercial scale as a "null indicator" (defined). The weight of the package or product is determined by using the official's test weights (defined), the commercial scale serving merely as an indicator for a "zero" or load balanced condition and not as an indicating device. (See Section 3.9.)

¹NBS Handbook 44.

SUPPLEMENTARY QUANTITY DECLARATIONS.¹ "The required quantity declaration may be supplemented by one or more declarations of weight, measure, or count, such declaration appearing other than on a principal display panel. Such supplemental statement of quantity of contents shall not include any terms qualifying a unit of weight, measure, or count that tends to exaggerate the amount of commodity contained in the package (e.g., 'giant' quart, 'full' gallon, 'when packed,' 'minimum,' or words of similar import)."

SURVEY TESTING. See audit testing.

TAPE RULES.² Flexible steel linear measures.

TARE WEIGHT. The weight of a container, wrapper, or other material (see discussion in Section 2.11.) that is deducted from the gross weight to obtain the net weight.

TARE SAMPLE. The packages or packaging material used to determine the average tare weight. (See Section 2.11.)

TARE SAMPLE SIZE. The number of packages or packaging material units used to determine the average tare weight. (See column 3 of Tables 2-2 or 2-5.)

TEST ALLOWANCE. An allowance made to compensate for differences in delivery of foam aerosol packaged products between normal consumer usage and the test procedure. (See Section 3.11.6.)

TEST WEIGHTS. Weights of known value used to check the accuracy of package quantities and scales (also used in substitution weighing). (See Section 3.1.)

TOLERANCE. A value fixing the limit of allowed departure from the labeled contents; usually presented as a (+) and a (-) value. (See Sections 1.2.2. and 5.7.)

UNIT OF MEASURE. An increment of weight, length, or volume chosen so that an inspector may record package errors in terms of small integers. (The package errors are actually the integers multiplied by the unit of measure.) (See Section 2.9.1.)

UNREASONABLE ERRORS. Minus package errors that exceed the MAV (defined). (See step 7 of Section 3.5.) The number of unreasonable errors permitted in a sample is specified by the sampling plan.

¹16 CFR §500.20.

²NBS Handbook 44.

VALVE ACTUATOR (VALVE BUTTON). The push button located on the top of the aerosol package that controls the flow of product by means of a valve.

VAPOR TAP VALVE. A push button aerosol delivery device that will expel product whether the container is in the upright or inverted position.

VOLUMETRIC MEASURES. Standard measuring flasks, graduates, cylinders, etc. for use in the measurement of volumes of liquids. (See Section 4.2.)

WET TARE. All packaging materials that can be separated from the packaged product after packaging. Washing, scraping, ambient air drying, and other techniques involving more than "normal" household recovery procedures may be used but laboratory procedures such as oven drying the packaging material are not used. As in the dry tare definition, prizes, decorations, and such are also part of the wet tare. (See Section 2.11.)

APPENDIX D. PACKAGE NET CONTENTS REGULATIONS

Certain portions of the Federal and State regulations that refer specifically to labeled net contents on packages are listed below. Additional information concerning packaging and labeling and appropriate methods of sale are contained in NBS Handbook 130.

D.1. FEDERAL REGULATIONS

References are taken from the April, 1983, Code of Federal Regulations.

D.1.1. U.S. Department of Health and Human Services, Food and Drug Administration

Food

21 CFR \$101.105

(q) The declaration of net quantity of contents shall express an accurate statement of the quantity of contents of the package. Reasonable variations caused by loss or gain of moisture during the course of good distribution practice or by unavoidable deviations in good manufacturing practice will be recognized. Variations from stated quantity of contents shall not be unreasonably large.

Food, aerosols 21 CFR §101.105

> (g) The declaration shall accurately reveal the quantity of food in the package exclusive of wrappers and other material packed therewith: Provided, That in the case of foods packed in containers designed to deliver the food under pressure, the declaration shall state the net quantity of the contents that will be expelled when the instructions for use as shown on the container are followed. The propellant is included in the net quantity declaration.

Prescription drugs 21 CFR §201.51

(g) The declaration of net quantity of contents shall express an accurate statement of the quantity of contents of the package. Reasonable variations caused by loss or gain of moisture during the course of good distribution practice or by unavoidable deviations in good manufacturing practice will be recognized. Variations from stated quantity of contents shall not be unreasonably large. In the case of a liquid drug in ampules or vials, intended for injection, the declaration shall be considered to express the minimum quantity and the variation above the stated measure shall comply with the excess volume prescribed by the National Formulary or the U.S. Pharmacopeia for filling of ampules. In the case of solid drug in ampules or vials, the declaration shall be considered to express the accurate net weight. Variations shall comply with the limitations provided in the U.S. Pharmacopeia or the National Formulary.

Over-the-counter drugs, aerosols 21 CFR §201.62

(f) The declaration shall accurately reveal the quantity of drug or device in the package exclusive of wrappers and other material packed therewith: Provided, That in the case of drugs packed in containers designed to deliver the drug under pressure, the declaration shall state the net quantity of the contents that will be expelled when the instructions for use as shown on the container are followed. The propellant is included in the net quantity declaration.

Over-the-counter drugs 21 CFR §201.62

(q) The declaration of net quantity of contents shall express an accurate statement of the quantity of contents of the package. Reasonable variations caused by loss or gain of moisture during the course of good distribution practice or by unavoidable deviations in good manufacturing practice will be recognized. Variations from stated quantity of contents shall not be unreasonably large.

Cosmetics, aerosols 21 CFR §701.13

(g)(1) In the case of cosmetics packed in containers designed to deliver the cosmetic under pressure, the declaration shall state the net quantity of the contents that will be expelled when the instructions for use as shown on the container are followed. The propellant is included in the net quantity declaration.

Cosmetics L21 CFR §701.13

(s) The declaration of net quantity of contents shall express an accurate statement of the quantity of contents of the package. Reasonable variations caused by loss or gain of moisture during the course of good distribution practice or by unavoidable deviations in good manufacturing practice will be recognized. Variations from stated quantity of contents shall not be unreasonably large.

Medical devices 21 CFR §801.62

(q) The declaration of net quantity of contents shall express an accurate statement of the quantity of contents of the package. Reasonable variations caused by loss or gain of moisture during the course of good distribution practice or by unavoidable deviations in good manufacturing practice will be recognized. Variations from stated quantity of contents shall not be unreasonably large.

D.1.2. U.S. Department of Agriculture, Food Safety and Quality Service

Meat

9 CFR §317.2

(h)(2) The statement as it is shown on a label shall not be false or misleading and shall express an accurate statement of the quantity of contents of the container exclusive of wrappers and packing substances. Reasonable variations caused (1) by loss or gain of moisture during the course of good distribution practices or (2) by unavoidable deviations in good manufacturing practice will be recognized. Variations from stated quantity of contents shall not be unreasonably large.

Poultry 9 CFR §381.121

(c)(6) The statement as it is shown on a label shall not be false or misleading and shall express an accurate statement of the quantity of contents of the container, exclusive of wrappers and packaging substances. Reasonable variations caused by loss or gain of moisture during the course of distribution, notwithstanding good distribution practices or by unavoidable deviations, notwithstanding good manufacturing practice will be recognized. Variations from stated quantity of contents shall not be unreasonably large. The statement shall not include any term qualifying a unit of weight, measure or count such as "jumbo quart," "full gallon," "giant quart," "when packed," "minimum" or words of similar import, except as provided in paragraph (b) of this section.

D.1.3. Federal Trade Commission

Non-food consumer commodities covered under the Fair Packaging and Labeling Act, 16 CFR §500.22.

(a) The statement of net quantity of contents shall accurately reveal the quantity of the commodity in the container exclusive of wrappers and other material packed therewith: Provided, That in the case of a commodity packed in a container designed to deliver the commodity under pressure, the statement shall declare the net quantity of the contents that will be expelled when the instructions for use are followed. The propellant is included in that net quantity statement.

(b) Variations from the stated weight or measure shall be permitted when caused by ordinary and customary exposure, after the commodity is introduced into interstate commerce, to conditions which normally occur in good distribution practice and which unavoidably result in change of weight or measure.

(c) Variations from the stated weight, measure or numerical count shall be permitted when caused bv unavoidable deviations in weighing, measuring, or counting the contents of individual packages which occur in good packaging practice: Provided, that such variations shall not be permitted to such extent that the average of the quantities in the packages comprising a shipment or other delivery of the commodity is below the quantity stated, and no unreasonable shortage in any package will be permitted, even though overages in other packages in the same shipment or delivery compensate for such shortage. Variations from stated quantity of contents shall not be unreasonably large.

D.1.4. Environmental Protection Agency

Pesticides (including aerosols) 40 CFR \$162.10

(d) Net weight or measure of contents.

(1) The net weight or measure of content shall be exclusive of wrappers or other materials and shall be the average content unless explicitly stated as a minimum quantity.

(2) If the pesticide is a liquid, the net content statement shall be in terms of liquid measure at 68 $^{\circ}$ F (20 $^{\circ}$ C) and shall be expressed in conventional American units of fluid ounces, pints, quarts, and gallons.

(3) If the pesticide is solid or semisolid, viscous or pressurized, or is a mixture of liquid and solid, the net content statement shall be in terms of weight expressed as avoirdupois pounds and ounces.

(4) In all cases, net content shall be stated in terms of the largest suitable units, i.e., "1 pound 10 ounces" rather than "26 ounces."

(5) In addition to the required units specified, net content may be expressed in metric units.

(6) Variation above minimum content or around an average is permissable only to the extent that it represents deviation unavoidable in good manufacturing practice. Variation below a stated minimum is not permitted. In no case shall the average content of the packages in a shipment fall below the stated average content.

