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NBS HANDBOOK 133 THIRD EDITION

U.S. DEPARTMENT OF COMMERCE / National Bureau of Standards

CHECKING THE NET CONTENTS OF PACKAGED GOODS

*as adopted by the
National Conference on
Weights and Measures*



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³ Located at Boulder, CO, with some elements at Gaithersburg, MD.

NBS HANDBOOK 133 – THIRD EDITION

CHECKING THE NET CONTENTS OF PACKAGED GOODS

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NOTE: As of 23 August 1988, the National Bureau of Standards (NBS) became the National Institute of Standards and Technology (NIST) when President Reagan signed into law the Omnibus Trade and Competitiveness Act.

U.S. DEPARTMENT OF COMMERCE, C. William Verity, Secretary

NATIONAL BUREAU OF STANDARDS, Ernest Ambler, Director

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FOREWORD

This handbook compiles the latest package checking procedures adopted by the National Conference on Weights and Measures (NCWM). At the 1985 annual meeting, the NCWM voted to adopt Handbook 133.

This edition includes amendments adopted at the annual meetings in 1986 through 1988. The Conference recommends adoption and promulgation by the States of these procedures as updated in this handbook.

The National Bureau of Standards has a statutory responsibility for "cooperation with the States in securing uniformity of weights and measures laws and methods of inspection." In partial fulfillment of this responsibility, the Bureau is pleased to publish these recommendations of the National Conference.

ERNEST AMBLER
Director
National Bureau of Standards

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 government officials, 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.
 - o The sampling plans in Handbook 67 have been modified and appear as "Category B" sampling plans in Handbook 133.
 - o 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, (or merely measured in advance of sale) 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 toward advising 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 THIRD EDITION

The National Conference on Weights and Measures adopted NBS Handbook 133 in 1985 and assigned its review and revision to the Committee on Laws and Regulations. The Package Checking Field Manual to Accompany NBS Handbook 133 (NBSIR 85-3172) was also published in 1985. Significant work by the Task Force on Commodity Requirements was adopted by the NCWM in 1987 and 1988.

The following tables list the revisions made to the second edition of the handbook.

Section	Action	Page
1.9.	Revised 1987, 1988	1-10
2.11.	Revised 1988	2-19
2.13.	Revised 1988	2-26
2.14.	Revised 1987, 1988	2-27
3.14.	Amended 1988	3-36
3.16.	Added 1986	3-37
3.17.	Added 1987	3-40
3.18.	Added 1988	3-49
4.12.	Revised 1988	4-32
4.15.	Added 1987	4-37
5.4.3.	Revised 1987	5-10
Appendix A	Worksheets Added	A-13 to A-15
Appendix B	Table 3-3 Added	B-17

Editorial Changes

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1.2.2.	Revised to explain all sampling plans	1-2
1.3.1.(c)	Reference to moisture loss added	1-4
1.6.	Emphasis on checkweighers added	1-7
1.9.	Footnote 2 added, description of gray area added	1-10
2.2.1.	References to both standard pack report forms added	2-2
2.3.2.	Reference to Section 3.18. added	2-6
2.5.	Section 2.9. renumbered 2.5.	2-7

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Section	Action	Page
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2.5.2.	Revised to incorporate changes in H-44	2-9
2.7.	Figures 2-6, 2-7 added	2-13,2-14
2.11.4.	Figure 2-9 added	2-24
2.12.	Further information about Table 2-8 added	2-26
3.5.	Step 2 Footnote added, Figure 3-5 added, Figure 3-7 deleted	3-6, 3-8
3.8.1.	More information given on selectiong MAV's	3-18
4.1.	Reference temperature for wine added Clarification on reference temperature added	4-1
4.5.	Step 10. Determination of package errors simplified	4-9
5.4.3.	Typographical errors corrected	5-10
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	Worksheet corrected	A-5, A-6
	Worksheet corrected	A-9, A-10
Appendix B	Table 2-9 MAV for "55.0 to 69.00 fl oz" corrected	B-12
	Table 3-1 revised to accommodate new Scales code in H-44	B-16
	Table 4-2 revised to accommodate new Scales code in H-44	B-19
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	"gray area"	C-3
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	"used tare"	C-8

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Section	Action	Page
Appendix C	Definitions revised: "dry tare" "reasonable variation" "wet tare"	C-2 C-6 C-8
Appendix F	Deleted (inspectors reported that it was not being used)	
Appendix G	Became Appendix F	F-1
Appendix H	Became Appendix G	G-1
Appendix H	Added	H-1
Appendix K	Deleted	

HOW TO USE THIS HANDBOOK

This handbook contains information on equipment, test methods, calculations, and test reporting. It is divided into five chapters, the first of which 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 subsequent parts 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 provides the tables referred to in Chapters 2 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 used throughout the handbook. Appendix D compiles 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 describes 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 is a random number table, and should also be tabbed for easy reference. Appendix G explains how to determine a range and an average range. Appendix H provides examples of completed report forms and worksheets. Appendix I lists equipment tolerances for field test weights and flasks.

An index at the end of the handbook will be valuable for directing the official to the appropriate test method for specific commodities.

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- 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 non-food consumer 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. The agencies responsible for these regulations are listed in Table 1-1, Appendix B.

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 and Individual Package Requirements

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. The quantity of contents of packaged goods must meet two requirements.

- 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's" (see Section 2.12. and pages B-9 through B-15).

In common parlance, it is often said that the package net contents must meet "the average requirement" (even though there are two requirements).

1.2.2. Two Exceptions

- a. **Packages Labeled by Count When the Count Is 50 or Fewer.** -- The average requirement is based on an underlying assumption about the way that the package quantities are distributed (called the "normal distribution"²). When very low numbers of discreet items are packaged and labeled by count, the count of items in the packages does not follow this "normal distribution" and, therefore, the average requirement cannot be applied. See Section 5.1. for the necessary special sampling and testing procedures.
- b. **Allowable Difference.** -- 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 Commodities³ 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 an al-

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 handbook does not discuss nor explain the statistical bases for the sampling plans presented herein. For further information, see any textbook including explanations on "acceptance sampling".

³This 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, and revised and printed each year by the U.S. Government Printing Office.

allowable difference, the average and individual package requirements described above do not apply. This handbook provides procedures for testing glassware in Section 5.7.

1.3. The Package Testing Program

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

1.3.1. Where to Test

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

a. 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.

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.

Package testing at production point cannot entirely replace that at wholesale or retail outlets, especially for packages that are permeable or subject to tampering. 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.

b. 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.

c. 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, of failure of some part of the packaging process, or simply the result of moisture loss, if the product is packaged in permeable media and subject to moisture loss. Therefore, locating fault in order to correct defects will be more difficult when retail testing is employed.

d. 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. 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:

1. 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.]
2. Choose a random sample from the inspection lot. [Instructions for taking a random sample are given in Appendix E.]

3. Determine the net contents of each package in the sample (described in Chapters 3, 4, and 5).
4. Perform calculations based on individual package net contents determinations (described in Sections 2.7. and 2.8. and as part of the package checking routine in Chapters 3, 4, and 5).
5. 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 2.7. and 2.8. 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:

1. The average of a lot, shipment, or delivery must equal or exceed the labeled net contents;
2. 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

1.6.1. Checkweighers

If a packager uses checkweighers, not only must 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 MAV.

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 erroneously 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 lots² a 50% probability of acceptance. Category A sampling plans give acceptable inspection lots a "high" probability of acceptance.

¹See exceptions in Section 5.1. (low count) and Section 5.7. (glassware).

²An "acceptable inspection lot" is one in which the average net contents exactly equals the labeled net contents.

Figure 1-1¹ illustrates some of the differences between Category A and Category B sampling plans.

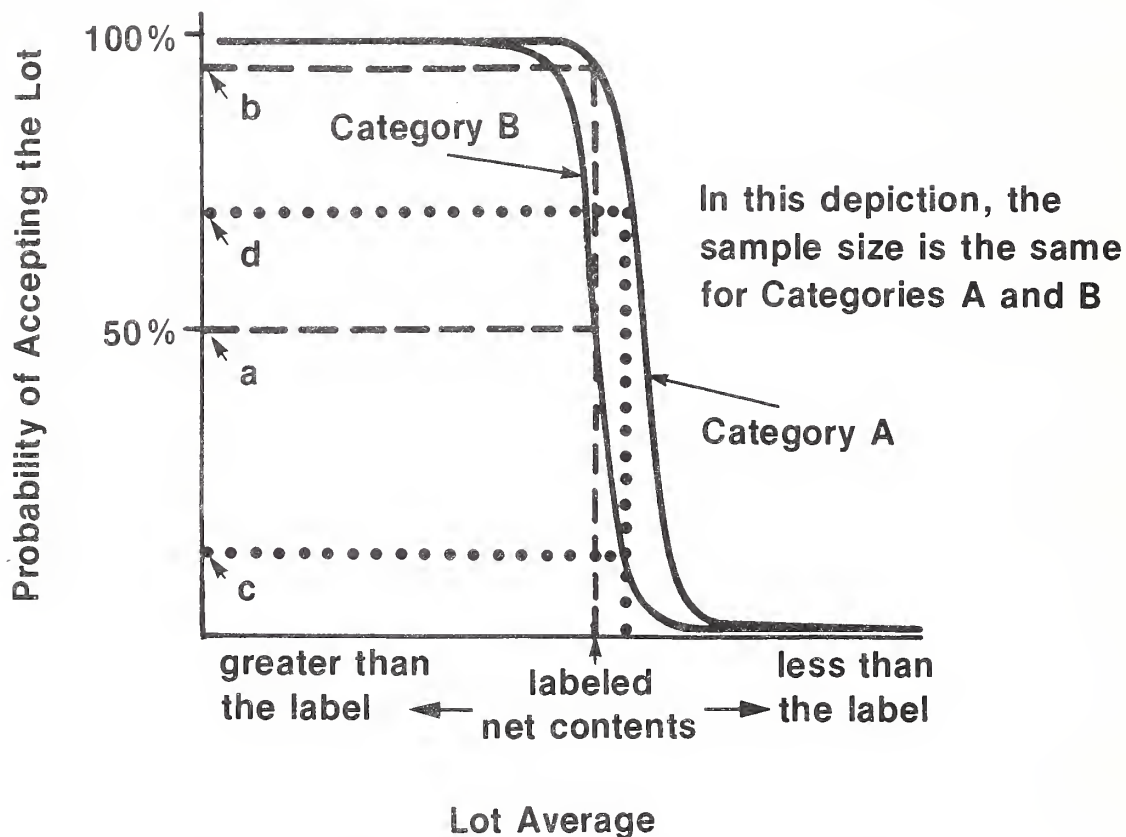


Figure 1-1. Differences between Category A and Category B.

1.8.1. 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").
- o 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.

1.8.2. 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.]

1.8.3. 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. Allowances for Variations Due to Moisture Loss or 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 moisture^{1,2} 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 for all products; however, it does provide two procedures (for flour, see Section 3.17., and for meat and poultry, see Section 3.18.) for determining compliance with those regulations that allow for quantity variations due to moisture loss or gain. These two procedures are based on the concept of a "gray area," also called a "no-decision" area, in which more information must be collected before lot compliance or noncompliance can be decided. When the average net weight of a sample is found less than the labeled weight but more than the boundary of the "gray area", the lot is said to be in the "gray" or "no-decision area." The "gray area" approach applies only to packages tested at retail or wholesale, not to those checked at the packaging plant. The gray area is not a tolerance.

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:

- a. which sampling plan category is to be used under what circumstances in the jurisdiction, and
- b. 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.

²All Federal and State requirements, except those of the U.S. Environmental Protection Agency (regulating pesticides), permit variations due to moisture loss.

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. Recording package errors
- 2.6. Selecting the sampling plan
- 2.7. Sampling plans in Category A
- 2.8. Sampling plans in Category B
- 2.9. Individual packages
- 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:

- a. identify the INSPECTION LOT to be tested,
- b. fill out a REPORT FORM, including information from the product label and the MAV (selected according to the labeled net contents),
- c. count the number of packages in the lot and record the LOT SIZE,
- d. refer to the designated SAMPLING PLAN and record SAMPLE SIZE, TARE SAMPLE SIZE, and ALLOWED NUMBER OF UNREASONABLE ERRORS,
- e. select a RANDOM SAMPLE and the RANDOM TARE SAMPLE,
- f. if label is not in terms of net weight, determine if WEIGHING METHOD may be employed (using one of the WORKSHEETS),
- g. determine UNIT OF MEASURE and the MAV in DIMENSIONLESS UNITS (the use of dimensionless units is optional),
- h. determine AVERAGE TARE (and CORRECTED TARE in some instances), and record on WORKSHEETS and REPORT FORM,
- i. determine PACKAGE ERRORS (using a NOMINAL GROSS WEIGHT where possible), and record values on REPORT FORM, and
- j. 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

The results of package testing must be documented on a report form. Examples of forms for standard pack packages are shown on pages A-1 and A-2. In the following sections and in subsequent chapters, the official will be referred to items corresponding to the numbered boxes indicated on these report forms. Chapters 3 and 4 introduce other report forms, derived from these examples.

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

We suggest that those reading the handbook for the first time keep handy a copy of the report forms on pages A-1 and A-2, and refer to them while reading the text. The box numbers 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 boxes on the report forms on pages A-1 and A-2 permit 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".] The report form on page A-1 is designed for standard pack packages labeled not by weight but (for example) by liquid volume, count, area, etc. It is designed to be used with an appropriate worksheet. The report form on page A-2 is designed for standard pack packages labeled by weight.

DATE		STANDARD PACK REPORT FORM				REPORT NUMBER
Location of TEST (Name, Address)		<input type="checkbox"/> Retailer <input type="checkbox"/> Wholesaler <input type="checkbox"/> Packager	PRODUCT IDENTITY	BRAND	LOT CODE(S)	CONTAINER DESCRIPTION
			1 LABELED CONTENTS	2 UNIT OF MEASURE <input type="checkbox"/> lb <input type="checkbox"/> oz	3 MAV (same units as label)	4 MAV (dimensionless units)
5	LOT SIZE (N)					
6	SAMPLE SIZE (n) <input type="checkbox"/> A (p B-3) <input type="checkbox"/> B (p B-5)					
7	TARE SAMPLE SIZE <input type="checkbox"/> Alternative (p B-6)					
8	Allowed Number UNREASONABLE ERRORS					

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

Figure 2-1 shows the report form heading from page A-1; the heading on page A-2 has only minor differences. Starting across the top of the form, "lot code" and

"container description" 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) may be guided by the labeled net contents and/or the measuring equipment being used, for example, the size of the scale division on the inspector's scale. [See Sections 2.5.1. 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.]

On the left side of the form, sampling plan information is recorded. 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).

2.2.2. Filling Out the Tare Information on the Report Form or Worksheets

The determination of tare is covered generally in Section 2.11. In general, no matter how the package is labeled (liquid volume, count, etc.), the inspector should try to convert to units of weight when testing the packages (see Section 2.10.). This conversion process is detailed in Chapters 4 and 5, and noted on the worksheets that accompany the form on page A-1.

When packages are labeled by weight, no worksheets are needed and, therefore, the tare can be recorded directly on the report form. This is the next section of the report form on page A-2 (shown in Figure 2-2). It 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.

a	GROSS WEIGHT						
b	TARE WEIGHT						
c	NET WEIGHT						
d	PACKAGE ERROR						
	a - 14						
e	PACKAGE ERROR (dimensionless units)						
	d - 2						
9	R _C (see c)	10	R _T (see b)	11	R _C ÷ R _T =	12	n _T (Table 2-7, p. B-7&8)
Range of Net Weights		Range of TARE Weights		9 ÷ 10 =			
				13	AVERAGE TARE	13a	TARE CORRECTION
				<input type="checkbox"/> dry <input type="checkbox"/> wet <input type="checkbox"/> alternative		<input type="checkbox"/> Moisture <input type="checkbox"/> Foam (p. B-17) <input type="checkbox"/> Vacuum Pack	
						14	
						NOMINAL GROSS WEIGHT	
						1 + 13 + 13a =	

See Section 2.11.4, page 2-23

Figure 2-2. Places to record tare sample information and the nominal gross weight on the Standard Pack Report Form - Weight Only.

An additional worksheet may be appended if more than five packages are opened to determine tare. This section of the report form is used only when the packages are labeled by weight. Special worksheets are provided to record this information for packages labeled in other units (volume, count, etc.) (compare with page A-1).

Returning to Figure 2-2, 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.

2.2.3. Recording Package Errors and Determining Whether the Lot Conforms to the Requirements

Figure 2-2 shows spaces beside the boxes labeled "d" and "e" for recording the package errors for those packages opened for tare. (The spaces beside the box labeled "c" are used only for the alternative tare procedure and are described in Section 2.11.4. and more fully in Section 3.11.)

Section 2.5.3. describes how to record package errors in the crosshatched area of the report form. See Figure 2-3.

PACKAGE ERRORS										TOTALS	
										(-)	(0/+)
CROSSHATCHED AREA											
RANGES										15 TOTAL ERROR	
16 NO UNREASONABLE MINUS ERRORS		17 IS 16 Greater than 8? <input type="checkbox"/> YES LOT FAILS <input type="checkbox"/> NO—CONTINUE		18 AVERAGE ERROR (Dimensionless Units) 15 ÷ 6 =		19 AVERAGE ERROR (labeled units)		20 IS 18 ZERO OR PLUS? <input type="checkbox"/> NO → Cat. B, Lot Fails <input type="checkbox"/> Cat. A, go to 21 <input type="checkbox"/> YES → LOT PASSES			
21 AVERAGE RANGE		22 Use 6 to look up value in Table 2-3 Col. 2 (p. B-3)		23 d = 21 × 22 =		24 (n/N) × 100 = (6 ÷ 5) × 100 =		25 Use 24 to look up f in Table 2-4 (p. B-4) f =		26 T = 23 × 25 =	
27 Disregarding the signs, is 18 larger than 26? <input type="checkbox"/> Yes → lot fails <input type="checkbox"/> No → lot passes											
28 DISPOSITION OF LOT <input type="checkbox"/> Approved <input type="checkbox"/> Rejected		Comments: <div style="text-align: right; margin-top: 10px;">Category A only</div>									
Acknowledged Receipt of Report											
Official											

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

Appendix G 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 2.7.1. (for Category A plans) and 2.8.1. (for Category B). The "average error" (boxes 18 and 19) is explained in Sections 2.7.2. (Category A) and 2.8.2. (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 2.7.2.

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.

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, 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 absolutely necessary to sort by lot code when testing packages in a retail location; a shipment or delivery may in fact be composed of packages with different lot codes.

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, the 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 packager "targets" the amount of product put into the package according to the net contents already selected to be on the package container's label.

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

- a. **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.
- b. **When the location of test is a warehouse:** The inspection lot must consist of packages with the same manufacturer's lot code.
- c. **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 with the net quantity.

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

- a. **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.]

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.

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. See also Section 3.18. for meat or poultry products from Federally-inspected plants. These packages must be sorted by lot code.

- b. **Special inspection lots.** -- 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.
- c. **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 forms (page A-1 or page A-2) 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.

$$\text{Package Error} = (\text{Measured Net Contents}) - (\text{Labeled Net Contents})$$

A positive (plus) package error means that there is more product in the package than the label declares. A minus package error means that there is less product than the label declares.

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

2.5. Recording Package Errors

Section 2.6. describes how to use the sampling plans to select a sample and determine the compliance of the lot. Methods of measuring the net contents of the sample packages are described in Chapters 3, 4, and 5. This section describes the method for recording measurement results on the report form.

2.5.1. 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 2-4). 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".

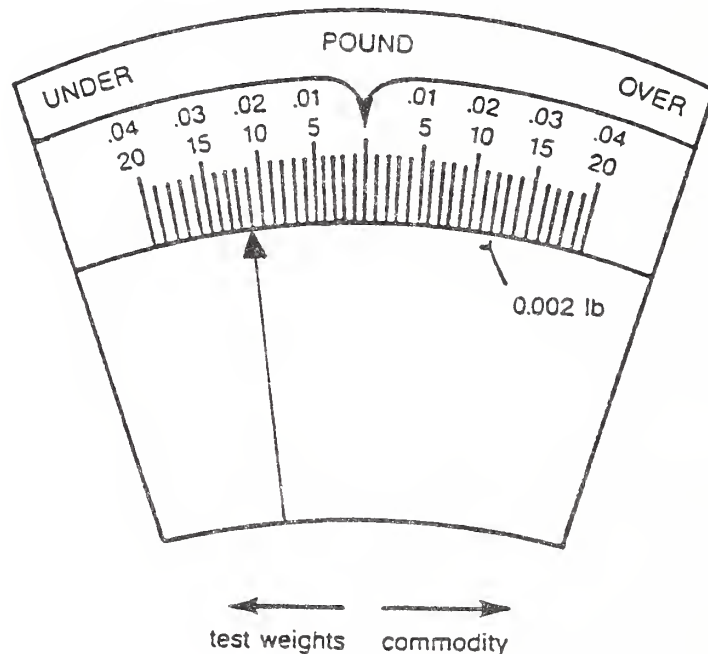


Figure 2.4. Reading a mechanical package-testing scale.

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. A -0.04 lb reading on an electronic scale becomes a "-4" on the report form, using a 0.01 lb unit of measure.

The report forms on pages A-1 through A-4 and the worksheets 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-2 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).

2.5.2. 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 one-third 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 1:3 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. In these instances, worksheets have been designed to accompany the report form on page A-1. For example, packages labeled "48 fl oz" have a MAV of 1.25 fl oz. (This value is recorded on a worksheet.) 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:

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

¹Appendix A, 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.

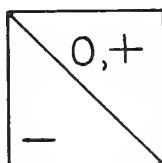
(This value is recorded on the report form on page A-1.)

The MAV/6 value is 0.013 lb or about 3/16 oz. In this instance, 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.

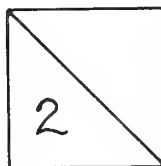
Equipment used to measure package quantities should be capable of discriminating measurements to 1/6 of the MAV for an individual package. This handbook suggests equipment that meets this criterion.

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

On the standard pack report forms on pages A-1 and A-2, package errors are entered in the "crosshatched" area.¹ 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 2.7. and Appendix G.] Each package error is entered in a two-triangle block according to the following scheme:

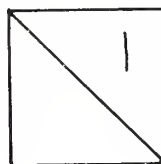


If the package error is minus, it is entered in the lower left triangle of the block:



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.

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).

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 (algebraic sum) 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.

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 G 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.]

PACKAGE ERRORS										TOTALS	
										(-)	(0/+)
2 ⁺	1		2	3	3					5	8
0 ⁻	0	2	1	3	1					3	2
	1	0	1	4	0					7	2
	1	2	1	3	1					7	2
	2	1	2	4	1					5	6
	3	0	1	4	1						
RANGES	5	1	3	1	4					15 TOTAL ERROR	-7

18 AVERAGE ERROR
(Dimensionless Units)
 $15 \div 6 = -2.5$

21 AVERAGE RANGE
 $\frac{15}{6} = 2.5$

Figure 2.5. Example of package errors, ranges, and total error recorded on part of the report form.

2.6. 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).

2.7. Sampling Plans in Category A

Table 2-2 on page B-3 lists six sampling plans according to the inspection lot size (called "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" (called "n"). Appendix E describes several methods for obtaining a random sample. [Note the special precautions for sample selection on page E-8.] 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 forms (pages A-1 and A-2), the official selects a sampling plan from Table 2-2 according to the lot size and records the corresponding sample size in box 6 on the report form (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.

As mentioned in Section 2.6., Table 2-2 lists the minimum 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). See Figure 2-6.

¹Sample sizes of 50 and over are the same as those in Military Standard 105-D, but the sampling plans are not the same as Military Standard 105-D because the decision criteria are different. In addition to the decision criterion for individual packages (Section 2.7.1), the lot must also pass the decision criterion for the average (Section 2.7.2).

5	LOT SIZE (N)				
	750	This report form is designed for standard packages <i>not</i> labeled by weight: for example, liquid volume, count, area, etc.			
6	SAMPLE SIZE (n)				
	50 <input checked="" type="checkbox"/> A (p. B-3) <input type="checkbox"/> B (p. B-5)	Fill out report form heading, boxes 1 & 2, and boxes 5 through 8.			
7	TARE SAMPLE SIZE				
	5 <input type="checkbox"/> Alternative (p. B-6)	Go to appropriate worksheets, follow directions on the worksheet, recording data on the report form as directed by the worksheet.			
8	Allowed Number UNREASONABLE ERRORS				
	2				
9	R _C (See Worksheet)	10	R _T (See Worksheet)	11	R _i - R _T
Range of Net Weights		Range of Tare Weights		9	10 =
				12	n _i (Table 2-7 (p. B-7&8))
				13	AVERAGE TARE
					See Worksheet
				14	NOMINAL GROSS WEIGHT
					See Worksheet

Figure 2-6. An example of a larger sample size selected on the report form.

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.

2.7.1. 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 forms on pages A-1 or A-2, the allowed number of unreasonable errors from column 4 of Table 2-2 is recorded in box 8 and the individual package errors in the crosshatched area of the report form. Each minus package error that exceeds the MAV should be circled on the report form and the total 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. Therefore, a "1" is 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. See Figure 2-7.

DATE		STANDARD PACK REPORT FORM WEIGHT ONLY				REPORT NUMBER	
Location of TEST (Name, Address)		<input type="checkbox"/> Retailer <input type="checkbox"/> Wholesaler <input type="checkbox"/> Packager		PRODUCT IDENTITY	BRAND	LOT CODE(S)	CONTAINER DESCRIPTION
				1. LABELED WEIGHT 12 oz	2. UNIT OF MEASURE .001 <small>(lb) <input checked="" type="checkbox"/> (oz) <input type="checkbox"/></small>	3. MAV Table 2-B (p. B-10) .036 lb	4. MAV (dimensionless units) [3] - [2] = 36
5. LOT SIZE (N) 500	a. GROSS WEIGHT						
6. SAMPLE SIZE (n) 30 <small><input type="checkbox"/> A (p. B-3) <input type="checkbox"/> B (p. B-5)</small>	b. TARE WEIGHT						
7. TARE SAMPLE SIZE 2 <small><input type="checkbox"/> Alternative (p. B-6)</small>	c. NET WEIGHT						
8. Allowed Number UNREASONABLE ERRORS 1	d. PACKAGE ERROR [a] - [14]						
9. R _C (see [c]) Range of Net Weights	e. PACKAGE ERROR (dimensionless units) [d] - [2]						
10. R _T (see [b]) Range of TARE Weights	11. R _C + R _T = [9] + [10] =	12. n ₁ (Table 2-7) p (p. B-7&8)	13. AVERAGE TARE <input type="checkbox"/> unused <input type="checkbox"/> used <input type="checkbox"/> alternative	13a. TARE CORRECTION <input type="checkbox"/> Moisture <input type="checkbox"/> Foam (p. B-17) <input type="checkbox"/> Vacuum Pack	14. NOMINAL GROSS WEIGHT [1] + [13] - [13a] =		
PACKAGE ERRORS							
TOTALS (-) (0/+)							
15	10	50	15	30	22		
8	42	30	20	47	12		
29	45	38	48	45	28		
10	22	20	50	38	10		
20	18	28	44	20	15		
RANGES						15. TOTAL ERROR	
16. NO UNREASONABLE MINUS ERRORS (Compare with box [4]) 3		17. IS [16] Greater than [8]? <input checked="" type="checkbox"/> YES LOT FAILS <input type="checkbox"/> NO—CONTINUE		18. AVERAGE ERROR (Dimensionless Units) [15] ÷ [6] =		19. AVERAGE ERROR (labeled units) [18] × [2] =	
21. AVERAGE RANGE		22. Use [6] to look up value in Table 2-3, Col. 2 (p. B-3)		23. d = [21] × [22] =		24. (n/N) × 100 = ([6] - [5]) × 100 =	
27. Disregarding the signs, is [18] larger than [26]? YES → LOT FAILS NO → LOT PASSES		25. Use [24] to look up f in Table 2-4 (p. B-4) f =		26. T = [23] × [25] =		20. IS [18] ZERO OR PLUS? <input type="checkbox"/> NO → Cat B, LOT FAILS Cat A go to [21] <input type="checkbox"/> YES → GO TO [28]	
Comments						26. DISPOSITION OF LOT: <input type="checkbox"/> APPROVED <input type="checkbox"/> REJECTED	

Figure 2-7. Example of lot failing the individual package requirement.

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 2.7.2, 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.

2.7.2. 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 forms on pages A-1 and A-2) by the number of packages in the sample (box 6). The average error is recorded in boxes 18 and 19 on the report forms. 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 values "d", "f", and "T" are computed or looked up in tables (as described below) and used to determine whether the lot conforms.

- (i) First compute "d".

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

where

\bar{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 G contains a detailed example of how to calculate \bar{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 See Figure 2-8 for a completed example.

\bar{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 $\bar{R} = 2$,

d (= Table 2-3, column 2 value $\times \bar{R}$) = $(0.1570) \times (2) = 0.3140$. See Figure 2-8 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, column 3, value in box 22.

RANGES										15 TOTAL ERROR
3	4	1	2	1	1					9
16 NO UNREASONABLE MINUS ERRORS		17 IS 16 Greater than 8		18 AVERAGE ERROR (Dimensionless Units)		19 AVERAGE ERROR (labeled units)		20 IS 18 ZERO OR PLUS?		
0		<input type="checkbox"/> YES LOT FAILS <input checked="" type="checkbox"/> NO—CONTINUE		15 ÷ 6 = -0.30		- .003 lb.		<input checked="" type="checkbox"/> NO → Cat. B, Lot Fails <input type="checkbox"/> YES → LOT PASSES		
21 AVERAGE RANGE		22 Use 6 to look up value in Table 2-3, Col. 2 (p. B-3)		23 d = 21 × 22 =		24 (n/N) × 100 =		25 Use 24 to look up f in Table 2-4 (p. B-4) f =		26 T = 23 × 25 =
2		0.1570		.3140		$\frac{30}{50} \times 100 = 60$ (6 ÷ 5) × 100 = 60		0.63		0.20
27 Disregarding the signs, is 18 larger than 26? <input checked="" type="checkbox"/> Yes → lot fails <input type="checkbox"/> No → lot passes										
28 DISPOSITION OF LOT.		<input type="checkbox"/> Approved <input checked="" type="checkbox"/> Rejected		Comments						
Acknowledged Receipt of Report										
Official										

Figure 2-8. 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 2-8.

- (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 2-8.

- (iv) Calculate "T",

$$T = d \times f$$

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 2-8.

- (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 2-8.

It should be remembered that the calculations in steps (i) through (v) above have to be made only when the average error is minus. See page H-3 for a complete example using a Category A sampling plan and filling out the report form.

2.8. 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 forms on pages A-1 or A-2, 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.

2.8.1. Decision Criterion: Individual Packages

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

On the report forms on pages A-1 and A-2, 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 forms). 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.

2.8.2. Decision Criterion: The Average Error

The "average error" of the sample is calculated from the values obtained from individual package measurements. The average error 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 forms) 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 forms. Whether the average error is a zero, plus, or minus value is recorded in box 20. See pages H-1 and H-2 for complete examples using a Category B sampling plan.

2.9. 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 forms on pages A-1 or A-2, under "Comments".

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. Worksheets have been designed to take the inspector through all the steps necessary to convert to units of weight and back again. [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 and opening the fewest packages needed for adequate testing. 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 non-weight labeled unit of measure (e.g., volume) can be converted to a weight value (for example, by using the measured weight of a known volume). If this is possible, the net contents of a package can be determined by subtracting the tare weight from the gross weight, then converting the resultant value from units of weight to the units on the package label.¹

The packages that are used to determine the average tare weight constitute the "tare sample". At least two individual packages should be used to obtain an average tare weight value (that is, the tare sample size should be at least two). For larger package samples, 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 package sample sizes.]

The average tare is recorded in box 13 on the report forms on page A-1 and A-2.

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

- a. **Unused tare** (also known as "dry tare") 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. Unused tare is weighed before the product is introduced into the container.
- b. **Used tare** comprises all packaging materials that can be separated from the packaged product, either readily (e.g., by shaking) or by washing, scraping, ambient air drying, or other techniques involving more than "normal" household recovery procedures, but not including such laboratory procedures as oven drying. As in the definition of unused tare, prizes, decorations and such are also part of the used tare.

¹In actual practice, a "nominal gross weight" value will be determined (and recorded in box 14 of the report forms shown on pages A-1 and A-2). 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 remaining in the sample in order to arrive at the individual package errors. For example, see steps 5 and 6 of Section 3.5.

There are two subcategories of "used tare:"

- **Wet tare.** Used tare may also be called "wet tare" when no effort is made to reconstruct unused tare by drying out the absorbent portion of the tare. Free-flowing liquid is part of the wet tare for meat or poultry products from Federally-inspected plants. See Section 3.18.
- **"Dried used tare"** refers to used tare that has been air dried, dried in a microwave oven, over a heating element, or in some other manner, to simulate the unused tare weight. See Section 3.18. for a further explanation of dried used tare.

In some cases (e.g., canned or glass- or plastic-packed goods), unused tare weights are equivalent to used tare (within the measurement precision of field test scales). However, the net contents value that is obtained when an unused 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 usable 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 chosen randomly. Appendix E contains descriptions of how to select random samples and random tare samples. The random number selection process that determines the whole sample also indicates the packages to be opened for tare.

Some jurisdictions have traditionally 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 unused tare is to be measured, Appendix E provides procedures 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 methods for cleaning packaging material to determine tare weight depend on the tare material and the product it contains. In general, a common sense approach should be followed. A bread bag, for example, may be turned inside out to remove all crumbs.

See Section 3.18. for specific procedures on obtaining a "dried used tare" weight for meat or poultry from Federally-inspected plants.

In cleaning tare material such as metal cans with paper labels, care should be taken not to wet the labels with water or other solvent used to clean the container. The interior of the container should be thoroughly dried with a clean dry cloth or else air dried, whichever is more practicable. Butter or bacon wrappers 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, 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 examples of 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 7 of the report forms on pages A-1 and A-2.

For packages labeled by weight,¹ the weights of the individual tare units (after cleaning) are recorded on the report form on page A-2 in the spaces marked "b" (see Figure 2-2); they should be averaged and the result 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 individual package errors.

2.11.4. Alternative Tare Procedure²

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.

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

First, determine the total number of packages to be opened for tare by:

- a. selecting the number of packages according to Table 2-6 (page B-6) for the "initial tare sample",
- b. determining the tare weights and net contents of those packages,
- c. obtaining the ratio of the range of net contents to the range of tare weights, and
- d. referring to Table 2-7 (pages B-7 and B-8), to obtain the total number of containers to be opened.

It may or may not be necessary to open additional packages, depending on whether or not the total number of packages to be opened for tare is greater than the initial tare sample size. The report form on page A-2 may be used for recording measurements for standard pack packages labeled by weight (see Figure 2-2).³ The detailed procedure is as follows:

- (i) 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.

¹For packages labeled in units other than weight, appropriate worksheets have space on them for recording the tare weights.

²Modification of a procedure in "Determining Tare in Net Weight Acceptance Sampling" by Robert S. Elder, Journal of Quality Technology, vol. 4, no. 3, July 1972, pp. 131-133.

³The report form on page A-1 plus the worksheet on pages A-5 and A-6 may be used for standard pack packages labeled by liquid volume. These products are often packaged in glass containers.

- (ii) The packages chosen for tare are gross weighed, 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.] Record gross weights in spaces beside "a" on the report form on page A-2.
- (iii) The tare weight is determined and recorded for each package. Record tare weights in spaces beside "b".
- (iv) The net weights for the initial tare sample are calculated and recorded.

$$\text{Net Weight} = \text{Gross Weight} - \text{Tare Weight}$$

Record tare weights in spaces beside "c".

- (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 G 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 minus the initial tare 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.