D.1.5. U.S. Department of the Treasury, Bureau of Alcohol, Tobacco and Firearms

Wine 27 CFR §4.37

(e) Tolerances. Statement of net contents shall indicate exactly the volume of wine within the container, except that the following tolerances shall be allowed:

(1) Discrepancies due exclusively to errors in measuring which occur in filling conducted in compliance with good commercial practice.

(2) Discrepancies due exclusively to differences in the capacity of containers, resulting solely from unavoidable difficulties in manufacturing such containers so as to be of uniform capacity: Provided, That no greater tolerance shall be allowed in case of containers which, because of their design, cannot be made of approximately uniform capacity than is allowed in case of containers which can be manufactured so as to be of approximately uniform capacity.

(3) Discrepancies in measure due to differences in atmospheric conditions in various places and which unavoidably result from the ordinary and customary exposure of alcoholic beverages in containers to evaporation. The reasonableness to discrepancies under this paragraph shall be determined on the facts in each case.

(f) Unreasonable shortages. Unreasonable shortages in certain of the containers in any shipment shall not be compensated by overages in other containers in the same shipment.

27 CFR § 240.578

Proprietors of bonded wine cellars will be held strictly responsible for the correct determination of the quantity and alcohol content of wine removed. As required by §240.173, appropriate and accurate measures and instruments for measuring and testing the wine must be provided at each wine cellar. Bottles must be filled as nearly as possible to conform to the amount shown on the label or blown in the bottle to be contained therein, but in no event may the amount of wine contained in any bottle, due to lack of uniformity of the bottles, vary more than two percent from the amount stated to be contained therein; and further in such case there shall be substantially as many bottled overfilled as there are bottles underfilled for each lot of wine bottled

Distilled spirits 27 CFR \$5.47 and 27 CFR \$5.47a

(b) Tolerances. The following tolerances shall be allowed:

(1) Discrepancies due to errors in measuring which occur in filling conducted in compliance with good commercial practice.

(2) Discrepancies due to differences in the capacity of bottles, resulting solely from unavoidable difficulties in manufacturing such bottles to a uniform capacity: Provided, That no greater tolerance shall be allowed in case of bottles which, because of their design, cannot be made of approximately uniform capacity than is allowed in case of bottles which can be manufactured so as to be of approximately uniform capacity.

(3) Discrepancies in measure due to differences in atmospheric conditions in various places and which unavoidably result from the ordinary and customary exposure of alcoholic beverages in bottles to evaporation. The reasonableness of discrepancies under this paragraph shall be determined on the facts in each case.

27 CFR §19.397

(b) Variations in proof and fill. If the contents do not agree with the respective data on the label or bottle as to -

(1) Quantity (fill), except for such variations in measuring as may occur in filling conducted in compliance with good commercial practice with the overall objective of maintaining 100 percent fill for all bottled products; and/or (2) Proof, subject to a normal drop in proof occurring during bottling operations not to exceed three-tenths of a degree the proprietor shall rebottle, recondition, or label the spirits in such manner that the label will correctly describe the contents.

Beer

21 CFR §245.126 (in part)

The statement of net contents shall indicate exactly the volume of beer within the bottle except for such variations in measuring as may occur in filling conducted in compliance with good commercial practice. Short-fill bottles of beer which are sold or otherwise disposed of by a brewery to its own employees for their own use but which are not for resale need not be labeled, but, if labeled, need not show an accurate statement of net contents

D.2. <u>REGULATIONS RECOMMENDED BY THE NOWM FOR STATE</u> ADOPTION

The National Conference on Weights and Meaures (NCWM), an organization of State and local weights and measures officials, has adopted guidelines and standards upon which individual States and other jurisdictions may model their laws and regulations. A majority of the States have adopted the following portion of the NCWM Uniform Packaging and Labeling Requirements¹ quoted below.

SECTION 6. DECLARATION OF QUANTITY: CONSUMER PACKAGES

6.13. <u>CHARACTER OF DECLARATION: AVERAGE</u>. —The average quantity of contents in the package of a particular lot, shipment, or delivery shall at least equal the declared quantity, and no unreasonable shortage in any package shall be permittaed, even though overages in other packages in the same shipment, delivery, or lot compensate for such shortage.

SECTION 7. DECLARATION OF QUANTITY: NONCONSUMER PACKAGES

7.6. <u>CHARACTER OF DECLARATION: AVERAGE</u>. — The average quantity of contents in the package of a particular lot, shipment, or delivery shall at least equal the declared quantity, and no unreasonable shortage in any package shall be permitted, even though overages in other packages in the same shipment, delivery, or lot compensate for such shortage.

1NBS Handbook 130.

12.1. PACKAGING VARIATIONS.

12.1.1. VARIATIONS FROM DECLARED NET QUANTITY. — Variations from the declared net weight, measure, or count shall be permitted when caused by unavoidable deviations in weighing, measuring, or counting the contents of individual packages that occur in good packaging practice, but such variations shall not be permitted to such extent that the average of the quantities in the packages of a particular commodity, or a lot of the commodity that is kept, offered, or exposed for sale, or sold, is below the quantity stated, and no unreasonable shortage in any package shall be permitted, even though overages in other packages in the same shipment, delivery, or lot compensate for such shortage. Variations above the declared quantity shall not be unreasonably large.

12.1.2. VARIATIONS RESULTING FROM EXPOSURE. --Variations from the declared weight or measure shall be permitted when 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, but only after the commodity is introduced into intrastate commerce: <u>Provided</u>, that the phrase "introduced into intrastate commerce" as used in this paragraph shall be construed to define the time and the place at which the first sale and delivery of a package is made within the state, the delivery being either

(a) directly to the purchaser to his agent, or

(b) to a common carrier for shipment to the purchaser, and this paragraph shall be construed as requiring that, so long as a shipment, delivery, or lot of packages of a particular commodity remains in the possession or under the control of the packager or the person who introduces the package into intrastate commerce, exposure variations shall not be permitted.

APPENDIX E. SELECTION OF A RANDOM SAMPLE

E.1. INTRODUCTION

All of the sampling plans presented in this handbook are based on the assumption that the packages constituting the sample are chosen at random from the inspection lot. Randomness in this instance means that every package in the lot has an equal chance of being selected as part of the sample. It does not matter what other packages have already been chosen, what the package net contents are, or where the package is located in the lot.

The selection of a random sample requires some care. The procedures that follow present several methods for obtaining a random sample, and a randomly selected subsample for tare. However they are not the only techniques that may be used. (See Section E.5.)

For the discussion that follows, there are considered to be N packages in the inspection lot and n packages in the sample.

To obtain a random sample, two steps are necessary. First it is necessary to identify each package in the lot of N packages with a specific number whether on the shelf, in the warehouse or coming off the packaging line. Then it is necessary to obtain n random numbers, as from a table of random numbers for example. These n random numbers indicate exactly which packages in the lot shall be taken for the sample.

E.2. LOT NUMBERING SYSTEMS

A numbering system or scheme for the lot must be decided upon before selecting the random numbers for the sample. There are many methods of numbering the lot, two of which are outlined below.

E.2.1. Serial Lot Numbering Systems

In a simple arrangement, such as packages on a shelf or on a packing line, the packages in the lot can be considered to be numbered from 1 to N. The testing official does not have to mark the packages with numbers, but may imagine each package as having a number associated with it. The official may straighten the packages on the shelf before beginning if that helps to clarify the envisioned numbering system. A simple sketch on a piece of cross-section paper may also be helpful. For example, if the packages are in only one layer, the packages could be found (or arranged) in rows and columns on the shelf, as shown (standing in front of and looking down at the shelf):

Imagine that the packages are numbered from 1 to 10 in some systematic fashion, perhaps:

If there is more than one layer of packages, the serial numbering system can be extended, layer by layer. In the example above, the second layer would be considered to be packages numbered 11 through 20, the third layer, packages numbered 21 through 30, etc.; in the same pattern as given for the first 10.

The inspector can use any numbering scheme provided that each package has a number associated with it, and can be located by its number. In the 3-layer scheme suggested above, with N = 30, package number 26 would be in the third layer, second row from the front, first package on the left.

E.2.2. Three-Dimensional Numbering System

If a large stack of packages must be numbered, it may be more convenient to use a three-dimensional lot numbering system with a designated "zero point" (starting place), say the lower left corner of the stack. The official can then use three directions to count from this starting place--to the Right, Up, and toward the Back (RUB). If, from the zero point, there are 10 units to the Right, 3 units Up, and 7 units Back, the dimensions of the stack are 10.by 3 by 7. As an example, unit number 4-1-5, would be the package located 4 units to the Right of the zero point, 1 unit Up, and 5 units towards the Back. (See Figure E-1).

E.3. THE RANDOM NUMBER TABLE

E.3.1. General

A random number table such as in Appendix G is composed of the digits from 0 through 9, with approximately equal frequency of occurrence. The table consists of 31 pages. On each page digits are printed in blocks of five columns and blocks of five rows. The printing of the table in blocks is intended only to make it easier to locate specific columns and rows.

E.3.2. Random Starting Place.

- a. <u>Starting Page</u>. The pages of Appendix G are numbered G-1 through G-31. Use the day of the month to determine the starting page. For example, if the inspection takes place on February 11, use page G-11 as the first page (then pages G-12 through G-31, followed by pages G-1 through G-10 if necessary).
- b. <u>Starting Column and Row.</u> Use the auxiliary table, Appendix F, to get the starting column and row. (Alternatively, the inspector may choose a starting page in the random number table and with eyes closed, drop a pencil anywhere on the page to indicate a starting place in the table.) Appendix F consists of two pages. On each page there are 600 pairs of numbers in parentheses. The first number of a pair indicates the starting column in Appendix G, and the second number the starting row. The first pair at the upper left hand corner of the first page may be used the first time. After a pair is used, it may be crossed out and another pair used the next time, proceeding systematically either across or down the page.

For example, assume that testing takes place on the 11th day of the month. Start with page G-11 of the random number table in Appendix G. Use the auxiliary table in Appendix F to select the starting place. If the auxiliary table is being used for the first time, use the first pair of numbers (22, 45). Start using the random number table of Appendix G, on page G-11, column 22, row 45. That number is 3.

If 1-digit random numbers are needed, record them, going down the column to the bottom of the page and then to the top of the next column, and so on. Ignore duplicates and record zero (0) as ten (10). Following on from the last example, these numbers are 3, 5, 7, 10, 4, etc. If two-digit random numbers are needed, rule off the page, and further pages if necessary, in columns of two digits each. If there is a single column left on the page, ignore this column, and rule the next page in columns of two. Again, ignore duplicate numbers and record 00 as 100. For example, using the same starting place as in the last example, (page G-11, column 22, row 45) the recorded two-digit recorded numbers would be 31, 58, 72, 2, 46, 71, 43, etc. When three-digit numbers are needed, rule the page in columns of three. Record 000 as 1000. Starting on page G-11, column 22, row 45. the recorded numbers would be 316, 585, 722, 24, 461, 715, 376, 244, 921, 289, etc.

E.4. OBTAINING RANDOM NUMBERS FOR THE SAMPLE

E.4.1. Serial Lot Numbering System

Once the packages in the lot have been assigned numbers (from 1 to N), it is necessary to obtain n random numbers that will correspond to those packages that will become the random sample. If the lot contains 100 packages or fewer, use two-digit random numbers. If the lot consists of more than 100, but not more than 1000 packages, use three-digit random numbers. Using the random number table (Appendix G), rule the table off in columns (if desired). Read off successive numbers less than or equal to N until n different numbers have been recorded on a worksheet. These designate the packages for the test sample.

The testing official may, of course, rearrange these random numbers in a serial fashion to facilitate actual package selection (or mark through the random numbers on the worksheet as packages are selected). In any event, the order in which the numbers come out of the random number table indicates those packages in the sample to be chosen as the tare.

For example: The lot consists of 99 packages. A sample of 10 packages is required. Starting on page G-11, column 22, row 45, the following random numbers are recorded: 31, 58, 72, 2, 46, 71, 43, 82, 79, 40. (If a duplicate appears in the table, it is ignored—e.g., 72 appears twice.) If 00 had appeared, it would have been ignored in this case (it would usually be recorded as 100). The packages corresponding to the 10 random numbers are selected for the sample.

Package Selection Worksheet for a Serial Lot Numbering System			
Sample package in the sequence to be used for tare determin- ation	Package number in lot (in the order they are selected from the random number table)	Rearranged in the in the order to be to be selected from the lot	
1 2 3 4 5 6 7 8 9 10	31 58 72 2 45 71 43 82 79 40	2 31 tare 40 43 46 58 tare 71 72 79 82	

Figure E-1.

Note that the tare sample is obtained according to the order in which the random numbers are recorded; that is, for a sample of 10, the tare sample in this instance, would be packages numbered 31 and 58 in the lot.

E.4.2. Three-Dimensional Lot Numbering System

The official should choose a convenient "zero point" (such as the lower left corner of the stack) and record the number of packages in the stack in each of the three directions (RUB). For example, the stack might be 10 by 7 by 3, i.e., 10 units to the Right of the starting place, 7 units Up, and 3 units Back.



Figure E-2. Choosing a starting place for a three-dimensional lot numbering system.

A work table like that in Figure E-3 is useful to record the positions of sample packages in the lot as determined from the random number table.

Package Selection Worksheet for a Three-Dimensional Lot Numbering System			
Sample package in the sequence to be used for tare determination	Package location		
	Right	Up	Back
1 2 3 4 5 6 7 8 9 10			
(continue if larger sample size is required)			
Dimensions of stack =	R	ប	B

Figure E-3.

At the bottom of the table in the spaces labeled "Dimensions of Stack," record the total number of units in each direction in the stack. This will aid in going through the random number table, because larger numbers in any column are not usable. Beginning at a random starting place in Appendix G, go down the column filling in the first column of the work table by using successive random numbers less than or equal to the dimension shown at the bottom of the work table. When the first column of the work table is completed, fill in the second column. When the bottom of a column is reached in Appendix G, begin at the top of the next column. If all dimensions of the stack are 10 or less, use one-digit columns of the random number table; if any dimension is greater than 10, but not greater than 100, use two-digit columns; if greater than 100, but not greater than 1000, use three-digit columns, and so on.

In the case of a three-dimensional lot numbering system, there is very little chance of duplicating all three numbers. Of course, if a set of three numbers should be found to duplicate an earlier entry, it should be replaced with the next available set.

If any dimension of the stack is "two", choose "one" if the random number in the table is odd and "two" if even. Alternatively, the random selection for that dimension can be made by successively tossing a coin rather than using the random number table. For example, the dimensions of a stack are 10 by 7 by 3 and 10 packages are to be selectd at random. The office needs three one-digit numbers to locate each of the 10 samples in the stack. Assume that the random starting place is the 22nd column and the 45th row on page G-11 of Appendix G.

The first sample package is found 3 packages to the right, 7 packages up, and the third package back from the zero point.

The ninth sample package is 5 packages to the right, 5 packages up, and the second package back. (See completed example in Figure E-4.)

Figure E-4. Completed example of package selection using a three-dimensional lot numbering system

Package Selection Worksheet for a Three-Dimensional Lot Numbering System			
Sample package in the sequence	Package location		
to be used for tare determination	Right	Up	Back
1 2 3 4 5 6 7 8 9 10	3 5 70(0) 4 7 3 9 5 2	7 3 1 2 7 3 6 5 2	3 1 3 1 2 2 1 2 2
(continue if larger sample size is required)			
Dimensions of stack =	10 R	7 U	3 B

E.5. OTHER METHODS OR TABLES TO OBTAIN RANDOM NUMBERS

Random number dice may be used as an alternative to the random number table as a way of obtaining random numbers. These are special 20-sided dice sold and used in a set of three. Each die has 20 faces--two faces numbered 0, two faces numbered 1, etc., through the number 9. Two sources for purchasing the dice are:

Lansford Publishing Company¹ P. 0. Box 8711 San Jose, California 95155

Technovate¹ 910 Southwest 12th Avenue Pompano Beach, Florida 33060

The random number dice can be used to get random numbers for the sample for serial lot-numbering systems if the lot contains 1000 packages or less, or for three-dimensional lot-numbering systems if no dimension is larger than 1000.

Other types of random number tables are helpful in choosing a random sample especially if the first digit of the lot size N is no greater than 5. For example, consider a lot of 200 serially numbered packages. Using the random number table in Appendix G requires elimination of all three-digit numbers over than 200. Since the numbers 0 to 9 occur with equal frequency, most of the random numbers in the table will be rejected. In such instances the book, Tables of Random Permutations, by Lincoln E. Moses and Robert V. Oakford (published by Stanford U. Press, Stanford, California in 1963) would be quite a time saver. In this book, a number of tables correspond to N with a small first digit (e.g., N = 10, 25, 50, 100), reducing the time to search (and the need to reject) many random numbers.

E.6. OTHER CONSIDERATIONS WHEN SELECTING THE SAMPLE

E.6.1. Selecting the Tare Sample

o The order in which numbers come out of the random number table determines those packages in the sample that are the tare sample.

> When testing glass or aerosol packages, it is very important, to retain the order of packages corresponding to the order in which the random numbers come out of the random number table, since the additional packages (if any) to be opened for tare are selected in this order.

¹The mention of firm names does not imply that they are endorsed or recommended by the Department of Commerce over other firms not mentioned.

The example worksheet shown on page E-4 provides a column labeled "Package Number in Lot." The random numbers are recorded in this column in the order in which they come from the random number table. The testing official will want to select the packages in the order corresponding to a serial arrangement of the numbers. One way of doing this and not forgetting the order of the packages for the tare sample (which, if glass or aerosol, could amount to a large proportion of the sample) is to associate each random number with the number printed to the left of it on a worksheet (page E-4 or E-6) and to order or mark the packages that are selected with this latter number. This number indicates the order in which the packages will be opened for tare. In the example of a package selection using a serial lot numbering system (referring to the example in Section E.4.), the package corresponding to random number 31 is the first package to be opened for tare, that package corresponding to random number 58 is the second and so on. However, in selecting the sample, the package corresponding to random number 2 may be the first removed from the lot. In this case, the official may wish to mark (or lay a piece of paper on) this first package removed from the lot with a "4". The second package removed from the lot in a serial fashion will be the package corresponding to the random number 31, but the inspector will want to note that this is the first package to be opened for tare determination.

When testing at the packaging location, if dry tare is to be used, the tare sample should be selected from the same lot of tare materials into which the finished product (which is being checked) is being packaged. The major contribution to the tare weight (the can, cardboard box, etc.) should be selected randomly in the same fashion as the sample packages are selected. As long as they do not comprise a major proportion of the tare weight, supplementary tare materials in the finished package (solder, ties, glue, labels, caps, etc.) may be selected from the lot without rigorous random selection; however, such materials should be visually identical to and selected from the same batch as other such materials on the packaging line.