¹For packages labeled in units other than weight, the suitability of using a weight value in place of the labeled measure is determined. This is accomplished 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: there is no tare determination.

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 lb*	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. See Figure 2-9.

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:

$$0.406 \text{ lb} - 0.146 \text{ lb} = 0.260 \text{ lb}$$

$$0.400 \text{ lb} - 0.150 \text{ lb} = 0.250 \text{ lb}$$

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 $n = 10$, $n_1 = 4$; therefore, two more packages must be opened to determine the average tare.

5 LOT SIZE (N)	a GROSS WEIGHT	0.406 lb	0.400 lb			
6 SAMPLE SIZE (n)	b TARE WEIGHT	0.146 lb	0.150 lb			
10 <input type="checkbox"/> A (p. B-3) <input checked="" type="checkbox"/> B (p. B-5)	c NET WEIGHT	0.260 lb	0.250 lb			
7 TARE SAMPLE SIZE 2 <input checked="" type="checkbox"/> Alternative (p. B-6)	d PACKAGE ERROR a - 14			additional tare		
8 Allowed Number UNREASONABLE ERRORS 0	e PACKAGE ERROR (dimensionless units) d ÷ 2					
9 R_c (see c) Range of Net Weights 0.010 lb	10 R_t (see b) Range of TARE Weights 0.004 lb	11 $R_c \div R_t =$ 9 ÷ 10 = 2.5	12 n_1 (Table 2-7) p (p. B-7&8) 4	13 AVERAGE TARE <input type="checkbox"/> unused <input type="checkbox"/> used <input checked="" type="checkbox"/> alternative	13a TARE CORRECTION <input type="checkbox"/> Moisture <input type="checkbox"/> Foam (p. B-17) <input type="checkbox"/> Vacuum Pack	14 NOMINAL GROSS WEIGHT 1 + 13 - 13a =

Figure 2-9. Example of alternative tare procedure.

- (x) Steps (ii), (iii), and (iv) are repeated for these additional packages.
- (xi) The average of all the tare weights is added to 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 gross weights of those packages that were opened for tare are compared with the nominal gross weight in box 14 to determine the package errors for the tare packages (and recorded in the spaces beside "d" and "e"). The nominal gross weight in box 14 is also used to compare against the sample packages not opened for tare. (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 on page A-2. Also see 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's¹

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 only.**² 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.

¹In addition, the average net contents of lots, shipments, or deliveries must equal or exceed the labeled net contents. The sampling plans of Category A or B are provided for testing packages subject to the average requirement.

²Note exception in Section 2.13 for textiles.

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. Two entries for each range of labeled weights are provided in Table 2-8 up to 1.08 lb. This will facilitate looking up the MAV for standard or random-pack packages. Standard-pack commodities up to 1 lb must be labeled in ounces; random-pack commodities will be labeled in decimal pounds.

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. For example, fertilizer in 72 lb bags would have an MAV of $0.02 \times 72 \text{ lb} = 1.44 \text{ lb}$. If the scale being used to test the product has 0.1 lb divisions, the MAV would be recording as 1.4 lb and in dimensionless units as $(1.4 \text{ lb}/0.1 \text{ lb}) = 14$.

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 forms on pages A-1 or A-2 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 package weights in spaces below box 10 and 11. [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.

2.13. Exceptions to the MAV's¹

When necessitated by packaging practices or the nature of the product, MAV's exceeding those listed in Tables 2-8 through 2-11 must be applied.

Specific Product Exceptions to the MAV:

2.13.1. Polyethylene sheeting and film

- a. When labeled thickness is less than 1 mil (0.001 in), any individual thickness measurement of polyethylene film may be as much as 35% below the labeled thickness (i.e., at least 65% of the labeled thickness).²
(Added 1988)

¹In addition, the average net contents of lots, shipments, or deliveries must equal or exceed the labeled net contents. The sampling plans of Category A or B are provided for testing packages subject to the average requirement.

²ASTM Standard D-2103-86, "Standard Specification of Polyethylene Film and Sheeting," 1986.

- b. When the labeled thickness is 1 mil or greater, any individual thickness measurement of polyethylene sheeting may be as much as 20% below the labeled thickness (i.e., at least 80% of the labeled thickness).¹
(Amended 1988)

The average thickness of a single package of polyethylene sheeting may be as much as -7% below the labeled thickness (i.e., at least 93% of the labeled thickness).² [See Section 5.4.3.]

2.13.2. Textiles

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

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

A minus error may be no larger than -3% of a declared dimension;
A plus error may be no greater than +6% of a declared dimension.
- b. For packages with any declared dimension less than 24 inches (60 cm):

A minus error may be no larger than -6% of a declared dimension;
A plus error may be no greater than +12% of a declared dimension.

2.13.3. Mulch

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

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

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

²1978 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, 1988, "Uniform Laws and Regulations."

⁴Section 10.11 of the Uniform Packaging and Labeling Regulation, NBS Handbook 130, 1988, "Uniform Laws and Regulations."

2.13.4. Meat or Poultry from Federally-Inspected Plants

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 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. See Section 3.18. on how to use these MAV's.

2.14. Moisture Allowance

When it is necessary to allow 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-2 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 if box 13a is used.

See Section 3.17. (for flour) and Section 3.18. (for meat and poultry) for procedures using the "gray area" technique.

¹See 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 mechanical package testing scale
- 3.5. Standard pack labeled by weight: CORE METHOD (unused tare)
- 3.6. Standard pack labeled by weight: used 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
- 3.14. Glazed raw seafood and fish
- 3.15. Canned coffee
- 3.16. Borax
- 3.17. Flour
- 3.18. Meat and poultry from Federally-inspected plants

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 used 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.

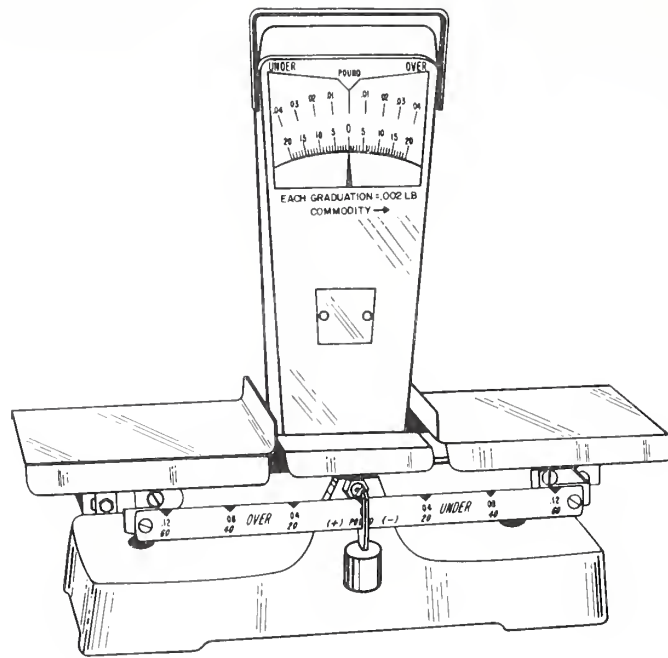


Figure 3-1. Equal-arm package testing scale for small weights (avoirdupois units).

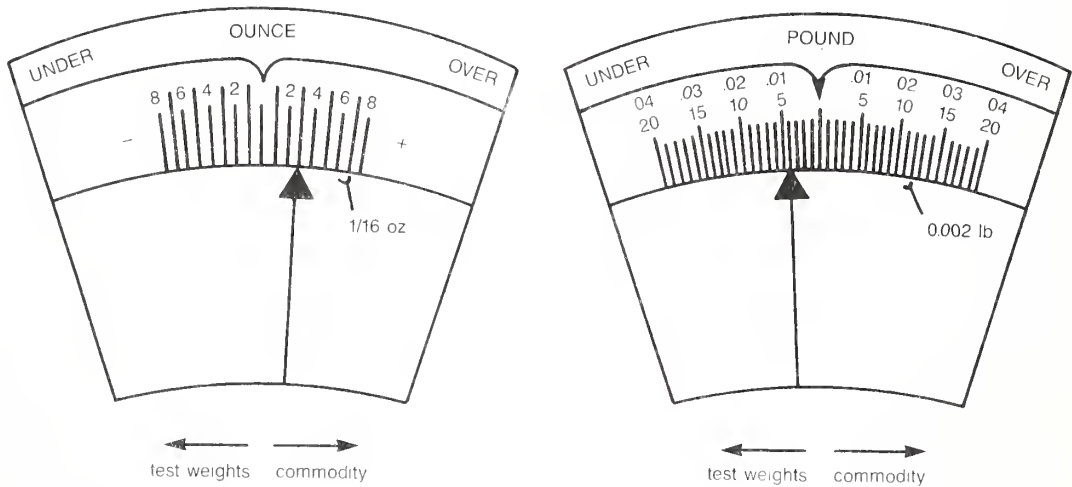


Figure 3-2. Mechanical package testing scale tower faces.

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.

Electronic Digital Scale. - 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:

- (i) The scale should be selected such that the division size should be no greater than MAV/6 for the size package being weighed. See Table 3-1, page B-16, for recommended scale divisions for different sizes of packages.
- (ii) The scale must meet all requirements of H-44 Scale Code.
 - The scale must meet the acceptance tolerances given in the Handbook for its class.
 - The scale must meet Section T.N.7.2., H-44, on discrimination.
- (iii) The scale must be portable and rugged.
- (iv) Slight out-of-level conditions should not introduce errors.
- (v) For the convenience of the inspector (although not mandatory), the scale should be battery powered.

Commercial Scale - If packages are heavier than the capacity of the official's package checking scale, or if they cannot be accommodated on the platform, 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.

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.

Analytical Balance - 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.]

Field Standard Weights¹ (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.

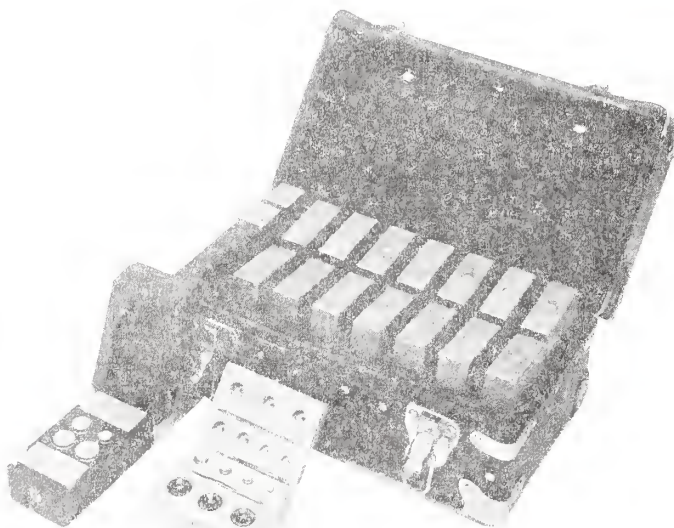


Figure 3-3. Test weight kit.

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, if leveling is required. 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 2.5.2.). If selected, the scale should not be released to commercial service until the testing has been completed.

3.3. Recording Package Weights²

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 also gives guidance on appropriate equipment for different labeled weight declarations.

3.4 Reading the Mechanical 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).

If an exact 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.

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

²Conventionally, 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.

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 halfway between two divisions, the official should record the value corresponding to the next higher division when recording the gross package weight, but should record the value corresponding to the next lower division when recording the tare.

3.5. Standard Pack Labeled by Weight: Core Method (Unused Tare)

The description below references numbered boxes on the report form on page A-2. Other report forms and worksheets are provided in Appendix A for special and more complex 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 unused 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 MAV² 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).³

Convert the labeled weight into the same units as the unit of measure, if necessary. For example, the labeled weight of 12 oz packages, to be weighed using a unit of measure of 0.002 lb, should be recorded as 0.75 lb.

Determine the inspection lot size (box 5). Record the:

- sample size (box 6),
- tare sample size (box 7), and

¹The unit of measure most often chosen is the size of the scale division. See discussion in Sections 2.5.1. and 2.5.2. on the unit of measure and dimensionless units.

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

³Round the resulting value to a whole number. Use the "odd and even rule" given in Handbook 44, Appendix A, Section 10.2. (When the digit to be deleted is a 5, round to an even number; 42.5 becomes 42, 43.5 becomes 44.)

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).

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.

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 weight¹ =
 labeled weight (box 1) +
 average tare weight (box 13) - tare correction (box 13a)

See Figure 3-5.

Location of TEST (Name, Address) Mann's 15 2nd St Industrial Park 8422		<input type="checkbox"/> Retailer <input type="checkbox"/> Wholesaler <input checked="" type="checkbox"/> Packager		PRODUCT IDENTITY 4% large curd cottage cheese	BRAND Mann's	LOT CODE(S) 233T-Apr 8	CONTAINER DESCRIPTION plastic tub
1 LABELED WEIGHT 8oz (0.5 lb)		2 UNIT OF MEASURE 0.001 <input checked="" type="checkbox"/> lb <input type="checkbox"/> oz		3 MAV Table 2.8 (p. B-9&10) 0.028 lb		4 MAV (dimensionless units) 3 + 2 = 28	
5 LOT SIZE (N) 800	a GROSS WEIGHT						
6 SAMPLE SIZE (n) 20 <input type="checkbox"/> A (p. B-3) <input checked="" type="checkbox"/> B (p. B-5)	b TARE WEIGHT 0.208 lb	0.208 lb					
	c NET WEIGHT						
7 TARE SAMPLE SIZE 2 <input type="checkbox"/> Alternative (p. B-6)	d PACKAGE ERROR a - 14						
8 Allowed Number UNREASONABLE ERRORS 0	e PACKAGE ERROR (dimensionless units) d ÷ 2						
9 R _c (see c) Range of Net Weights	10 R _t (see b) Range of TARE Weights	11 R _c ÷ R _t = 9 ÷ 10 =	12 n _i (Table 2-7) p (p. B-7&8)	13 AVERAGE TARE .208 lb <input checked="" type="checkbox"/> unused <input type="checkbox"/> used <input type="checkbox"/> alternative	13a TARE CORRECTION <input type="checkbox"/> Moisture <input type="checkbox"/> Foam (p. B-17) <input type="checkbox"/> Vacuum Pack	14 NOMINAL GROSS WEIGHT 1 + 13 - 13a = 0.708 lb	

Figure 3-5. Steps 1 - 5 completed on a report form.

6. Compare the sample packages with the nominal gross weight.

- Equal-arm device: Put field standard test weights equal to the nominal gross weight² 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 2.5.3. on how to fill out this part of the report form.] Complete the first column with the first five

¹It may be necessary to round the nominal gross weight to a value comparable to the inspector's smallest field test weight. For example, 1.2125 lb should be rounded to 1.212 lb (using the odd and even rule of Handbook 44) so that the appropriate weights can be placed on the inspector's scale.

²When 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.

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.

See page H-1 for a completed example of the crosshatched area of the report form.

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. See page H-1 for an example.
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 2-3 and 2-8.] See Appendix F on how to compute a "range".
- Average the group ranges and record the average range \bar{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.)

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.

- Determine "d":

$d = \text{Table 2-3, column 2 value multiplied by } \bar{R}$

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 \bar{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":

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

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. See page H-3 for a completed example.

3.6. Standard Pack Labeled by Weight: Used Tare

The CORE METHOD is followed except:

- o 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).
- o Tare weights are determined by emptying, cleaning or wiping dry, then weighing all packaging materials from the tare sample (in step 3).
- o Package errors are determined for the tare sample 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. See pages H-1 and H-2 for completed examples.

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.¹ [See Appendix E for sample selection techniques.]
 3. Determine and record individual package gross weights for tare sample. [See Figure 3-6.] 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.

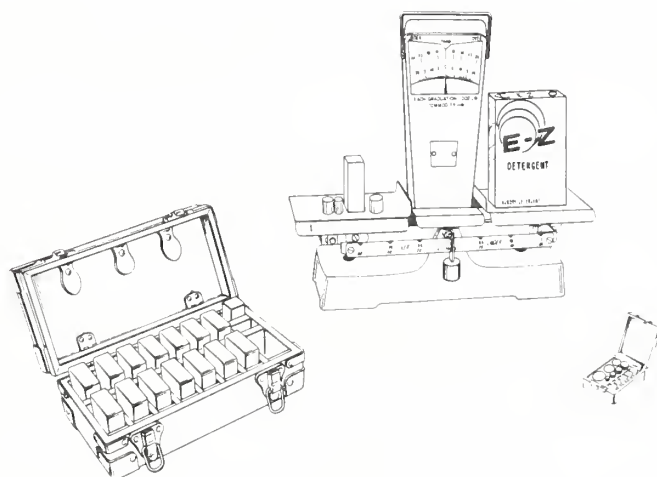


Figure 3-6. The determination of the gross weight of a package.

¹If the lot is large enough, the inspector will find it easier to select the tare sample, in addition to the sample, from the lot. For example, select 10 packages for a Category B sample from a lot of 50 packages, and select two more packages for tare. Then a nominal gross weight can be compared with all 10 unopened sample packages and step 6 can be skipped.

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

Nominal gross weight =

$$\text{labeled weight (box 1) +} \\ \text{average tare weight (box 13) - tare correction (box 13a)}$$

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 cross-hatched 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 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. 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.

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

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.

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. See page H-3 for a completed example.

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, \bar{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":

$$d = \text{Table 2-3, column 2 value multiplied by } \bar{R}$$

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":

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

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 (Section 3.5.) is followed except:

- a. The sample packages are kept in the order in which their corresponding random numbers were obtained.
- b. The random tare sample is the "initial tare sample" and is selected from the random sample.
- c. Tare weights are determined by emptying, cleaning, and weighing all packaging materials.
- d. The range of tare weights (R_t) and range of net weights (R_c) is determined for the initial tare sample.
- e. 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.
- f. 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. See Figure 2-9 for an example of part of the completed report form.

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 size¹ (box 6), and
 - allowed number of unreasonable errors (box 8).Determine and record initial tare sample size from Table 2-6 (page B-6) in box 7.
2. Select random sample from inspection lot keeping sample 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.

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

4. Empty these packages, clean them, determine and record tare weights (in boxes labeled b).
5. Determine the range of tare weights (R_t). Record R_t in box 10. [See Appendix F on determining a "range".]
6. Subtract each tare weight from the corresponding gross 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_n). Record in box 9.
8. Divide R_n (box 9) by R_t (box 10) and record in box 11.
9. Find the value recorded in box 11 for R_n/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 , 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 packages must be opened to determine average tare. For example, if 2 packages were opened initially and, using Table 2-7, $n = 5$ (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 weights and record in box 13.

If all packages have been opened,¹ 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 pack-

¹If 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.

age 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 cross-hatched area of report form.
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 cross-hatched 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 cross-hatched 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 (\bar{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":

$d = \text{Table 2-3, column 2 value multiplied by } \bar{R}$

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":

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

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 unused tare, used tare, or alternative tare.

Section 3.8.1. describes the most common test procedure for random pack, using unused 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 used tare, or alternative tare.

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

3.8.1. Selecting the MAV

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

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.

Therefore, this handbook recommends for audit testing:

- (1) 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.
- (2) When testing inspection lots defined as the entire meat case, or entire store-packed produce counter, etc., apply the MAV corresponding to the average labeled weight in the sample.

In (1) above, if the individual package errors are all smaller than the MAV for the smallest package, then the lot will pass the individual requirement in an official test as well.

When official tests are performed, it may be necessary to identify the appropriate MAV for each package labeled weight. In (2), the labeled weights may range from very small to very heavy packages. Look up the MAV for the lightest package. If all package errors are less than this MAV, it is not necessary to look up any other MAV. If any package error is larger than that MAV, look up the MAV corresponding to that package's labeled weight. This lookup process can be continued in a step-wise fashion for the entire sample from lightest to heaviest package.

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.

3.8.2. Random Pack, Unused Tare, Category B Sampling Plans

The CORE METHOD should be followed, except:

- a. Labeled weight and MAV cannot be recorded until the sample has been selected.
- b. 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).
- c. Variability of tare weights should be tested. However, the unused tare weight of many random pack packages varies less than the detection capability of the official's equipment. In these instances, a single unused 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.

- d. 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. See page H-7 for a completed example.

1. 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 unused tare box under "Tare" on the right side of the report form.
2. Select random sample. [See Appendix E.] Have tare made 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 tests, record MAV in box 10 corresponding to:

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

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

Divide the MAV (box 10) by the unit of measure (box 5) to get the MAV in dimensionless units. Record this value in 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 unused 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

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

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 unused tare¹ plus field standard weights equal to the labeled weight marked 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.
- 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.

3.8.3. Random Pack, Used 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 average tare weight must be determined for each and every type and size of tare in the sample.

Unlike the procedure for random pack using unused 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 used tare weights for random pack packages of meat, poultry, fish and similar products, the official may note large variations in tare weights

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

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 be useful in the determination of the average tare weight. Use of the alternative tare procedure is described in the method below. See also Section 3.18. for special considerations for meat or poultry packaged at Federally-inspected plants.

a. Summary of Used Tare, Alternative Tare, and/or Category A Methods

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

- o 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.

b. 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_n , in box 6a. Compute R_n/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 pack-

age 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 the number of unreasonable errors in box 13. Record in box 19 (on the second page of the report form) whether the number of unreasonable errors (box 13) exceeds the allowed number (box 4). 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 3-7.

Determining Gross Weight or Tare Weights

<u>Step</u>	<u>standard weights on pan (decimal pounds)</u>	<u>scale reading</u>
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 additional weight	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 weight	104.46 lb	104.5 lb
3b. After removing standard weights equal to tare + labeled wt and adding sample package	3.11 lb	104.2 lb
4b. 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		

*With an electronic digital scale, see instructions in step 4.

Figure 3-7. Examples of substitution weighing.

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.
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 3-7), 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.²

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.³

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

²If 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.

³See Method 32.002 of the Official Methods of Analysis of the Association of Official Analytical Chemists.

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

Scales and weights recommended in Section 3.1. are suitable for determinations of drained weight.

Sieves

- a. 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.
- b. For drained weight greater than 3 lb (1.36 kg), one 12-in (or 30-cm) sieve, with same specification as above.

Stopwatch - 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, page A-2. 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 liquid from the product to drain into receiving pan for 2 minutes. [Do not shake or shift material on the sieve.] Remove sieve and product.
4. Weigh the receiving pan, liquid, wet container, and any other tare material. [Do not include sieve and product.] [See Figure 3-8.] Record this weight as tare and receiving pan.
5. Subtract the weight of the receiving pan, determined in step 1, from the weight obtained in step 4 to obtain the tare weight (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-2.

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

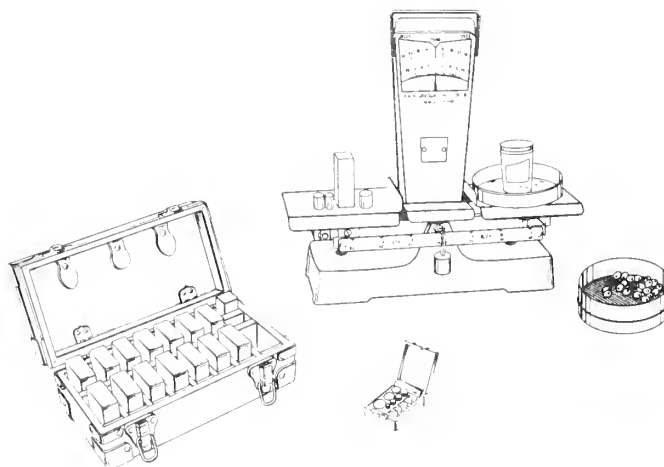


Figure 3-8. The determination of tare for packages labeled by drained weight (example: olives).

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

Scales and weights recommended in Section 3.1. are suitable for weight determinations.

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

- (i) support stand.
- (ii) utility clamp.
- (iii) gasoline can.

- (iv) two dishpans, and
- (v) 1/2-inch carriage bolt (either 2 to 3 in or 5 to 7 cm long) and nut.

3.11.2. Preparation for Test

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.]

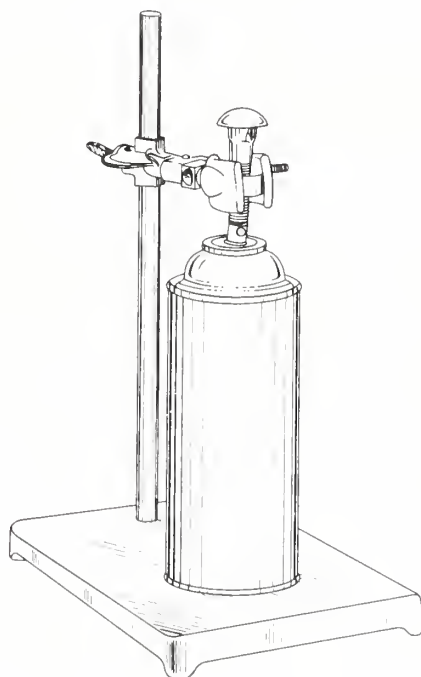


Figure 3-9. Portable test stand for all aerosol products except paints and coatings.

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 °F. 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.

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 unused 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 unused tare basis.

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.

Regulations under the Fair Packaging and Labeling Act¹ 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."

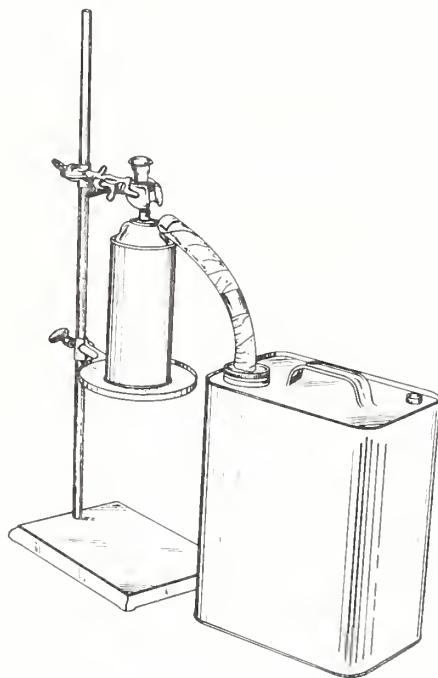


Figure 3-10. Portable test stand for aerosol paints and coatings.

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-2) 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.

¹Regulations 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 10.2) in NBS Handbook 130. Quotations above from 21CFR 101.105(g).

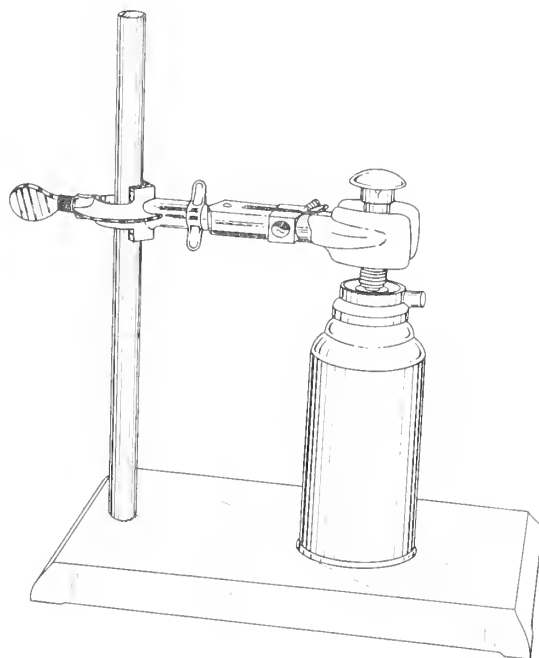


Figure 3-11. Portable test stand showing aerosol foam product ready to expel to in upright position.

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.

¹A 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.

- 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.

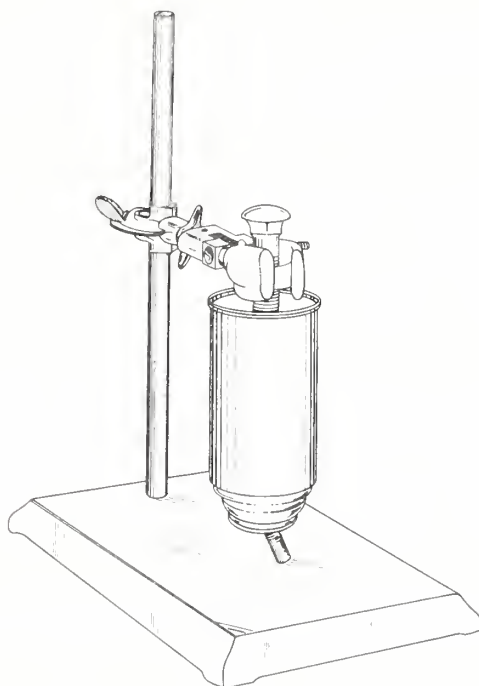


Figure 3-12. Portable test stand showing aerosol foam product ready to expel in inverted position.

Agitate the container with a swirling motion for 30 seconds. Hold the container at an angle of 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 the container.] Continue this procedure until no additional product or gas is expelled. Any undelivered product should be ex-

¹Examples of other products: Frostings, syrups, cheese spread, hair sprays, colognes, window cleaners, starches and fabric finishes, insecticides, room deodorants, personal deodorants, water-proofers, antiseptics and medicants, de-icers, ignition sprays, insect repellents, 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.

pelled as completely as possible by holding the container in the hand 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 °F (or 20 to 27 °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_n .
5. Determine and record in box 10 the range of tare weights, R_t .
6. Compute R_n/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.

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

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-2. 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.

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, unused tare), 3.6. (used 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. Therefore, the method 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 not to be refrozen after the test.

¹Tare 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.

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

4-gallon or larger container 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 °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 work-sheet 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. In general, the product should remain rigid; however, the ice glaze on certain products, such as small to medium-sized shrimp, sometimes cannot be removed without defrosting the product. Nonetheless, remove the glaze because glazing is a substantial part of the gross package weight.
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 of report form on page A-2. 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:

- (i) 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.

3.16. Borax

This section describes a method for testing packaged commodities in powdered or granular form consisting predominantly (more than 50 percent) of borax.

Such commodities are labeled by weight, but borax can lose more than 23 percent of its weight due to moisture loss. However, it does not lose volume upon moisture loss, and this property makes possible a method of testing based on volume. The method may be used either to verify that the purchaser receives at least a declared minimum volume of commodity or, as a means of audit testing, to identify possible short-filling by weight at point of pack. Since the bulk density of these commodities can vary at point of pack, further investigation would be required to determine whether such short filling had occurred.

3.16.1. Equipment

- o Equal-arm scale or balance having a sensitivity of 0.002 lb.
- o Metal density cup having a capacity of 1 dry pint (550.6 mL) (such as O'Haus #104)¹, with the dimensions shown in Figure 3-13.
- o Metal density funnel with slide-gate and stand (such as Cox #29)¹, with the dimensions shown in Figure 3-13. [Density cup and funnel available from Seedboro Equipment Co., Chicago.¹]
- o Rigid straight edge or ruler.
- o Pan (metal or plastic) suitable for containment of overflow of density cup.

3.16.2. Procedure

1. Follow the steps described in Section 3.6. If the lot does not comply by weight with the sampling plan requirements (either the average or individual package requirements), select the lightest package (noting the actual net weight for this package) and continue.
2. Determine the tare weight of the density cup.
3. Place the density cup in the pan, and the funnel on top of the density cup. Close the funnel slide-gate.
4. Pour sufficient commodity into the funnel so that the density cup can be filled to overflowing.
5. Quickly remove the slide-gate from the funnel, allowing the commodity to flow into the density cup.
6. Carefully, without agitation of the density cup, remove the funnel and level off the commodity with the ruler or straight edge. Hold the ruler or straight

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.

edge at right angles to the rim of the cup, and draw it back carefully across the top of the density cup so as to leave an even surface.

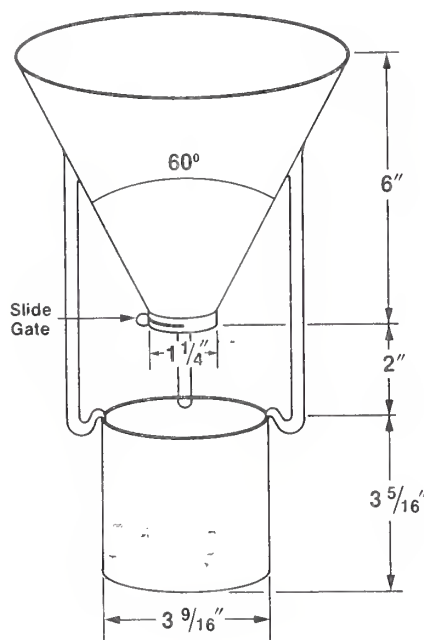


Figure 3-13. Density cup and funnel.

7. Weigh the filled density cup (in pounds). Subtract the tare weight of the cup from the gross weight of the commodity plus cup to obtain the net weight of commodity in the cup.

3.16.3. Determination of Volume

1. Multiply the actual net weight (in pounds) as found for the package under test (step 1 in Section 3.16.2.) by 550.6.
2. Divide the answer obtained above by the weight of the commodity in the density cup (step 7 in Section 3.16.2.). The result is the net volume of commodity in the package in mL.
3. Compare the net volume of commodity in the package with the volume declared on the package. The volume declaration will be found at a location other than the principal display panel. It will be in the following form (1 mL = 1 cc):

Vol. ___cc per NBS Handbook 133, Sec. 3.16.

3.16.4. Action

If the net volume of commodity in the lightest package is less than the declared volume on the package, the lot is out of compliance and enforcement action should be taken.

If the net volume of commodity in the lightest package equals or exceeds the declared volume on the package, the official may treat the lot as being in compliance on the basis of volume and take no further action. Alternatively, the official may take further steps to determine whether the lot was in compliance with net weight requirements at point of pack or was shortfilled by weight. To determine this, the official may do one or more of the following:

1. perform a laboratory moisture loss analysis¹ to ascertain the weight of the original borax product when it was fully hydrated;
2. obtain additional data at the location of the packager; and/or
3. investigate the problem with the packager of the commodity.

3.17. Flour

3.17.1. Background for Administrator and Inspector

The test procedure for flour is based on the concept of a "gray area" that extends down from the labeled weight to 97% of the labeled weight. It applies only to package lots checked at retail or wholesale, and not to those checked in the plant. The gray area does not represent a tolerance, nor do lots in the gray area automatically pass or automatically fail. If the average weight of a package lot is in the gray area, the moisture content at time of test and at time of pack must be determined in order to judge whether the lot is in compliance.

a. Enforcement action, inside and outside the gray area

The overall objective is to test packages as routinely as possible. If package lots are short weight, but fall in the gray area, additional information must be obtained in order to decide whether or not the lots are in compliance. The usual enforcement action is to be taken on packages found short weight and outside the gray area.

For package lots found short weight, but inside the gray area, a decision must be made as to what to do with the packages while additional information is being collected. It is recommended that a hold or stop sale order be put on these packages until their final status can be determined. If the product cannot be held and subsequent tests or information indicate that the lot is out of compliance, seek the strongest legal remedy.

¹Procedure available upon request from the Office of Weights and Measures, National Bureau of Standards.

b. Which packages to consider as part of the lot being tested

When taking a sample from retail, an inspector will ordinarily record lot codes, but will not select the lot for test by sorting the packages by lot code. The sample is selected from all packages of the same brand, style, and size on the shelf or in the stock room. If short weight is found and the results are in the gray area, a follow-up test will now require sorting out the lot codes in order to ascertain the moisture content at the time of pack (which varies from one lot code to another).

c. Package errors

The discussion below is based on recording the package weights as "package errors" -- how much and in what direction the actual package weight differs from the labeled weight. Thus, if a package labeled 2 lb actually weighs 2.10 lb, it is assigned a package error of +0.10 lb. The same situation holds for average package weights. If the average of 10 package weights is 1.994 lb, the average package error is (1.994 lb - 2.000 lb =) -0.006 lb.

d. Package lots have to meet the average requirement and the individual requirement

Using H-133 Category B sampling plans¹ for packages not subject to possible moisture loss, two requirements must be met:

- (1) The average net weight of a sample of 10 or 30 packages must equal or exceed the labeled net weight. Thus, the average package error (for the 10 or 30 packages) must be zero or plus.
- (2) In addition, no single package among the 10 or 30 packages in the sample can be short weight by more than the MAV.