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E.6.2. Selecting the Sample at Various Locations

- o When the lot consists of packages on a retail shelf, a customer may remove packages from the lot while the official is choosing his sample. The official should continue choosing the sample as if a missing package had not been there initially (that is, by selecting the next package in sequence).
- o It is permissible to eliminate individual packages from the sample (and from the inspection lot) if found to be defective by visual examination alone, e.g., cut boxes, empty bottles, torn wrappers, etc. Such individual packages should not become part of the sample. However, individual packages must not be eliminated from the sample after quantitative measurements have been made.

If a defective package is found during sampling, the official may select a package immediately adjacent to the defective package. If found after selection, but before measurement, and the original package location is not conveniently accessible, the official may select another random number to identify a package for replacing the defective one in the sample.

- When the lot is defined as packages on open display 0 plus cartons in a storeroom, the sample should be taken proportionately from the packages on the shelf Thus, with 24 packages on and from the cartons. display and 220packages in the storeroom, approximately 1/10 of the sample should be from packages on display and 9/10 from packages in the storeroom. If there are to be 30 packages in the sample, 3 should come from the display and 27 from the storeroom.
- When the lot consists of cartons in a storage area or warehouse, the random sample can be obtained by using the three-dimensional lot numbering system. However, it may be extremely difficult to collect the sample if the packages are aggregated into larger storage units, such as cartons, strapped-together pallets, or shrink-packs.

Therefore, for convenience, the official may randomly select more than one package from each carton, and more than one carton from each pallet. However, choosing the entire sample from a single pallet or a single carton must be strictly avoided. The testing official may find it convenient to use the three-dimensional numbering system for selection of cartons on a pallet, and the serial numbering system for the selection of pallets and of packages from a carton.

The official should first choose the pallets (if any) from which the sample will be taken, then the cartons from those pallets (or from the entire lot if there are no pallets), and finally choose from the previously selected cartons, the individual packages that will comprise the sample. The number of units selected at each stage (pallet, carton, and package) does not have to be the same.

When the lot consists of a portion of production at the packing plant, the packages coming off the packaging line can be considered to be numbered serially from 1 to N (the last package in the lot). Random numbers may be obtained from the random number table as described for serial lot numbering systems. The random numbers should be chosen, then ordered serially before physically choosing the packages corresponding to those numbers from the packing line.

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APPENDIX F: AUXILIARY TABLE FOR RANDOM STARTING PLACE

Table provided by James F. Filliben, Statistical Engineering Division, National Bureau of Standards. Derived from <u>A Million Random Digits</u> by the Rand Corporation, coyright, 1955, The Free Press.
(50,20 (23,35 (12, 6 (32, 4 (10, 6	(3,1 (42,22 (4,26 (28,35 (28,48	(12,35 (9,18 (34,12 (31,27 (31,27)	(26,42 (46,49 (50,38 (32,33 (32,13)	(24,18) (44,42) (44,9) (17,49) (17,49) (9,8)	(11,10) (11,11) (16,18) (16,18) (31,40) (31,40) (8,4)	(19.37) (44,33) (6,43) (16,43) (11) (11) (5,16)	(35,5) (28,41) (14,7) (14,7) (2,30) (1,13)	(19,40) (28, 31) (35,31) (12,11) (32,22)	(11,42) (46,3) (46,13) (21,38 (21,38
(18,42) (12,33) (14,2) (32,48) (35,22)	(45,32) (6,31) (7,26) (48,36) (9,1)	(23,42) (7,50) (29,37) (16,44) (14,4)	(1,36) (15,1) (2,22) (35,23) (23,16)	(33,46) (19,41) (20,28) (27,11) (25,19)	(25,39) (12,18) (3,18) (24,2) (16,26)	(LL,L) (L2,84) (20,24) (20,24) (41,04)	(49,35) (28,4) (29,36) (29,11) (3,11) (3,25)	(24, 45) (34, 6) (13, 23) (41, 25) (27, 37)	(2,1) (28,32) (38,4) (38,4) (23,21)
(1,13) (13,26) (3,33) (23,20) (23,20) (47,43)	(5,46) (47,12) (20,50) (22,35) (32,1)	(38,34) (19,11) (44,443) (3,12) (37,31)	(6,42) (8,33) (18,21) (29,39) (23,33)	(15,42) (15,12) (6,8) (14,30) (9,24)	(25,33) (47,10) (42,26) (19,39) (32,23)	(36,22) (30,2) (14,2) (48,16) (44,22)	(41,47) (25,5) (44,11) (42,41) (17,18)	(26,49) (20,37) (47,26) (19,23) (8,18)	(17,7) (18,41) (21,50) (23,9) (34,21)
(20,31) (36,47) (33,25) (34,8) (29,9)	(24,42) (16,5) (26,4) (37,48) (47,43)	(34,42) (10,2) (8,47) (6,22)	(41,26) (13,30) (35,19) (47,43) (3,4)	(46,38) (17,12) (27,3) (29,48) (3,16)	(13,37) (40,27) (28,6) (47,5) (48,32)	(32,28) (46,39) (44,50) (26,16) (26,16)	(38,37) (1,7) (24,5) (28,8) (22,37)	(17,15) (1,27) (50,10) (44,10) (38,23)	(9,42) (19,38) (10,40) (19,2) (36,45)
(27,26) (836) (43,4) (42,10) (11,3)	(18,13) (47,32) (7,42) (37,21) (6,14)	(19,12) (35,50) (50,13) (50,16) (24,13)	(19,16) (11,12) (25,28) (21,45) (44,15)	(7,22) (49,34) (42,34) (41,32) (41,32) (41,32) (41,32)	(19,47) (41,47) (17,20) (5,44) (28,26)	(50,29) (7,9) (50,32) (8,49) (15,35)	(15,27) (15,27) (27,28) (19,14) (32,3)	(10, 6) (27,48) (35, 1) (38,19) (29,23)	(17, 6) (30,19) (49,19) (31,30) (31,30)
(10,26) (28,43) (33,34) (15,35) (36,14)	(27,42) (9,19) (25,28) (15,46) (19,23)	(43,23) (6,26) (6,18) (6,13) (39,8)	(43,42) (50,10) (18,34) (10,31) (17,14)	(37, 7) (27,24) (32,22) (32,19) (27,16)	(30,28) (2,48) (1,39) (33,40) (22,48)	(15,37) (35,9) (48,48) (21,16)	(47,29) (27,47) (14,30) (33,10) (42,30)	(24,23) (27,48) (27,28) (5,22) (40,24)	(5,28) (48,44) (25,7) (45,23) (44,34)
(17 4:2) (24,50) (1,20) (18,9) (3,12)	(41, 9) (34,49) (39,11) (20,35) (43,38)	(9,5) (35,9) (16,14) (37,2) (34,17)	(49,28) (34,43) (25,36) (20,22) (47,20)	(26, 8) (12,46) (27,4) (15,29) (38,38)	(44,30) (31,6) (13,23) (13,23) (18,13)	(25, 1) (46, 34) (49, 27) (20, 45) (20, 45)	(29, 37) (44, 38) (47, 39) (13, 4) (31, 5)	(10, 9) (18, 8) (11,42) (16,31) (6,10)	(9,33) (27,9) (7,22) (44,9) (37,40)
(21,45) (20,11) (41,2) (5,30) (14,43)	(33,13) (32,5) (37,4) (40,7) (2,8)	(20,20) (41,3) (9,46) (5,15) (18,20)	(31,10) (21,27) (22,15) (18,48) (7,26)	(46, 3) (42, 8) (46,26) (34,27) (33, 3)	(48,30) (8,24) (1,48) (36,40) (15,50)	(45,14) (32,6) (33,16) (28,46) (21,12)	(16,42) (36,16) (33,37) (24,4) (23,10)	(21,50) (42,42) (4,45) (24,29) (24,29)	(19,39) (49,26) (43,33) (47,23) (32,48)
(44,20) (9,9) (42,22) (47,48) (30,25)	(22,21) (35,27) (19,19) (50,16) (5,5)	(15, 6) (49, 7) (18, 35) (11, 13) (47, 48)	(7,8) (35,34) (12,10) (24,34) (1,39)	(16, 6) (44,48) (44,23) (21,16) (21,16) (9,29)	(13,13) (49,12) (2,48) (7,10) (25,5)	(42,19) (34,50) (20,47) (46,39) (24,43)	(47,45) (3,10) (11,20) (41,20) (17,37)	(42,20) (39,19) (31,21) (2,7) (6,48)	(15,23) (53,48) (55,48) (40,23) (44,34)
(μ0, 7) (23,35) (16,21) (μ7,30) (8,49)	(50,16) (11,27) (8,43) (4,29) (5,25)	(48,29) (49,30) (9,39) (30,33) (40,25)	(18,11) (35,37) (23,21) (5,18) (38,31)	(44, 9) (34,25) (2,41) (45,29) (25,38)	(23, 6) (22,45) (49,37) (21,5) (14,18)	(43,15) (10,21) (19,44) (29,19) (25,26)	(29,49) (28,32) (20,4) (46,20) (10,25)	(25, 3) (48, 49) (37, 32) (37, 32) (19, 40)	(26,31) (31,18) (32,28) (47,26) (31,46)
(4,49) (50,38) (5,44) (5,44) (14,49)	(31,15) (19,14) (28,41) (29,3) (22,41)	(10,19) (38,44) (20,14) (21,19). (47,43)	(18,29) (38,37) (15,18) (22,3) (47,31)	(35,45) (29,28) (39,40) (17,19) (43,7)	(44,49) (35,17) (26,21) (30,17) (36,15)	(34,27) (33,45) (15,50) (18,7) (33,13)	(27,26) (40,49) (23,36) (26,10) (37,35)	(14,10) (25,8) (20,10) (28,7) (42,7)	(46,33) (11,33) (11,33) (12,25) (15,25) (26,27)
(22,45) (26,44) (47,12) (8,20) (2,33)	(4,24) (42,18) (2,38) (14,49) (28,15)	(40,27) (9,41) (29,11) (38,10) (23,28)	(6,28) (14,17) (33,17) (23,11) (23,11) (39,47)	(28,19) (5,27) (19,48) (15,17) (9,38)	(17, 9) (14,24) (19,27) (34,42) (34,42)	(4, 1 5) (1, 6) (8,38) (9,27) (2,27)	(37,23) (27,1) (32,37) (9,34) (1,19)	(25,38) (21,37) (33,11) (13,26) (18,13)	(31,12) (19,36) (48,8) (19,21) (8,43)

(11,21) (14,22) (2,31) (50,40) (32,2)	(15,7) (41,37) (22,17) (41,36) (41,36) (31,7)	(43,15) (9,35) (35,16) (49,17) (29,11) (29,11)	(24,20) (27,49) (27,45) (42,28) (42,28) (27,36)	(18,36) (29,44) (27,19) (35,34) (4,30)	(35,24) (26,41) (14,27) (39,17) (23,21)	(50,33) (38,37) (16,36) (22,2) (46,31)	(48,40) (49,6) (27,25) (27,29) (47,9)	(11,23) (3,36) (4,3,19) (50,27) (34,35)	(24,10) (11,37) (148,2) (26,24) (25,27) (25,27)
(47,41) (37,2) (47,6) (37,39) (37,39) (20,28)	(36,26) (33,28) (7,9) (22,50) (14,31)	(2,24) (19,17) (11,6) (32,15) (38,18)	(42,10) (17,6) (17,6) (14,41) (34,12)	(17,30) (14,44) (26,13) (26,13) (14,44) (26,13)	(27,14) (19,40) (16,14) (29,43) (24,11)	(36,25) (37,6) (33,12) (44,38) (15,46)	(13,19) (25,13) (14,30) (12,30) (44,39)	(13,43) (2,43) (14,47) (22,11) (25,2)	(46, 1) (37,49) (7,11) (47,18) (3, 5)
(13, 9) (27, 19) (42, 31) (46, 48) (6, 42)	(17,26) (27,16) (44,36) (22,39) (38, 5)	(28,40) (44,42) (6,6) (33,16) (9,23)	(29,28) (49,25) (17,43) (14,3) (3,35)	(29,31) (7,26) (37,20) (37,20)	(10,32) (4,4,5) (19,11) (128,31) (47,18)	(39,47) (32,44) (3,30) (4,40) (28,38)	(29, 7) (14,32) (28,10) (25,24) (44,45)	(13,30) (47,5) (31,25) (36,14) (37,49)	(15,13) (2,41) (10,47) (6,9) (36,15)
(21,38) (49,40) (28,13) (34,40) (30, 5)	(3,25) (10,15) (14,9) (10,46) (38,38)	(5,3) (16,9) (28,33) (6,50) (26,14)	(24,42) (50,31) (47,48) (4,30) (36,24)	(30,43) (49,14) (19,47) (13,10) (30,32)	(15,14) (23,37) (48,49) (11,32) (9,10)	(44,50) (45,18) (32,49) (46,12) (39,24)	(11,12) (23,2) (6,37) (15,17) (15,17) (1,43)	(50,46) (9,42) (48,20) (6,45) (38,16)	(20,28) (14,27) (16,25) (26,11) (25,5)
(7,21) (48,32) (10,10) (33,33) (41,45)	(19,24) (30,27) (30,44) (31,2) (31,2) (17,47)	(50,46) (31,45) (47,39) (35,30) (13,3)	(14,21) (38,47) (18,10) (35,42) (40,15)	(43,29) (5,34) (7,15) (28,16 (41,23)	(17,44) (39,14) (19,29) (41,24) (25,36)	(38,16) (14,13) (20,30) (16,45) (11,4)	(4, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,	(7,47) (38,28) (27,31) (40,28) (46,20)	(33,19) (48,35) (15,49) (15,49) (19,19)
(28,18) (25,4) (13,29) (15,29) (20,1)	(14, 7) (5, 1) (9, 33) (46, 9)	(11, 6, 11) (12, 31) (19, 36) (19, 38) (34, 29)	(32,33) (7,33) (26,20) (34,50) (4,16)	(38,20) (20,15) (24,42) (14,40) (20,33)	(15,47) (4,12) (25,29) (48,42) (9,31)	(28,32) (47,48) (3,22) (11,13) (3,49)	(28,17) (27,12) (22,22) (13,46) (15,27)	(20,30) (44,16) (11,24) (8,45) (39,221)	(9,1) (6,13) (28,35) (46,34) (44,20)
(1, 9, 11) (23, 20) (5, 3) (35, 3) (1,7, 38)	(50,19) (31,18) (29,31) (49,7) (40,33)	(14,18) (47, 3) (15, 7) (17,23) (7,48)	(34,39) (50,45) (44,48) (10,1) (9,17)	(25,29) (36,17) (30,16) (39,48) (11,42)	(2,38) (41,26) (6,30) (34,12) (35,36)	(4,32) (38, 1) (10, 4) (21,11) (21,11) (11,38)	(3,50) (24,28) (20,45) (3, 1) (27, 6)	(1,25) (41,41) (14,47) (29,24) (15,41)	(42,5) (14,33) (45,17) (21,17) (21,17) (19,21)
(50,36) (49,15) (42,43) (47,37) (17,25)	(16,14) (16,14) (17,12) (14,44) (14,44) (21,44)	(44,21) (40,23) (36,32) (27,40) (42,45)	(36,42) (45,32) (4,28) (4,28) (4,5,34) (15,32)	(1,23) (18,18) (45,18) (40,34) (8,4)	(3,2) (33,36) (20,26) (30,25) (36,41)	(19,48) (25,37) (50,20) (1,20) (44,42)	(39,48) (15,11) (17,30) (47,48) (6,42)	(46,11) (33,11) (12,18) (12,50) (46,21)	(11,11) (30,19) (30,31) (3,29) (23,21)
(11,12) (1,17,9) (1,17,6) (1,17,50) (1,17,50) (1,17,27)	(13,15) (18,47) (49,49) (12,29) (17,6)	(15,35) (39,20) (32,30) (9,46) (35,32)	(25,22) (49,39) (20,46) (23,1) (42,23)	(45,35) (23,25) (44,19) (38,33) (41,35)	(7,1) (37,12) (19,34) (18,10) (5,50)	(23,19) (33,20) (36,44) (31,18) (12,10)	(8,34) (5,2) (24,36) (36,1) (10,8)	(26, 5) (25, 5) (24,34) (33,39) (33,48)	(9,42) (42,50) (1,25) (27,19) (21,32)
(16,45) (21, 1) (19,36) (9,48) (23,47)	(17,24) (35,11) (19,28) (46,19) (23,19)	(23,20) (24,23) (9,27) (11,24) (40,38)	(15, 1) (28,24) (45,25) (38,45) (28,28)	(16, 7) (15,25) (29,31) (26,36) (32,38)	(12,13) (17,12) (20, 2) (36,23) (15,15)	(4,29) (14,15) (30,27) (49,40) (34,1)	(2,20) (31,20) (2,23) (16,16) (27,12)	(27,33) (4,19) (4,1,36) (36,16) (1,6)	(21,46) (40,49) (47,4) (47,1) (14,11) (14,12)
(6,14) (44,37) (28,7) (6,14) (30,34)	(34, 9) (28,11) (39,43) (21,49) (37,44)	(45,32) (35,5) (27,13) (38,3) (40,6)	(13,28) (7,9) (28,42) (9,20) (40,42)	(11, 7) (14, 22) (16, 41) (16, 41) (14, 44)	(43,44) (17,19) (12,30) (12,29) (40,49)	(43,39) (27,38) (1,4,1) (1,26) (1,1,11)	(30,21) (6,35) (29,30) (38,42) (20,7)	(34,12) (50,15) (47,7) (24,18) (41,14)	(18,50) (29,46) (15,39) (24,20) (5,39)
(50,33) (31,16) (44,11) (44,46) (7,21)	(23,32) (37,2) (5,15) (14,13) (35,44)	(13,14) (27,11) (35,34) (24,28) (37,27)	(29,13) (33,36) (39,17) (17,16) (17,16) (42, 1)	(24,16) (34,23) (11,44) (22,6) (28,43)	(43,39) (13,35) (22,34) (26,4) (21,1)	(12, 5) (24,15) (17,41) (19,30) (38,38)	(31,28) (30,14) (50,39) (20,8) (5,8)	(34,41) (5,15) (7,50) (23,8) (32,40)	(20,11) (20,49) (9,38) (3,15) (2,23)