For flour, these two requirements become the upper boundary for the gray area. 97% of the labeled net weight defines the lower boundary of the gray area. (See Figure 3-14.)

For example, for 5-lb packages of flour, 3% of the labeled weight is 0.15 lb. Therefore, if the average package error for a lot of 5 lb packages is minus but between zero and -0.15 lb, the lot is in the gray area. The lot should be neither passed nor failed: more information is needed to decide its disposition.

If the official is following a Category B sampling plan, a package that is short weight by more than the MAV may put the lot in the gray area. The official will have to add the 3% gray area to the MAV to find the limits of the gray area for an individual package. Table 3-3 is provided to help the inspector determine whether or not the lot is in the gray area for all the common sizes of flour. This table is in Appendix B.

¹For simplicity only, this background discussion presupposes a Category B sampling plan test.

Example: The Gray Area for 5 lb Flour Packages

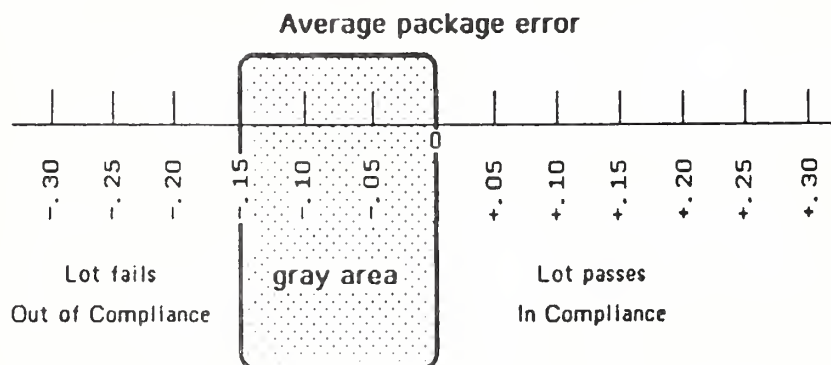


Figure 3-14. An example of a gray area.

e. How many lots will be in the gray area

The flour survey conducted by the NCWM Task Force on Commodity Requirements, printed in the Report of the 71st National Conference on Weights and Measures, 1986, page 70, is the source from which the estimates are predicted. If all flour samples are drawn from retail, an estimated 5 to 6 out of 10 lots will have a minus average error and will be in the gray area. This will vary according to the time of year of testing. Probably only one out of 100 lots found at retail would be rejected outright because of being outside the gray area.

3.17.2. Field Equipment

Use Scales and Weights recommended in Section 3.1. (H-133) and glass canning jars (1/2 pint or larger) and lids.

3.17.3. Procedure

a. Summary Sheet

A Flour Summary Sheet is provided on page A-14 for use with the standard pack report form, page A-2. The following information can be entered on the Flour Summary Sheet when setting up a test:

<u>Type of Information</u>	<u>Examples</u>	<u>Item No. on Summary Sheet</u>
Brands	Name of brand	Item 1
Type of flour	all purpose self rising whole wheat, rye, graham, etc. DO NOT USE THIS TEST FOR CORN MEAL OR MIXES	Item 2

<u>Type of Information</u>	<u>Examples</u>	<u>Item No. on Summary Sheet</u>
Labeled weight (lb)	2 lb 5 lb 10 lb up to 100 lb	Item 3
Location of test	R, W, P, L R for retail, W for wholesale, P for packager's storage area, or L for on-line at the packaging plant.	Item 4

b. Selection of Lots

When an inspection lot composed of packages bearing different lot codes is found in the gray area, sort the inspection lot by lot code. Redefine the inspection lot to be those packages bearing the same lot code. Record the lot code in item 5 on the Summary Sheet. The lot code is the packer's own identifying marks, not the universal product code (UPC). The size of the inspection lot, Item 6 on the Summary Sheet and box 5 on the Standard Pack Report Form, page A-2, is the number of packages with a single lot code available for inspection at one location.

Note on the summary sheet if there is no lot code. Contact the packager to determine if there is any identifying lot code information. (See Section 3.17.3.i. for how to contact the packager.)

c. Sample Size

Record the sample size in Item 7 on the Summary Sheet and in box 6 on the Standard Pack Report Form, page A-2.

d. Tare

Open the number of packages indicated in the sampling plan to get the average tare weight of the bag or other packaging material. (These packages may be in addition to the sample selected for net weight determination, if you prefer.) Record the average tare weight in Item 8 on the Summary Sheet and in box 13 on the Standard Pack Report Form.

e. What a Package Should Weigh

Add the average tare weight to the labeled net weight to determine what the package is supposed to weigh, the "nominal gross weight".

average tare weight + labeled weight = nominal gross weight

Record this value on the Standard Pack Report Form (page A-2, box 14.)

f. Package Errors

Use the package checking scale to compare the packages in the sample with the nominal gross weight. A package that weighs more than the nominal gross weight is overweight and has a "plus package error". A package that weighs less than the nominal gross weight is underweight and has a "minus package error".

package error = package gross weight - nominal gross weight

Record these values on the Standard Pack Report Form (page A-2).

g. The Average Requirement

The explanation below follows a Category B sampling plan. (When following a Category A plan, compute T before determining whether the lot in question falls in the gray area.)

Compute the average error for the package lot under test. Sum all individual package errors and divide by the number of packages in the sample. Do not delete any individual package errors from the calculation. Record the average error on the Standard Pack Report Form in box 18, and in Item 9 on the Summary Sheet.

If the average error is zero or plus, the lot passes the average requirement.

Consult Table 3-3 in Appendix B to find the limits of the gray area for the labeled net weight. (According to the labeled weight in column 1, look up the limits of the gray area in column 2.) Note that the gray area only applies if testing is at retail or wholesale. **If the test is conducted at the packaging plant, there is no gray area.**

If the average error is minus by more than 3% of the labeled weight (assuming a category B test), the lot does not comply; it fails the test. Reject the lot and take the usual enforcement action (Circle "no" in Item 11 on the Summary Sheet.)

If the average error is minus, but by less than 3% of the labeled weight, the lot is in the gray area. Go to that part of the procedure headed "What to do when the lot is in the gray area", Section 3.17.3.i. (Circle "yes" in Item 11 on the Summary Sheet.)

h. The individual package requirement

Compare the largest individual minus package error on the standard pack report form with Table 3-3 (Columns 3 and 4) to see if the lot is in the gray area. The Flour Summary Sheet, page A-14, provides spaces for recording the largest minus package error (Item 10), and recording whether or not the lot is in the gray area (Item 11).

For example, if the package size is 2 lb. the MAV is 0.07 lb (column 3 of Table 3-3). For package sizes not listed in Table 3-3, see Table 2-8 (you will have to compute 3% of the labeled weight.)

The size of the gray area is 3% of the labeled net weight; for 2 lb this is 0.06 lb. Therefore, an individual short weight package with a package error less than zero but not as much as -0.07 lb would not fail the lot. If the package error is larger than -0.13 lb (-0.07 lb + -0.06 lb), the lot should be automatically rejected and enforcement action taken. But if the largest individual minus package error is between -0.07 lb and -0.13 lb, the lot is in the gray area (see Table 3-3 columns 3 and 4).

i. What to do when the lot is in the gray area

Testing for moisture content is the only way to determine whether flour found short weight at retail or wholesale is short due to underpacking or due to moisture loss.

Fill a canning jar with flour from one package¹ from the lot in question. Seal it with a canning lid, label it, and send it to the laboratory to run a moisture test. The results will be provided in terms of percent moisture content (for example, 10.3%). Record this in Item 12 on the Summary Sheet.

Contact the packager² to obtain from the contact person the moisture content value at the time of pack for the lot code in question. Record this in Item 13 on the Summary Sheet. The moisture content at time of pack will normally be between 13.5 and 14.0% for all-purpose and most types of whole-wheat, graham, etc., flours. Self-rising flour will be about 0.7% lower in moisture content (between 12.8 and 13.3%). If there is no lot code, assume a moisture content of 13.75% at the time of pack for all-purpose and all types of whole-wheat flour; 13% for self-rising flour.

Subtract the moisture content value at the time of test from the moisture content at time of pack:

$$\text{Moisture loss} = \begin{array}{r} \text{moisture content} \\ \text{at pack} \end{array} - \begin{array}{r} \text{moisture content} \\ \text{at time of test} \end{array}$$

This is the amount of moisture lost by the flour during distribution. Record the moisture loss in Item 14 on the Summary Sheet.

For example, if the moisture content at time of pack was reported to be 14% and the moisture content at time of test is 11%, the moisture loss is 14% - 11%, or 3%. A moisture loss of 1% translates directly into a weight loss of 1%. If you are testing 2-lb packages of flour, a 3% moisture loss is a weight loss of 2 lb x 0.03 or 0.06 lb. Calculate the weight loss for the lot under test by multiplying the percentage moisture loss by 0.01 (to convert it to a decimal) and then by the labeled weight (to convert it to pounds.) See Summary Sheet for calculation. Record the weight loss in Item 15 on the Summary Sheet.

¹Both packages opened for tare may be sampled for moisture determination, if desired.

²Each State has been sent this information and the Milling Directory as further sources for packager contacts. Available from NBS, OWM or the Millers' National Federation (600 Maryland Ave., Suite 305 W., Washington, DC 20024; Tel: (202)484-2200).

For example, if a moisture loss of 3% is found for a 2-lb lot of flour, this is a weight loss of 0.06 lb ($2 \text{ lb} \times 3 \times 0.01$).

If the moisture loss (in item 15) is equal to or larger than the amount of shortage found for the average error (in item 9), then the lot can be accepted. If the moisture loss is less than the average shortage, then the lot should be rejected and further enforcement action taken.

For example, assume the average package error for a 2-lb lot of packages is 0.05 lb. If a moisture loss of 3% is found, the weight loss of 0.06 lb ($2 \text{ lb} \times 0.03$) is more than the amount of shortage (0.05 lb), therefore, the lot would pass the average requirement. Record this in Item 16.

Similarly, if any individual minus package errors exceed the MAV and place the lot into the gray area, add the amount of weight lost due to moisture loss (Item 15) to the largest individual minus package error (recorded in Item 10). If the resulting package error is still larger than the MAV (see Table 3-3, third column), the lot should be rejected. If the resulting package error is smaller than the MAV, the lot should be accepted. Record this in Item 17.

For example, if the largest individual package error for a lot of 2-lb packages is -0.08 lb, this puts the lot into the gray area, even if the average package error is zero or plus. If a moisture loss of 3% is found, the weight loss of 0.06 lb added to the individual package error makes the package error -0.02 lb ($-0.08 \text{ lb} + 0.06 \text{ lb}$). The MAV for 2-lb package lots is -0.07 lb, so this lot passes if the average is zero or plus.

3.17.4. Moisture Content Laboratory Test

a. Equipment

- o Forced-air (or equivalent) laboratory convection oven
- o Desiccator and drying agent
- o Analytical balance
- o Drying dishes with covers
- o Calibrated thermometer
- o Tongs or insulated gloves

b. Procedure

1. Set oven to 130 ± 3 °C. Let temperature stabilize.
2. Weigh at least three empty drying dishes and covers for each lot of flour being tested (that is, run a triplicate).
3. Weigh covered dishes with about 2 g flour in each one.
4. Uncover dishes, place them in the oven.

5. Start timing for one hour from the time the temperature returns to 130 °C.
6. Cover the dishes, transfer them to a desiccator, and weigh after the dishes return to room temperature.
7. Compute the moisture content (%) =
$$\frac{\text{flour weight before drying} - \text{flour weight after drying}}{\text{flour weight before drying}} \times 100$$
8. Average the results on three dishes for each lot.

Exchange samples with flour milling plant in order to determine whether their laboratory results are equivalent to yours.

3.18. Meat and Poultry from Federally-Inspected Plants

3.18.1. Background for Administrator and Inspector

These test procedures are for meat and poultry coming from Federally-inspected plants. If inspectors check these packages at wholesale or retail, and use Category A sampling plans from H-133 and either unused or dried used tare (see Section 3.18.3.5. for definition), the tested packages are either in or out of compliance: there is no gray area. If a jurisdiction uses wet tare (see Section 3.18.3.5. for definition), there is a "gray" or "no-decision" area. **The gray area is not a tolerance. If packages are found in the gray or no-decision area, they neither automatically pass nor fail the test. If lots are tested and found inside the gray area, they are not necessarily in compliance. The jurisdiction will have to do more work to find out the final status of the lot.**

The size of the gray area is defined as a percentage of the labeled weight that extends downward from the labeled weight.

a. Enforcement action inside and outside the gray area

The overall objective is to test packages as closely as possible to a routine test. However, one difference will immediately be apparent:

Category A sampling procedures must be employed at retail or wholesale locations when testing packages put up in a Federally-inspected plant. (This is because a test similar to a Category B test has already been run on the packages at the plant level.)

Category B sampling procedures may be used when testing at the packaging plant.

b. "Dry Tare" Jurisdictions

For jurisdictions that normally utilize unused tare to test meat and poultry packaged at a retail store, it will be necessary to simulate unused tare for packages from Federally-inspected plants by drying out absorbent materials (if any) comprising the used tare and to determine a "dried used tare".

No additional information will be needed other than the results of a Category A test using "dried used tare" before taking enforcement action on lots.

c. "Wet Tare" Jurisdictions

For jurisdictions that normally use wet tare, if the package lots are found short weight with wet tare tests, but fall in the "gray area", it is necessary to collect additional information to determine whether or not the lot complies with net weight requirements.

If the package lots are found short weight using a Category A sampling plan and wet tare, it will first be necessary to determine whether the lot is inside or outside the gray area. If the lot falls in the gray area, additional information will have to be collected before reaching a final determination whether the lot is in or out of compliance. Of course, nothing additional will be needed for lots that fall outside the gray area. Appropriate enforcement should be taken on packages found short weight and outside the gray area.

A "hold" or a "stop sale" order should be put on packages found short weight, but inside the gray area, until their status can be determined. If this is not possible, the strongest legal remedy should be sought if the product cannot be held and subsequent tests or information indicates that the lot is out of compliance.

d. Which packages to consider as part of the lot being tested

Ordinarily, an inspector taking a sample from retail will record lot codes, but will not select the lot for test by sorting the packages by lot code. He or she will simply select a sample from all packages of the same brand and style and size on the shelf or in the stock room. If short weight is found and the results are in the gray area (wet tare only), follow-up investigation requires sorting the lot codes at this point.

e. Category A sampling plans must be used for all tests

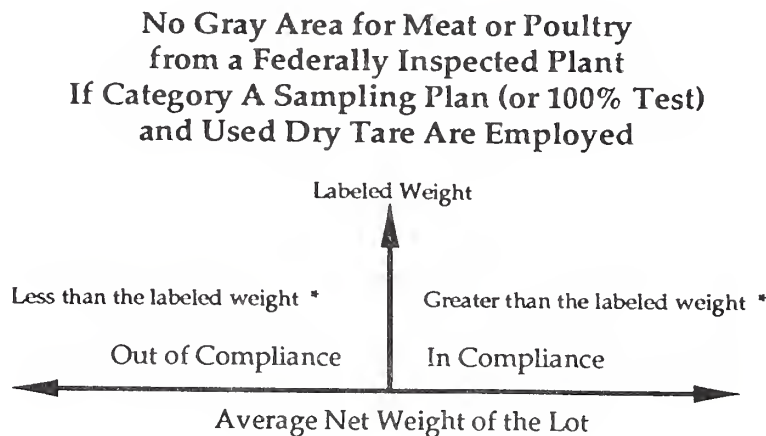
See Section 3.18.3. for details. The discussion below is based on using these procedures and on recording the "package errors" -- how much and in what direction the actual package weight differs from the labeled weight. Thus, if a package labeled 2 lb actually weighs 2.010 lb, its package error is +0.010 lb. Similarly, the "average package error" is the difference between the average weight of the sampled packages and the labelled package weight. If the average of 10 package weights is 1.994 lb, the average package error is $(1.994 - 2.000 \text{ lb}) = -0.006 \text{ lb}$.

f. Package lots must meet the average requirement and the individual requirement

When checking packages not subject to possible moisture loss and using Category A sampling plans, two requirements must be met:

- (1) The average net weight of the sample must equal or exceed the labeled net weight minus an adjustment factor called T ,¹ which represents the possible deviation between the sample average and the actual lot average.

If a jurisdiction applies either unused or used dried tare to meat and poultry packages, this is sufficient to determine whether the average requirement has been met. See Figure 3-15.



* When following a Category A Sampling Plan, the sampling factor T must be computed and applied to the average error of the sample.

Figure 3-15.

If a jurisdiction uses wet tare, an amount defined by the gray area must be considered before determining noncompliance of the lot under test without further information or data collection. See Figure 3-16.

The size of the gray area has been set at 3% of the average labeled weight for raw, fresh poultry, and 2-1/2% of the labeled weight for franks and hot dogs (whether made from meat or poultry).

¹See the general discussion of T in Chapter 2 and in NCWM Training Module 10.

- (2) The number of packages that may fall below the MAV is specified in Category A sampling plans according to the sample size. Ordinarily, the inspector uses Table 2-8 to look up the MAV for packages labeled by weight.

USDA Meat and Poultry Inspection uses a different set of MAV's for products under its supervision. These are given in Table 2-12. Use Table 2-12 for all products coming from a Federally-inspected plant, instead of Table 2-8.

The size of the gray area must be added to the individual package limits specified in Table 2-12 when the jurisdiction uses wet tare.

Gray Area for Poultry or Hot Dogs from a Federally Inspected Plant Using Wet Tare

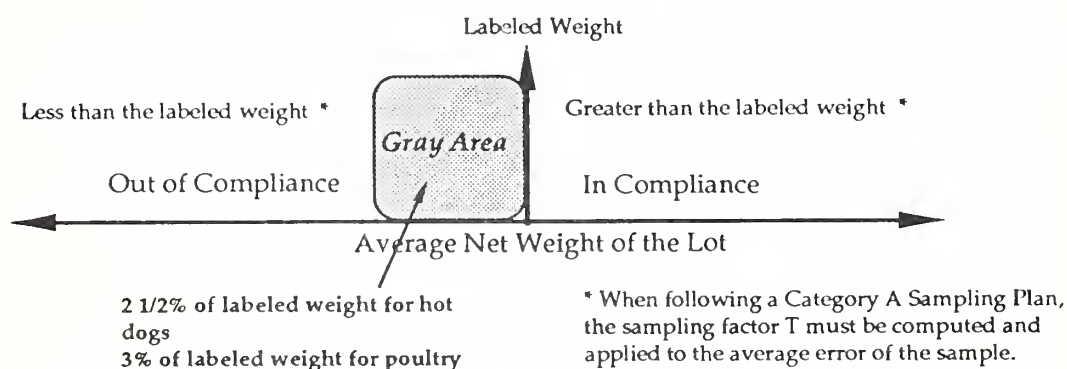


Figure 3-16.

g. What to do when the lot is in the gray area ("Wet Tare" Jurisdictions Only)

Contact the USDA Regional Director or the Inspector-in-charge at the packaging plant (see Section 3.18.3.h.) to determine what information (either USDA's or the plant's) is available at the plant to clarify the status of the lot in question. General guidelines are given in Section 3.18.3.h.

According to the location of the plant, either visit the plant, or call and ask the weights and measures authorities where the plant is located to visit and test.

3.18.2. Types of Products

a. Bacon

There should be no free-flowing liquid in packaged bacon (otherwise the product is subquality). Wet tare and dried used tare are equivalent. Wipe all packaging materials dry of fat and clinging moisture before weighing tare. There is no gray area for bacon.

b. Fresh Sausage and Luncheon Meats

There is no gray area for fresh sausage or luncheon meats (for example, bologna). Carefully clean and wipe all tare materials. Wet tare and dried used tare are equivalent.

c. Franks/Hot Dogs

A gray area of 2-1/2% of the labeled weight is to be applied when wet tare tests are conducted.

d. Fresh Poultry

A gray area of 3% of the average labeled weight of the sample is to be applied when wet tare tests are conducted.

3.18.3. Procedure

a. Field Equipment

Use Scales and Weights recommended in Section 3.1.

b. Report Forms

Use either the Standard Pack-Weight Only-Report Form (page A-2) or the Random Pack Report Form (pages A-3 and A-4). Record the official establishment number from the USDA logo in the space provided underneath name and address.

c. Selection of Lots

Refer to Section 2.3. for defining and selecting the inspection lot. The lot codes are the packer's own identifying marks, not the universal product code (UPC). In many instances, the lot code may be represented by a "pull" or "sell by" date. Record the lot code(s) on the report form.

d. Sample Size

Select the sample according to the size of the inspection lot following a Category A sampling plan (Table 2-2, page B-3). Do not sort random-pack packages from lightest to heaviest as recommended in Section 3.8.1., step 2.

e. Tare

Select the tare sample as given in Table 2-2.

(1) Unused or Dried Used Tare

Unused tare material is rarely available at retail or wholesale locations for package lots packaged at Federally inspected plants. The tare weights printed on the shipping containers may not be accurate. Therefore, it is necessary for the inspector to reconstruct an unused tare weight by drying the used tare and weighing it. The following technique should be followed to get "dried used tare":

A fresh poultry package will be used as the example.

Shrink Wrap: Open package shrink wrap, remove wrinkles from heat-seal area as much as possible, and wipe or pat dry with paper toweling or other suitable material.

Tray: If tray is foam or plastic, rinse tray and wipe or pat dry. If tray is paper or cardboard, pat dry between sheets of toweling and lay tray on heating element of prepack scale or heat in microwave oven to dry. Depending on the power of the oven, total times between 2 and 5 minutes may be necessary. Frequent short bursts of power (30-sec intervals), checking after each cycle, are better than a single 5-minute run. (The trays can burn if too long a cycle is used to dry.) Let the tray cool and become dry to the touch before final weighing.

Soaker Pad: Many soaker pads are composed of plastic sheets laminated with fibrous paper tissue. Peel the plastic sheeting away from the tissue (if possible), press the tissue between sheets of paper toweling, and dry the tissue on the heating element of the scale or in a microwave as described above for a paper tray. Wipe or pat the plastic sheeting dry and weigh it with the cooled tissue pad, tray, shrink wrap, and label. Do not attempt to rinse soaker pads--they will often disintegrate if loaded with water.

Depending on the surface area of the microwave oven tray and the size of the soaker pads, do not load more than two to five tare pads in a microwave at one time and do not stack them. Stacking or loading too many pads at one time will take more oven time and power, increasing the possibility of burning or charring the pads.

What a package should weigh using unused or dried used tare

Add the average "dried" tare weight to the labeled net weight to determine what the package is supposed to weigh -- the "nominal gross weight".

average tare weight + labeled weight = nominal gross weight

Package errors using unused or dried used tare

Use the package checking scale to compare the packages in the sample with the nominal gross weight. A package that weighs more than the nominal gross weight is overweight and has a "plus package error"; a package that weighs less than this is underweight and has a "minus package error".

package error = package gross weight - nominal gross weight

Go to Section 3.18.3.f. on the average requirement.

(2) Wet Tare

Determining the Net Weight

All free liquid is part of the wet tare. To avoid destroying too many packages:

- (a) gross weigh two packages opened for tare,
- (b) weigh solids inside,
- (c) get wet tare by subtracting solids weight from gross weight,
- (d) average wet tare weight + labeled weight = nominal gross weight.

Use the alternative tare procedure (Section 2.11.4.) to determine whether to open more packages (i.e., whether the tare is too variable).

(Packages opened for a wet tare test may be rewrapped by the supermarket as long as the USDA logo does not go on the package. The supermarket may wish to contact the original packager if it intends to leave the brand name on the product on it when repackaging.)

Determining Package Errors

If individual package net weights were measured:

Package error = package net weight - labeled net weight

A package that weighs more than the labeled weight is overweight and has a "plus package error". A package that weighs less than the labeled weight is underweight and has a "minus package error".

If an average tare weight and nominal gross weight were determined:
 Package error = package gross weight - nominal gross weight

f. The Average Requirement

Compute the average error for the sample. Sum all individual package errors and divide by the number of packages in the sample. Record the average package error in box 18 on the standard pack report form or box 20 on page 2 of the random pack report form.

If the average error is zero or plus, the lot complies with the average requirement.

If the average error is minus, first compute T^1 (see Section 2.7, in this handbook and Chapter 6 of the Inspector's Manual in Module 10 for further instructions if this procedure is unfamiliar to you). Record T on the report form, and continue with subsections (1), (2), or (3) below as appropriate.

(1) Unused or Dried Used Tare

With dried used tare, if the average minus error is larger than T , the lot does not comply with the average requirement; enforcement action should be taken. Also, follow the process outlined in Section 3.18.3.7.

(2) Wet Tare - Fresh Poultry

- (a) Compute 3% of the average labeled weight.

$$\text{average labeled weight} \times 0.03 = \text{gray area}$$

There is space below column 8 of the Random Pack Report Form to compute the average labeled weight of the sample.

- (b) Record this in the comments section as "gray area."
- (c) If T was computed, add the gray area to T , calculated and recorded on page 2 of the random pack report form. Record in remarks section as "gray area + T ".
- (d) Compare value in box 20 with "gray area + T ".
- (e) If the value in box 20 is larger than the "gray area + T ", the lot fails to comply. (Since box 20 will always have a minus value - - or else you would not have calculated T --, disregard the sign when comparing with gray area + T .) If the value in box 20 is between T and the gray area + T , go to Section 3.18.3.8. If the value in box 20 is less than T , the lot complies.

¹Unless the lot is so small that the inspector is testing all packages in the lot (100% test). If this is the case, and the average error is minus, the lot fails if it is a dried used tare test; the lot may be in the gray area if it is a wet tare test.

(3) Wet Tare - Hot Dogs or Franks

- (a) Compute 2-1/2% of the labeled net weight recorded in box 1 of the standard pack report form.

(value in box 1) x 0.025 = gray area (lb or oz)

- (b) Convert to dimensionless units by dividing by the unit of measure in box 2.

$$\frac{\text{gray area (lb or oz)}}{\text{box 2}} = \text{gray area (dimensionless units)}$$

Record this in comments section as "gray area".

- (c) Continue with (c), (d), and (e) as for Subsection (2), Wet Tare - Fresh Poultry.

g. The Individual Package Requirement

Table 2-12 gives the limits for individual package errors for packages produced at Federally-inspected plants. Use this table instead of Table 2-8 for looking up the MAV. The number of individual minus package error permitted to be larger than the "lower limit for individual weights" (see the righthand column of this table) is given in Table 2-2 (page B-3). Convert this value (or values if a random pack lot falls between groups) to dimensionless units and record on the report form.

When conducting a dried used tare test, compare the value(s) from Table 2-12 (converted to dimensionless units) with the minus package errors. If the number of minus package errors that exceed the limits of Table 2-12 is more than allowed by the Category A plan being followed, the lot does not comply.

Wet Tare

When conducting a wet tare test on hot dogs or fresh poultry, the size of the gray area must be added to Table 2-12 value(s) before counting the number of packages that exceed the MAV. In Section 3.18.3.f, the size of the gray area (in dimensionless units) was recorded in the comments area of the report form. The values from Table 2-12 are recorded in boxes 10 and 11 on the random pack report form and box 4 on the standard pack report form. Add the size of the gray area to the value(s) from Table 2-12 (converted to dimensionless units) before comparing with the minus package errors.

If the number of minus package errors that are greater than (Table 2-12 + the gray area) exceeds the number permitted in Category A plans, the lot does not comply. If minus package errors fall between the Table 2-12 value and (Table 2-12 + the gray area), they place the lot in the gray area if the number of these types of minus package errors exceeds the number permitted in Category A plans.

h. What to Do When the Lot Is in the Gray Area

Although the following discussion is intended primarily for those jurisdictions using wet tare for meat and poultry, any jurisdiction is encouraged to follow these procedures when product from Federally-inspected plants fails to comply with net weight tests.

The "Meat and Poultry Inspection Directory" is available from the USDA Regional Offices listed below:

Regional Offices	States or Territories
Western Regional Office 620 Central Avenue, Bldg. 2C Alameda, CA 94501 415/273-7402	Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, Oregon, Utah, Washington, Wyoming, North Dakota, South Dakota, Samoa, and Guam
Southwestern Regional Office 1100 Commerce Street Dallas, TX 75242 214/767-9116	Arkansas, Kansas, Louisiana, Missouri, New Mexico, Texas, and Oklahoma
North Central Regional Office 607 E. Second Street Des Moines, IA 50309 515/284-4042	Illinois, Indiana, Iowa, Michigan, Minnesota, Nebraska, Wisconsin, and Ohio
Southeastern Regional Office 1718 Peachtree Street, NW Atlanta, GA 30309 404/881-3911	Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, West Virginia, Puerto Rico, and the Virgin Islands
Northeastern Regional Office 1421 Cherry St., 7th Floor Philadelphia, PA 19102	Connecticut, Maine, Maryland, Massachusetts, Delaware, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia, and the District of Columbia

Meat and poultry packaging plants are listed by "establishment number". Use the establishment number on the package to look up the location and telephone number of the plant. A separate number is sometimes provided for the USDA Inspector-in-charge. If the establishment number is not listed in this directory (since new businesses, established after the directory was published, may not be listed in the directory), call the Regional Office to get the telephone number(s) of the plant and the appropriate USDA official for the plant in question.

Contact the appropriate USDA official to determine what information is available on the lot in question (see subsection (1) below). If a lot of hot dogs or fresh poultry has been tested using wet tare, any average package error that is minus and larger than T may place the lot in the gray area.

(1) Further Information

Ask the USDA official:

- (a) Whether the plant is operating under a "Total or Partial Quality Control Program" (TQC or PQC).
Some plants operate under a Federally approved "Total or Partial Quality Control Program". If such a program is in place, records on the lot in question will be maintained by the establishment, not by USDA. If the establishment is not operating under a TQC or PQC Program, USDA may or may not have tested the lot in question. The USDA official will be able to tell you what information he has, as compared with information that may be available from the plant personnel.
- (b) What information is available from USDA concerning the particular lot in question.
 - How many packages are tested at what time intervals?
 - How many packages are produced in that time interval?
 - What criteria are employed to decide when adjustments to the net weight are required?
 - What were the net weight checks on the lot in question?
 - What adjustments were made to the target weight?

If USDA has data on the specific lot in question or if there is an approved TQC or PQC program producing data on the lot, this data may serve to substantiate that the lot complied with net weight requirements when it left the plant. If data on the specific lot in question were not collected by USDA or under an approved QC program, the weights and measures test results are the only regulatory agency data on the lot. In this instance, the weights and measures authority should take whatever action is deemed appropriate; USDA has no data to dispute the weights and measures findings.

- (c) What scale maintenance and testing program is in place in the plant.
- (d) What tare verification system is in place in the plant, including how the tare is determined, how often it is monitored, how it is verified when new tare materials are delivered.
- (e) What kind of net weight verification or testing (and how often) the USDA official conducts.
- (f) Who are the establishment personnel to contact to review establishment-maintained records on the lot in question.

(2) Test Packages and Scales at the Packaging Plant

Optionally, make arrangements to visit the plant or call the weights and measures jurisdiction where the plant is located. Discuss the net weight control program with plant quality control personnel, check their scales (if possible), and test packages. Even though it is not possible to test the lot in question at the plant, it may be possible to establish confidence in plant process and weight control procedures.

Note the type of scales used to monitor the fill weights of the packages. Ask to test the scales. (This may be disruptive during a production run.)

Test a sample of packages from the line or storage area using H-133 Category B sampling procedures plus the Table 2-12 values for individual packages. Since you are at the packaging plant and no distribution has occurred, there is no gray area to consider at this point. Due to the large number of packages in the lot when testing at the plant, the sample size will usually be 30 packages. Ask the USDA inspector if he will conduct a test using his procedures and equipment on the same lot.

(3) Other Optional Information Available from the Packer

When testing at the packaging plant, this is the appropriate time (or it may be necessary to explore the issue by telephone) to get some optional information:

- How many packages are produced in a single production run? How much of the plant's production does each lot code represent (a single line's run, 8 hours/24 hours production, etc.)?
- What is the target weight for each label? How is this value set? (This will be considered confidential information.)
- What scales or other measuring equipment and procedures are used to measure or control the package net weights (checkweighers; line supervisor weighs a package every hour, etc.)?
- How quickly can adjustments be made to package fill targets that are found out of bounds?
- How often are the scales tested; who does the testing (yearly service call; quality control supervisor on a daily basis, etc.)?
- How does the plant determine the tare weight, how often does the plant change the tare weight, what does the plant do with tare information? (For example: actual tare unit used and changed whenever new shipment of tares sent; average weight to closest 0.01 lb is added to target weight; etc.)

- Does the packager report different tare weights to different areas of his market? (For example: wet tare values, unused tare values, something in between.) How are these determined?
- What variation in package weights from the labeled declaration does the line or plant normally encounter? (Ask them to show you or send copies of their records. These records are proprietary and may be available only for viewing.)
- What are the details of the PQC or TQC program if they are operating one? (Again, this may be proprietary information.)

CHAPTER 4. METHODS OF TEST FOR PACKAGES LABELED BY VOLUME

- 4.1. Measuring liquid volumes
- 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. Mulch
- 4.13. Solids or semisolids
- 4.14. Goods labeled by capacity
- 4.15. Ice cream novelties

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).¹ For products sold unrefrigerated, the reference temperature is generally accepted as 68 °F (20 °C).² The reference temperature for beer is 39.1 °F.³ The reference temperature for distilled spirits is 60 °F,⁴ and for wine is 68 °F (20 °C).⁵

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. This does not mean that the inspection official must equilibrate the entire sample at the reference temperature. It does mean that the official should be aware of the effects of temperature on volume and minimize these effects. The following discussion describes the magnitude of these effects.

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 °F (4 °C) and a larger volume at 0 °F (-18 °C) than their volume at 40 °F (4 °C).

²21CFR§101.105(b)(ii).

¹16CFR§500.8(b). See also the definition for petroleum products in Appendix C and in the Uniform Regulation for the Method of Sale of Commodities, NBS Handbook 130, "Uniform Laws and Regulations," latest edition, available from the U.S. Government Printing Office.

²16CFR§500.8(b); 21CFR§101.105(b)(iii); 40CFR§162.10(2); 21CFR§201.62(b); 21CFR§701.13(b)

³27CFR§7.10

⁴27CFR§5.11

⁵28CFR§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 only important to maintain 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 °F weighs 8.322 lb, but weighs 8.320 lb at 70 °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 °F difference in product temperature is enough to account for a 0.002 lb difference in the weight of one gallon.

a. Preparation of Flasks

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.

b. Product Does Not Need to Be at the Reference Temperature

If volumes are determined on products at temperatures higher than their reference temperature of 60 or 68 °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

¹Weighed in air.

²Alternatively, 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.

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.¹

4.2. Equipment for Liquid Volume Determinations

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

Volumetric Measures - 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,² 500 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.³

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.

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

Defoaming agents 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

¹This is also true for malt beverages (e.g., beer).

²250-milliliter may be used also.

³Flask 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).

- o Antifoam B¹
Dow-Corning Corporation
Midland, Michigan

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

Bubble level

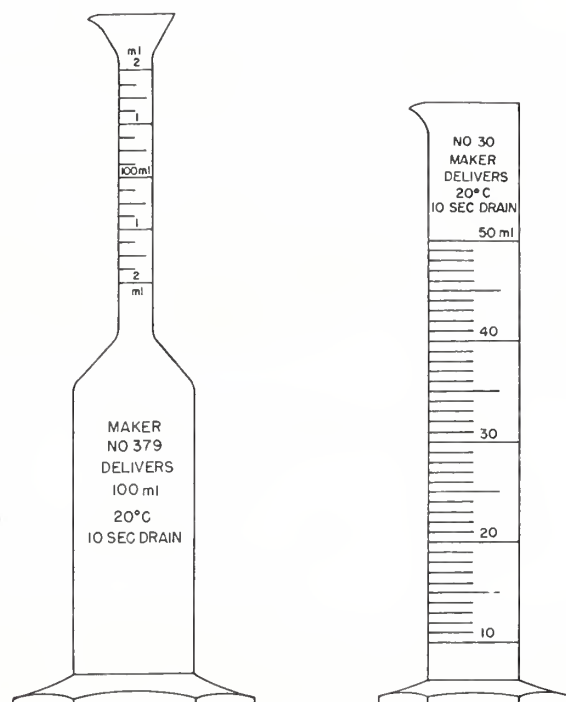


Figure 4-1. Standard measuring flask and graduate for test packages labeled in metric units of volume.

4.3. Using Liquid Volumetric Measures

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

- (i) Gravimetric measurement. An amount of product (not necessarily 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

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.

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) Volumetric measurement. 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.

a. 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

b. 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 "wetdown" condition.

c. 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

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).

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

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.]

d. 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 (not with liquid from the package) 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.

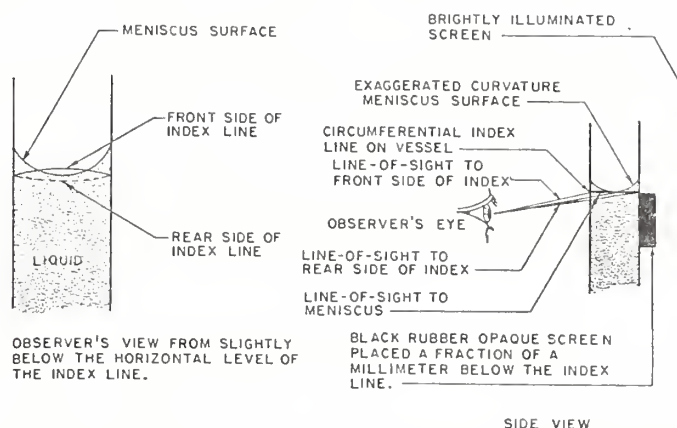


Figure 4-2. Reading the liquid level on the neck of a flask.

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 production 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 production lot included in the sample. 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. See pages H-4, H-5, and H-6 for a completed example.

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 in terms of fluid ounces 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.

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.
4. Empty, clean, and dry the package container. Weigh the package container and record this weight in item 2 of the worksheet.

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 used in order to determine whether the scale is sensitive enough to detect individual package errors.

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 a 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.

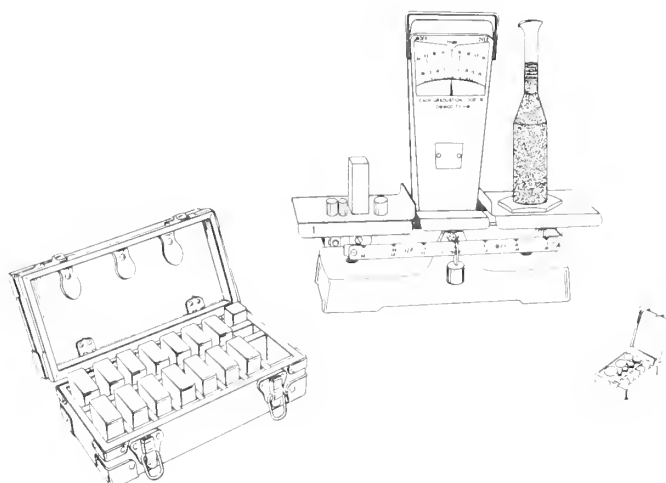


Figure 4-3. Weighing a known volume of liquid.

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. After subtracting the weight of the empty flask, the weight of 32 fl oz of the liquid is found to be 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. Standard Pack Liquids Labeled by Liquid Volume: General Method, Part 2, Using the Weight of the Labeled Volume

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 =

$$\frac{\text{average weight of known volume} \times \text{labeled volume}}{\text{known volume}}$$

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. See a completed example on pages H-10, H-11, and H-12.
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. (Remember that a separate tare sample may be selected from the lot if there are enough packages. For example, if the sample size is 10 and tare sample is 2, 12 packages may be selected from the lot. Then, the package errors for the two packages opened for tare do not have to be computed. The nominal gross weight can be used to compare with the 10 unopened packages selected as the sample. This will save calculation time.)

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:

$$\text{MAV (weight)} = \text{MAV (volume)} \times \frac{\text{average weight of labeled volume}}{\text{labeled volume}}$$

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. Method A: Determining the Volume at the Liquid Level of 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).

a. Equipment

Micrometer depth gage (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.

¹The rods will have to be custom ground.

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

b. 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.
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. Method B: Measuring the Weight of a Known Volume for 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 within the container, this method uses the weight of a known volume to calculate the weight of the labeled volume for each package. 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.

a. 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.

b. 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 =

$$\frac{\text{weight of known volume (from package 1)} \times \text{labeled volume}}{\text{known volume}}$$

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) =

$$(\text{gross weight}) - (\text{tare weight} + \text{weight of labeled volume})$$

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) =

$$(\text{package error in units of weight}) \times \frac{\text{labeled volume}}{\text{weight of labeled volume}}$$

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: $(2.245 \text{ lb}) - (0.075 \text{ lb} + 2.156 \text{ lb}) = +0.014 \text{ lb}$. In units of volume, the package error is $(+0.014 \text{ lb}) \times (32 \text{ fl oz}) / (2.156 \text{ lb}) = +0.21 \text{ fl oz}$.

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. Method C: Measuring the Volume Delivered from the 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 below.] 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.

a. 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:

$$\frac{(\text{wet container} - \text{dried container weight}) \times \text{known volume}}{\text{weight of known volume}}$$

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

b. 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:

$$\frac{\text{weight difference (step 12)} \times \text{labeled volume}}{\text{average weight of labeled volume (step 8)}}$$

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

$$\frac{\text{weight difference (step 12)} \times \text{labeled volume}}{\text{weight of labeled volume for each package}}$$

(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 report form (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.

c. 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

$$\begin{aligned} &= 32 \text{ fl oz} + 8 \text{ fl oz} - 1/16 \text{ fl oz} \\ &= 39.9375 \text{ fl oz delivered.} \end{aligned}$$

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.

Therefore, the total product volume is:

$$39.94 \text{ fl oz} + 0.18 \text{ fl oz} = 40.12 \text{ fl oz}$$

The package error is:

$$40.12 \text{ fl oz} - 40.00 \text{ fl oz} = +0.12 \text{ fl oz}$$

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. except that the selected flask may be equal in volume to that declared on the milk container.

4.7.1. Summary

Sections 4.4. and 4.5. are followed except:

- a. 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.
- b. 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.

4.7.2. 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 define the 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. Keep temperature of tare sample and flasks as close as possible to 40 °F. 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. Open second package and add milk if 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.
6. 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.

Chapter 4

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. Every package in the sample must be opened.

4.8.1. Equipment

Volumetric measures recommended in Section 4.2.

Plastic disks (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 retailer; 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.

Micrometer depth gage (ends of rods fully rounded), 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.

Paint solvent 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.

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

Rubber spatula.

Bubble level.

Optional: Micrometer.

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.

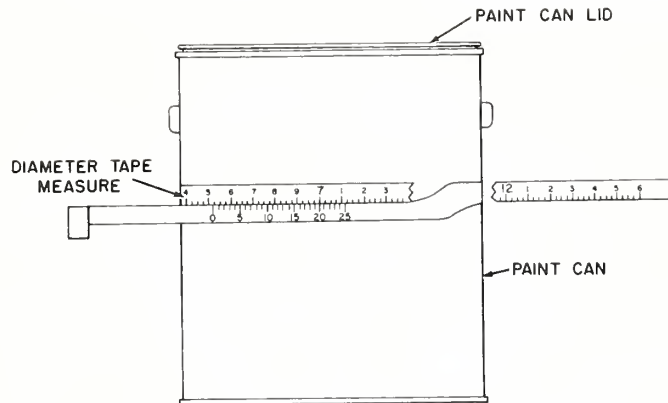


Figure 4-4. Measuring the diameter of a paint can.

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, therefore, is 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 followed), 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.

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.

6. Place the spanning bar and depth gage across the top of the paint can as shown in Figure 4-5.

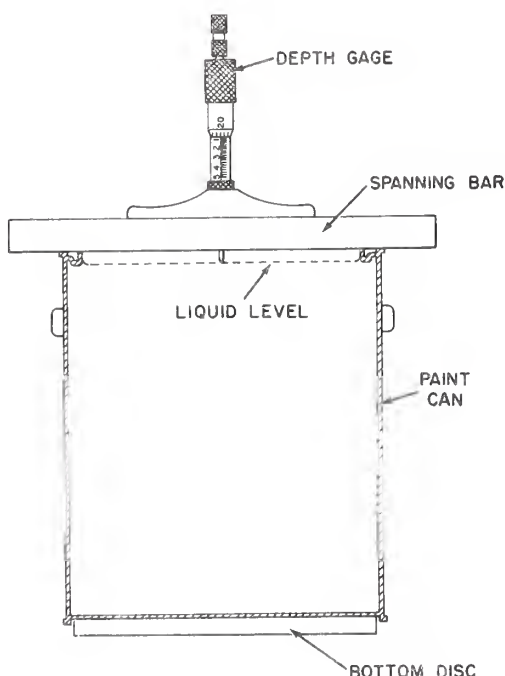


Figure 4-5. Measuring the distance to the liquid level.

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.

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.

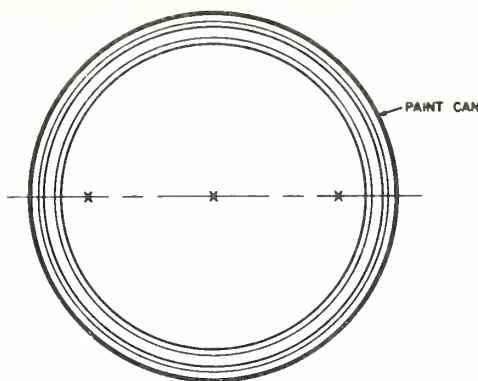


Figure 4-6. Top view of paint can showing locations at which depth measurements are made.

8. Subtract the average distance to the liquid level (column 7 of the worksheet) 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:

$$\begin{aligned}\text{Volume} &= 0.7854 D^2 H \\ &= 0.7854 \times D \times D \times H\end{aligned}$$

Where D = average liquid diameter (column 6 of the worksheet) 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.

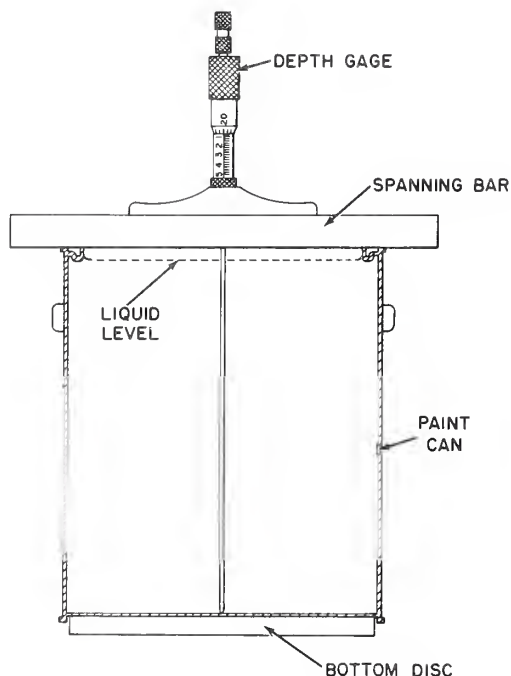


Figure 4-7. Measuring the distance to the bottom of a container.

6. Place the spanning bar and depth gage across the top of the paint can. Measure the liquid level at the center of the surface and record the level in 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 amounts 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. In order to determine whether weighing can be used to test the other packages in the sample, follow only steps 7, 8, and 9 when no paint adheres to the lid.
7. Subtract the weight of the container (column 5) from the gross weight (column 2) to arrive at the net weight of paint in the selected container. Record the net weight in column 7 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 (for the first package opened for tare) =

$$\frac{\text{net weight (col. 7)} \times \text{labeled volume (col. 1)}}{\text{volume of paint in can (column 6)}}$$

Record this value in column 8 of the worksheet.

- 8a. Calculate the package volume =

$$\text{volume in can (col. 6)} + \frac{\text{labeled paint weight (col. 8)} \times \text{can volume (col. 6)}}{\text{net weight (col. 7)}}$$

Record it in column 9 of the worksheet.

9. Calculate the package error.

$$\text{Package error} = (\text{column 6 value}) - (\text{labeled volume})$$

- 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 (average of values recorded in column 8) plus the average tare (average of values recorded in column 3). 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 and every package in the sample must be opened. Follow steps 2 through 9a but skip steps 7, 8, and 9, if paint is adhering to the lid. Follow steps 2 through 6, and then step 9, if paint is not adhering to the lid.

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.

4.10.1. Equipment

Small-capacity scale and weights recommended in Section 3.1.

Pycnometer, 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".

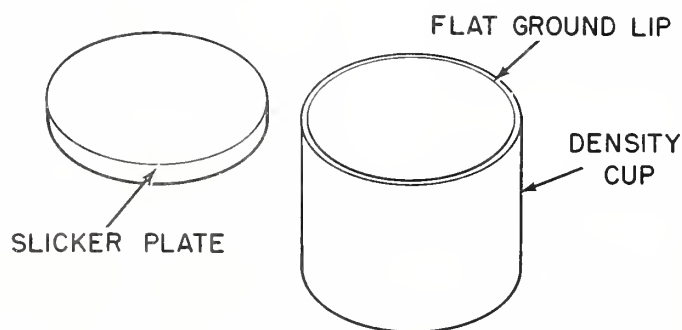


Figure 4-8. Empty density cup and slicker plate.

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.

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

Appropriate solvents (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.

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.

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 worksheet 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.

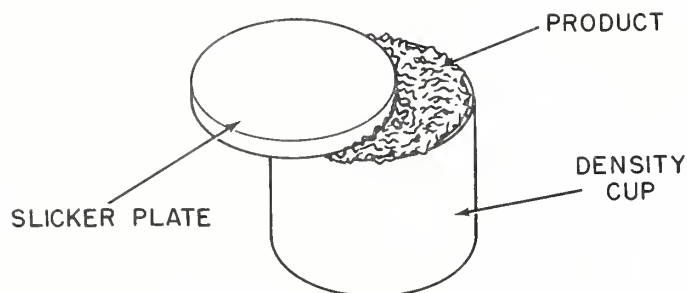


Figure 4-9. Density cup filled with product.

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

$$\frac{\text{Product weight in cup} \times \text{labeled volume}}{\text{density cup volume}}$$

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) =

$$\frac{\text{Package error (weight)} \times \text{cup volume}}{\text{weight of product in cup}}$$

[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.

4.11.1. Compressed Volume

Compressed volume can be estimated by measuring the dimensions of the compressed material or can be determined by submerging the package in water. The latter method will require:

- (1) sealing the package to make it watertight;
- (2) building a container with overflow spout large enough to contain the package. (See Section 4.15. for a small-volume displacement container.)

4.11.2. Volume After Sieving

The following method is for use in testing the volume declaration, including the volume that can be recovered from the compressed state. 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).

4.11.3. 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-m³ 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.

4.11.4. 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 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. Mulch

Mulch is defined in the Uniform Regulation for the Method of Sale of Commodities² as "Any product or material except peat or peat moss [see Section 2.4.] that is advertised, offered for sale, or sold for primary use as a horticultural, above-ground dressing; for decoration, moisture control, weed control, erosion control, temperature control, or other similar purposes."

4.12.1. Equipment

Construct a test measure using 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 at 1/2-inch intervals. Other interior dimensions are acceptable as long as the test measure approximates the configuration of the package under test (e.g., 12- by 12-inch cross section). Test measure height may also be reduced from 48 inches, but this will restrict the maximum size of package that can be tested. A lexan or plexiglass³ 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.

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.

²NBS Handbook 130, "Uniform Laws and Regulations," revised and printed each year by the U.S. government Printing Office.

³The use of brand names does not constitute an endorsement of the product.

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

Record each package error.

$$\text{Package error} = (\text{package net volume}) - (\text{labeled volume})$$

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.

NOTE: Some types of mulch are susceptible to clumping and compaction. Steps should be taken to ensure that the material is loose and free flowing when poured into the test measure. Gently rolling the bag before opening may reduce the compaction of material; using your hands to sift the material as it pours into the measure may also reduce clumping.

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 may be tested using kerosene or ice water 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 Graduate or volumetric flask of capacity larger than the labeled volume of package being tested.
- o Container with overflow spout of physical dimensions large enough to contain commodity, plus graduate or volumetric flask equivalent to labeled volume.

Thin wire.

Water or other fluid 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 spout. Open the first package and carefully 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.

Plastic Disks. 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.

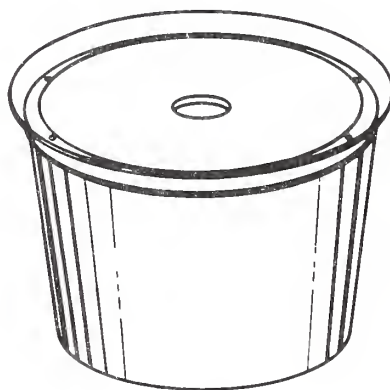


Figure 4-10. Plastic disk (beveled edge upward) inserted in the seat of a container to be tested.

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.

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

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.]

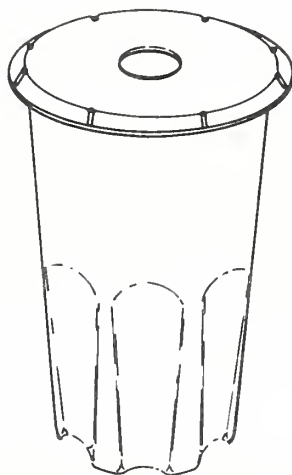


Figure 4-11. Disk in place for flush fill (or brim-full) capacity determination.

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 4-11.]
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 overflow 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.

4.15. Ice Cream Novelties

The following procedure is a volume displacement method derived from Section 4.13., using a displacement vessel specifically designed for ice cream novelties such as ice cream bars, ice pops, sandwiches, or cones. The method measures the volume of the novelty by measuring the amount of water displaced when the novelty is submerged in a displacement vessel. Two displacements per package will be required if the volume of sticks or cups must be subtracted.

In addition, two novelty packages under test are weighed to determine if the densities of the novelties are the same from package to package (in the same lot) in order to use a net weight check to determine if the labeled volumes are correct. If weighing can be used (see the worksheet on page A-13 and A-14 and the procedure in Section 4.15.2.), an average weight for the declared volume is computed from two packages, checking is completed by weighing. If weighing cannot be used to determine the volume, the displacement method must be followed for all packages in the sample.

4.15.1. Equipment

- o Scales and weights recommended in Section 3.1.
- o Displacement vessel of physical dimensions large enough to contain the commodity. One design¹ that can be constructed of clear plastic is shown in Figure 4-12. Its advantages are that the interior baffle reduces wave action when the novelty is inserted into the vessel, and the downward angle of the overflow spout reduces dripping. Other designs may be used.
- o Graduate larger than the labeled volume.

¹This displacement vessel can be constructed or obtained from Custom Design Products, 6527 Dickens Place, Richmond, VA 23230. (The use of firm names does not imply that they are endorsed or recommended by the Department of Commerce over similar products commercially available from other manufacturers.)

- o Thin wire, clamp, or tongs
- o Ice water maintained at 33 °F or below.
- o Freezer or ice chest and dry ice. Product must be maintained at 0 °F or lower.
- o Indelible marker (for ice pops only).
- o Single-edged razor or sharp knife (for sandwiches only).
- o Thermometer

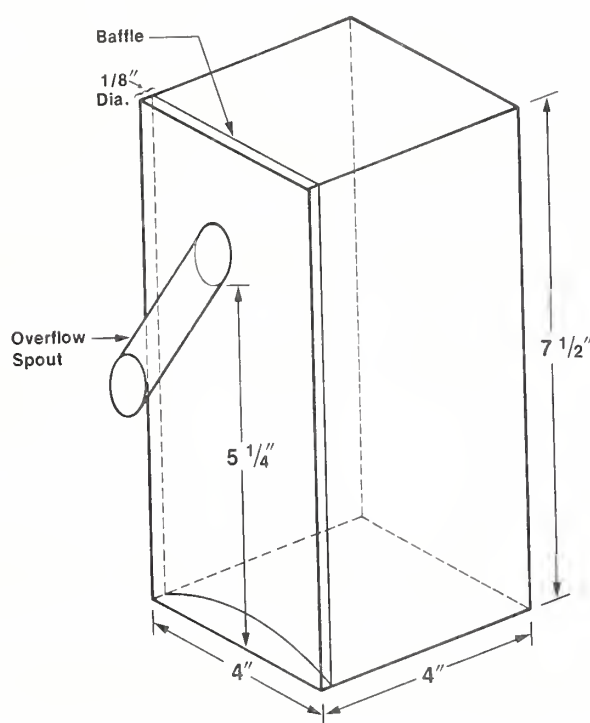


Figure 4.12. Displacement vessel for ice cream novelties

4.15.2. Procedure

1. Determine inspection lot, fill out the standard pack report form heading, page A-1, and select the random sample and tare sample. Place the sample in the freezer or ice chest until ready to test. Remove packages from the freezer one at a time.
2. Fill the displacement vessel with ice water until the water overflows the spout. Allow to sit until dripping stops. Place the graduate underneath the spout. Raise the displacement vessel as necessary so that the graduate fits beneath the spout.

3. Remove the first package from the freezer and gross weigh it. Record this weight on the Worksheet on page A-13 in item 1.

4. According to the type of novelty, prepare the product as follows:

Ice pop. Mark on the stick(s) with the indelible marker the point to which the pop will be submerged in the ice water.

Cone. Poke a small hole in the cone side wall below the ice cream portion.

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

Cup. Remove the cap from the cup. (After the cup and novelty contents have been submerged, the novelty will be removed from the cup to determine the volume of the cup alone.)

5. Carefully submerge each novelty until it is completely below the liquid level of the ice water in the displacement vessel.

Ice pop. Use a clamp, tongs, or your fingers to hold the stick(s) and submerge the pop to the level marked in step 4.

Cone. Shape the wire into a loop, and use it to push the cone head-first (ice cream portion first) into the ice water. Do not completely submerge the cone immediately; let water fill the cone through the hole made in step 4 before completely submerging the novelty. (See Figure 4-13.)

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

6. Record the volume of water in the graduate on the worksheet in the space beside item 4 labeled "Total water volume". For a cone or sandwich, this volume is the net volume of the package contents. Record the net volume for a cone or package contents. Record the net volume for a cone or sandwich in item 6 on the worksheet. For pops or cups, the volume of the stick(s) or cup must be subtracted to determine the net contents. See a. and b. below for pops, a. and c. below for cups.

- a. Refill the displacement vessel with water to overflowing. Empty the graduate and place it under the overflow spout.

- b. Ice pop. Melt the ice pop off the stick or sticks. Submerge the stick or sticks to the line marked in step 4. Record the volume of water displaced into the graduate on the worksheet in the space beside item 5 labeled "Volume of tare materials". This is the volume of the stick. The net volume for the ice pop is the volume recorded in step 6 minus (-) the volume in 6.b. Record

this volume on the worksheet in the space beside item 6 "volume of novelty".

- c. Cup. Remove the novelty from the cup. Rinse the cup, then carefully submerge it. (Making small pinholes in the base of the cup makes submersion easier.) Record the volume of water displaced into the graduate on the worksheet in item 5. This is the volume of the cup. The net volume for the novelty is the volume in step 6 minus (-) the volume in 6.c. Record this volume on the worksheet in the space beside item 6.

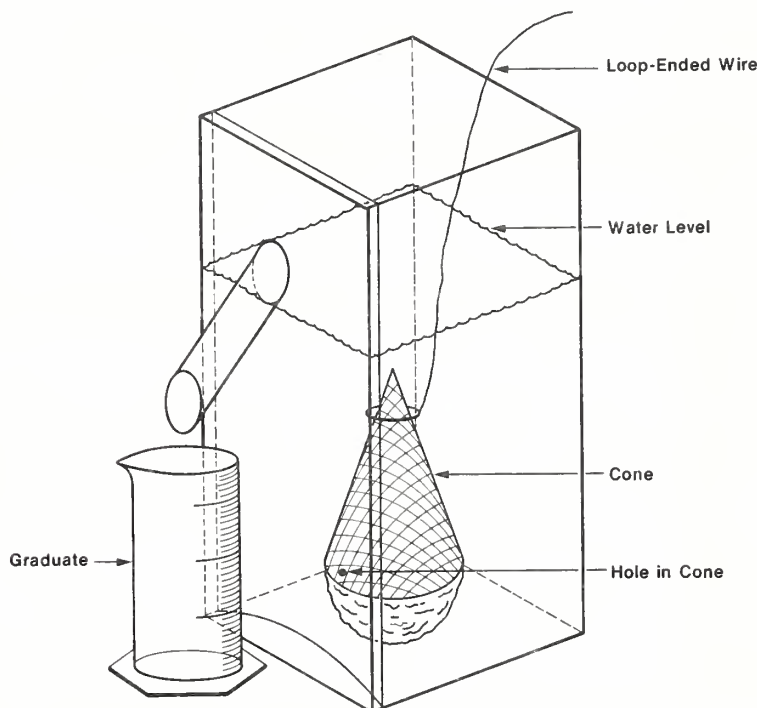


Figure 4-13. Using a looped-end wire to submerge a cone.

7. Clean and air dry the tare materials (sticks, wrappers, cup, lid, etc.). Weigh and record the weight of these materials for the first package on the worksheet beside item 2.
8. Subtract the tare weight from the gross weight and record on the worksheet in item 3.
9. Compute the weight of the labeled volume for the first package and record the result in item 7:

$$\text{weight of labeled volume} = \text{labeled volume} \times \frac{\text{weight in item 3}}{\text{volume in item 6}}$$
10. Repeat steps 3 through 9 for a second package.

11. Net weights and the weights of the labeled volume are computed in order to decide whether the novelties can be weighed to determine compliance with the volume declaration.

Determine whether the two weights recorded in item 7 differ from each other by more than the value in Table 4-3 (page B-20). (See item 8 on the worksheet.) If you check "no", go on to step 12. If you check "yes", compute the package error for each of the two packages by subtracting the labeled volume from the net volume for each package. Repeat steps 4 through 6 for each of the remaining packages in the sample to determine their net volumes and package errors. (No further weighing is required since package errors cannot be determined by weighing.)

12. Average the weights of the labeled volume for the first two packages (see item 8 on the worksheet.)
13. Determine the tare for the rest of the tare sample, if any additional tare sample packages remain. Record the tare weights on the worksheet. Average the tare weights and record the average tare on the worksheet in item 9 and on the report form.
14. Complete the package checking test by computing the "nominal gross weight", looking up the MAV, and converting the MAV to dimensionless units. Follow the worksheet, filling in items 10 through 12. (See steps 10 and 11 in Section 4.5., page 4-12, in which the procedure is described for standard pack packages labeled by liquid volume.)
15. Compare the weight of the unopened packages in the sample with the nominal gross weight, recording the package errors directly on the report form in the crosshatched area. Compare the minus package errors with the MAV. Average the package errors, and convert final results to units of volume as given on the worksheet in item 14. (See steps 7 through 12 in Section 3.6., the CORE METHOD, in which it is described for standard pack packages.)

CHAPTER 5. METHODS OF TEST FOR PACKAGES LABELED BY COUNT, LINEAR MEASURE, 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, LINEAR MEASURE, 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.

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).

¹The NCWM MoS appears in NBS Handbook 130, "Uniform Laws and Regulations" and is printed annually by the U.S. Government Printing Office.

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, or
 - 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

$$= \frac{\text{labeled count} \times \text{weight (step 3)}}{\text{count (step 3)}}$$

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) =

$$(\text{actual package gross weight}) - (\text{nominal gross weight})$$

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:

$$\text{Package error (count)} = \frac{\text{Package error (weight)} \times \text{labeled count}}{\text{labeled count weight (step 4)}}$$

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-7 and A-8 guide the inspector through the procedure. See pages H-14, H-15, and H-16 for a completed example.

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 exact number of items 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 scale division (or at least as large as the smallest increment in the read-out 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 the tare weight of the first package opened on the worksheet in item 2.
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 \times $\frac{\text{contents weight}}{\text{contents count}}$

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 on the worksheet in item 11 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) =

$$\text{MAV (count)} \times \frac{\text{average weight of labeled count}}{\text{labeled count}}$$

See item 14 on worksheet for calculation.

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

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 and the allowed number of undercount packages are given in Table 5-1 (page B-22). Average count does not apply.

5.2.1. 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. However, individual packages that are undercount from the labeled count by more than the MAV are considered defective (even if the lot as a whole passes inspection); they should be repacked, relabeled, or otherwise handled.

5.2.2. 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 because it is under count by more than the MAV.

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-7 and A-8) 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-7 and A-8) 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 =

$$\text{labeled measurement} \times \frac{\text{contents weight}}{\text{contents measurement}}$$

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 and convert the MAV/6 to units of weight as shown 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 the 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).

For example, an inspector finds that 200 sq ft of product weighs 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. [See item 8 on the worksheet.]

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 cross-hatched area of the report form.
12. Convert the MAV to units of weight.

MAV (weight) = $\frac{\text{avg. wt. of label measurements} \times \text{MAV (length)}}{\text{labeled measurements}}$

Record MAV in units of weight on the worksheet in item 14.

Convert the MAV to dimensionless units in item 15. 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. [This portion of the procedures does not follow a decision chart.] 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:

- o A deadweight dial micrometer (see Figure 5-1) equipped with a flat anvil, 1/4-in (6-mm) diameter or larger, and a 3/16-in (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 (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 (50 mm) in diameter. The dial indicator should be continuously graduated to read directly to 0.0001 in (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 lb (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 (0.02 mm).

The indicator reading must be repeatable to 0.00005 in (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.

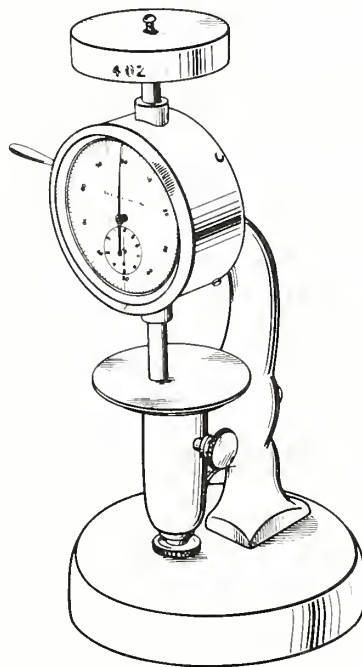
T-square.

Figure 5-1. Deadweight dial micrometer.

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.

5.4.3. Procedure

Steps 3a and 6a below apply to rolled product, steps 3b and 6b to folded product. Steps 8a and 8b apply to a two-stage MAV and, therefore, both steps 8a and 8b 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:

$$W = T \times A \times D \times 0.03613, \text{ where}$$

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/cm^3 to lb/in^3 .

Assume a minimum density (D) of 0.92 g/cm^3 .

For example, if the label reads:

6 ft wide x 100 ft long
4 MIL
net weight 11.9 lb

$$W = (.004 \text{ in}) \times (100 \text{ ft} \times 12 \frac{\text{in}}{\text{ft}})$$

$$\times (6 \text{ ft} \times 12 \frac{\text{in}}{\text{ft}}) \times 0.03613 \times 0.92 = 11.49 \text{ lb net weight}$$

Therefore, a declaration of 11.9 lb indicates that the label is not 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 8a 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. 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 (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 read-out 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 (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. No measured thickness of polyethylene labeled 1 mil or greater should be less than 80% of the labeled thickness.

No measured thickness of polyethylene labeled less than 1 mil should be less than 65% of the labeled thickness.

Circle any value in the thickness columns of the worksheet that is smaller than (0.8 x labeled thickness) [or 0.65 x label if thickness is less than 1 mil]. 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 x 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 con-

¹Count circled average thicknesses only; do not include circled individual thicknesses in this count.

form 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.

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.

Measuring base of any flat, sturdy material approximately 15 in (40 cm) square. Two vertical side pieces approximately 1 in (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.

Graph paper, 20 divisions per inch (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 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

¹Equipment and method derived from those provided by Mr. William Marks, American Can Co., 333 No. Commercial St., Neenah, WI 54956.

count, but Table 2-5 requires a sample size of 30 packages for this lot size for checking dimensions.

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 1 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.)

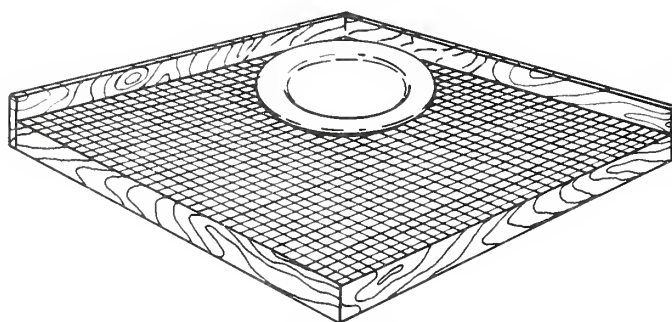


Figure 5-2. Preparing to measure the dimensions of a paper plate.

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).

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 measured 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.

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.

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. However, weighing can be a useful audit method.

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

Plastic plate, 1/8 to 1/2 in (0.3 to 2 cm) thick, 20 by 20 in (50 by 50 cm).

Rule, 12 in (30 cm) in length, 0.02 in (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.

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.
2. 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 nonconformance, measure at least 10 sheets

¹Derived from apparatus and method by Mr. William Marks, American Can Co., Neenah, WI 54956.

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 average 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 stemware.¹ 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.

¹The National Conference on Weights and Measures (NCWM) Uniform Sale of Commodities Regulation (MoS) is a standard for State regulatory use which is periodically updated by State agency representatives. The 1989 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.

<u>Product</u>	<u>Allowable Difference</u>	<u>Reference to the NCWM MoS</u>
Pressed and blown tumblers and stemware labeled by count and capacity	<p>Inch-pound: $\pm 1/4$ oz for items less than or equal to 5 oz; $\pm 5\%$ for items greater than 5 oz.</p> <p>Metric: ± 10 mL for items less than or equal to 200 mL; $\pm 5\%$ for items greater than 200 mL.</p>	Section 3.2.1.