APPENDIX G: RANDOM NUMBER TABLE

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31000	63837	17813	08076	19164	95508	17513	29416	61238	25818
87014	83331	25804	32768	85680	08844	59844	68794	32783	60318
33898	89236	06100	68848	47494	94074	40842	07221	96274	43398 92166
26877	95856	65227	25165	01752	99463	15216	28719	04716	80246
	-						20120	0.110	
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61981	00340	43594	22386	41782	94104	08867	68590	61716	36120
96056	16227	74598	28155	23304	66923	07918	15303	44988	79076
64013	74715	31525	62676	75435	93055	37086	52737	89455	83016
59515	37354	55422	79471	23150	79170	74043	49340	61320	50390
38534	33169	40448	21683	82153	23411	53057	26069	86906	49708
41422	50502	40570	59748	59499	70322	62416	71408	06429	70123
38633	80107	10241	30880	13914	09228	68929	06438	17749	81149
48214	75994	31689	25257	28641	14854	72571	78189	35508	26381
54799	37862	06714	55885	07481	16966	04797	57846	69080	49631
25848	27142	63477	33416	60961	19781	65457	23981	90348	24499
27576	47298	47163	69614	29372	24859	62090	81667	50635	08295
52970	93916	81350	81057	16962	56039	27739	59574	79617	45698
69516	87573	13313	69388	32020	66294	99126	50474	04258	03084
94504	41733	55936	77595	55959	90727	61367	83645	80997	62103
67935	14568	27992	09784	81917	79303	08616	83509	64932	34764
63345	09579	40232	51061	09455	36491	04810	06040	78959	41435
87119	21605	86917	97715	91250	79587	80967	39872	52512	78444
02612	97319	10487	68923	58607	38261	67119	36351	48521	69965
69860	16526	41420	01514	46902	03399	12286	52467	80387	10561
27669	67730	53932	38578	25746	00025	98917	18790	51091	24920
59705	91472	01302	33123	35274	88433	55491	27609	02824	05245
36508	74042	44014	36243	12724	06092	23742	90436	33419	12301
13612	24554	73326	61445	77198	43360	62006	31038	54756	88137
82893	11961	19656	71181	63201	44946	14169	72755	47883	24119
97914	61228	42903	71187	54964	14945	20809	33937	13257	66387
APPENDIX H. CALCULATION OF THE AVERAGE RANGE

To calculate the average range of package errors for groups of 5 packages:

1. Record the package errors in successive groups of five packages in the order of weighing. (See Figure 2-5, page 2-19, and page A-1.)

For example, the following package errors were recorded on the report form (only the first three columns are shown):

pkg.	pkg.	pkg.	pkg.	pkg.	pkg.
number	error	number	error	number	error
(1)	+2	(6)	-2	(11)	+2
(2)	+4	(7)	-4	(12)	-4
(3)	+5	(8)	-5	(13)	+5
(4)	+10	(9)	-10	(14)	+10
(5)	+3	(10)	-3	(15)	-3

2. Calculate the range (R) of package errors for each group of five. R does not have a sign.

The range is obtained as follows:

o If there are only plus errors in a group of five, <u>subtract</u> the smallest plus error from the largest plus error. This is the range (R) for the group.

For example for the first group of five packages:

$$\begin{array}{r} +2 \\ +4 \\ +5 \\ +10 \\ +3 \\ R = +10 - (+2) = 8 \end{array}$$

o If there are only minus errors in the group, <u>subtract</u> the largest number with a minus sign from the smallest number with a minus sign. This is the range (R) for the group.

For example for the second group of five packages:

$$\begin{array}{r} -2 \\ -4 \\ -5 \\ -10 \\ -3 \\ R = -2 - (-10) = 8 \end{array}$$

o If there are both plus and minus errors in the group of five, <u>add</u> the largest error which has a plus sign to the largest error which has a minus sign (but ignore the minus sign). This is the range (R) of the group.

For example for the third group of five packages:

 $\begin{array}{r} +2 \\ -4 \\ +5 \\ +10 \\ -3 \\ R = +10 + 4 = 14 \end{array}$

- 3. Calculate the sum of all R and note the number of groups. For example, let us consider the previous three examples as one set of sample data. For these examples the sum of R = 8 + 8 + 14 = 30 and the number of groups is 3.
- 4. Calculate the average R, called R, as follows:

 $R = \frac{\text{sum of all } R \text{ (step 3)}}{\text{number of groups}}$

In the example above, R = $\frac{30}{3}$ = 10

When calculating the range in net weights or range in tare weights for the alternative tare procedure, the range is the difference between the largest and smallest weights.

For example, the following tare weights are recorded:

0.201 lb 0.200 lb 0.204 lb 0.199 lb 0.201 lb

The range in tare weights is 0.204 lb - 0.199 lb = 0.005 lb.

APPENDIX I. EQUIPMENT TOLERANCES

Table I-1. Tolerances for field standard weights (avoirdupois and metric).^a

CLASS F	TOLERANCES FOR FIELD	
STANDARD	WEIGHTS (Avoirdupois)	

Tolerances for weights 2 lb or larger are 1 part in 10,000; weights between 0.5 lb and 0.02 lb are 1 part in 5,000; weights smaller than 0.02 lb have tolerances determined by the equation in footnote c. For all denominations not shown, but which are intermediate between those listed, the tolerance for the smaller denomination shall apply. CLASS F TOLERANCES FOR FIELD STANDARD WEIGHTS (Metric)

Tolerances for weights 1 kg or larger are 1 part in 10,000; weights between 300 g and 10 g are 1 part in 5,000; weights smaller than 10 g have tolerances determined by the equation in footnote c. For all denominations not shown, but which are intermediate between those listed, the tolerance for the smaller denomination shall apply.

Denomination	Tolerances		Denomination	Tolerances
Pounds (1b)	Pounds (1b)	Grams (g)	Kilograms (kg)	Grams (g)
10,000 5,000 3,000 2,500 2,000 1,000 500 100	1.00 0.50 0.30 0.25 0.20 0.10 0.05 0.010 0.025	454 227 136 113 90.5 45.5 22.5 4.5 2.3	500 300 200 100 50 30 20 10	50.0 30.0 20.0 10.0 5.00 3.00 2.00 1.00
30 20 10	0.003 0.002 0.001	1.4 0.91 0.45	5 3 2	Milligrams (mg) 500 300 200
	Micropounds	Milligrams (mg)	Grams (g)	100
5 3 2 1 0.5 0.3 0.2 0.1 0.05 0.03 0.02 ^c 0.01 0.005 0.003 0.002 0.001 0unces (oz)	500 300 200 154 100 60 40 20 10 6 4 3.20 2.58 2.18 1.92 1.54	227 136 91 70 45 27 18 9.1 4.5 2.7 1.8 1.45 1.17 0.99 0.87 0.70 Milligrams (mg)	500 300 200 100 50 30 20 10 ^c 5 3 2 1 Milligrams (mg) 500 300 200	70 60 40 20 10 6 4 2 1.50 1.28 1.12 0.90 0.72 0.61 0.54
8 4 2 1 (1/2) 0.5 0.3 ^c (1/4) 0.25 0.2 (1/8) 0.125	(µ1b) ^b 100 50 25 12 6.2 3.92 3.70 3.44 2.96	45 23 11 5.4 2.8 1.78 1.68 1.56 1.34	100 50 30 20 10 5 3 2 1	0.43 0.35 0.29 0.26 0.21 0.17 0.14 0.12 0.10

Denomination	Tol	erances	
Ounces (oz)	Micropounds	Milligrams (mg)	
0.1 (1/16) 0.0625 0.05 (1/32) 0.03125 0.03 0.02 0.01	(µ1b) ^b 2.76 2.38 2.20 1.90 1.87 1.65 1.32	1.25 1.08 1.00 0.86 0.85 0.75 0.60	

Table I-1. Tolerances for field standard weights (avoirdupois and metric) (Continued).

^aNBS Handbook 105-1, <u>Specifications and Tolerances for Reference Standards and Field</u> <u>Standard Weights and Measures.</u> 1. <u>Specifications and Tolerances for Field Standard</u> <u>Weights and Measures</u>, in preparation.

^b1 μ 1b = 0.000001 1b

^CThe following equation for tolerances for weights smaller than 10 g is designed to be used only with metric units. Avoirdupois values must be converted.

 $T(w) = 0.9 w^{0.318}$ where T(w) is the tolerance in milligrams and w is the metric equivalent in grams of the nominal weight for which the tolerance is being determined.

APPENDIX I. EQUIPMENT TOLERANCES

Table I-2. Scale units and tolerances for field standard flasks and cylinders (inch-pound and metric fluid measures)^a Scale units for flasks in inch-pound fluid measure

Size		Graduated range o each side of nomi	n nal	Minimum graduation				
Gill 1/2 Pint Pint Quart 1/2 Gallon Gallon		1/2 fl dr 1 fl dr 2 fl dr 4 fl dr 6 fl dr 8 fl dr		1/4 fl dr 1/4 fl dr 1/2 fl dr 1 fl dr 1 fl dr 1 fl dr				
Tolerances for (with	Tolerances for inch-pound field standard flasks and cylinders (with conversions to milliliters)							
Nominal capacity at 68 °F	_	Tolerances at nominal capac	ity	Tolerances at total or partial capacity (i.e. graduated portion)				
<pre>1 Gill 1 920 Minims (118.3 mL) 1/2 Pint 3 840 Minims (236.6 mL) 1 Pint 7 680 Minims (473.2 mL) 1 Quart 15 360 Minims (946.3 mL) 1/2 Gallon 30 720 Minims (1 892.7 mL) 1 Gallon 61 440 Minims (3 785.4 mL) 2 Fluid 960 Minims (59.1 mL) 0 unce Cylinder</pre>		3 Minims (0.18 mL) 4 Minims (0.25 mL) 7 Minims (0.43 mL) 12 Minims (0.74 mL) 16 Minims (0.99 mL) 20 Minims (1.23 mL) 5 Minims (0.31 mL)		1.0 Minims (0.06 mL) 1.5 Minims (0.09 mL) 3.0 Minims (0.18 mL) 5.0 Minims (0.31 mL) 5.0 Minims (0.31 mL) 5.0 Minims (0.31 mL) 5.0 Minims (0.31 mL)				
Sc	Scale units for metric flasks							
Size		Graduated range o each side of nomi	n nal	Minimum graduation				
100 mL 200 mL 250 mL 500 mL 1000 mL 2000 mL		2 mL 4 mL 4 mL 8 mL 15 mL 25 mL		0.5 mL 0.5 mL 0.5 mL 0.5 mL 1.0 mL 1.0 mL				
Tolerances for metric field standard flasks and cylinders								
Capacity	r	Tolerance at nominal capacity	Toler or pa (i.e.	ance at total rtial capacity graduated portion)				
10 mL ^b 100 mL 200 mL 500 mL 1000 mL 2000 mL 50 mL cylinder		0.2 mL 0.3 mL 0.3 mL 0.5 mL 1.0 mL 0.3 mL		0.08 mL 0.10 mL 0.10 mL 0.20 mL 0.30 mL 0.30 mL				

^aNBS Handbook 105-2, <u>Specifications and Tolerances for Reference Standard and Field</u> <u>Standard Weights and Measures. 2.</u> <u>Specifications and Tolerances for Field Standard</u> <u>Measuring Flask</u>, revision in preparation.