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 and 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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One of the authors, Mrs. Mary Natrella, passed away before the third edition was published. She will be sorely missed by the entire statistical and legal metrology communities

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APPENDIX A. FORMS AND WORKSHEETS

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REPORT NUMBER

REPORT NUMBER

Location of TEST (Name, Address)		<input type="checkbox"/> Retailer <input type="checkbox"/> Wholesaler <input type="checkbox"/> Packager		PRODUCT IDENTITY	BRAND	LOT CODE(S)	CONTAINER DESCRIPTION
		1 LABELED WEIGHT	2 UNIT OF MEASURE <input type="checkbox"/> lb. <input type="checkbox"/> oz.	3 MAV Table 2-8 (p. B-9&10)	4 MAV (dimensionless units) <input type="text"/> ÷ <input type="text"/> =		
5 LOT SIZE (N)	a GROSS WEIGHT						
6 SAMPLE SIZE (n) <input type="checkbox"/> A (p. B-3) <input type="checkbox"/> B (p. B-5)	b TARE WEIGHT						
	c NET WEIGHT						
7 TARE SAMPLE SIZE <input type="checkbox"/> Alternative (p. B-6)	d PACKAGE ERROR <input type="text"/> a - 14						
8 Allowed Number UNREASONABLE ERRORS	e PACKAGE ERROR (dimensionless units) <input type="text"/> d + 2						
9 R_C (see <input type="text"/> c) Range of Net Weights	10 R_T (see <input type="text"/> b) Range of TARE Weights	11 $R_C \div R_T =$ <input type="text"/> 9 ÷ <input type="text"/> 10 =	12 n_t (Table 2-7, p (p. B-7&8)	13 AVERAGE TARE <input type="checkbox"/> unused <input type="checkbox"/> used <input type="checkbox"/> alternative	13a TARE CORRECTION <input type="checkbox"/> Moisture <input type="checkbox"/> Foam (p. B-17) <input type="checkbox"/> Vacuum Pack	14 NOMINAL GROSS WEIGHT <input type="text"/> 1 + <input type="text"/> 13 - <input type="text"/> 13a =	

PACKAGE ERRORS

TOTALS

(-)

(0/+)

[illegible]

16 NO UNREASONABLE MINUS ERRORS (Compare with box 4)	17 IS 16 Greater than 8 <input type="checkbox"/> YES: LOT FAILS <input type="checkbox"/> NO—CONTINUE	18 AVERAGE ERROR (Dimensionless Units) 15 ÷ 6 =	19 AVERAGE ERROR (labeled units) 18 × 2 =	20 IS 18 ZERO OR PLUS? <input type="checkbox"/> NO → Cat B, LOT FAILS <input type="checkbox"/> Cat A, go to 21 <input type="checkbox"/> YES → GO TO 28
21 AVERAGE RANGE	22 Use 6 to look up value in Table 2-3, Col 2 (p.B-3)	23 d = 21 × 22 =	24 (n/N) × 100 = (6 ÷ 5) × 100 =	25 Use 24 to look up f in Table 2-4 (p.B-4) f =
26 T = 23 × 25 =				
27 Disregarding the signs, is 18 larger than 26? <input type="checkbox"/> YES → LOT FAILS <input type="checkbox"/> NO → LOT PASSES				

Comments:

28 DISPOSITION OF LOT:

☐ APPROVED

☐ REJECTED

Acknowledged Receipt of Report

Official

DATE

RANDOM PACK REPORT FORM
(Page 1 of 2)

REPORT NUMBER

LOCATION OF TEST (Name, Address)

Retailer
Wholesaler
Packager

1 LOT SIZE (N)

2 SAMPLE SIZE (n)

☐ A (p B-3)
☐ B (p B-5)

3 TARE SAMPLE SIZE

☐ alternative
(p B-6)4 ALLOWED NUMBER OF
UNREASONABLE ERRORS5 UNIT OF MEASURE
(size of scale div)

lb

oz

TARE DRY
WET (page 2 for alternative)7 PRODUCT DESCRIPTION, LOT CODE
UNIT PRICE8 LABELED
WEIGHT9 PACKAGE ERROR
- 0/+10 MAV
(Weight)
(p B-9&10)11 MAV (dimen-
sionless) 10-5

TARE 1

PACKAGE 1

PACKAGE 2

6 AVERAGE TARE

TARE 2

6 AVERAGE TARE

TARE 3

6 AVERAGE TARE

TARE 4

6 AVERAGE TARE

LOT DISPOSITION
(B only; see page 2 for A)14 IS 13 GREATER THAN ZERO?
YES → LOT FAILS
NO → CONTINUE15 AVERAGE = TOTAL ÷ NO. OF
ERROR ERROR PACKAGES
= 12 ÷ 216 AVERAGE = AVERAGE × UNIT OF
ERROR ERROR in Scale div MEASURE
in units of weight
= 15 × 5
=17 IS AVERAGE ERROR 0/+ ?
YES → GO TO 18
NO → LOT FAILS18 LOT ACCEPTED LOT REJECTED
COMMENTS.

12 TOTAL ERROR

13 NUMBER OF MINUS
PACKAGE ERRORS
EXCEEDING MAV

Acknowledged Receipt of Report

Official

RANDOM PACK REPORT FORM Page 2 of 2

REPORT NUMBER

ALTERNATIVE TARE CALCULATIONS.

a	GROSS WEIGHT						
b	TARE WEIGHT						6b $R_T =$
c	NET WEIGHT						6a $R_C =$
d	PACKAGE ERROR $a - 6e - 8$						6c $R_C \div R_T =$ $6a \div 6b$
e	PACKAGE ERROR (in scale div) $d \div 5$						6d n_t (Table 2-7 p. B-7&8)
Additional Tare weights	GROSS WT						6e AVERAGE TARE
	TARE WT						

LOT DISPOSITION CATEGORY A

NOTE: PACKAGES SHOULD NOT BE ARRANGED FROM LIGHTEST TO HEAVIEST WHEN FOLLOWING A

19	<p>ON PAGE 1, THE NUMBER OF MINUS PACKAGE ERRORS EXCEEDING THE MAV IS RECORDED IN BOX 13</p> <p>BOX 4 CONTAINS THE ALLOWED NUMBER.</p> <p>IS 13 Greater than 4 ?</p> <p>YES → LOT FAILS NO → GO TO 20</p>			20	<p>AVERAGE ERROR (Scale div)</p> <p>= TOTAL ERROR ÷ NO OF PACKAGES</p> <p>= 12 ÷ 2</p>			
			21	<p>AVERAGE ERROR in units of weight</p> <p>= AVERAGE ERROR in no. of scale div.</p> <p>= 20 × 5</p>				
			22	<p>IS 20 MINUS?</p> <p>NO → LOT PASSES YES → GO TO 23</p>				
23	GROUP	RANGE OF PACKAGE ERRORS FOR EACH GROUP OF 5 PACKAGES	25	TABLE 2-3 Col. 2 value (page B-4)	26	<p>$d = 24 \times 25$</p> <p>=</p>	27	<p>$(n/N) \times 100 =$ $(2 \div 1) \times 100 =$</p>
	1							
	2							
	3		28	Use 27 to look up f in Table 2-4 (page B-4) f =	29	<p>$T = 26 \times 28$</p> <p>=</p>		
	4							
	5							
	6							
	7							
	8							
	9							
	10							
24	<p>AVERAGE = SUM OF ÷ NO. OF GROUPS R</p> <p>$\bar{R} =$</p>		<p>DISREGARDING THE SIGNS, IS 20 larger than 29 ? Yes → Lot Fails No → Lot Passes</p>					
			Record final lot disposition on page 1 in 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 8, skip boxes 3 and 4.

		(1st Pkg)	(2nd Pkg)	(3rd)	(4th)	(5th)
1. Gross Weight						
2. Tare Weight	*R _T =					
Net Weight	*R _C =					
3. Flask Weight (full)						
4. Flask Weight (empty, wetted)						
5. Weight of Liquid (Step 3 – Step 4)						
6. Volume of Flask						
7. Temperature of Liquid						

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 box is checked, open all packages in sample and determine each package error by volume (see Section 4.6.).

NO ☐ If this box is checked, continue below.

9. AVERAGE WEIGHT OF LIQUID IN FLASK = AVERAGE OF STEP 5 =

10. AVERAGE WEIGHT OF LABELED VOLUME = $\frac{\text{LABELED VOLUME}}{\text{FLASK VOLUME}} \times \text{AVG. WEIGHT OF LIQUID IN FLASK}$

= $\frac{\text{box } \span style="border: 1px solid black; padding: 0 2px;">1}{\text{Step 6}} \times \text{Step 9} =$

* 11. (R_C/R_T = _____) (n_t = _____)[†] See Table 2-7 (pages B-7 and 8)

12. AVERAGE TARE = AVERAGE OF STEP 2 (or average of Step 2 and additional tares)*

= Record 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.

$$13. \text{ NOMINAL GROSS WEIGHT} = \frac{\text{AVERAGE TARE}}{\text{AVERAGE WEIGHT OF LABELED VOLUME}} +$$

$$= \text{Step 12} + \text{Step 10} =$$

Record in box **14** on report form

14. For packages opened for Tare:

$$\text{PACKAGE ERROR (weight)} = \text{GROSS WEIGHT} - \text{NOMINAL GROSS WEIGHT}$$

$$= \text{Step 1} - \text{Step 13}$$

1	2	3	4	5
---	---	---	---	---

$$15. \text{ PACKAGE ERROR (dimensionless units)} = \frac{\text{PACKAGE ERROR (weight)}}{\text{UNIT OF MEASURE}}$$

$$= \text{Step 14} \div \text{box } \mathbf{2}$$

1	2	3	4	5
---	---	---	---	---

Record package errors on report form in crosshatched area.

$$16. \text{ MAV (volume) from Table 2-9} = \text{(pages B-11\&12)}$$

Record in box **3** on report form.

$$17. \text{ MAV (weight)} = \frac{\text{MAV (volume)} \times \text{AVERAGE WEIGHT OF LABELED VOLUME}}{\text{LABELED VOLUME}}$$

$$= \text{Step 16} \times \frac{\text{Step 10}}{\text{box } \mathbf{1}} =$$

$$18. \text{ MAV (dimensionless units)} = \frac{\text{MAV (weight)}}{\text{UNIT OF MEASURE}}$$

$$= \text{Step 17} \div \text{box } \mathbf{2} =$$

Record 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:

$$\text{AVERAGE PACKAGE ERROR (volume)} = \text{AVG. PACKAGE ERROR (dimensionless units)} \times \text{UNIT OF MEASURE} \times \frac{\text{LABELED VOLUME}}{\text{AVG. WEIGHT OF LABELED VOLUME}}$$

$$= \text{box } \mathbf{18} \times \text{box } \mathbf{2} \times \frac{\text{box } \mathbf{1}}{\text{Step 10}}$$

$$=$$

Record in box **19** on report form

(Boxes above with "3", "4", "5" in corners are for larger tare sample sizes.)

WORKSHEET FOR CHECKING PAINT

Audit

① Can Height	Can Diameter				⑥ Average Liquid Diameter	⑦ Average Liquid Level	⑧ Average Container Depth	⑨ Average Liquid Depth	⑩ Volume
	② Top	③ Middle	④ Bottom	⑤ Average					

cu. in. = 0.004329 gal.

$$\text{Volume } ⑩ = 0.7854 \times ⑥ \times ⑥ \times ⑨$$

cm³ = 0.001 L

If volume in ⑩ is less than labeled volume, use possible violation procedures (Section 4.9.4.)

Possible Violation

① Label	② Gross Weight	③ Lid Weight Wet (-) Dry	④ Liquid Level	⑤ Tare	⑥ Water Volume	⑦ Net Weight = ② - ⑤	⑧ Weight of Label Volume = $\frac{⑦ \times ①}{⑥}$	⑨ Package Volume = $⑥ + \left[\frac{③}{⑦} \times ⑥ \right]$

WORKSHEET FOR PACKAGES LABELED BY COUNT

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 through box 8, skip boxes 3 and 4

	(1st Pkg)	(2nd Pkg)	(3rd)	(4th)	(5th)
1. Gross Weight					
2. Tare Weight					
3. Count in Each Package					
4. Weight of Counted Items					
5. Weight of Labeled Count					
= $\frac{\text{Labeled Count} \times \text{Step 4}}{\text{Step 3}}$ =					

6. MAV from Table 2-10 (count) (page B-13) = Record in box 3 on the report form

7. $\frac{\text{MAV}}{6} \text{ (weight)} = \frac{\text{MAV}}{6} \text{ (count)} \times \frac{\text{WEIGHT OF COUNTED ITEMS}}{\text{COUNT IN PACKAGE}}$

= $\frac{\text{Step 6}}{6} \times \frac{\text{Step 4 (for first package)}}{\text{Step 3 (for first package)}}$ =

8. If using an equal-arm package checking scale, is value calculated in Step 7 equal to or larger than 1/2 the smallest graduation?

If using an electronic package checking scale, is value calculated in Step 7 at least as large as the smallest increment?

NO ☐ If this box is checked, open all packages in sample and determine each package error by actually counting the items inside the packages.

YES ☐ If this box is checked, continue below.

9. Do the weights recorded in Step 5 above differ from each other by more than the value in Table 4-3 (page B-20)?

YES ☐ If this box is checked, open all packages in sample and determine each package error by counting items inside packages.

NO ☐ Average Weight of Labeled Count = average of Step 5 =

10. AVERAGE TARE = AVERAGE OF STEP 2 = Record in box 13 on report form.

11. NOMINAL GROSS WEIGHT = AVERAGE TARE + AVERAGE WEIGHT OF LABELED COUNT

= Step 10 + Step 9 =

Record in box 14 on report form.

12. For packages opened for Tare:

$$\text{PACKAGE ERROR (weight)} = \text{GROSS WEIGHT} - \text{NOMINAL GROSS WEIGHT}$$

$$= \text{Step 1} - \text{Step 11}$$

$$= \begin{array}{|c|c|c|c|c|} \hline 1 & 2 & 3 & 4 & 5 \\ \hline \end{array}$$

$$13. \text{ PACKAGE ERROR (dimensionless units)} = \text{PACKAGE ERROR (weight)} \div \text{UNIT OF MEASURE}$$

$$= \text{Step 12} \div \text{box } \boxed{2}$$

$$= \begin{array}{|c|c|c|c|c|} \hline 1 & 2 & 3 & 4 & 5 \\ \hline \end{array}$$

Record these package errors on report form in crosshatched area.

$$14. \text{ MAV (weight)} = \text{MAV (count)} \times \frac{\text{AVERAGE WEIGHT OF LABELED COUNT}}{\text{LABELED COUNT}}$$

$$= \text{Step 6} \times \frac{\text{Step 9}}{\text{box } \boxed{1}} = \boxed{}$$

$$15. \text{ MAV (dimensionless units)} = \text{MAV (weight)} \div \text{UNIT OF MEASURE}$$

$$= \text{Step 14} \div \text{box } \boxed{2} = \boxed{} \text{ Record in box } \boxed{4} \text{ on report form}$$

16. Compare unopened packages with nominal gross weight (Step 11 or box $\boxed{14}$).

Record package errors for remaining packages in sample directly on report form in crosshatched area.

Compare minus package errors with MAV (Step 15 or box $\boxed{4}$).

Average package errors (box $\boxed{18}$). Convert back to units of count as given below:

$$\text{AVERAGE PACKAGE ERROR (count)} = \text{AVG. PACKAGE ERROR (dimensionless units)} \times \text{UNIT OF MEASURE} \times \frac{\text{LABELED COUNT}}{\text{AVG. WEIGHT OF LABELED COUNT}}$$

$$= \text{box } \boxed{18} \times \text{box } \boxed{2} \times \frac{\text{box } \boxed{1}}{\text{Step 9}}$$

$$= \boxed{} \text{ Record in box } \boxed{19} \text{ on report form.}$$

(Boxes above with "3", "4", and "5" in corners are for larger tare sample sizes)

WORKSHEET FOR CHECKING
POLYETHYLENE SHEETING

Labeled Length

Labeled Width

Labeled Thickness

Labeled Weight

If Labeled Thickness is less than 1 mil

0.65 x labeled thickness = Compare with All Thickness Measurements

If Labeled Thickness is 1 mil or greater

0.8 x labeled thickness = Compare with All Thickness Measurements

0.93 X Labeled Thickness Compare with Average Package Thickness

Package	Length	Width		Thickness				Package	Length	Width		Thickness			
Package Average															
Package Average															
Package Average															
Package Average															
Package Average															
Package Average															
Sample Average															

WORKSHEET FOR ICE CREAM NOVELTIES

	(1st Pkg)	(2nd Pkg)	(3rd Pkg)	(4th Pkg)	(5th Pkg)
1. Gross Weight					
2. Tare Weight					
3. Net Weight					
4. Total water volume					
5. Volume of tare materials					
6. Volume of novelty					
7. Weight of labeled volume					
= labeled volume $\times \frac{\text{item 3}}{\text{item 6}}$ =					

8. Do the weights recorded in item 7 above differ from each other by more than the value in Table 4-3 (page B-20)?

YES ☐ If this box is checked, open all packages in sample and determine each package error by volume displacement

NO ☐ Average weight of labeled volume = average of item 7 =

9. Average tare = average of item 2 =

Record in box 13 on report form

10. Nominal Gross Weight = Average Tare + Average weight of the labeled volume

= item 9 + item 8 =

Record in box 14 on report form

11. MAV (volume) from Table 2-9 (pages B-11 & 12) = Record in box 3 on report form

WORKSHEET FOR ICE CREAM NOVELTIES

Page 2

12.
$$\begin{aligned} \text{MAV (Dimensionless units)} &= \frac{\text{MAV (Volume)} \times \frac{\text{Average Weight of Labeled Volume}}{\text{Labeled Volume}}}{\text{Unit of Measure}} \\ &= \frac{\text{item 11} \times \text{item 8}}{\text{box } \boxed{1} \times \text{box } \boxed{2}} \\ &= \boxed{} \end{aligned}$$

13. You should select additional packages over and above the sample size just for the determination of the tare weight and average weight of the labeled volume (for example, select 2 additional packages beyond a sample of 10). This will avoid having to determine the package errors for these additional packages. If the inspection lot is very small, however, you may not have access to additional packages just for tare. In this situation, you'll have to determine the package errors for those packages you opened for tare and convert the errors so they can be recorded in the crosshatched area of the report form:

$$\begin{aligned} \text{Package Error (Dimensionless units)} &= \frac{\text{Gross Weight} - \text{Nominal Gross Weight}}{\text{Unit of Measure}} \quad \text{for each package} \\ &= \frac{\text{item 1 (for each package)} - \text{item 10}}{\text{box } \boxed{2}} \\ &= \begin{array}{ccccc} \text{(1st pkg)} & \text{(2nd pkg)} & \text{(3rd pkg)} & \text{(4th pkg)} & \text{(5th pkg)} \\ \boxed{} & \boxed{} & \boxed{} & \boxed{} & \boxed{} \end{array} \\ &\quad \text{Record these package errors on report form in crosshatched area.} \end{aligned}$$

14. Compare weight of unopened packages with Nominal Gross Weight (item 10 and box $\boxed{14}$)
 Record package errors for unopened packages directly on report form in crosshatched area.
 Compare minus package errors with MAV (item 12 or box $\boxed{4}$)
 Average the package errors (and record in box $\boxed{18}$)
 Convert back to units of volume as given below:

$$\begin{aligned} \text{Average package error (Volume)} &= \frac{\text{Average package error (Dimensionless units)}}{\text{Unit of Measure}} \times \frac{\text{Labeled Volume}}{\text{Average Weight of Labeled Volume}} \\ &= \text{box } \boxed{18} \times \text{box } \boxed{2} \times \frac{\text{box } \boxed{1}}{\text{item 8}} \\ &= \boxed{} \quad \text{Record in box } \boxed{19} \text{ on the report form} \end{aligned}$$

FLOUR SUMMARY SHEET

DATE TESTED	
1.	BRAND
2.	TYPE OF FLOUR
3.	LABELED WEIGHT (LB)
4.	LOCATION OF TEST (RWPL)
5.	LOT CODE
	5A. LOCATION PACKED
	5B. DATE PACKED
6.	LOT SIZE
7.	SAMPLE SIZE
8.	TARE WEIGHT
9.	AVERAGE PACKAGE ERROR (LB)
10.	LARGEST MINUS PACKAGE ERROR (LB)
10A.	MAV (LB)
11.	IS LOT IN GRAY AREA? (SEE TABLE 3-3)
	YES
	NO
12.	MOISTURE CONTENT AT TIME OF TEST (%)
13.	MOISTURE CONTENT AT TIME OF PACK (%)
14.	MOISTURE LOSS (LB)
	(= ITEM 13. - ITEM 12.)
15.	WEIGHT LOSS (LB)
	(= ITEM 14. X 0.01 X ITEM 3.)
16.	IS WEIGHT LOSS (ITEM 15.) AT LEAST AS LARGE AS AVERAGE PACKAGE ERROR (ITEM 9.)
	YES--LOT PASSES AVERAGE REQ.
	NO
17.	DOES LARGEST MINUS ERROR (ITEM 10.) + MOISTURE LOSS (ITEM 15.) STILL EXCEED MAV (ITEM 10A.)?
	YES
	NO --LOT PASSES INDIVIDUAL REQ.

APPENDIX B. TABLES

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Table 1-1. Agencies responsible for package regulations. *

Agency	Product
U.S. Department of Agriculture, Food Safety and Inspection Service	meat and poultry
U.S. Department of Health 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.

**Table 2-1. Guide to locations on the report forms for
standard pack packages on pages A-1 and A-2**

Box	Subject	Section	Page
1	Labeled Contents	2.2.1.	2-2
2	Unit of Measure	2.5.1.	2-18
3	MAV	2.12.	2-25 B-9 to B-15
4	MAV (dimensionless units)	2.5.1.	2-18
5	Lot Size (N)	2.3.3.	2-7 B-3 or B-5
6	Sample Size (n)	2.7., 2.8.	2-12, 2-17
7	Tare Sample Size (n_t)	2.7., 2.8., 2.11.	2-12, 2-17 2-19
8	Allowed Number of Unreasonable Errors	2.7.1., 2.8.1.	2-13, 2-17
9	Range of Net Weights (R_c)	2.11.4.	2-23
10	Range of Tare Weights (R_t)	2.11.4.	2-23
11	$R_c + R_t$	2.11.4.	2-23
12	n_t from Table 2-7	2.11.4.	2-23, B-7
13	Average Tare	2.11., 2.11.3., 2.11.4.	2-19, 2-22, 2-25
13a	Tare Correction	moisture 2.14., foam 3.11.6., vacuum pack 3.15.	2-28 3-33, B-17 3-36
14	Nominal Gross Weight	3.5.	3-8
15	Total Package Error	2.9.3.	2-11
16	Actual Number of Unreasonable Errors	2.7.1., 2.8.1.	2-13, 2-17
17	Decision on Unreasonables	2.7.1., 2.8.1.	2-13, 2-17
18	Average error (dimensionless units)	2.7.2., 2.8.2.	2-15, 2-18
19	Average Error (labeled units)	2.7.2., 2.8.2.	2-15, 2-18
20	Decision on Average	2.7.2., 2.8.2.	2-15, 2-18
21	Average Range	2.7.2., Appendix G	2-15, G-1
22	Value from Table 2-3, column 2	2.7.2.	2-15, B-3
23	d	2.7.2.	2-16
24	$(n/N) \times 100$	2.7.2.	2-16
25	f	2.7.2.	2-16, B-4
26	T	2.7.2.	2-16
27	Decision on Average (for Cat. A only)	2.7.2.	2-16
28	Disposition of Lot Summary of boxes 17, 20, 27	2.2.3.	2-5

Table 2-2. Sampling plans of Category A.

1	2	3	4
Lot size (number of packages in lot)	Sample size (number of packages in sample)	Tare sample size ^a (number of packages chosen for tare determination)	Number of minus package errors allowed to exceed the MAV ^b
N	n	n _t	
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

^a Special 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).

^b See Tables 2-8 through 2-11 (pages B-9 through B-14), and Sections 2.12., and 2.13.

Table 2-3. Values of $\frac{0.8598}{\sqrt{n}}$ and $\frac{2}{\sqrt{n}}$ for sample size n.

1	2	3
n sample size	$\frac{0.8598}{\sqrt{n}}$ used only when R is calculated is	$\frac{2}{\sqrt{n}}$ used only when s calculated
30	0.1570	0.3652
50	0.1216	0.2828
80	0.09613	0.2236
125	0.07691	0.1789
200	0.06080	0.1414

Table 2-4. Values of f for percent of lot sampled *

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	.83	66	.58		
32	.82	67	.57		
33	.82	68	.57		
34	.81	69	.56		
35	.81	70	.55		

* Percent of lot sampled = $\frac{\text{sample size} \times 100}{\text{lot size}} = \frac{n}{N} \times 100$

Table 2-5. Sampling plans of Category B.

1	2	3	4
Lot size (number of packages in lot)	Sample size (number of packages in sample)	Tare sample size ^a (number of packages chosen for tare determination)	Number of minus package errors allowed to exceed the MAV ^b
N	n	n _t	
Up to and including 250	10	2	0
251 and greater	30	2	0

^a Special rules for tare sampling apply when Section 2.11.4.
is used (glass or aerosol packages).

^b See Tables 2-8 through 2-11 (pages B-9 to B-14), Sections 2.12. and 2.13.

Table 2-6. Initial tare sample size for alternative tare procedures.

Sampling plan Category	Lot size	Initial tare sample size
A	all	5 packages
B	equal to or less than 250 packages	2 packages
	greater than 250 packages	5 packages

Table 2-7. Total number* of packages (n_t) to be opened for tare determination.

Ratio R_c/R_t	number of packages in sample				
	$n = 10$	$n = 30$	$n = 50$	$n = 80$	$n = 200$
	n_t	n_t	n_t	n_t	n_t
0.2 OR LESS	10	30	50	80	200
0.21 - 0.40	10	29	49	77	193
0.41 - 0.60	10	28	46	74	184
0.61 - 0.80	9	26	44	69	173
0.81 - 1.00	8	24	40	64	160
1.01 - 1.20	8	23	37	59	148
1.21 - 1.40	7	21	34	54	135
1.41 - 1.60	7	19	31	49	122
1.61 - 1.80	6	17	28	45	111
1.81 - 2.00	5	15	25	40	100
2.01 - 2.20	5	14	23	37	91
2.21 - 2.40	5	13	21	33	82
2.41 - 2.60	4	12	19	30	75
2.61 - 2.80	4	11	17	28	68
2.81 - 3.00	4	10	16	25	62
3.01 - 3.20	3	9	15	23	57
3.21 - 3.40	3	8	13	21	52
3.41 - 3.60	3	8	12	19	48
3.61 - 3.80	3	7	11	18	44
3.81 - 4.00	2	6	10	16	40
4.01 - 4.20	2	6	10	15	37
4.21 - 4.40	2	6	9	14	35
4.41 - 4.60	2	5	8	13	32
4.62 - 4.80	2	5	8	12	30
4.81 - 5.00	2	5	7	12	28
5.01 - 5.20	2	4	7	11	26
5.21 - 5.40	2	4	7	10	25
5.41 - 5.60	2	4	6	10	23
5.61 - 5.80	2	4	6	9	22
5.81 - 6.00	2	3	5	8	20

* Including those already opened for initial tare determination.

Table 2-7 (continued). Total number* of packages (n_t) to be opened for tare determination.

Ratio R_C/R_t	number of packages in sample				
	$n = 10$	$n = 30$	$n = 50$	$n = 80$	$n = 125$ $n = 200$
	n_t	n_t	n_t	n_t	n_t
6.01 - 6.20	2	3	5	8	12
6.21 - 6.40	2	3	5	8	12
6.41 - 6.60	2	3	5	7	11
6.61 - 6.80	2	3	5	7	10
6.81 - 7.00	2	3	5	7	10
7.01 - 7.20	2	3	5	6	9
7.21 - 7.40	2	3	5	6	9
7.41 - 7.60	2	2	5	6	9
7.61 - 7.80	2	2	5	5	8
7.81 - 8.00	2	2	5	5	8
8.01 - 8.20	2	2	5	5	8
8.21 - 8.40	2	2	5	5	7
8.41 - 8.60	2	2	5	5	7
8.61 - 8.80	2	2	5	5	7
8.81 - 9.00	2	2	5	5	6
9.01 - 9.20	2	2	5	5	6
9.21 - 9.40	2	2	5	5	6
9.41 - 9.60	2	2	5	5	6
9.61 - 9.80	2	2	5	5	5
9.81 - 10.00	2	2	5	5	5
10.01 - 10.20	2	2	5	5	5
10.21 - 10.40	2	2	5	5	5
10.41 - 10.60	2	2	5	5	5
10.61 - 10.80	2	2	5	5	5
10.81 - 11.00	2	2	5	5	5
11.01 - 11.20	2	2	5	5	5

* Including those already opened for initial tare determination.

Table 2-8. MAV's for an individual package labeled by weight^a.

Avoirdupois Units			Metric Units	
Labeled Weight	MAV		Labeled Weight	MAV
Pounds or Ounces	Decimal Pounds	Fractional Ounces	Grams	Grams
up to and including 0.08 lb up to and including 1.28 oz	10% of labeled weight		up to and including 36	10% of labeled weight
0.08 + ^b to ^c 0.12 lb 1.28 + to 1.92 oz	0.008	1/8	36 + to 54	4
0.12 + to 0.18 lb 1.92 + to 2.88 oz	0.012	3/16	54 + to 82	5
0.18 + to 0.26 lb 2.88 + to 4.16 oz	0.016	1/4	82 + to 118	7
0.26 + to 0.34 lb 4.16 + to 5.44 oz	0.020	5/16	118 + to 154	9
0.34 + to 0.46 lb 5.44 + to 7.36 oz	0.024	3/8	154 + to 209	11
0.46 + to 0.58 lb 7.36 + to 9.28 oz	0.028	7/16	209 + to 263	13
0.58 + to 0.70 lb 9.28 + to 11.20 oz	0.032	1/2	263 + to 318	15
0.70 + to 0.84 lb 11.20 + to 13.44 oz	0.036	9/16	318 + to 381	16
0.84 + to 0.94 lb 13.44 + to 15.04 oz	0.040	5/8	381 + to 426	18
0.94 + to 1.08 lb 15.04 + to 17.28 oz	0.044	11/16	426 + to 490	20
1.08 + to 1.26 lb	0.048	3/4	490 + to 572	22
1.26 + to 1.40 lb	0.052	13/16	572 + to 635	24
1.40 + to 1.54 lb	0.056	7/8	635 + to 698	25
1.54 + to 1.70 lb	0.060	15/16	698 + to 771	27

^a Applies only to shortages in package weight (that is, the MAV is compared with minus package errors only)

^b 0.08 + means "greater than 0.08"

^c "to" means "to and including"

Table 2-8. (continued) MAV's for an individual package labeled by weight.

Avoirdupois Units			Metric Units	
Labeled Weight	MAV		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	0.14	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 labeled weight		24.70 +	2% of labeled 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	b	up to and including 0.18 cu in	0.03	up to and including 3 mL	0.5 ^c
		0.18 + to 0.49 cu in	0.06	3 + to 8 mL	1.0 ^c
		0.49 + to 0.92 cu in	0.09	8 + to 15 mL	1.5 ^c
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	3.5
2.25 + to 4.25 fl oz	0.19	4.06 + to 7.67 cu in	0.34	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	9
7.50 + to 11.75 fl oz	0.38	13.54 + to 21.21 cu in	0.68	222 + to 347 mL	11
11.75 + to 17.00 fl oz	0.50	21.21 + to 30.68 cu in	0.90	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	22
Liquid Measure Equivalents					
1 pint = 16 fl oz					
1 quart = 32 fl oz					
1 gallon = 128 fl oz					

^a Applies to shortages in package volume (that is, minus package errors).

^b Convert to metric units and use laboratory glassware.

^c Use laboratory glassware.

^d 0.50 + 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 MAV (mL)
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	1.50	99.26 + to 124.5 cu in	2.71	1.627 + to 2.041 L	44
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	74
160 + to 185.6 fl oz	3.0	288.8 + to 335.0 cu in	5.4	4.732 + to 5.489 L	89
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	9.0	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 (5 gal)	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	9.0	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	Over 26.734 L	1% of labeled volume
See Section 2-13 for exception: bark mulch		Dry Measure Equivalent			
		1 Dry Pint = 33.6003125 cu in 1 Bushel = 2150.42 cu in			
		1 Dry Quart = 67.200625 cu in 1 cu ft = 1728 cu in			

Table 2-10. MAV's for an individual package labeled by count^a.

Labeled count	MAV
up to and including 17 ^b	0
18 - 50 ^b	1
51 - 83	2
84 - 116	3
117 - 150	4
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	14
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

^a Applies only to shortages in package count (that is, minus package errors).

^b See Section 5.2. for sampling plans to be used with these package sizes.

Table 2.11. MAV's for an individual package labeled by length (width) or by area^a

Length		
Inch-Pound Labeled Length (yards)	MAV (expressed as a percentage of the labeled length)	Metric Labeled length (meters)
Up to and including 1	3%	Up to and including 1
1 + ^b to ^c 48	1.5%	1 + to 40
48 + to 96	2%	40 + to 85
96 + to 154	2.5%	85 + to 140
154 + to 330	3%	140 + to 300
330 + to 1100	4%	300 + to 1000
1100 +	5%	1000 +
Area		
The MAV for packages labeled by area is 3% of the labeled area.		

a Applies only to shortages in package measure (that is, minus package errors).

b 1 + means greater than 1

c "to" means "to and including"

See Section 2.13. for exceptions: textiles, polyethylene sheeting.

**Table 2-12. U.S. Department of Agriculture, Meat and Poultry,
Groups and Lower Limits for individual packages**

Group Name	Definition of Group (numbers are labeled weight in ounces)		Lower Limit for Individual Weights
	Homogeneous, Fluid When Filled	All Other Products	
A	less than 3		10 % of labeled weight
1	3-16	-	7.1 g 0.016 lb 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 0.031 lb 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 0.062 lb 1 oz
4	-	over 48 to 160	42.5 g 0.094 lb 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 0.125 lb 1/4 lb

Table 3-1. Recommended maximum units of measure to be used in recording package weights.

Avoirdupois		Metric units	
Labeled weight	Units of measure (oz avoird)	Labeled weight	Units of measure (kg)
Up to and including 1.92 oz (0.12 lb)	a	Up to and including 82 g	a
Greater than 1.92 oz (0.12 lb) to and including 5.44 oz (0.34 lb)	1/32 ^b	Greater than 82 g to and including 250 g	0.001 ^b
Greater than 5.44 oz (0.34 lb) to and including 20 oz (1.25 lb)	1/16	Greater than 250 g to and including 900 g	0.002
Greater than 1.25 lb to and including 4 lb	1/8	Greater than 900 g to and including 2.5 kg	0.005
Greater than 4 lb to and including 8 lb	1/4	Greater than 2.5 kg to and including 30 kg	0.01
Greater than 8 lb to and including 25 lb	1/2	Greater than 30 kg to and including 60 kg	0.05
Greater than 25 lb to and including 50 lb	1	Greater than 60 kg	0.1
Greater than 50 lb to and including 150 lb	4		
Greater than 150 lb	8		

^a An analytical or other high accuracy balance will be necessary for weighing packages in this category.

^b The 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.

Table 3-2. Test allowances for foam aerosol products

Avoirdupois:		Test allowance	
Labeled weight of package		Ounce	Pound
0 to less than	1 1/2 oz	0	0
1 1/2 oz to less than	5 oz	1/16	0.004
5 oz to less than	8 oz	1/8	0.008
8 oz to less than	11 oz	3/16	0.012
11 oz to less than	14 oz	1/4	0.016
14 oz to less than 1 lb	1 oz	5/16	0.020
1 lb 1 oz or more		3/8	0.023
Metric:		Test allowance	
Labeled weight of package		Grams	
0 to less than	50 g	0	
50 g to less than	100 g	1	
100 g to less than	200 g	3	
200 g to less than	300 g	5	
300 g to less than	400 g	7	
400 g to less than	500 g	9	
Over 500 g		10	

Table 3-3

Boundaries of the Gray Area for Different Sizes of Flour Packages

The retail or wholesale lot is in the gray area if:

<u>Column 1</u>	<u>Column 2</u>	<u>Column 3</u>	<u>Column 4</u>
the labeled weight is	the average package error is minus and between zero and 3% of label weight	and any individual package error is minus and is between the MAV and	MAV + 3%
2 lb	-0.06 lb	-0.07 lb	-0.13 lb
5 lb	-0.15 lb	-0.14 lb	-0.29 lb
10 lb	-0.30 lb	-0.22 lb	-0.52 lb
20 lb	-0.60 lb	-0.31 lb	-0.91 lb
25 lb	-0.75 lb	-0.37 lb	-1.12 lb
50 lb	-1.50 lb	-0.50 lb	-2.00 lb
100 lb	-3.00 lb	-2.00 lb	-5.00 lb

Table 4-1. Weighing devices appropriate to use to check common consumer products labeled by liquid volume.

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 4-2. Recommended maximum units of measure to be used for recording the weights of packaged goods labeled by liquid volume.

Inch-Pound			Metric	
Labeled volume	Units of measure		Labeled volume	Units of measure (g)
	(oz avoird)	(lb)		
Up to and including 4.25 fl oz	a	a	Up to and including 3 mL	0.01 ^a
			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	0.02		
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		

^a Use analytical or other high accuracy balance.

^b Use 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
Analytical or other high accuracy balance	0.0001	0.05
Small capacity equal-arm scale* or equivalent electronic scale	0.002	1.0
Large capacity equal-arm scale equivalent electronic scale	0.004 0.005	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

* When using an electronic scale with a capacity different from the 5-lb or 20-lb equal-arm scales (some having capacities ranging as high as the 30-lb commercial scales), use the permitted difference in weight corresponding to the range of the equivalent equal-arm scale.

That is:

- for weights up to 5 lb, permit 0.002 lb
- for weights between 5 and 20 lb, permit 0.005 lb
- for weights between 20 and 30 lb, permit 0.01 lb

Table 4-4. Thickness of paint can walls and labels.

Wall Thickness			
Inch-Pound		Metric	
can size	in	can size	mm
1 gal	0.010	4 L	0.25
1/2 gal	0.010	2 L	0.25
1 qt	0.009	1 L	0.23
1 pt	0.008	500 mL	0.23
		250 mL	0.20
Label thickness (paper) ^a (all can sizes)			
Inch-pound		Metric	
0.004 in		0.10 mm	

^a The thickness of labels lithographed directly onto the container may be ignored.

Table 5-1. Sampling plans for packages labeled by low count^a

1	2	3	4
Lot size (number of packages in lot)	Sample size (number of packages in sample)	Tare sample size (number of packages chosen for tare determination)	Number of packages allowed to contain fewer than the labeled count.
N	n	n _t	
Up to and including 500	10	2	1
501-5000	30	2	2
5001 and greater	50	5	3

^a Labeled count is 50 or fewer units.

Table 5-2. Sampling plans for packages given tolerances.

1	2	3	4
Lot size	Sample size	Tare sample size	Number of package errors which may exceed allowable difference
N	n	n_t	
Up to and including 500	10	2	0
501-5,000	30	2	1
5,0001 and over	50	5	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 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.]

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.]

¹NBS Handbook 44.

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.

DIVISION² (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.]

DRIED USED TARE. Used tare (defined) that has been air-dried, dried in a microwave oven, over a heating element, or in some other manner, to simulate the unused tare weight. [See Section 3.18.]

DRY MEASURE. Rigid containers designed for general and repeated use in the volume measurement of particulate solids.

DRY TARE. Unused tare.

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.

¹NBS Handbook 130, Uniform Method of Sale of Commodities Regulation.

²NBS Handbook 44.

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.

GRAY AREA. For packaged goods subject to moisture loss, when the average net weight of a sample is found between the labeled weight and the boundary of the gray area, the lot is said to be in a gray or no-decision area. Further information is required to determine lot compliance or noncompliance. See Section 3.17. and 3.18.

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.

¹NBS Handbook 130, Uniform Packaging and Labeling Regulation.

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. 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.¹ 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 predetermined 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.

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.]

MULCH. Any product or material other than peat or peat moss (see Section 2.4) that is advertised, offered for sale, or sold for primary use as a horticultural, above-ground dressing for decoration, moisture control, weed control, erosion control, temperature control, or other similar purposes.

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.]

¹NBS Handbook 44.

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.¹ 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.]

PETROLEUM PRODUCTS.² "Petroleum products" are gasoline, diesel fuel, kerosene, or any product (whether or not such a product is actually derived from naturally occurring hydrocarbon mixtures known as "petroleum") commonly used in powering, lubricating, or idling engines or other devices, or labeled as fuel to power camping stoves or lights. Sewing machine lubricant, camping fuels, and synthetic motor oil are "petroleum products" for the purposes of this regulation. Brake fluid, copier machine dispersant, antifreeze, cleaning solvents, and alcohol are not "petroleum products".

POISE.³ "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.

PRINCIPAL DISPLAY PANEL.² "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."

¹16 CFR §500.2(h).

²NBS Handbook 130

³NBS Handbook 44.

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 and F.]

RANGE. The difference between the largest and the smallest of a set of measured values. [See Appendix G.]

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.] Reasonable variations from the labeled declaration are recognized for (1) unavoidable deviations in good manufacturing practice, and (2) loss or gain of moisture in good distribution practice.

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 commercial 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.]

¹NBS Handbook 44.

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.]

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.

UNUSED TARE. All packaging materials (including glue, labels, ties, etc.) that contain or enclose a product, including prizes, gifts, coupons, or decorations that are not part of the product. Unused tare is weighed before the product is introduced into the container.

USED TARE. All packaging materials that can be separated from the product, either readily (e.g., by shaking) or by washing, scraping, ambient air drying, or other techniques involving more than "normal" household recovery procedures, but not including laboratory procedures such as oven drying. Prizes, decorations, and the materials that are not part of the product are included in the used tare. See also "wet tare" and "dried used tare."

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. Used tare (defined) when no effort is made to reconstruct unused tare weight by drying out the absorbent portion (if any) of the tare. Free-flowing liquid is part of the wet tare for meat or poultry products from Federally-inspected plants. See Section 3.18.

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, 1988, 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

21 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 Inspection 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 ex-

pelled 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 by 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 °F (20 °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 permissible 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.Regulations Recommended by the NCWM for State Adoption

The National Conference on Weights and Measures (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 Requirements quoted on the following pages.

SECTION 6. DECLARATION OF QUANTITY: CONSUMER PACKAGES

- 6.13. CHARACTER OF DECLARATION: AVERAGE. 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.

SECTION 7. DECLARATION OF QUANTITY: NONCONSUMER PACKAGES

- 7.6. CHARACTER OF DECLARATION: AVERAGE. 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.

SECTION 12. VARIATIONS TO BE ALLOWED.**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: Provided, 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.

12.2. MAGNITUDE OF PERMITTED VARIATIONS.

The magnitude of variations permitted under Sections 12., 12.1., 12.1.1., and 12.1.2. of this regulation shall be those expressly set forth in this regulation and variations such as those contained in the procedures and tables of National Bureau of Standards Handbook 133, "Checking the Net Contents of Packaged Goods."

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.

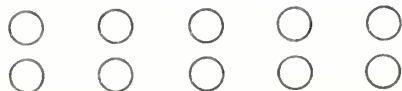
To obtain a random sample, two steps are necessary. First it is necessary to identify each package in the lot of N packages with a specific number whether on the shelf, in the warehouse or coming off the packaging line. Then it is necessary to obtain n random numbers, as from a table of random numbers 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 F 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. Starting Page. The pages of Appendix F are numbered 1 through 31. Use the day of the month to determine the starting page. For example, if the inspection takes place on February 11, use page 11 as the first page (then pages 12 through 31, followed by pages 1 through 10 if necessary).
- b. Starting Column and Row. 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.

For example, assume that testing takes place on the 11th day of the month. Start with page 11 of the random number table in Appendix F. Assume that you have dropped your pencil on the page and it has indicated a starting place at column 22, row 45. Start using the random

number table of Appendix F, on page 11, column 22, row 45. That number is 1.

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 1, 6, 7, 8, 2, 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 11, column 22, row 45), the recorded two-digit recorded numbers would be 14, 63, 79, 89, 24, 2, 17, etc. When three-digit numbers are needed, rule the page in columns of three. Record 000 as 1000. Starting on page 11, column 22, row 45, the recorded numbers would be 142, 636, 797, 891, 245, 28, 794, 710, 66, 353, 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 F), 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.

Package Selection Worksheet
for a Serial Lot Numbering System

Sample package in the sequence be used for tare determination	Package number in lot (in the order they are selected from the random number table)	Rearranged in the order to be selected from the lot
1	14	2
2	63	10
3	79	14 tare
4	89	17
5	24	24
6	2	37
7	17	53
8	37	63 tare
9	10	79
10	53	89

Figure E-1.

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 11, column 22, row 45, the following random numbers are recorded: 14, 63, 79, 89, 24, 2, 17, 37, 10, 53. [If a duplicate appears in the table, it is ignored. 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.

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.

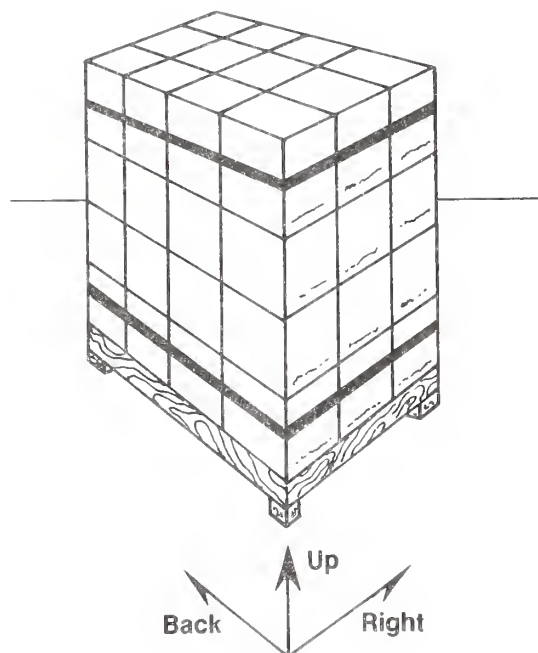


Figure E-2. Choosing a starting place for a three-dimensional lot numbering system.

A work table like the one on the following page is useful to record the positions of sample packages in the lot as determined from the random number table.

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 F, 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 F, 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.

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)			
<hr/>			
Dimensions of stack =	\bar{R}	\bar{U}	\bar{B}

Figure E-3.

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.

Appendix E

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 selected 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 11 of Appendix F.

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.]

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	3	7	3
2	6	3	1
3	7	1	3
4	10(0)	2	1
5	4	2	1
6	7	7	2
7	3	3	2
8	9	6	1
9	5	5	2
10	2	2	2
(continue if larger sample size is required)			
Dimensions of stack =	10	7	3
	\bar{R}	\bar{U}	\bar{B}

Figure E-4. Completed example of package selection using a three-dimensional lot numbering system.

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. O. Box 8711
San Jose, California 95155

Technovate²
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 F 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.

The example worksheet shown on page E-5 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

¹The mention of firm names does not imply that they are endorsed or recommended by the Department of Commerce over other firms not mentioned.

²The mention of firm names does not imply that they are endorsed or recommended by the Department of Commerce over other firms not mentioned.

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, of 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-5 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.

- o 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.

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.

- o When the lot is defined as packages on open display plus cartons in a storeroom, the sample should be taken proportionately from the packages on the shelf and from the cartons. Thus, with 24 packages on display and 220 packages 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.

- o 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.

- o 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.



APPENDIX F: RANDOM NUMBER TABLE

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TABLE OF RANDOM DIGITS

11164	36318	75061	37674	26320	75100	10431	20418	19228	91792
21215	91791	76831	58678	87054	31687	93205	43685	19732	08468
10438	44482	66558	37649	08882	90870	12462	41810	01806	02977
36792	26236	33266	66583	60881	97395	20461	36742	02852	50564
73944	04773	12032	51414	82384	38370	00249	80709	72605	67497
49563	12872	14063	93104	78483	72717	68714	18048	25005	04151
64208	48237	41701	73117	33242	42314	83049	21933	92813	04763
51486	72875	38605	29341	80749	80151	33835	52602	79147	08868
99756	26360	64516	17971	48478	09610	04638	17141	09227	10606
71325	55217	13015	72907	00431	45117	33827	92873	02953	85474
65285	97198	12138	53010	94601	15838	16805	61004	43516	17020
17264	57327	38224	29301	31381	38109	34976	65692	98566	29550
95639	99754	31199	92558	68368	04985	51092	37780	40261	14479
61555	76404	86210	11808	12841	45147	97438	60022	12645	62000
78137	98768	04689	87130	79225	08153	84967	64539	79493	74917
62490	99215	84987	28759	19177	14733	24550	28067	68894	38490
24216	63444	21283	07044	92729	37284	13211	37485	10415	36457
16975	95428	33226	55903	31605	43817	22250	03918	46999	98501
59138	39542	71168	57609	91510	77904	74244	50940	31553	62562
29478	59652	50414	31966	87912	87154	12944	49862	96566	48825
96155	95009	27429	72918	08457	78134	48407	26061	58754	05326
29621	66583	62966	12468	20245	14015	04014	35713	03980	03024
12639	75291	71020	17265	41598	64074	64629	63293	53307	48766
14544	37134	54714	02401	63228	26831	19386	15457	17999	18306
83403	88827	09834	11333	68431	31706	26652	04711	34593	22561
67642	05204	30697	44806	96989	68403	85621	45556	35434	09532
64041	99011	14610	40273	09482	62864	01573	82274	81446	32477
17048	94523	97444	59904	16936	39384	97551	09620	63932	03091
93039	89416	52795	10631	09728	68202	20963	02477	55494	39563
82244	34392	96607	17220	51984	10753	76272	50985	97593	34320
96990	55244	70693	25255	40029	23289	48819	07159	60172	81697
09119	74803	97303	88701	51380	73143	98251	78635	27556	20712
57666	41204	47589	78364	38266	94393	70713	53388	79865	92069
46492	61594	26729	58272	81754	14648	77210	12923	53712	87771
08433	19172	08320	20839	13715	10597	17234	39355	74816	03363
10011	75004	86054	41190	10061	19660	03500	68412	57812	57929
92420	65431	16530	05547	10683	88102	30176	84750	10115	69220
35542	55865	07304	47010	43233	57022	52161	82976	47981	46588
86595	26247	18552	29491	33712	32285	64844	69395	41387	87195
72115	34985	58036	99137	47482	06204	24138	24272	16196	04393
07428	58863	96023	88936	51343	70958	96768	74317	27176	29600
35379	27922	28906	55013	26937	48174	04197	36074	65315	12537
10982	22807	10920	26299	23593	64629	57801	10437	43965	15344
90127	33341	77806	12446	15444	49244	47277	11346	15884	28131
63002	12990	23510	68774	48983	20481	59815	67248	17076	78910
40779	86382	48454	65269	91239	45989	45389	54847	77919	41105
43216	12608	18167	84631	94058	82458	15139	76856	86019	47928
96167	64375	74108	93643	09204	98855	59051	56492	11933	64958
70975	62693	35684	72607	23026	37004	32989	24843	01128	74658
85812	61875	23570	75754	29090	40264	80399	47254	40135	69911

TABLE OF RANDOM DIGITS

40603	16152	83235	37361	98783	24838	39793	80954	76865	32713
40941	53585	69958	60916	71018	90561	84505	53980	64735	85140
73505	83472	55953	17957	11446	22618	34771	25777	27064	13526
39412	16013	11442	89320	11307	49396	39805	12249	57656	88686
57994	76748	54627	48511	78646	33287	35524	54522	08795	56273
61834	59199	15469	82285	84164	91333	90954	87186	31598	25942
91402	77227	79516	21007	58602	81418	87838	18443	76162	51146
58299	83880	20125	10794	37780	61705	18276	99041	78135	99661
40684	99948	33880	76413	63839	71371	32392	51812	48248	96419
75978	64298	08074	62055	73864	01926	78374	15741	74452	49954
34556	39861	88267	76068	62445	64361	78685	24246	27027	48239
65990	57048	25067	77571	77974	37634	81564	98608	37224	49848
16381	15069	25416	87875	90374	86203	29677	82543	37554	89179
52458	88880	78352	67913	09245	47773	51272	06976	99571	33365
33007	85607	92008	44897	24964	50559	79549	85658	96865	24186
38712	31512	08588	61490	72294	42862	87334	05866	66269	43158
58722	03678	19186	69602	34625	75958	56869	17907	81867	11535
26188	69497	51351	47799	20477	71786	52560	66827	79419	70886
12893	54048	07255	86149	99090	70958	50775	31768	52903	27645
33186	81346	85095	37282	85536	72661	32180	40229	19209	74939
79893	29448	88392	54211	61708	83452	61227	81690	42265	20310
48449	15102	44126	19438	23382	14985	37538	30120	82443	11152
94205	04259	68983	50561	06902	10269	22216	70210	60736	58772
38648	09278	81313	77400	41126	52614	93613	27263	99381	49500
04292	46028	75666	26954	34979	68381	45154	09314	81009	05114
17026	49737	85875	12139	59391	81830	30185	83095	78752	40899
48070	76848	02531	97737	10151	18169	31709	74842	85522	74092
30159	95450	83778	46115	99178	97718	98440	15076	21199	20492
12148	92231	31361	60650	54695	30035	22765	91386	70399	79270
73838	77067	24863	97576	01139	54219	02959	45696	98103	78867
73547	43759	95632	39555	74391	07579	69491	02647	17050	49869
07277	93217	79421	21769	83572	48019	17327	99638	87035	89300
65128	48334	07493	28098	52087	55519	83718	60904	48721	17522
38716	61380	60212	05099	21210	22052	01780	36813	19528	07727
31921	76458	73720	08657	74922	61335	41690	41967	50691	30508
57238	27464	61487	52329	26150	79991	64398	91273	26824	94827
24219	41090	08531	61578	08236	41140	76335	91189	66312	44000
31309	49387	02330	02476	96074	33256	48554	95401	02642	29119
20750	97024	72619	66628	66509	31206	55293	24249	02266	39010
28537	84395	26654	37851	80590	53446	34385	86893	87713	26842
97929	41220	86431	94485	28778	44997	38802	56594	61363	04206
40568	33222	40486	91122	43294	94541	40988	02929	83190	74247
41483	92935	17061	78252	40498	43164	68646	33023	64333	64083
93040	66476	24990	41099	65135	37641	97613	87282	63693	55299
76869	39300	84978	07504	36835	72748	47644	48542	25076	68626
02982	57991	50765	91930	21375	35604	29963	13738	03155	59914
94479	76500	39170	06629	10031	48724	49822	44021	44335	26474
52291	75822	95966	90947	65031	75913	52654	63377	70664	60082
03684	03600	52831	55381	97013	19993	41295	29118	18710	64851
58939	28366	86765	67465	45421	74228	01095	50987	83833	37276

TABLE OF RANDOM DIGITS

37100	62492	63642	47638	13925	80113	88067	42575	44078	62703
53406	13855	38519	29500	62479	01036	87964	44498	07793	21599
55172	81556	18856	59043	64315	38270	25677	01965	21310	28115
40353	84807	47767	46890	16053	32415	60259	99788	55924	22077
18899	09612	77541	57675	70153	41179	97535	82889	27214	03482
68141	25340	92551	11326	60939	79355	41544	88926	09111	86431
51559	91159	81310	63251	91799	41215	87412	35317	74271	11603
92214	33386	73459	79359	65867	39269	57527	69551	17495	91456
15089	50557	33166	87094	52425	21211	41876	42525	36625	63964
96461	00604	11120	22254	16763	19206	67790	88362	01880	37911
28177	44111	15705	73835	69399	33602	13660	84342	97667	80847
66953	44737	81127	07493	07861	12666	85077	95972	96556	80108
19712	27263	84575	49820	19837	69985	34931	67935	71903	82560
68756	64757	19987	92222	11691	42502	00952	47981	97579	93408
75022	65332	98606	29451	57349	39219	08585	31502	96936	96356
11323	70069	90269	89266	46413	61615	66447	49751	15836	97343
55208	63470	18158	25283	19335	53893	87746	72531	16826	52605
11474	08786	05594	67045	13231	51186	71500	50498	59487	48677
81422	86842	60997	79669	43804	78690	58358	87639	24427	66799
21771	75963	23151	90274	08275	50677	99384	94022	84888	80139
42278	12160	32576	14278	34231	20724	27908	02657	19023	07190
17697	60114	63247	32096	32503	04923	17570	73243	76181	99343
05686	30243	34124	02936	71749	03031	72259	26351	77511	00850
52992	46650	89910	57395	39502	49738	87854	71066	84596	33115
94518	93984	81478	67750	89354	01080	25988	84359	31088	13655
00184	72186	78906	75480	71140	15199	69002	08374	22126	23555
87462	63165	79816	61630	50140	95319	79205	79202	67414	60805
88692	58716	12273	48176	86038	78474	76730	82931	51595	20747
20094	42962	41382	16768	13261	13510	04822	96354	72001	68642
60935	81504	50520	82153	27892	18029	79663	44146	72876	67843
51392	85936	43898	50596	81121	98122	69196	54271	12059	62539
54239	41918	79526	46274	24853	67165	12011	04923	20273	89405
57892	73394	07160	90262	48731	46648	70977	58262	78359	50436
02330	74736	53274	44468	53616	35794	54838	39114	68302	26855
76115	29247	55342	51299	79908	36613	68361	18864	13419	34950
63312	81886	29085	20101	38037	34742	78364	39356	40006	49800
27632	21570	34274	56426	00330	07117	86673	46455	66866	76374
06335	62111	44014	52567	79480	45886	92585	87828	17376	35254
64142	87676	21358	88773	10604	62834	63971	03989	21421	76086
28436	25468	75235	75370	63543	76266	27745	31714	04219	00699
09522	83855	85973	15888	29554	17995	37443	11461	42909	32634
93714	15414	93712	02742	34395	21929	38928	31205	01838	60000
15681	53599	58185	73840	88758	10618	98725	23146	13521	47905
77712	23914	08907	43768	10304	61405	53986	61116	76164	54958
78453	54844	61509	01245	91199	07482	02534	08189	62978	55516
24860	68284	19367	29073	93464	06714	45268	60678	58506	23700
37284	06844	78887	57276	42695	03682	83240	09744	63025	60997
35488	52473	37634	32569	39590	27379	23520	29714	03743	08444
51595	59909	35223	44991	29830	56614	59661	83397	38421	17503
90660	35171	30021	91120	78793	16827	89320	08260	09181	53622

TABLE OF RANDOM DIGITS

54723	56527	53076	38235	42780	22716	36400	48028	78196	92985
84828	81248	25548	34075	43459	44628	21866	90350	82264	20478
65799	01914	81363	05173	23674	41774	25154	73003	87031	94368
87917	38549	48213	71708	92035	92527	55484	32274	87918	22455
26907	88173	71189	28377	13785	87469	35647	19695	33401	51998
68052	65422	88460	06352	42379	55499	60469	76931	83430	24560
42587	68149	88147	99700	56124	53239	38726	63652	36644	50876
97176	55416	67642	05051	89931	19482	80720	48977	70004	03664
53295	87133	38264	94708	00703	35991	76404	82249	22942	49659
23011	94108	29196	65187	69974	01970	31667	54307	40032	30031
75768	49549	24543	63285	32803	18301	80851	89301	02398	99891
86668	70341	66460	75648	78678	27770	30245	44775	56120	44235
56727	72036	50347	33521	05068	47248	67832	30960	95465	32217
27936	78010	09617	04408	18954	61862	64547	52453	83213	47833
31994	69072	37354	93025	38934	90219	91148	62757	51703	84040
02985	95303	15182	50166	11755	56256	89546	31170	87221	63267
89965	10206	95830	95406	33845	87588	70237	84360	19629	72568
45587	29611	98579	42481	05359	36578	56047	68114	58583	16313
01071	08530	74305	77509	16270	20889	99753	88035	55643	18291
90209	68521	14293	39194	68803	32052	39413	26883	83119	69623
04982	68470	27875	15480	13206	44784	83601	03172	07817	01520
19740	24637	97377	32112	74283	69384	49768	64141	02024	85380
50197	79869	86497	68709	42073	28498	82750	43571	77075	07123
46954	67536	28968	81936	95999	04319	09932	66223	45491	69503
82549	62676	31123	49899	70512	95288	15517	85352	21987	08669
61798	81600	80018	84742	06103	60786	01408	75967	29948	21454
57666	29055	46518	01487	30136	14349	56159	47408	78311	25896
29805	64994	66872	62230	41385	58066	96600	99301	85976	84194
06711	34939	19599	76247	87879	97114	74314	39599	43544	36255
13934	46885	58315	88366	06138	37923	11192	90757	10831	01580
28549	98327	99943	25377	17628	65468	07875	16728	22602	33892
40871	61803	25767	55484	90997	86941	64027	01020	39518	34693
47704	38355	71708	80117	11361	88875	22315	38048	42891	87885
62611	19698	09304	29265	07636	08508	23773	56545	08015	28891
03047	83981	11916	09267	67316	87952	27045	62536	32180	60936
26460	50501	31731	18938	11025	18515	31747	96828	58258	97107
01764	25959	69293	89875	72710	49659	66632	25314	95260	22146
11762	54806	02651	52912	32770	64507	59090	01275	47624	16124
31736	31695	11523	64213	91190	10145	34231	36405	65860	48771
97155	48706	52239	21831	49043	18650	72246	43729	63368	53822
31181	49672	17237	04024	65324	32460	01566	67342	94986	36106
32115	82683	67182	89030	41370	50266	19505	57724	93358	49445
07068	75947	71743	69285	30395	81818	36125	52055	20289	16911
26622	74184	75166	96748	34729	61289	36908	73686	84641	45130
02805	52676	22519	47848	68210	23954	63085	87729	14176	45410
32301	58701	04193	30142	99779	21697	05059	26684	63516	75925
26339	56909	39331	42101	01031	01947	02257	47236	19913	90371
95274	09508	81012	42413	11278	19354	68661	04192	36878	84366
24275	39632	09777	98800	48027	96908	08177	15364	02317	89548
36116	42128	65401	94199	51058	10759	47244	99830	64255	40550

TABLE OF RANDOM DIGITS

47505	02008	20300	87188	42505	40294	04404	59286	95914	07191
13350	08414	64049	94377	91059	74531	56228	12307	87871	97064
33006	92690	69248	97443	38841	05051	33756	24736	43508	53566
55216	63886	06804	11861	30968	74515	40112	40432	18682	02845
21991	26228	14801	19192	45110	39937	81966	23258	99348	61219
71025	28212	10474	27522	16356	78456	46814	28975	01014	91458
65522	15242	84554	74560	26206	49520	65702	54193	25583	54745
27975	54923	90650	06170	99006	75651	77622	20491	53329	12452
07300	09704	36099	61577	34632	55176	87366	19968	33986	46445
54357	13689	19569	03814	47873	34086	28474	05131	46619	41499
00977	04481	42044	08649	83107	02423	46919	59586	58337	32280
13920	78761	12311	92808	71581	85251	11417	85252	61312	10266
08395	37043	37880	34172	80411	05181	58091	41269	22626	64799
46166	67206	01619	43769	91727	06149	17924	42628	57647	76936
87767	77607	03742	01613	83528	66251	75822	83058	97584	45401
29880	95288	21644	46587	11576	30568	56687	83239	76388	17857
36248	36666	14894	59273	04518	11307	67655	08566	51759	41795
12386	29656	30474	25964	10006	86382	46680	93060	52337	56034
52068	73801	52188	19491	76221	45685	95189	78577	36250	36082
41727	52171	56719	06054	34898	93990	89263	79180	39917	16122
49319	74580	57470	14600	22224	49028	93024	21414	90150	15686
88786	76963	12127	25014	91593	98208	27991	12539	14357	69512
84866	95202	43983	72655	89684	79005	85932	41627	87381	38832
11849	26482	20461	99450	21636	13337	55407	01897	75422	05205
54966	17594	57393	73267	87106	26849	68667	45791	87226	74412
10959	33349	80719	96751	25752	17133	32786	34368	77600	41809
22784	07783	35903	00091	73954	48706	83423	96286	90373	23372
86037	61791	33815	63968	70437	33124	50025	44367	98637	40870
80037	65089	85919	74391	36170	82988	52311	59180	37846	98028
72751	84359	15769	13615	70866	37007	74565	92781	37770	76451
18532	03874	66220	79050	66814	76341	42452	65365	07167	90134
22936	22058	49171	11027	07066	14606	11759	19942	21909	15031
66397	76510	81150	00704	94990	68204	07242	82922	65745	51503
89730	23272	65420	35091	16227	87024	56662	59110	11158	67508
81821	75323	96068	91724	94679	88062	13729	94152	59343	07352
94377	82554	53586	11432	08788	74053	98312	61732	91248	23673
68485	49991	53165	19865	30288	00467	98105	91483	89389	61991
07330	07184	86788	64577	47692	45031	36325	47029	27914	24905
10993	14930	35072	36429	26176	66205	07758	07982	33721	81319
20801	15178	64453	83357	21589	23153	60375	63305	37995	66275
79241	35347	66851	79247	57462	23893	16542	55775	06813	63512
43593	39555	97345	58494	52892	55080	19056	96192	61508	23165
29522	62713	33701	17186	15721	95018	76571	58615	35836	66260
88836	47290	67274	78362	84457	39181	17295	39626	82373	10883
65905	66253	91482	30689	81313	01343	37188	37756	04182	19376
44798	69371	07865	91756	42318	63601	53872	93610	44142	89830
35510	99139	32031	27925	03560	33806	85092	70436	94777	57963
50125	93223	64209	49714	73379	89975	38567	44316	60262	10777
25173	90038	63871	40418	23818	63250	05118	52700	92327	55449
68459	90094	44995	93718	83654	79311	18107	12557	09179	28408

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96195	07059	13266	31389	87612	88004	31843	83469	22793	14312
22408	94958	19095	58035	43831	32354	83946	57964	70404	32017
53896	23508	16227	56929	74329	12264	26047	66844	47383	42202
22565	02475	00258	79018	70090	37914	27755	00872	71553	56684
49438	20772	60846	69732	07612	70474	46483	21053	95475	53448
65620	34684	00210	04863	01373	19978	61682	69315	46766	83768
20246	26941	41298	04763	19769	25865	95937	03545	93561	73871
09433	09167	35166	32731	73299	41137	37328	28301	61629	05040
95552	73456	16578	88140	80059	50296	07656	01396	83099	09718
76053	05150	69125	69442	16509	03495	26427	58780	27576	31342
34822	35843	78468	82380	52313	71070	71273	10768	86101	51474
07753	04073	58520	80022	28185	16432	86909	82347	10548	83929
04204	94434	62798	81902	29977	57258	87826	35003	46449	76636
96770	19440	29700	42093	64369	69176	29732	37389	34054	28680
65989	62843	10917	34458	81936	84775	39415	10622	36102	16753
06644	94784	66995	61812	54215	01336	75887	57685	66114	76984
88950	46077	34651	12038	87914	20785	39705	73898	12318	78334
21482	95422	02002	33671	46764	50527	46276	77570	68457	62199
55137	61039	02006	69913	11291	87215	89991	26003	55271	08153
98441	81529	59607	65225	49051	28328	85535	37003	87211	10204
57168	30458	23892	07825	53447	53511	09315	42552	43135	57892
71886	65334	38013	09379	83976	42441	14086	33197	82671	05037
40418	59504	52383	07232	14179	59693	37668	26689	93865	78925
28833	76661	47277	92935	63193	94862	60560	72484	29755	40894
37883	62124	62199	49542	55083	20575	44636	92282	52105	77664
44882	33592	66234	13821	86342	00135	87938	57995	34157	99858
19082	13873	07184	21566	95320	28968	31911	06288	77271	76171
45316	29283	89318	55806	89338	79231	91545	55477	19552	03471
22788	55433	31188	74882	44858	69655	08096	70982	61300	23792
08293	86193	05026	21255	63082	92946	28748	25423	45282	57821
29223	70541	67115	84584	10100	33854	26466	77796	70698	99393
22681	80110	31595	09246	39147	11158	43298	36220	88841	11271
74580	90354	43744	22178	38084	60027	24201	71686	59767	33274
69093	71364	08107	96952	50005	30297	97417	89575	04676	35616
40456	91234	58090	65342	95002	28447	21700	43137	13746	85959
72927	67349	83962	58912	59734	76323	02913	46306	53956	38936
61869	33093	81129	06481	89281	83629	81960	63704	56329	10357
40048	16520	07638	10797	22270	57350	72214	36410	95526	87614
68773	97669	28656	89938	12917	25630	08068	19445	76250	24727
09774	30751	49740	11385	91468	28900	76804	52460	52320	70493
46139	36689	82587	13586	35061	76128	38568	62300	43439	53434
26566	95323	32993	89988	12152	01862	93113	33875	31730	62941
06765	57141	48617	18282	13086	76064	83334	70192	15972	80429
35384	90380	12317	89702	33091	68835	62960	38010	52710	87604
49333	78482	36199	11355	86044	88760	03724	22927	91716	92332
45595	14044	56806	99126	85584	87750	78149	22723	48245	78126
79819	15054	76174	12206	06886	06814	43285	20008	75345	19779
11971	62234	74857	46401	20817	57591	41189	49604	29604	30660
11452	89318	53084	21993	62471	74101	61217	76536	58393	63718
38746	81271	96260	98137	60275	22647	33103	50090	29395	10002

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93369	13044	69686	78162	29132	51544	17925	56738	32683	83153
19360	55049	94951	76341	38159	31008	41476	05278	03909	02299
47798	89890	06893	65483	97658	74884	38611	27264	26956	83504
69223	32007	03513	61149	66270	73087	16795	76845	44645	44552
34511	50721	84850	34159	38985	75384	22965	55366	81632	78872
54031	59329	58963	52220	76806	98715	67452	78741	58128	00077
66722	85515	04723	92411	03834	12109	85185	37350	93614	15351
71059	07496	38404	18126	37894	44991	45777	02070	38159	23930
45478	86066	31135	33243	01190	47277	55146	56130	70117	83203
97246	91121	89437	20393	76598	99458	76665	83793	37448	32664
22982	25936	96417	34845	28942	65569	38253	77182	12996	19505
48243	62993	47132	85248	79160	90981	71696	79609	33809	60839
93514	14915	67960	82203	22598	94802	75332	95585	69542	79924
69707	98303	93069	16216	01542	51771	16833	20922	94415	27617
87467	91794	70814	12743	17543	04057	71231	11309	32780	83270
81006	81498	59375	30502	44868	81279	23585	49678	70014	10523
15458	83481	50187	43375	56644	72076	59403	65469	74760	69509
33469	12510	23095	48016	22064	39774	07373	10555	33345	21787
67198	07176	65996	18317	83083	11921	06254	68437	59481	54778
58037	92261	85504	55690	63488	26451	43223	38009	50567	09191
84983	68312	25519	56158	22390	12823	92390	28947	36708	25393
35554	02935	72889	68772	79774	14336	50716	63003	86391	94074
04368	17632	50962	71908	13105	76285	31819	16884	11665	16594
81311	60479	69985	30952	93067	70056	55229	83226	22555	66447
03823	89887	55828	74452	21692	55847	15960	47521	27784	25728
80422	65437	38797	56261	88300	35980	56656	45662	29219	49257
61307	49468	43344	43700	14074	19739	03275	99444	62545	23720
83873	82557	10002	80093	74645	33109	15281	38759	09342	69408
38110	16855	28922	93758	22885	36706	92542	60270	99599	17983
43892	91189	87226	56935	99836	85489	89693	49475	31941	78065
93683	09664	53927	49885	94979	88848	42642	93218	80305	49428
32748	02121	11972	96914	83264	89016	45140	20362	63242	86255
49211	92963	38625	65312	52156	36400	67050	64058	45489	24165
63365	64224	69475	57512	85097	05054	88673	96593	00902	53320
63576	26373	44610	43748	90399	06770	71609	90916	69002	57180
41078	47036	65524	68466	77613	20076	71969	47706	22506	81053
70846	89558	64173	15381	67322	70097	82363	90767	17879	32697
68800	64492	20162	32707	69510	82465	26821	79917	34615	35820
44977	89525	51269	63747	30997	97213	53016	65909	05723	50168
79354	63847	24395	53679	07667	67993	24634	78867	78516	00448
14954	22299	40156	52685	19093	06090	23800	06739	76836	19050
01711	98439	09446	33937	98956	85676	89493	05132	45886	49379
62328	55328	45738	93940	15772	81975	91017	21387	57949	13992
73004	62109	81907	71077	50322	66093	79921	61412	18347	21115
34218	89445	03609	52336	19005	15179	94958	99448	11612	76981
99159	01968	45886	86875	05196	64297	59339	39878	61548	56442
92858	29949	15817	93372	34732	61584	72007	58597	43802	51066
27396	97477	65554	71601	01540	26509	19487	39684	18676	41219
37103	45309	30129	43380	66638	10841	77292	40288	25826	61431
57347	97012	48428	20606	54138	75716	23741	50462	13221	47254