^bTolerance of 10 mL graduate is 0.08 mL calibrated "to contain" and 0.10 mL calibrated "to deliver".

APPENDIX J. EXCERPT FROM THE USDA MEAT AND POULTRY INSPECTION MANUAL

NET WEIGHT

Subpart 18-K

(Regs: M-317; P-Subpart N)

Net weights must be accurate. Systematic plant controls must be maintained over container contents to comply with regulations.

18.61 NET WEIGHT

(a) Definition

Net weight includes all nutritious contents suitable for food. It is the gross weight minus the tare weight.

When meat or poultry product is packed in nonnutritious medium--water, brine, agar--the net weight is the drained weight.

(b) Determination

Net weight may be determined by approved quality control system or lot inspection.

(1) Approved quality control.

(i) <u>Inspector</u>. When a plant quality control system, approved by STS-SDS is in effect (Subpart 18-A), the inspector shall:

1. Assure that approved procedure is on file in the Government office. Such procedure includes sampling rates, limits, and actions to be taken when limits are exceeded.

2. Observe plant sampling, weighing, and recording of random intervals at least five times a week.

Subpart 18-K, "Net Weight", pp. 168-174, from combined changes through December 1981, U.S. Department of Agriculture, Food Safety and Inspection Service, Meat and Poultry Inspection Program. 3. Review charts and keep a log of observations in the Government office.

4. Sample one subgroup at least twice a week. Weigh and record as required of the plant. Use alternate scales and check for accuracy. Keep a log of results on file in the Government office.

5. Assure that (1) he is notified when prescribed limits are exceeded, (2) plant personnel take corrective action, and (3) sampling and recording data are accurate.

6. Check a lot by the lot inspection procedure at least once a week, and keep record.

7. Adhere to general requirements in Subpart 18-A.

(ii) Plant. Plant's quality control personnel shall:

1. Maintain records of net weights taken during filling operations. Each individual weight will be recorded as well as the time, filling line, product, code and any other necessary identifying information. Also the target weight, required weight, and limits for individual and subgroup averages must be shown. Displaying weights graphically on control charts has been shown to be effective in clearly reflecting trends and predicting eventual lot acceptability.

2. Check net weights in groups of 5 or 10 containers at a time. Record all weights on the chart even if product is reworked immediately. Check at least one group an hour. This should be increased to maintain a rate of at least one group per 2,000 containers but need not exceed three per hour.

3. Total the weights in each group and determine the average (X) and the range (R).

4. Plot the lowest and the average value as well as the range. On the chart indicate action taken whenever underweights exceed limits in Table 18.14.

5. Take the following action when such limits are exceeded:

Try to ascertain the cause when a. an individual weight falls below the "Lower Limit for Individual Weights (LRL)." If an assignable cause is found, correct the fault immediately. If no cause is found, increased sampling must be instituted and maintained for a reasonable period of time before concluding that the low individual weight was an accident. Notify the Government inspector who may require retention and sorting if this occurs more than once in 40 subgroups on any one production line.

b. If a group average falls below the "Lower Limit for Subgroup Averages $(LRL_{\overline{x}})$ or $(LRL_{\overline{x}})_{5}$," take the same

action as outlined in "a" for low individual weights.

c. If a series of group averages below the label weight equals or exceeds the run criteria listed in Table 18.15 segregate all production back to the last group weighed before the run. Notify the inspector who will retain this portion because of low average net weight.

d. Retain the entire shift's production if the average of all subgroups weighed during the shift is less than the stated label weight. (Exclude from this average all subgroups representing portions of production rejected during the shift for failure to meet the run criteria). Notify the inspector who will retain the production because of low net weights.

e. Notify production personnel whenever the range equals or exceeds the "Range Limits (R) or (R)."

They should search for assignable causes (such as a malfunctioning filling machine) and make necessary adjustments.

6. Contact STS-SDS with requests for permission to use limits more liberal than those in Table 18.14.

(2) Lot Inspection. For all import inspections and when an approved plant

Part	18
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					a morection	
Standard deviation	Standard deviation			.16 oz.	.33 oz.	.50 oz.
X' = Marked or requir net weight	X̄' = Marked or required net weightGroup A			Group 2	Group 3	Group 4
Lower limit for individual weights (LRL)	X' Minus	107. of X'	7.1 gm. .25 oz. 8/32 oz. 4/16 oz. 2/10 oz. 2/8 oz. 1/4 oz.	14.2 gm. .50 oz. 16/32 oz. 8/16 oz. 5/10 oz. 4/8 oz. 2/4 oz.	28.3 gm. 1 oz. 1 oz. 1 oz. 1 oz. 1 oz. 1 oz. 1 oz.	42.5 gm. 1.50 oz. 1 16/32 oz. 1 8/16 oz. 1 5/10 oz. 1 4/8 oz. 1 2/4 oz.
Lower limit for subgroup averages of 10 weights (LRL-) X 10	x' Minus	37. of X'	2.2 gm. 0.08 oz. 2/32 oz. 1/16 oz. (<u>2</u> /) (<u>2</u> /) (<u>2</u> /)	4.5 gm. .16 oz. 5/32 oz. 2/16 oz. 1/10 oz. 1/8 oz. (<u>2</u> /)	9.1 gm. .32 oz. 10/32 oz. 5/16 oz. 3/10 oz. 2/8 oz. 1/4 oz.	13.6 gm. .48 oz. 15/32 oz. 7/16 oz. 4/10 oz. 3/8 oz. 1/4 oz.
Lower limit for subgroup averages of 5 weights (LRL-) X 5	X' Minus	4% of X'	3.5 gm. .12 oz. 4/32 oz. 2/16 oz. 1/10 oz. 1/8 oz. (<u>2</u> /)	7.0 gm. .25 oz. 8/32 oz. 4/16 oz. 2/10 oz. 2/8 oz. 1/4 oz.	14.1 gm. .50 oz. 16/32 oz. 8/16 oz. 5/10 oz. 4/8 oz. 2/4 oz.	21.2 gm. .75 oz. 24/32 oz. 12/16 oz. 7/10 oz. 6/8 oz. 3/4 oz.
Limit for ranges of subgroups of 10 weights (R) ₁₀		15% of %'	10.8 gm. .38 oz. 12/32 oz. 6/16 oz. 3/10 oz. 3/8 oz. 1/4 oz.	21.5 gm. .76 oz. 24/32 oz. 12/16 oz. 7/10 oz. 6/8 oz. 3/4 oz.	43.4 gm. 1.53 oz. 1 17/32 oz. 1 8/16 oz. 1 5/10 oz. 1 4/8 oz. 1 2/4 oz.	64.9 gm. 2.29 oz. 2 9/32 oz. 2 4/16 oz. 2 2/10 oz. 2 2/8 oz. 2 1/4 oz.
Limit for ranges of subgroups of 5 weights (R)5		127, of X'	9.1 gm. .32 oz. 10/32 oz. 5/16 oz. 3/10 oz. 2/8 oz. 1/4 oz.	18.4 gm. .65 oz. 20/32 oz. 10/16 oz. 6/10 oz. 5/8 oz. 2/4 oz.	36.8 gm. 1.30 oz. 1 9/32 oz. 1 4/16 oz. 1 3/10 oz. 1 2/8 oz. 1 1/4 oz.	55.0 gm. 1.94 oz. 1 30/32 oz. 1 15/16 oz. 1 9/10 oz. 1 7/8 oz. 1 3/4 oz.

Table 18.14 - Minimum and maximum limits $\frac{1}{2}$ for QC inspection

2

1/ Use limits recorded in terms of scale calibrations used. Ex: If scale is in 1/16ths, use limits in 1/16ths; if in grams use gram limits. Do not convert.

2/ Minimum limit is the marked or required net weight when sensitivity of scales used does not permit calibrations as precise as those recorded above.

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Table 18.15 - Run criteria $\frac{1}{2}$

Number of consecutive subgroup averages plotted on control chart	7	11	14	17	20	23
This number of subgroup averages below stated label weight is excessive	7	10	12	14	16	18

Consecutive subgroup averages

<u>1</u>/ Action should be taken when four consecutive low subgroup averages occur. Frequent runs over four low averages indicate an ineffective control program; it would be cause for approval withdrawal and return to lot inspection.

quality control system does not exist, the inspector shall determine net weight compliance by the following procedure.

1. Check a total of 10 lots each week. This should be increased if frequency of underweight lots warrants, or should be decreased if volume of production is low. Emphasis should be placed on those items which are frequently borderline or low in weight.