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66378	02919	34012	50080	15113	73092	72220	61774	50603	82144
84019	30690	25656	72996	45318	00042	70751	59853	37249	19934
17701	21292	14880	15386	09233	40427	08906	03314	16402	48894
32546	92072	62522	21504	47540	42652	37497	43224	82602	18452
97138	61919	97789	28575	57944	77307	40383	93636	90110	81264
35292	27924	55467	43036	54696	58741	51284	23602	77342	28937
02737	08168	30043	63450	93882	61891	56568	20421	98628	40240
28261	37844	12543	14398	61867	98343	60165	77171	81634	94273
80573	30606	48644	53008	92214	49340	45426	93327	31152	39354
77153	88552	26843	12844	46093	28992	94520	35454	94065	00135
85149	57504	15059	36849	98386	91490	84796	60343	26106	49199
35229	72837	36752	71655	47769	28417	18450	48237	68208	67162
40117	24346	32189	87074	45796	23893	53744	90810	82904	12358
60875	97545	68652	92160	91134	97433	25977	27972	94637	55846
03769	32551	74801	41692	45900	23015	98639	58761	82335	69677
94077	92209	31506	69606	04593	85788	66441	70949	41566	62756
94376	00666	94145	22399	01020	70300	56798	75325	00320	62369
42354	11347	90920	03864	78317	46754	72541	11215	10006	37652
81149	43291	10817	44348	63321	04864	17293	02891	56618	22737
10631	78238	00157	46259	42238	64175	84446	14684	31084	67708
86300	07689	14006	77753	49355	87189	75358	86489	31618	66028
19850	39650	65222	15563	29509	42419	50070	20990	92104	89808
94464	66432	62243	13674	22209	70154	84551	94793	34989	31748
23921	49730	21718	92314	83489	73148	11294	99678	51477	25232
72775	23716	42853	74793	93006	42319	20691	52698	72634	46029
27816	46704	82735	03339	56793	44546	98700	56122	54589	16335
20207	77088	17167	24531	86232	71116	40809	32773	80660	08606
59283	04494	60725	21431	90168	85716	54354	55972	36949	59694
88731	36376	51383	57619	32032	51284	96664	17839	17909	77617
84762	67996	75000	01745	71191	50665	55117	27216	06809	58392
20754	92355	57955	10940	25021	10984	63457	20548	36746	35395
28065	69564	06835	56845	62194	63900	85428	44451	45140	72451
62175	73353	84972	17726	14731	01123	63229	04314	93330	94742
11044	50483	68821	97426	23049	31150	21432	22006	56305	55944
00331	63422	99622	76757	18696	35065	94558	62346	65239	83265
67157	26419	37978	16511	35469	30507	60676	02958	93043	98253
87713	50841	46270	26508	10702	19594	73436	95946	01484	67191
10281	82525	74155	86749	00482	92822	65022	25704	29402	92275
91367	74033	67020	69092	16720	09572	14224	01013	76228	16256
40560	36914	69176	31918	25477	70819	00166	51860	30787	85137
29223	38383	30315	70999	30985	76535	17420	52608	75402	83873
49095	40238	81697	12474	57003	34567	27567	79053	57170	41774
27466	26927	53345	11379	93190	56387	25198	31109	08243	48094
57463	70045	65123	49070	01183	78541	34520	30483	79873	58151
50558	92242	52732	81502	62679	62628	84731	93530	17217	68762
28413	95918	44156	46959	67273	29385	70159	01792	85278	22024
56657	43193	58130	54273	53078	40040	85048	38398	23985	14998
13121	68867	95763	59667	48361	87719	31157	82712	98813	98441
96996	89356	22784	60184	89217	61725	58709	50429	73155	52967
60742	22226	89993	24597	78667	49333	56033	89466	57502	42354

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29417	20972	84134	29166	98735	51882	67956	16763	47369	57699
70185	05460	07353	85855	33574	85856	86601	65244	39279	53684
06393	52017	21236	20530	89576	39382	15894	71278	93489	10447
42605	92474	09361	42404	98327	93965	26963	27559	80658	42064
26483	48873	84260	33285	54486	07807	19501	16301	59056	86367
93609	77425	57268	69320	47886	78105	44992	50968	90693	30386
19790	03265	68474	29678	64436	43985	02438	31659	44210	70037
63434	67251	20510	80627	80523	61412	33660	46175	96063	14298
76636	42771	12583	56329	88902	90805	43650	48624	78197	17341
51258	74330	47751	52672	41346	17119	71058	64586	90439	81864
13260	14238	88391	50858	33941	47838	15835	54615	11310	96537
31811	50935	89510	15566	81745	08429	78817	18322	18877	41188
48832	69524	32113	46673	60234	80108	23226	55892	24186	26337
32367	18457	03312	25564	04592	06851	25711	36530	82476	31527
90346	17476	71039	21497	69318	25435	40724	84818	49860	07960
98513	08679	69413	82067	68726	67113	40086	72201	30638	07325
08484	15617	82790	08324	99044	79719	36547	61979	60216	25646
60042	87562	49728	26400	60016	17568	40307	18847	65227	69061
87653	86409	09277	38379	67336	39500	51808	48837	76158	59441
35711	00398	30494	50923	80938	44246	96023	46732	72639	62603
46483	32722	74799	60277	48013	22077	35044	47279	47006	75983
60858	06337	20220	34952	81472	48710	23779	86304	77694	50299
70783	01452	87661	24028	92844	03155	40197	05708	57209	84186
65346	43042	62134	32285	62069	49502	34239	67037	21845	98032
96349	52164	23298	72217	82646	63148	09096	56628	07565	65311
63469	13459	11091	96646	20039	98596	16363	56477	87651	48233
60579	75498	97815	86151	93260	41511	93160	36087	59894	99494
31018	74081	01494	06165	71990	83637	59628	33849	35822	70572
00047	33802	73342	54338	25353	98962	63678	43163	50144	89114
55754	86900	87931	01238	89004	11096	05920	17752	31277	11325
38058	30346	35722	78849	21471	82278	29213	94845	26930	54801
06904	43200	89092	30974	59755	88454	59602	94727	16714	95354
48430	79189	59690	93830	07776	08664	52263	83606	41333	77071
78556	58776	35370	24774	52236	29341	94488	07145	52220	34192
07662	07712	70410	99428	09331	44474	67177	13482	14976	49213
98745	12338	11088	05454	19181	45072	04773	19862	89161	27594
52923	81343	14908	23896	48471	91001	05586	70459	13254	82573
35165	93108	32068	21547	50105	70715	13223	74563	87710	23591
65221	12207	66079	59434	87191	04713	99292	80521	26791	49068
74453	55975	85463	94567	22358	78781	07962	69360	54235	42738
03496	60656	69735	55053	22640	71582	51654	75274	31698	05457
64252	80987	44416	31438	29264	19936	89867	70965	28692	63067
49225	11647	69733	79939	75002	58901	75790	07104	80964	27632
62476	19365	16568	62509	95910	93286	36240	51418	74732	73312
21119	31166	78385	14875	59615	83512	68197	66244	24795	33326
35086	50039	71251	45769	15637	04632	62198	36796	32974	11077
33330	78701	88536	41398	26023	58580	15762	53745	24286	37132
68346	45355	37072	40832	74406	56020	02685	70679	72827	99738
55526	31747	57309	09238	04385	66239	47653	25865	05159	54276
86020	55748	08636	63773	89977	73945	88713	51011	93969	21070

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71993	42819	28799	13095	92514	43984	30508	77680	81212	34526
11838	02291	89882	41613	56488	91842	09935	19546	77195	36522
14300	55319	47908	39232	84764	34927	38034	87475	98920	90263
33722	47722	12547	29759	05623	55683	52102	56424	69762	30662
51275	84821	87443	02491	31346	94515	55958	28692	40921	32924
13568	00825	80835	83639	76675	92132	90241	18876	70177	46012
08456	01475	40317	72077	91708	72684	70649	72149	72628	80008
62618	64027	64477	50432	68807	37744	51667	65524	12539	63269
59512	25249	42185	09622	98781	71616	11055	31366	52988	46575
10995	91922	50217	14187	13657	39404	11526	43462	98759	71632
60735	58965	58492	09666	08054	06806	36456	42019	84600	61047
22096	26338	30240	04343	43547	83752	93996	69829	96426	48078
24965	97107	41856	85296	33054	52750	77969	26418	64225	62110
75109	93142	91951	68894	57715	24245	60150	99352	86685	37711
64001	54264	71667	94262	97116	96803	56737	65317	76279	88744
68250	74501	48846	09100	97912	93608	95614	34069	70938	72961
95091	27082	73949	59533	03598	44067	03278	52967	22451	75302
10112	10630	82873	39312	03038	88123	82814	31665	52913	17460
09934	57587	44005	21090	78217	46487	69921	33254	05461	95641
33308	51441	13804	32609	84224	68692	18223	48840	96263	48875
09299	42617	94654	11315	07768	64785	72420	70730	41800	83608
98218	69710	03427	99255	33424	39386	84382	04880	36954	01658
41830	40472	46041	08952	72011	64159	63843	52630	94814	09739
35201	85672	66688	53948	00732	73504	91298	09614	45853	12731
41640	63018	74280	91670	26180	58938	58106	47810	68656	64983
37849	34389	55974	99443	14719	80076	12741	03905	67009	87629
60236	75705	83339	84923	01011	30063	06330	07599	00709	16850
70802	88189	11594	13447	75457	71004	44009	24915	56302	41824
43354	93950	54765	37553	84181	36216	39059	62882	41979	50520
15449	28847	82635	68543	53790	48389	45804	32925	01402	87082
92825	40536	76780	44264	83862	90043	72894	68578	53969	69222
00701	66589	04622	51354	97218	72396	31680	09782	52733	72400
59939	95137	65799	41147	59992	78037	93538	97788	47200	82661
57490	85805	04168	07403	73199	64966	06777	69181	66031	79795
76513	69339	33701	32184	95855	78070	58843	45540	85120	14177
06871	50132	50010	24089	24637	46572	54011	93201	54097	81368
01529	09499	57660	02309	71292	99365	09723	97643	58286	95363
54739	73796	14283	76959	68821	09189	23962	35933	96809	94564
94946	17241	82754	18073	98777	87952	75887	37642	99145	95108
49800	30054	85780	23094	72493	90128	27829	41329	71701	75852
15393	82529	15760	89788	20939	99670	99740	32598	75246	42702
26055	30056	15226	11081	56480	79276	05693	46518	57306	04516
86305	35043	66219	74831	78298	75297	84645	31731	61932	80390
89146	25324	22759	35601	09637	51779	46695	44974	05740	88907
86857	99404	91547	74934	47344	21891	15953	02025	49801	34923
27908	48944	09017	54397	38659	87114	36189	64093	28964	84500
86413	20709	41589	63641	00751	69701	45034	61896	55597	06060
33915	53890	19887	34108	21483	26278	02526	05353	28966	13298
78742	69971	30148	72647	29626	92136	17375	48739	23903	66165
07228	05082	72821	91026	66418	32184	74335	40574	42972	47241

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55430	37351	61633	90285	16917	94437	66824	11533	47863	22046
00577	42290	05963	11700	70037	10034	07311	11165	56974	46426
36154	75723	91542	16787	03110	66975	68337	81488	88300	27592
31848	99978	03207	88329	39253	53667	81785	48694	23657	91525
28946	62580	97582	65977	48600	05775	07558	59054	27667	61959
30385	72415	17502	56376	64472	81329	27483	91871	89057	25372
14575	77914	76183	26389	24144	64046	34085	80473	93356	73102
31279	44590	58035	77282	33273	85383	09044	09051	30775	50537
77512	36523	02015	41387	32093	43100	52315	22460	62864	88965
58912	77671	23085	06297	54791	41618	37930	53749	85415	16192
95333	10954	80389	02367	40610	90067	63624	80579	71190	89361
44054	28736	41611	78199	19251	76557	63720	31737	55312	49930
72491	94500	66094	62300	15472	63317	13240	23829	39534	55728
18432	23434	45169	68475	66149	67899	34912	05001	35806	03549
12234	89085	40297	00502	52220	58525	58894	19424	27450	06784
39718	85211	05151	34764	71249	01696	36708	35472	90029	64745
36051	64039	45396	00231	00921	95069	09399	90489	38419	12894
96613	66423	12689	64130	97479	95070	99004	23857	35986	40841
70359	91570	09183	14919	38929	84349	95042	17965	95220	15038
01989	19136	08131	53541	82422	45411	94928	81813	36181	09889
02230	70595	43419	53135	15179	29316	02112	01163	97902	71971
88096	81100	41977	35332	68396	08718	87458	60429	23100	40152
12683	11308	66462	18355	99662	88440	99728	14617	22483	81152
64001	81364	72636	33089	47742	43137	20303	44359	10009	17314
40900	25813	59368	69601	38226	59114	63688	37557	77626	02514
58242	41328	88904	50177	27632	55378	54675	08082	69762	14873
60715	53340	33022	10108	14753	73985	92060	46542	34788	36835
27238	22745	90163	03647	08894	46365	75304	67152	22811	24288
37938	78516	70563	16215	84028	04909	30989	22702	26560	73607
98205	55748	04831	08645	15310	55194	66845	05297	98721	30976
53145	51353	74684	18951	70927	81358	52578	44186	44301	20256
04867	59259	63294	43736	66210	91762	06169	92793	59830	64408
36524	23073	50311	20308	52936	45882	60664	95436	88015	12450
30123	11384	54364	20822	69977	45475	20214	54841	99153	35895
99860	31178	90268	08936	68418	66916	82793	69670	86672	55962
89936	45662	28554	69150	62793	94303	96210	75302	33213	08911
44281	71696	11871	37533	86744	45388	30330	79558	10506	07316
18771	30537	30207	33269	85734	23948	97113	39233	70946	68834
57638	65330	80035	85200	78007	04261	32958	14342	72272	80287
42122	96482	72041	76811	58927	01851	10621	96858	80262	77083
29549	52394	33317	87784	38281	72471	97664	49234	68672	84733
02614	31183	44649	30912	85627	72531	46205	31099	62954	64305
68748	11782	23219	84286	56440	19060	65523	92682	12306	29432
40406	22301	85290	99804	44860	78323	71123	10198	55941	76946
70213	06164	97933	57753	11421	04614	52460	03356	95919	38888
32844	83961	54598	10176	86364	49453	61773	54996	35570	12160
74486	07969	05309	89645	17976	08674	22694	46786	41597	52978
18802	30705	91643	38942	88911	52954	73963	77774	11868	37502
26486	32173	34687	95608	12454	99834	17370	43161	81162	84622
65622	79759	36338	71899	90283	97945	55898	12684	74479	51385

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61135	19665	05114	78638	63586	11795	97063	48450	77369	16263
16106	90185	96263	02507	91354	86528	17639	24186	30941	67315
35544	06278	48854	72399	99098	04573	81375	58400	83941	31748
80943	67569	93454	24181	02658	78568	68093	47958	81018	13003
97554	50203	70567	72092	07479	71742	81281	14511	72580	85115
67186	42955	61445	36045	31475	34402	33044	44804	68627	94487
65875	42175	28863	88771	84637	85500	10318	45017	45885	40101
90975	81559	67859	63602	20673	30213	96834	96080	20713	00534
81481	13183	71222	70225	43280	21323	50650	68177	85899	15746
76975	96995	12166	92352	48167	80000	66596	18627	28474	30303
35326	21359	72586	86189	99624	17808	10140	53357	44206	79386
29579	38761	92734	58214	52970	39794	15188	85638	03904	04746
02642	09600	65315	66327	18498	72727	27563	29180	84175	74225
81230	53743	22876	21823	04454	55654	12995	44595	43380	99903
17495	19813	17892	74515	12955	13978	92161	14003	43931	95242
46928	25916	87337	77943	06748	90165	99789	40967	67469	80345
84152	31826	67287	33338	87928	41809	31096	18247	17045	14563
82678	82298	30776	56257	09826	18112	79533	32018	37463	11527
18552	08390	69351	40652	93435	50131	25840	13588	42468	23940
95628	15010	90573	52277	20840	10250	89858	99644	99584	14678
63357	32875	36020	01311	79113	24584	19481	09984	88414	98036
72232	67441	45296	79939	92919	28144	60793	15581	19450	59181
68095	26353	04601	94392	71594	52459	57119	63269	31433	21046
25519	87458	09157	11623	00131	02897	16951	99280	92301	27000
65059	29857	32049	48635	18488	98309	18998	04148	40815	03836
41103	04031	56320	51601	06682	86666	66628	04309	21400	59609
67468	08107	41583	10751	51870	69294	31919	62518	19665	57360
77403	64125	83677	64105	01858	28424	71327	56365	70044	08497
71771	13873	37037	42717	00380	77145	86054	05966	63492	96890
22948	52941	24102	42194	73798	39978	69166	78465	14161	44969
79101	44098	54888	32439	73735	45963	78134	63873	93209	23198
59679	85623	88665	37662	02965	58303	90708	20025	96903	24799
84573	79324	28628	53865	98859	23851	27965	62394	48210	76695
63748	94408	23530	63312	33666	62570	64775	78428	76852	00048
10114	75450	93426	70371	81666	26440	20422	05720	30569	37120
35751	28954	14867	66639	15838	47174	76866	14330	16063	23541
29634	54059	56385	33733	89793	34378	08730	56522	58639	90829
77546	31070	84436	05763	78155	22466	81978	57323	95095	70716
89727	55485	90625	89569	16381	66207	11698	99314	16472	32211
65143	33136	44476	48637	75002	80827	53867	37797	93294	27644
83641	44229	27256	79396	99982	27601	62686	44711	35760	52115
42509	94666	07497	02578	84543	87442	50033	14021	26234	31110
03222	57102	02972	39437	77757	54043	46176	42391	87583	83865
32091	19016	83832	23879	80871	32792	87989	72248	76388	95781
73976	97790	30387	84634	30500	28220	12444	71840	13089	47446
37004	53393	47810	83454	04011	86934	79689	48048	74554	06192
58638	90302	44598	54242	15223	42680	48605	90969	57894	97459
00064	39994	39797	26064	82782	04264	92328	60166	14422	41386
27403	20773	51850	76189	85982	19110	25299	94014	33369	36871
22246	11715	78980	11721	44139	12903	85181	29422	88453	66811

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09837	30099	09890	91086	33155	25803	74128	62587	75542	83952
97936	09531	88934	55670	43209	88444	67390	39478	37734	16841
59748	22944	55610	56053	55916	62868	15090	46271	15368	61289
43674	57633	59107	15866	85233	43351	90338	69730	20157	03882
19907	54221	87469	62470	72344	80954	08326	66252	59875	79489
39011	69117	20730	84109	28718	49685	37494	57614	08688	50770
24443	23940	83835	01173	13695	88589	92115	87165	55980	24226
42151	42932	19174	43447	42239	81909	05523	98082	55686	28753
29128	85212	44711	79196	24576	92069	54255	25551	62687	28016
10326	23793	33748	95030	90604	37109	02427	88708	63399	36756
93511	19561	33904	94847	52831	53261	53502	67348	34216	73035
00445	35484	08948	24476	55265	18650	10627	60331	95501	95650
01459	74240	49911	19293	53893	32104	02817	52551	20742	10286
65861	30122	71598	88038	53814	55132	82451	89913	29607	18861
91552	72609	51067	08116	18866	31009	80131	85725	31198	12761
51669	27478	56704	84321	17599	62553	53199	34504	02916	84398
90446	46560	56067	42872	98808	79720	88018	02058	48880	01344
50210	60431	06618	78800	32218	57637	79725	11316	11340	96568
89807	86813	96184	64874	93202	93962	10070	54761	12871	80259
88701	79175	95189	56183	20134	39952	55671	41839	61322	65305
99120	47851	99248	71078	35928	33346	52690	84624	99064	82376
55753	83469	12873	15666	37927	38817	16278	23009	89151	04147
52249	48504	05514	91035	04252	38551	77103	80607	12542	63504
88553	20662	27815	86222	34551	64412	05837	66772	75870	76501
68092	45819	56220	31065	64940	20215	26969	16754	04551	59866
59444	88501	20563	57500	94698	00694	58263	51637	02643	34774
76783	26669	03258	66590	99900	77736	64500	92834	74489	09419
87333	99460	08006	16664	54955	85395	19513	19216	38129	72813
26886	48483	06544	13311	45905	35597	97774	65174	48862	37284
24829	55203	70963	70417	21224	84944	54909	58727	71064	45757
06983	18667	72551	18069	89516	55161	39607	70273	56851	07374
59030	46378	53814	72266	41626	30637	93389	47031	95613	27793
47231	20629	02354	70449	98491	19104	83113	31601	65493	36034
00701	73044	64727	69779	61109	97978	34380	98115	56408	35097
66124	02919	25416	66785	75566	90942	26021	42000	22815	20025
90358	19222	79867	18981	10341	51670	09522	28998	96078	06133
22622	26654	78088	30362	26633	05406	19549	48909	97920	56785
95960	07162	45135	26190	32766	92745	20116	49477	07861	42719
08200	82788	54543	81081	13269	55917	20155	41556	41900	50181
24466	85430	21152	32005	20096	63112	74990	24203	83129	57271
07936	41258	02989	96393	59573	94337	07848	96299	60352	82057
78023	66997	65064	24971	23253	30317	93164	00892	21248	75561
47644	77336	63231	11783	71237	33310	54754	26599	75253	19600
03275	06036	31911	78867	72068	06468	47267	33887	36670	34105
89723	55468	14608	20790	48213	35887	29166	20548	20193	97882
07119	24466	22195	42250	43549	03643	63697	53993	36803	19566
46591	66615	55236	32666	13684	82005	92931	89534	48533	31121
80529	78904	04827	17554	43371	03062	86386	08229	40206	14806
07725	06697	33393	19121	97224	63716	75365	59456	02107	16906
47362	05024	99720	27920	85724	15142	42358	74210	79346	99831

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24958	33522	16576	98787	50028	63586	77889	11911	46931	69833
81735	27718	93834	92043	66195	88484	18151	36810	89557	14218
55017	97610	34328	66427	53869	89788	09577	05165	84666	67472
20683	84532	28479	05715	63659	71923	68695	40036	64104	33248
13585	72457	19619	03832	74432	61549	54065	83075	91311	40107
48711	64144	80337	71585	70504	59408	93064	64847	13706	92344
52208	49447	15412	14280	23017	28577	84247	27343	23563	88277
33886	96047	29009	76516	80299	75350	78954	03463	51700	91620
20147	67103	41584	78231	06171	51292	53726	74138	11410	62759
63763	87499	38079	46238	21799	28457	62029	55944	13972	96195
92802	97341	83751	64571	71053	55546	65944	06105	89591	27569
63925	65647	49815	19034	21439	13203	42650	76610	07768	88840
94393	11275	05903	02499	63627	68125	27983	17349	28637	53662
46698	40194	85026	24980	19170	44276	51561	30169	42534	07143
60702	45371	61023	55256	96207	64734	37891	23723	65421	25704
58956	77949	65228	95469	81436	20018	24235	96339	76400	46060
58399	81720	75659	69541	21809	54248	17509	60559	27767	97751
19939	09958	00963	82529	52513	43776	21662	88924	78219	74910
13325	93167	73632	33467	85680	26017	17913	07410	56130	64563
89764	86727	77790	72109	39695	75198	51559	76932	16633	44977
42988	22394	20119	98892	31673	79554	31751	32325	67156	54504
34143	03455	98981	82000	20579	79606	56347	56350	83354	00364
27776	02410	01010	19110	61499	85908	43201	12711	30589	28762
32892	66745	40277	28854	81041	71064	16514	46341	12078	35395
09065	26941	02981	34114	86863	09045	73456	07708	42225	15575
39467	03634	40779	30458	19834	26706	96191	63280	48979	95486
34951	24766	22229	13483	10335	85140	89329	38960	47397	02738
40268	96086	43940	65334	51462	58852	85547	20000	36988	09085
90843	49913	81093	78977	97922	60965	94573	58072	89174	66916
97195	04805	65143	18688	16464	77815	84482	15877	28459	14942
78785	19381	61854	20215	49659	07003	88940	11334	97363	20454
56255	41713	41822	78782	35637	02954	57363	99163	54207	74573
42161	53846	65132	30178	04000	92671	69653	13983	47994	23735
85128	55549	19090	06111	78175	67231	81783	30315	55139	40986
28493	20155	68213	07719	99559	50765	41050	49881	87962	19545
86775	97256	68451	44802	17864	29560	01641	04734	90850	25142
21862	00623	00176	32474	27615	82953	67921	50137	95074	48299
13313	66702	07409	70205	06099	67366	48618	29441	79933	08899
05285	62489	94862	77544	70518	84170	78777	22013	47581	44495
07229	73956	83592	53742	75890	29900	96995	30719	32381	03636
10734	46061	60672	09961	56395	25280	04395	55532	57336	35480
10846	93370	88133	20560	75362	73349	94824	56230	00938	30905
94599	05590	80918	24514	40078	34149	13607	47818	06580	23924
56856	21810	55862	31803	84960	83054	89669	98686	83808	03627
75640	68389	04303	06221	07067	79214	30410	16324	73874	98988
78527	87354	15097	00295	59243	27377	18444	06155	39229	82710
70685	50737	82934	72591	55818	89149	12159	15038	80362	81818
36726	07910	43790	20031	92837	73214	86196	59638	25127	05882
94995	14932	31246	91861	78981	62082	59369	53932	12481	12132
02619	94869	42227	48150	25417	38335	29557	22037	64564	98239

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71695	56817	33742	61981	27464	02468	46987	65079	32859	76848
05713	72652	87394	99086	90087	62262	21899	69361	12664	88653
25426	94434	20539	96410	45076	00236	67622	59330	46044	67558
70054	86630	41579	14132	93063	73035	92054	22880	82965	01316
54154	77646	37952	85081	99733	97253	93631	68572	44366	24903
33318	84532	43135	53804	85674	41056	69733	33682	52318	29412
58102	26587	41601	24417	08483	10482	31149	19864	00024	61254
14943	26696	27514	93517	38028	79059	03417	07954	69618	14704
32482	36369	05240	85092	58564	21380	41315	49856	56480	32759
54876	24416	13083	16854	84999	20091	38910	38611	95731	40798
46675	51060	03144	58625	59711	73026	68371	45620	42949	06756
83398	31844	31973	45655	69263	50221	40727	07944	98084	16249
28137	34532	66104	34640	16732	06078	69434	99860	05735	31991
07182	54128	48715	41303	91104	27185	01921	12489	75728	34078
70889	96217	70820	71864	58657	91269	11081	71160	66631	68818
59570	17211	20470	44704	25282	81038	41606	68187	41392	27643
65430	80350	73621	40020	61960	18633	99648	40020	22461	40843
12513	90021	13475	59218	20083	32413	05332	22558	00691	84443
55239	24781	55101	97285	62739	18511	98370	42799	37452	11453
97890	01225	51055	43154	68791	09096	04876	10609	88173	25685
54639	30515	33859	12713	77652	16538	94402	76686	02829	42652
50101	30361	59665	11446	74798	80076	72084	34130	79713	27118
24632	77662	61445	80796	48554	74864	46157	90379	17231	58722
36125	47641	83726	34714	41599	92080	49757	42763	54830	54176
09239	69881	04801	24434	39236	17416	93480	40963	75479	66200
35130	44300	14175	15870	90871	84757	14215	06831	61659	30510
78423	77321	07987	24137	18452	58335	14370	90530	14299	75289
58703	32394	86582	34072	34058	20388	66463	85784	62741	23246
76548	18459	83286	16542	21938	77244	81753	09120	95165	24283
74138	84261	87542	64964	12443	95194	72461	82588	60500	26282
13667	58864	85579	94418	34423	94411	28993	48660	28349	63742
50712	94031	85425	85484	18036	15263	28443	66341	15867	95537
68160	71701	57550	88163	20935	23506	84587	12854	66132	60430
20236	06096	90931	42298	75752	99976	50476	18688	97886	67119
39500	20891	23879	10313	66343	54923	35134	24847	57127	57402
25589	85276	13740	33744	36877	27045	35065	89527	31824	18280
24474	99053	54613	93220	41156	20566	99125	29797	38323	25015
38511	94433	39189	55630	44191	97516	40722	16578	52809	88495
84583	18367	84116	32684	72415	54853	81549	02322	62031	49460
01612	41201	51574	41413	39294	26990	77812	54542	89375	83875
14090	39566	14412	62631	06462	64041	17472	42601	11260	59553
22847	15030	64634	98931	72204	25805	23875	37235	63299	29352
42967	06072	64739	23173	88608	35807	95525	41424	13722	77716
82554	76462	51139	40780	93617	08307	30336	89177	47110	45309
73663	83884	60199	73338	59173	73070	08557	04943	87144	89936
10105	30023	64695	33009	53071	23432	07993	22379	62799	82718
00471	54754	36580	85560	11769	30533	68013	44214	46633	22220
51655	38726	40423	89344	11214	49887	01423	76451	30933	47300
28755	85334	29252	97421	36429	93294	83390	55559	46006	12761
01310	03357	12199	99974	05223	66587	53405	99363	55507	90910

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74452	38409	42926	75980	52242	92927	39894	73478	45093	81595
76547	11904	59737	70354	94635	22752	31138	37663	22670	46715
84627	22865	75988	06481	55847	46204	08452	93605	48695	36791
55765	93196	62547	58409	82527	28979	72976	05771	51751	13350
89905	60533	17874	12688	93920	13692	93781	51781	19904	05789
24734	01194	10075	13485	43145	81515	28060	77317	34176	84143
97094	74291	31899	92010	38393	47126	24636	91415	45077	15613
63980	88288	98956	26679	00748	88177	17848	66342	10893	88391
66006	74865	33060	97838	87081	24181	76320	02273	10852	60397
15759	76795	80775	74179	67307	88621	89028	23477	60192	23979
90971	39333	68974	94089	61533	81046	93774	20327	35721	07208
81463	00806	24683	40348	08520	59610	99334	48469	18248	62739
48002	67511	07323	26190	56024	21335	49876	81060	27207	74104
35365	91853	85428	42775	92714	86837	90649	04835	69472	89204
36572	91812	70735	35564	59805	90652	24983	15319	35558	81256
32913	68383	22573	85726	35573	38118	06076	50525	46222	28159
38951	27616	91328	40925	91659	00772	05510	77388	56809	66607
59944	94555	36393	39363	66446	77159	04557	00925	32845	06551
96507	56281	78158	31720	74083	15120	01288	22613	32393	93160
46708	73179	88644	07734	94854	55368	43020	50369	03564	30863
65301	12953	42180	39432	68212	40338	26977	19347	72323	17618
05137	92796	23236	47042	52717	40790	57365	70030	15953	45872
19520	97157	87586	31462	05105	66632	21755	62313	42802	40043
54354	75375	85641	01377	95253	44487	79904	21266	74922	07092
85170	81635	47767	42467	60196	19715	14605	80311	91906	64254
82768	31169	11730	02740	54711	42873	22438	87763	24786	57678
84731	60843	94104	91264	96426	20055	69257	61622	85902	61448
99448	69788	13097	56339	64117	26057	59760	33448	72104	67221
71621	86697	68438	83975	16540	89525	45693	94359	66359	64829
41818	43427	70362	94547	32727	17801	43191	87654	63935	62125
24303	61743	11076	15493	06005	76612	05530	06814	49457	39723
50715	45199	28904	94628	34354	18192	59004	61984	80373	08066
78698	30642	46423	11046	19593	36204	88753	51670	03071	77976
10165	64353	33618	83928	67124	21864	78424	14001	86457	26582
88958	69871	84796	94683	57484	82870	26683	80388	68115	35554
98921	97577	58394	68771	16975	69861	34937	98295	64721	49511
54087	55839	26820	71501	43452	66707	00965	23451	72551	32052
28024	28386	98320	25743	35509	96209	77892	77830	69054	42504
48227	92366	18148	01955	32463	47807	34220	44702	67189	82734
96099	75774	86751	95153	28497	20388	71032	42182	00551	63297
93251	16304	27700	64563	76697	09654	25138	29549	24061	52850
99641	37676	34956	87228	50769	60259	21491	74858	01247	68977
11221	61510	48761	93166	00559	51856	66345	13400	79350	80860
69359	82626	43230	74399	50255	46678	18560	40986	23541	14198
42342	29993	03023	89508	51423	20434	59817	76923	35384	88973
31611	53191	98984	81410	07941	47321	75763	75519	17999	62204
52565	11937	86407	85579	67525	79315	22501	06329	00422	54770
49733	59387	62203	48276	11584	65328	29716	13680	93833	06388
60354	21366	23000	50019	85860	50111	61277	85399	82506	85554
72463	61242	39729	30540	83397	53859	97883	92659	98369	44149

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37751	04998	66038	63480	98442	22245	83538	62351	74514	90497
50915	64152	82981	15796	27102	71635	34470	13608	26360	76285
99142	35021	01032	57907	80545	54112	15150	36856	03247	40392
70720	10033	25191	62358	03784	74377	88150	25567	87457	49512
18460	64947	32958	08752	96366	89092	23597	74308	00881	88976
65763	41133	60950	35372	06782	81451	78764	52645	19841	50083
83769	52570	60133	25211	87384	90182	84990	26400	39128	97043
58900	78420	98579	33665	10718	39342	46346	14401	13503	46525
54746	71115	78219	64314	11227	41702	54517	87676	14078	45317
56819	27340	07200	52663	57864	85159	15460	97564	29637	27742
34990	62122	38223	28526	37006	22774	46026	15981	87291	56946
02269	22795	87593	81830	95383	67823	20196	54850	46779	64519
43042	53600	45738	00261	31100	67239	02004	70698	53597	62617
92565	12211	06868	87786	59576	61382	33972	13161	47208	96604
67424	32620	60841	86848	85000	04835	48576	33884	10101	84129
04015	77148	09535	10743	97871	55919	45274	38304	93125	91847
85226	19763	46105	25289	26714	73253	85922	21785	42624	92741
03360	07457	75131	41209	50451	23472	07438	08375	29312	62264
72460	99682	27970	25632	34096	17656	12736	27476	21938	67305
66960	55780	71778	52629	51692	71442	36130	70425	39874	62035
14824	95631	00697	65462	24815	13930	02938	54619	28909	53950
34001	05618	41900	23303	19928	60755	61404	56947	91441	19299
77718	83830	29781	72917	10840	74182	08293	62588	99625	22088
60930	05091	35726	07414	49211	69586	20226	08274	28167	65279
94180	62151	08112	26646	07617	42954	22521	09395	43561	45692
81073	85543	47650	93830	07377	87995	35084	39386	93141	88309
18467	39689	60801	46828	38670	88243	89042	78452	08032	72566
60643	59399	79740	17295	50094	66436	92677	68345	24025	36489
73372	61697	85728	90779	13235	83114	70728	32093	74306	08325
18395	18482	83245	54942	51905	09534	70839	91073	42193	81199
07261	28720	71244	05064	84873	68020	39037	68981	00670	86291
61679	81529	83725	33269	45958	74265	87460	60525	42539	25605
11815	48679	00556	96871	39835	83055	84949	11681	51687	55896
99007	35050	86440	44280	20320	97527	28138	01088	49037	85430
06446	65608	79291	16624	06135	30622	56133	33998	32308	29434
37913	83900	49166	00249	53178	72307	72190	75931	77613	20172
89444	98195	46733	37201	71901	55023	54570	83126	09462	93979
12582	41940	36060	56756	07999	64138	06492	25815	19518	86938
50494	80008	64774	51382	08059	66448	16437	91579	39197	43798
78301	66128	12840	22254	15193	81210	95747	47344	33660	41707
79457	31686	94486	27386	41641	72199	67265	51794	81521	01556
49337	10475	49588	79338	32156	47732	29464	92835	09498	81902
92540	56528	21200	87462	08924	56993	57330	85069	10903	80904
17729	61914	74616	20433	59474	21270	96406	13090	94308	02072
24003	80475	19793	71578	52010	72216	15692	96689	80452	46312
16129	49245	21693	20946	60873	82451	32516	23823	30046	06870
05453	03060	83621	43443	17082	04401	15299	64642	73497	88426
67711	70526	46700	00171	55077	11440	95932	91116	17259	19645
76306	39287	31026	49379	30267	68885	98147	70311	43856	37376
81300	17782	76403	00972	12558	46140	19818	20440	83967	61036