Groups. For purpose of assigning individual and average weight limits, all products are placed into one of five groups as shown in Table 18.16. Homogeneous products are those which

	Definitions	
Group	Homogenous fluid when filled (Ounces)	All other products (Ounces)
A	Less than 3	Less than 3
1	3 to 16	
2	Over 16	3 to 7
3		Over 7 to 48
4		Over 48 to 160
5		Over 160

Table 18.16 - Groups

are of uniform consistency throughout. Baby food is homogeneous; beef stew is not. "Fluid" at time of filling refers to liquids and solid products (like shortening) which are heated and filled as a liquid.

Scales. Any accurate scale may be used, although tolerances are generally more liberal when scales with greater sensitivity are used. Scales should be set on a solid foundation and periodically checked with weights of known accuracy. In reading a scale, should the pointer fall between two subdivisions, the weight should always be read as the lower calibration. Never round off to the higher calibration.

2. Determine the average tare weight. The total weight of all containers weighed divided by the number weighed is the average tare weight.

a. Sources of Containers.

The individual empty containers which were or will be weighed to obtain individual gross weights.

Any other samples of empty containers from the lot before or after filling.

Different lots of containers of the same type, style, size and manufacture (provided past experience shows less than one-eight ounce variation in average tare weights between lots).

b. Determination of Tare Weight. If prior to filling empty containers and lids from the same source are

Range of first 3 container tare weights (ounces)	Total number of container <u>1</u> / tare weights required (include first 3)
0 to 1/8	3
3/16	6
1/4	9
5/16	12
3/8 or more	15

Table 18.17 - Tare weights

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1/ If unfilled containers are not available and total number needed for tare weights exceeds the number opened for product examination, use only number opened. In this case, maintain a history of succeeding lots of same cans until a proper average tare is obtained (at least 15 samples).

available, weigh a minimum of 15 containers. Use the average weight of the 15 as the tare weight.

When unfilled containers are not available, empty, wash, dry and weigh three containers from the lot. Use the same scale as that used for net weight determination or one of greater sensitivity.

Determine the range of container weights. The total number of empty containers weighed to establish the average tare weight for a lot will be based on the difference between the highest and lowest of these first three weights as indicated in Table 18.17.

3. Select samples from the completed lot or if the size of the lot to be packed can be predicted, samples may be randomly selected during the packing operation. Under no circumstances are weights to be determined until after the lot is completed. Check weights are strictly plant's function during production.

4. Determine the individual net weights on an initial sample of 10 clean, dried, filled containers randomly selected from the lot. Record them on Form MP 486. File this form in the inspector's office for one year.

5. Calculate the average net weight by adding the 10 individual weights and dividing by 10. This average should always be expressed in the same denomination as the scale calibration. If the scale is calibrated in 16ths of an ounce, the average weight should be expressed in ounces rounded off to the nearest 16th. (for example, if we had 10 weights which averaged 8 .67 16

oz., we would round it off to 1/16 and express the average for the lot as 8 1/16 oz.).

6. For Groups A and 1 through 4, determine:

a. The two lowest individual net weights, and

b. The plus or minus difference between the declared label weight and the sample average.

7. Select the proper group for underweight limits from Table 18.16.

8. Use the limits prescribed in Table 18.18 for the proper group. Select those that are listed in the same calibration as the scale being used.

9. Accept the lot without further sampling if

a. Neither of the 2 lowest individual weights is less than the appropriate "Lower Limit for Individual Weights (L)," in Table 18.18.

X = Marked or requir net weight	ed	Group A	Group 1	Group 2	Group 3	Group 4
Lower limit for individual weights (L)	χ' Minus	107. of X'	7.1 gm. 0.25 oz. 8/32 oz. 4/16 oz. 2/10 oz. 2/8 oz. 1/4 oz.	14.2 gm. .50 oz. 16/32 oz. 8/16 oz. 5/10 oz. 4/8 oz. 2/4 oz.	28.3 gm. 1 oz. 1 oz. 1 oz. 1 oz. 1 oz. 1 oz. 1 oz.	42.5 gm. 1.50 oz. 1 16/32 oz. 1 8/16 oz. 1 5/10 oz. 1 4/8 oz. 1 2/4 oz.
Lower limit for averages of first 10 weights (A ₁)	X' Minus	37. of X.	2.2 gm. .08 oz. 2/32 oz. 1/16 oz. (<u>2</u> /) (<u>2</u> /) (<u>2</u> /)	4.5 gm. .16 oz. 5/32 oz. 2/16 oz. 1/10 oz. 1/8 oz. (<u>2</u> /)	9.1 gm. .32 oz. 10/32 oz. 5/16 oz. 3/10 oz. 2/8 oz. 1/4 oz.	13.6 gm. .48 oz. 15/32 oz. 7/16 oz. 4/10 oz. 3/8 oz. 1/4 oz.
High value for averages of first 10 weights (A ₂)	X' Plus	37 of 7	2.2 gm. .08 oz. 3/32 oz. 2/16 oz. 1/10 oz. 1/8 oz. 1/4 oz.	4.5 gm. .16 oz. 6/32 oz. 3/16 oz. 2/10 oz. 2/8 oz. 1/4 oz.	9.1 gm. 0.32 oz. 11/32 oz. 6/16 oz. 4/10 oz. 3/8 oz. 2/4 oz.	13.6 gm. .48 oz. 16/32 oz. 8/16 oz. 5/10 oz. 4/8 oz. 2/4 oz.
Limit for low averages of 40 for permitting additional weights (when requested)	X' Minus	1Z of X'	1.1 gm. 0.04 oz. 1/32 oz. (2/) (2/) (2/) (2/)	2.3 gm. 0.08 oz. 2/32 oz. 1/16 oz. (<u>2</u> /) (<u>2</u> /) (<u>2</u> /)	4.5 gm. 0.16 oz. 5/32 oz. 2/16 oz. 1/10 oz. 1/8 oz. (<u>2</u> /)	7.0 gm. .25 oz. 8/32 oz. 4/16 oz. 2/10 oz. 2/8 oz. 1/4 oz.

Table 18.18 - Minimum and maximum limits $\frac{1}{2}$ for lot inspection

 $\frac{1}{16}$ Use limits recorded in terms of scale calibrations used. Ex.: If scale is in 1/16ths, use limits in 1/16ths; if in grams, use gram limits. Do not convert.

2/ Minimum limit is the marked or required net weight when sensitivity of scales used does not permit calibrations as precise as those recorded above.

b. The sample average equals or exceeds the appropriate "High Value for Averages (A₂)," Table 18.18.
10. Retain the lot without further sampling if

a. The 2 lowest weights are both less than the appropriate "Lower Limit for Individual Weights (L)," or

b. The sample average is less than the appropriate "Lower Limit for Averages (A₁)," Table 18.18. 11. Weigh an additional 30 filled containers randomly selected from the lot if:

a. One of the 2 lowest of the first 10 weights is less than the appropriate "Lower limit for the Individual Weights (L)," or

b. The sample average of the first 10 weights is less than "High Value for Averages (A_2) ," but not less than the "Lower Limit for Averages (A_1) ."

Group A	Group 1	Group 2	Group 3	Group 4
(Ounces)	(Ounces)	(Ounces)	(Ounces)	(Ounces)
Less than .15	.15-25	Over .2550	Over .50-1.0	Over 1.0-1.5

Table 18.19 - Basic average ranges for groups A and 1 thru 4

12. If an extra 30 weights are needed, calculate the average net weight by dividing the total of all 40 weights by 40. Then note:

a. The two lowest of the 40 individual net weights, and

b. The plus or minus difference between the sample average and the label weight.

c. Accept lot if (1) not more than l of 2 lowest of the 40 weights is less than the appropriate "Lower Limit for Individual Weights (L)," and (2) the average of the 40 weights equals or exceeds the label weight.

d. Retain the lot if (1) both of two lowest of the 40 weights is less than the appropriate "Lower Limit for Individual Weights (L)," or (2) the average of the 40 weights is less than the label weight. If the average underweight does not exceed the appropriate Limit for Averages of 40 in Table 18.18, an additional 40 weights may be taken, if requested, to verify the results. All 80 weights should then be averaged and the criteria for a sample of 40 applied. Accept the lot only if average equals full label weight and not more than one sample is lower than (L).

e. If continued sampling of a particular product in an establishment results in frequent samplings of additional 30 containers, check to see if the ranges of the first 10 weights have been generally within the "Basic Average Range" for a lower group in Table 18.19. If so, limits for this lower group may then be used. 13. For all products in Group 5 (either catch weighed or in preprinted packages), weigh 10 sample units and accept the lot, if

a. Acceptable variations between actual weights and labeled weights. (1) For scales calibrated in 1/4 pound graduations or more no label net weight exceeds the actual weight by more than one scale graduation. E.g. scale marked in 1/4 pounds. Acceptable marked weight 15 1/4 pounds, actual weight 15 pounds. Unacceptable marked weight 15 1/4 pounds, actual weight 14 3/4 pounds, or (2) for scales calibrated in less than 1/4 pound graduations no label net weight exceeds the actual weight by more than two ounces. E.g. scale marked in 1/2ounce. Acceptable - marked weight 15 pounds 3 ounces, actual weight 15 pounds 1 ounce. Unacceptable - marked weight 15 pounds 3 ounces, actual weight 15 pounds 3/4 ounce, and

b. The inspector must read and record net weights as outlined in paragraph (b) (2) under scales. The total net weight of the 10 sample units equals or exceeds the total marked weight of the 10 sample units.

c. Product not meeting the above criteria is rejected. If domestic, it may be reweighed and remarked.

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