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91337	07867	85818	65793	94263	76470	55316	60468	08349	45373
75176	34589	68879	21968	49330	69953	43194	73403	09469	72748
17160	57451	22993	95995	65311	75701	39954	72526	76626	35516
28433	57629	08205	40781	24032	05442	99691	23744	09335	37022
50035	05553	85933	12491	10333	22326	60921	66083	34233	62188
69869	15344	31396	84367	15970	82126	09434	49383	98426	67431
30549	59241	82898	42180	48283	61393	96352	66506	73120	72516
29510	94096	26791	34413	88006	46738	92985	58330	28828	25577
44878	71668	78750	05324	02977	60163	54814	86186	66435	49621
25302	83121	47707	40863	31768	13771	64374	84821	99617	59335
57860	93507	29529	28458	79241	63109	68637	02226	54253	81563
33141	88879	02957	47149	49699	57716	17690	72899	82110	50629
65052	68319	69412	42527	34032	73030	58548	26646	48104	69594
24941	84062	88054	84373	44486	15538	39804	41207	97125	40784
01886	16174	50628	56233	49071	45200	25060	64423	63523	94480
08016	10413	94602	56457	68610	28844	03045	81694	27016	45353
03882	87648	52697	60711	16286	69365	19673	51940	32269	04815
62834	27330	10699	90885	05127	00613	37668	24302	28583	40091
33247	41643	70927	31321	59888	70963	71137	42109	38158	17938
82307	23559	85689	89446	63527	23039	20393	65964	82023	12341
58583	21453	28978	48964	01446	52847	13768	00416	69238	65102
32465	48311	35585	50557	94283	57524	34992	89948	75223	45146
61519	69204	68996	70758	21707	81001	23564	01868	98506	59743
86356	73642	09518	44369	55689	62728	78302	40813	09885	13404
53767	63388	16796	64813	24031	58407	36014	82654	94428	44226
01218	35379	29727	75386	43958	83453	79412	34890	66209	23890
52325	44710	40757	72146	13007	68360	97749	35695	62741	40189
73098	80330	84222	90943	40885	12939	05442	28368	12356	36643
59149	22391	48474	10852	76908	20478	79099	58081	78839	95399
00959	53551	79830	46543	24309	92935	42933	69419	16665	14742
14787	76869	94191	19491	68418	98110	28340	96802	00155	90570
64171	14812	41393	79529	75592	91281	80861	92359	27033	61817
01313	45726	99886	09578	45279	35895	64531	37081	19201	75326
84200	47129	52395	96899	10099	30822	12216	55826	07438	51617
06919	85363	47361	64574	37336	64547	14307	99149	38123	44970
23247	15253	75585	68626	45053	17334	29523	25995	49177	00386
19658	32970	01091	45103	91007	14371	16727	10672	12276	92746
19504	38856	54884	51710	84680	86301	93226	58570	26240	85420
44859	39279	43361	20494	20982	65480	12559	05155	45526	55095
18895	76874	87386	17071	81719	55002	82422	05533	02083	85519
67768	88621	48517	81164	41457	13462	73180	86033	20848	21596
96705	61333	01858	75027	71436	89366	34988	26212	48603	40920
20496	87788	03519	59104	06733	16899	55862	03673	20130	93779
52971	29093	74501	75044	68659	68836	12192	19632	39351	87090
64486	09512	28015	20215	59494	57338	26610	18188	49863	25604
60855	01535	36174	84390	95903	43073	72221	26938	75745	52048
73464	55057	02820	35790	18578	76635	05076	54096	43744	62741
42149	51759	70209	07229	11232	59252	05658	92153	81191	12886
32443	55682	43668	66255	09746	68332	08375	58222	22940	15506
82791	62679	59688	39350	48456	04296	72295	86030	79582	16887

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20310	77002	08809	22157	10837	71671	40011	44950	08812	89044
87713	03653	72959	99220	49349	55866	07342	17276	14385	47580
01304	58542	93111	59184	56795	41444	97257	29251	90935	78755
75167	02264	36350	96969	68482	95351	27884	78041	57494	71810
20514	69194	16525	55700	85691	27944	38202	07653	55353	09228
38651	73921	21065	76885	59715	69431	47300	82925	63159	98386
91432	56096	09432	89016	48635	10822	97521	75326	09490	70732
64648	16578	48775	96524	61467	76628	99168	71869	33656	05111
02578	28544	85951	86854	56879	37601	56236	26362	26414	19770
08263	68390	88578	04906	15120	38134	88312	48784	12144	73774
96847	82997	44049	56919	51967	74978	39095	89368	65052	22026
55743	33067	65333	70110	54996	59078	48207	03510	70877	37715
99974	80400	28970	45945	01347	36123	34017	67485	43932	58168
80869	55953	06116	94984	16708	98205	22688	65663	62542	56806
34133	57740	24854	07745	54507	76746	47071	78675	38891	93434
61460	93738	25458	72431	99401	84744	70029	37552	59235	47645
27720	41497	55835	52179	59856	15137	13634	19160	79183	84221
29115	91897	65377	47852	08506	04883	14182	95392	25651	41223
46566	15684	60425	30754	18933	42320	70330	18224	12619	09212
09166	81832	17131	73877	85185	23257	65957	81090	42262	64146
11426	02937	27646	21492	34247	22028	19725	85702	11885	94579
71294	73973	08698	66073	73598	55915	99355	26331	59699	23153
34149	60989	34642	47018	69538	60987	96434	57148	71403	93693
03117	65967	50719	01158	06293	16789	17186	60551	33461	86534
33412	74112	08513	72254	35441	01465	36390	84108	39682	44807
75823	19406	09287	08045	00284	44855	75010	88978	90337	65939
54649	54778	95187	10435	38504	87250	18668	92455	22756	03152
51253	02095	28294	67201	25339	90312	68379	01594	32215	87783
50381	16499	51078	12819	49757	74947	91123	52742	87292	08808
19323	89732	82986	02663	84229	34473	58682	87418	50883	76946
06150	24302	95150	76250	30801	03983	63178	57284	26729	33230
41202	64645	22622	01826	35905	01766	70576	62048	12165	41462
04107	09235	24716	59101	96506	40431	54894	78427	67072	98128
68092	53213	36257	48868	71457	00233	75910	26193	33917	67907
39812	15673	42947	63253	65921	66415	70671	20297	05417	34109
11047	87686	29213	11044	94290	69771	09846	66908	74773	27961
00879	91116	86460	30312	20158	92075	16847	77830	35734	99626
89058	65950	49736	08478	27892	53189	96087	54988	23526	43816
17259	56085	77598	72104	55654	20004	85473	56234	01324	70296
25411	57465	03522	11757	38547	13256	23061	89802	01550	12090
16844	26314	97394	13923	22228	17457	99469	44466	57998	26190
54875	69644	34870	32813	12194	20938	87868	88800	98026	78615
68051	31819	39629	16528	68949	29051	24774	63877	45775	47802
46942	28156	02580	15889	31907	45118	82628	01092	14494	17896
81065	22467	11394	75004	26255	10501	16189	56729	31596	49276
17024	65778	67948	14135	39013	46168	33721	45504	98510	95966
97912	09250	18218	50565	47469	36903	65701	93253	26939	60982
33845	37199	78192	00698	68234	03355	42538	83296	62628	95946
69169	45052	14542	16950	46813	07437	37065	41377	31216	79554
30123	19753	94439	57665	35875	12349	56542	84527	34164	56472

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07582	10165	22765	37876	98820	61272	27785	25547	34911	64205
51480	69619	66291	27231	43772	28456	74575	93028	03679	52910
93739	83946	04719	11810	17250	86498	20470	29275	30011	44864
77501	89638	71462	20353	16660	45710	68589	03412	19037	11087
90070	98435	70028	37100	89837	04596	22914	24344	71949	05517
44399	35944	05742	73053	82760	63425	79763	01524	77249	64155
92534	18121	16118	83052	15246	08566	45043	10783	66959	74543
48828	62179	91332	49387	03157	74038	26541	56445	48785	44853
79319	16283	52233	73316	45122	27554	29756	96759	33056	28606
51577	91142	93436	96303	89977	90087	13120	96091	24860	96828
22330	70504	48545	68126	45291	87475	24163	63742	87730	10358
93466	42332	97252	73472	46156	24496	61541	43245	61115	76533
43548	07899	25513	56361	91766	50421	09152	50804	10524	53850
93814	72986	91962	56915	30066	33977	31649	90594	68052	11915
86690	89880	43558	30069	79333	86609	68156	03137	07062	12783
38845	16253	74871	72687	89654	29577	83454	58022	17563	64899
48172	47714	51084	56465	40616	48157	71219	01505	66833	05679
35017	63495	74271	22106	31321	64839	25807	93473	00137	09671
48399	77906	54288	52557	54449	59957	01875	85988	08703	78168
03864	37086	98008	02258	15132	43129	17844	99260	15479	79507
68826	46808	09740	05601	15669	82364	61491	72149	35136	29264
06708	90751	72685	50708	11633	08781	27393	31221	48557	86877
12966	34702	90807	75258	75273	26574	22325	62233	44291	48101
85245	07384	81098	60159	45365	54011	59455	22429	22388	11746
41252	27833	72517	83243	47382	59457	58316	07600	58372	40620
60963	10072	54197	73482	38989	87698	53824	96807	07702	59683
89049	84026	91594	28935	40383	37849	32870	80310	58152	52064
26335	55349	63228	26650	36705	47502	37429	20549	29159	99513
05538	36619	77560	62853	93456	99936	59752	87944	86025	67095
10692	32066	16697	56702	29937	97062	02973	16832	90964	04313
54634	00944	10987	58027	51085	57901	52057	32216	80157	14493
00065	43328	72560	94569	45286	43007	05623	55638	29026	78978
87902	75424	51968	99835	91860	38605	30828	46802	72824	44637
52464	95337	26963	73756	48064	93381	07851	42047	83453	35547
74781	69454	57066	59100	28487	73375	46167	88425	39545	34565
19778	88098	60830	09768	62342	67444	26690	80168	32673	93179
13673	64531	13295	17276	14824	90690	93546	49550	93772	06666
10581	32609	77341	77516	43008	61601	20859	28394	59152	49459
08255	66125	14216	77191	57386	62633	21499	92101	34687	19276
07927	55998	77344	31246	83636	40349	20643	73957	26607	52369
74359	95321	05227	32068	06193	91798	83383	42196	09963	38558
58407	97943	96211	70429	05732	84384	07289	72218	31832	40059
25769	28088	65834	85252	89747	90925	25387	08361	84422	36949
48502	15084	18310	30630	94253	38363	63020	71106	79959	78764
80387	72508	61422	84197	35945	31591	81385	00556	43766	98053
00114	36950	14846	37110	96470	81446	08894	29688	56198	19288
32478	76248	53488	65023	27532	23879	60687	52494	36356	46115
58306	88322	13319	18658	64549	26343	50840	57983	07147	02956
76793	68692	16029	71460	12660	02502	06572	48869	10663	14735
83370	38797	98734	04847	26773	77920	51944	62222	92685	35368

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44769	30517	70102	66923	44820	87677	92753	97416	49040	45922
78167	79756	46021	08007	14957	42072	28847	68098	03020	57701
61357	23817	54307	87620	52470	33231	78231	68904	35244	75326
90513	40593	76830	99762	80331	00978	40513	40869	64414	70194
59618	46710	45424	10208	59234	14898	43962	84909	91099	71236
20790	12661	16732	42985	09722	50012	86981	02675	10748	48194
90996	12554	68221	76416	66663	62282	31281	35310	80429	53301
99377	51058	67559	84520	17347	89148	72921	85622	84691	47401
36123	67434	22169	98844	25735	75091	06435	84263	63017	81123
93281	30118	21101	99258	94424	25367	33796	45239	70499	25201
79845	91249	04478	93512	52468	89556	99373	63512	36198	18488
52174	97493	89196	04195	30269	66444	12716	28502	05710	94284
00747	68207	55502	22986	75167	17918	74538	09006	86861	79838
16708	72807	51857	76255	18089	73679	42403	13166	77358	88333
25623	07537	61833	84987	69387	92203	96450	05098	90102	45271
77340	32486	29584	44787	88123	17770	46250	11973	83550	42060
89364	93797	82953	50369	03536	11029	08471	30520	50259	02545
16751	06982	24904	06093	16397	52900	68895	92443	98929	52244
71971	08765	12203	78484	75450	99981	59082	14163	92913	19360
03017	06605	58501	81539	22510	68940	33522	20394	46543	79589
64476	34523	12343	18725	65151	86970	62418	26581	61981	09410
51202	74086	70109	12998	02414	71494	03159	83585	45049	51966
96665	30303	34324	46645	80830	23626	79945	91301	24673	01868
55015	35912	10139	48894	46664	38253	87095	53670	25907	72444
11107	88149	16479	54078	63841	16040	65827	92043	17168	74054
87487	46485	00775	16395	38806	60805	44173	65070	50358	40176
90190	58447	39859	09743	26109	79438	70577	49328	11703	42824
15175	92478	35998	99946	69636	84461	21613	76409	70423	74254
48068	40067	04295	56385	48823	30656	55038	87457	39053	15670
61279	10958	30360	52786	76705	72222	76212	51245	21360	31498
49672	96218	82786	51464	35871	78978	19468	86810	91449	89707
85392	48762	14256	03122	84412	24149	24762	34112	08091	79402
59083	94045	81670	89861	32988	20506	57560	83323	60916	43444
54434	11174	51054	81668	98144	35628	39569	37318	80469	88969
53797	11255	91633	39361	51927	43900	29343	45914	04119	39826
89002	74155	90048	46919	49107	65018	45120	30152	14586	39212
87878	09597	27210	21524	87794	63108	68891	62097	90211	75549
96089	64097	93624	29544	74626	63955	14223	16713	70479	51782
11217	82046	21690	42798	72671	80157	67183	85814	00687	42780
11454	12808	74747	59364	42198	17040	21888	64529	28011	75832
85046	32890	61264	91708	59412	38046	64493	41077	72953	48261
49356	71164	23918	30539	19653	87575	61952	11840	36853	34843
41572	19594	67804	33784	88371	36837	30432	98502	64064	55115
64031	22150	19036	20184	07617	71583	06870	57690	93763	77946
21815	94757	90566	64964	97723	88266	11694	01972	72578	41448
48305	92755	57563	82367	47101	00825	58050	06008	88913	25230
56443	27724	53965	99981	80671	57160	01935	32543	83901	74639
42291	13232	67671	44308	23769	10164	91375	20266	87208	10029
45518	87623	78203	37081	71466	47657	28642	73195	54720	72520
95177	24146	58627	31986	40878	81410	21087	39818	88101	98552

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49700	93636	17696	49470	05785	31850	24058	10335	71118	61008
85464	51836	31914	99649	87672	44549	46424	05491	25679	77871
62655	74647	62554	37187	09047	28791	21209	01568	52913	17355
06320	33866	96498	31330	92909	17389	68992	99793	95228	76380
51461	51599	86470	40445	91436	05876	82817	85125	52671	81294
18857	16278	71419	05556	68588	61157	09191	20340	64056	98558
34463	81982	48477	81794	44416	04882	17404	06782	24258	95494
00423	58351	43782	81504	15053	92051	32495	22477	01595	43298
08243	23838	49624	68462	77414	07235	04376	19828	54728	35566
59193	70070	32331	21381	45322	49199	31324	88166	69588	48202
71672	51886	70816	25768	46318	65078	52972	72108	03410	14524
63654	55203	76327	71815	46922	82676	87830	37674	37260	17826
57868	90557	36651	19813	89746	93377	66565	41700	15636	66171
29693	15650	18462	16235	39948	21692	51043	94949	22302	40925
63484	57044	91540	21718	64104	12367	64575	94814	27737	64187
85364	93913	61737	86962	65697	88283	68927	39794	57169	45095
16287	25375	15867	95283	33168	56120	17513	00645	85390	15997
92595	72413	33993	06030	95112	94896	54377	90062	16452	93037
33704	76376	74659	41267	76688	18133	38060	41881	83328	83809
58901	90840	56669	78835	05858	64675	09010	54958	35284	30958
07412	63696	33825	16694	73967	29246	98894	23157	76935	79074
12702	64736	50409	57464	31820	64825	45097	32627	60476	12723
62539	08011	40908	80672	89862	46152	69461	49787	37692	48566
59885	75421	36861	92169	98661	72550	96749	56746	62393	42373
17329	62987	78476	90023	08495	06192	91019	67045	74653	67824
27327	96394	58207	44955	40169	12618	58778	16831	05430	88563
90445	35276	86762	41317	53064	51069	88832	16357	64774	36891
11032	38240	45319	47241	25264	53636	45866	06170	27993	58351
51302	77958	52490	77170	03358	54742	34447	84967	68776	42571
66622	49435	99589	67210	74073	06215	88928	77780	60377	91754
76190	58111	09874	39403	10930	87677	82626	07795	59952	86542
30251	49227	99611	78308	80759	01809	58367	97705	24760	36788
33739	69843	74131	28427	22541	37407	84982	66320	93462	85311
15650	01776	68372	82826	64110	78678	51879	38065	46716	07576
57821	75997	83634	22908	38022	55507	01740	47670	42274	38423
34343	08908	26518	65718	53480	22587	73718	32834	18956	18956
23323	23619	35494	49657	50202	35740	39927	31645	20394	29700
33169	40216	96184	76191	96100	00153	99894	02730	34575	58631
30947	82726	46414	97199	21409	89041	17941	19749	21881	35136
11003	16963	31132	60853	17296	82316	70414	95317	15582	75017
95588	29968	92394	07440	12419	33386	35328	63832	84703	62860
68370	22340	21612	81839	36711	08197	40371	79421	58106	29504
42195	30429	64620	88496	07693	86177	56488	57422	47472	38570
01202	29289	62427	21438	14086	50187	83666	35786	05575	45977
93116	68142	74107	53938	04110	36326	99386	56376	94949	52729
84852	41998	79676	66284	06426	63679	11174	49449	88357	43065
00508	14804	58844	33124	11055	86970	77175	71558	54818	55379
47218	97203	61792	03128	41854	09790	67417	77503	84469	94306
66522	09899	91201	69710	81752	70872	33761	09139	78477	44794
06716	73148	33959	53602	39151	97205	66752	37464	38524	43791

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86751	31643	10000	46973	15087	50441	33585	31612	10799	40417
22075	90102	99392	38021	24560	12098	73510	34936	83802	40115
92802	95959	60734	27582	57848	24679	05293	27893	76916	43104
89282	36942	15446	64195	75093	75370	74322	52947	68985	05946
87628	03798	99146	21924	43463	66948	36919	98824	62696	06805
91565	65182	22592	37091	63310	84183	00250	23232	87824	14836
32355	04912	27541	82754	98750	70583	53914	60443	42725	05652
40753	39101	19457	47716	26380	83323	51486	84110	46644	79903
88500	42967	83510	40351	32837	32931	10396	04227	63362	20199
51908	65736	18945	68812	75109	06155	99387	08558	62262	98645
47094	87097	97020	91143	62118	12672	15815	74889	19460	58829
02463	75357	61308	99327	39737	10905	26508	46274	40242	05121
54312	66277	76735	44678	83716	33437	98718	52480	84904	77402
71694	39162	60033	50627	34244	71057	96691	08950	25773	00840
42141	63916	32684	26794	36497	57035	89022	05056	27721	58418
75410	03049	79995	53825	99440	36379	70519	47389	87208	36804
58786	26768	23616	75784	64974	58390	61220	94563	81387	58213
67457	11902	86054	57434	97776	66667	35131	40681	87357	28996
02269	38528	38539	64446	81182	47008	68770	90087	86998	23953
39579	37209	84309	39514	01443	97739	99688	21648	38269	79846
09845	40529	15953	04468	54735	88384	77433	13991	26343	29174
91508	98658	97677	78987	55041	26069	59032	51459	13674	93368
42465	67897	14979	54427	11491	84275	26730	54679	79978	38660
25901	25266	68376	76031	19778	40024	31528	55005	84202	37708
02308	73829	60006	14336	60963	69077	85372	77144	82833	92738
67699	27124	13614	72455	34177	76885	62394	24262	03243	14892
78434	23436	37596	76093	04771	20421	09079	45135	77736	62773
84423	55226	74167	47189	21397	67216	59455	60806	30259	76527
28994	65862	76866	06285	31842	27856	10944	46281	33203	85619
57712	37532	36262	59486	35348	27308	56888	32540	66150	12565
34286	50145	31754	04608	88572	70970	86240	78315	18150	16449
14070	96540	44832	14328	55954	81422	75636	61384	81002	38167
14575	09832	02340	40571	22235	55739	24478	10396	82247	03378
04642	12704	55126	60540	05627	19456	22498	73069	02367	30472
19882	68656	05854	48336	24020	96081	24103	71547	22927	64479
24399	28569	67059	36678	82387	96295	01883	02186	72497	59359
78075	76213	63842	60194	95601	73986	16253	02032	85983	18591
76865	38951	72179	83837	87268	50837	46733	76276	01305	36076
29356	13761	39554	58643	20267	51215	95103	65929	48615	19415
69558	33476	76530	81445	77370	81641	40544	26476	55469	37355
54153	41099	44019	80102	97019	16566	13080	66141	88031	51448
47310	75214	29401	05735	22185	42348	36342	82187	06839	49242
74270	44556	95074	53671	69191	01130	75643	18867	79022	71624
41926	96712	45102	53071	76092	26242	14761	50354	21789	05811
28235	92676	47125	75400	22396	62923	30002	08977	00137	45432
30424	47064	87505	02895	68756	35808	20944	71881	15349	27621
83314	27859	81501	44065	43147	86966	69895	53177	17535	82449
91586	14696	79194	59405	93918	39407	46639	69836	88607	48230
58738	37211	88377	93993	25907	73891	77396	32784	24226	76949
91381	02549	36568	75701	86457	46185	52042	99690	79160	83208

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50726	74393	31973	84106	64425	12642	36875	71476	75225	26330
05881	74144	40457	16607	94763	90145	00967	74384	13314	46451
38545	34867	16785	87639	97660	53725	09103	47031	41299	06918
64527	63958	17881	46501	90532	33574	32714	56320	24705	01276
46449	67466	08277	97047	43095	24641	39217	20842	85893	51308
15866	12544	63978	15405	04996	26765	80116	63423	84494	89769
16259	67008	46009	93954	44615	97313	04420	81775	39688	49641
39819	69878	32181	74382	25796	03603	32276	40280	44340	58510
86261	00049	69264	06955	11086	41119	28077	77714	55049	77389
37609	25867	30211	36403	13720	20693	99251	56284	36848	75218
42106	25504	33216	50066	43518	38741	47963	63160	40639	25678
56646	21790	37380	09401	47855	03344	14721	43210	80014	35873
53690	34414	68765	41013	67475	35060	93626	78479	21641	75905
75294	68750	81418	67282	13137	17772	98727	57355	25090	08499
15148	83911	56760	54942	92081	60027	89579	20591	76713	54151
04039	73225	28949	67208	44922	26070	53522	76347	72016	15756
00499	51004	71264	91086	50630	49523	09661	73730	69514	00978
49787	54835	59521	15140	12421	40355	37468	96233	08406	76096
56233	14442	93500	18222	56271	55939	19256	25647	54149	31042
27402	18243	68845	34466	03950	65370	83450	45245	59679	67178
09362	13643	03232	19487	12788	67098	76974	61016	48398	97862
41049	25247	77408	59153	61660	50024	75271	92132	92594	13581
63899	09272	07544	66391	25385	41798	53186	55607	68948	20366
03649	64424	07099	59996	80523	14922	10181	46527	86421	04385
20160	09516	76891	46220	03995	73836	30148	16205	20266	70270
08458	17935	07860	74380	52246	60651	06229	18260	51535	06259
17402	93441	52213	93147	35213	58733	90739	16035	67365	70942
57624	09068	41452	05223	53796	09281	16947	01498	13111	05085
32834	86429	86133	59960	30179	33599	02378	68645	15470	25184
48219	98400	16939	71951	98891	69473	99985	83260	15068	45190
38161	98167	02560	91259	98715	60319	13908	19825	32868	56898
87021	22023	49849	95186	46358	10474	51411	79644	33408	17821
17475	40115	36801	48144	41216	52910	95223	13745	44535	92624
83665	83371	27524	48461	38686	76881	35297	72094	09460	19761
92345	19485	38393	42221	63815	14550	84919	67594	66466	89791
71310	92845	00642	82394	88293	58265	36810	48694	99445	02928
21239	42666	81258	24162	04102	67592	76040	09497	83131	46500
43885	15177	90965	85145	74531	80794	06430	52190	19853	30261
53920	48070	93860	87927	48623	44728	08869	14512	76101	62936
52435	74255	12190	19079	54002	03848	26800	18457	44366	39386
27334	43294	82124	75087	60427	77967	47928	09553	24429	32974
42175	71531	12253	00745	48371	76610	17479	57895	15497	21620
09461	23504	38614	22886	68945	69276	80491	47894	42258	13093
89420	55911	10186	26555	03172	31977	78118	56512	09939	82905
47393	72183	46711	28477	25436	76522	92775	90616	05555	89461
14212	09921	73672	27693	21241	53948	29960	71119	83591	94836
73727	45201	35558	87800	51266	49478	47262	42697	18566	15342
62516	16335	32912	08816	93032	55497	30971	29350	67310	32667
90139	06729	04333	46369	35222	27125	81058	06124	95393	43771
26922	27674	37981	90379	74918	21805	61992	64346	95600	78851

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97446	30328	05262	77371	13523	62057	44349	85884	94555	23288
15453	75591	60540	77137	09485	27632	05477	99154	78720	10323
69995	77086	55217	53721	85713	27854	41981	88981	90041	20878
69726	58696	27272	38148	52521	73807	29685	49152	20309	58734
23604	31948	16926	26360	76957	99925	86045	11617	32777	38670
13640	17233	58650	47819	24935	28670	33415	77202	92492	40290
90779	09199	51169	94892	34271	22068	13923	53535	56358	50258
71068	19459	32339	10124	13012	79706	07611	52600	83088	26829
55019	79001	34442	16335	06428	52873	65316	01480	72204	39494
20879	50235	17389	25260	34039	99967	48044	05067	69284	53867
00380	11595	49372	95214	98529	46593	77046	27176	39668	20566
68142	40800	20527	79212	14166	84948	11748	69540	84288	37211
42667	89566	20440	57230	35356	01884	79921	94772	29882	24695
07756	78430	45576	86596	56720	65529	44211	18447	53921	92722
45221	31130	44312	63534	47741	02465	50629	94983	05984	88375
20140	77481	61686	82836	41058	41331	04290	61212	60294	95954
54922	25436	33804	51907	73223	66423	68706	36589	45267	35327
48340	30832	72209	07644	52747	40751	06808	85349	18005	52323
23603	84387	20416	88084	33103	41511	59391	71600	35091	52722
12548	01033	22974	59596	92087	02116	63524	00627	41778	24392
15251	87584	12942	03771	91413	75652	19468	83889	98531	91529
65548	59670	57355	18874	63601	55111	07278	32560	40028	36079
48488	76170	46282	76427	41693	04506	80979	26654	62159	83017
02862	15665	62159	15159	69576	20328	68873	28152	66087	39405
67929	06754	45842	66365	80848	15262	55144	37816	08421	30071
73237	07607	31615	04892	50989	87347	14393	21165	68169	70788
13788	20327	07960	95917	75112	01398	26381	41377	33549	19754
43877	66485	40825	45923	74410	69693	76959	70973	26343	63781
14047	08369	56414	78533	76378	44204	71493	68861	31042	81873
88383	46755	51342	13505	55324	52950	22244	28028	73486	98797
29567	16379	41994	65947	58926	50953	09388	00405	29874	44954
20508	60995	41539	26396	99825	25652	28089	57224	35222	58922
64178	76768	75747	32854	32893	61152	58565	33128	33354	16056
26373	51147	90362	93309	13175	66385	57822	31138	12893	68607
10083	47656	59241	73630	99200	94672	59785	95449	99279	25488
11683	14347	04369	98719	75005	43633	24125	30532	54830	95387
56548	76293	50904	88579	24621	94291	56881	35062	48765	22078
35292	47291	82610	27777	43965	31802	98444	88929	54383	93141
51329	87645	51623	08971	50704	82395	33916	95859	99788	97885
51860	19180	39324	68483	78650	74750	64893	58042	82878	20619
23886	01257	07945	71175	31243	87167	42829	44601	08769	26417
80028	82310	43989	09242	15056	48250	04529	96941	48190	69644
83946	46858	09164	18858	12672	55190	02820	45861	29104	75386
00000	41586	25972	25356	54260	95691	99431	89903	22306	43863
90615	12848	23376	29458	48239	37628	59265	50152	30340	40713
42003	10738	55835	48218	23204	19188	13556	06610	77667	88068
86135	26174	07834	17007	97938	96728	15689	77544	89186	41252
54436	10828	41212	19836	89476	53685	28085	22878	71868	35048
14545	72034	32131	38783	58588	47499	50945	97045	42357	53536
43925	49879	13339	78773	95626	67119	93023	96832	09757	98545

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59367	86990	48714	48661	27925	64600	15031	53011	28158	90210
02661	26233	18351	02243	48003	81875	58445	29164	91290	64914
58256	97097	53105	20303	13301	65032	95838	06793	51119	08152
24502	66475	73604	50125	02482	08330	15359	20355	91382	76605
93698	60165	17647	85355	49883	46358	04105	91461	63455	40285
13399	96277	81024	29371	73294	43568	37884	57081	57897	14475
22933	01744	97148	81176	26520	88687	94379	68214	80784	08084
71949	66439	35737	03808	22826	97570	01121	14617	20128	74584
84585	67379	84726	30396	62134	00022	79032	76094	73172	82288
20689	76212	00874	91436	76142	52764	75398	61131	66146	22675
17157	10429	96795	70274	86139	63178	45025	49336	52482	51324
21428	89654	46718	33039	96969	76207	87969	01023	62551	33024
91028	68875	49757	84014	13004	88590	51318	50187	12792	91702
08528	73444	24551	39140	04749	42415	83629	23463	94735	32098
94931	87793	18268	09541	56116	20355	73274	06548	40358	76545
75900	68321	22221	80562	86284	52332	59503	37119	44981	84328
12061	77586	90110	86018	20409	87965	09770	42619	28103	35379
74607	96188	07679	50122	26258	73470	74302	62607	35523	54683
97719	34876	57747	30062	26002	97315	86448	17977	40494	27764
07537	73378	94568	11459	28838	20912	84546	30711	05438	85811
91409	43928	63290	33406	27673	96579	97362	76177	16699	03222
56812	06974	04062	17440	58275	03941	10982	93447	36984	26262
65238	17593	64657	63540	47885	20005	68673	89452	65847	39926
34937	60090	21179	40332	23476	59147	53352	28807	75459	15344
87906	34989	24568	70169	78495	24522	53329	74384	17011	60954
81360	64547	23230	15390	36439	11809	47758	66624	10235	53787
22568	73744	86250	18658	54594	62546	16063	41418	88308	71777
76779	83852	85969	90422	16696	64937	87253	09320	88295	91911
33271	60230	02948	16753	20716	64469	37457	95500	28012	36480
93614	07479	44908	26096	87406	36777	15578	78690	40106	06436
42354	09043	79612	57757	49652	16678	44202	67351	00529	17492
25054	77308	37731	49835	26520	34231	47934	36061	73174	15238
87778	60143	36487	26960	50908	04385	66215	66711	66201	71042
94476	88257	33008	10818	41671	83183	67457	65654	95348	38673
24318	66046	66096	04641	38830	50676	44534	73278	79976	19923
11580	00137	95916	10557	33189	38393	57518	43567	00872	96899
57549	12136	87445	31754	02550	62968	27303	06251	48630	64886
41384	89663	71633	46001	98535	86900	86527	52583	43839	54316
38899	76603	89769	42103	07220	41186	36526	55031	06587	47235
17436	79899	68836	05395	58725	90129	47527	21013	90852	92678
76354	86991	48927	04587	01609	18754	41964	83723	12893	51082
89687	43203	70575	70199	62802	24301	11868	89041	72098	58483
88266	25669	25499	07501	23249	45840	11145	85924	20305	34893
77145	07043	14339	19870	26929	14308	61418	74674	78000	47778
54243	63409	21570	96270	04714	43820	19344	93988	32684	32900
92887	63985	39679	29926	79629	92717	64974	27179	89368	24503
86805	28965	28374	27341	10563	84650	39780	52027	97556	54086
52305	63604	83378	09511	81678	06418	44645	33313	94843	68189
86858	26768	28362	02994	14220	64721	88876	78946	93961	26397
90009	70432	41734	04052	79548	57976	90493	08265	51679	64140

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71677	15315	45651	93161	26293	21014	86635	88747	21382	43274
60923	20643	01015	73270	70795	94536	05098	00943	92821	92627
67988	11829	29734	38819	90899	98442	44737	09325	79247	63872
83959	23985	03984	44549	25884	09662	52709	78073	58919	53654
43994	49682	49083	09135	17058	73055	61286	04728	69177	67201
13934	75565	74112	48202	60925	42855	68689	48180	42891	50850
20745	38804	40869	31039	31048	57486	87728	21282	03367	07763
01938	55677	06431	17896	15880	72117	27012	04951	57575	85007
12475	87436	75833	20607	78451	07153	22597	53346	37627	41413
25165	63719	97250	97914	47904	03626	16697	65874	31404	60770
12883	78607	81019	62286	21762	89632	30421	89391	23694	21941
62975	98240	13035	15973	32753	23705	81301	05350	00289	93433
95973	56748	64662	46388	93253	31281	19333	40401	19471	64250
89262	96753	48368	15985	23790	28339	40161	68343	10727	47893
65659	72898	48791	31594	52216	11979	74010	15295	18914	56131
45674	97757	12127	42680	68380	07270	98045	07327	81083	73274
43857	60930	54709	97205	61921	89836	66249	64768	02567	97281
13752	51419	82523	78500	09200	54379	16712	88395	03498	95211
27311	13684	02210	64507	85032	44877	10187	35269	50612	96293
71540	62486	82902	22445	76842	57081	17935	18855	34978	22123
30292	99240	82374	92053	79998	09062	13275	37173	84198	81093
81995	64855	28198	45704	71759	94454	62540	28910	58498	94147
80703	92192	44722	56978	61645	17302	90263	62764	65225	43262
60387	24758	93470	65205	55171	48988	43317	80166	68927	25471
90440	01499	48272	85849	70354	46180	66282	02745	53881	67518
57365	52293	48814	49364	50345	29783	63521	78547	97357	01667
04026	79874	10518	16241	03095	10938	65813	29490	09288	63706
42485	45612	13680	44064	98559	48286	56520	81434	21154	32158
73767	41005	69234	35878	08960	61054	51987	40674	86452	59666
45777	66312	67401	88536	06636	83867	76701	03565	51220	92029
50252	27223	87398	07346	48274	99436	58998	12327	29014	52991
78716	33225	69098	25275	70566	20842	10379	90471	43129	26088
49156	88982	63772	24292	55798	52564	67995	42462	76097	76384
48007	99787	21907	77085	34604	12943	87088	66444	28191	17284
02998	51186	71695	98669	88338	90073	06816	82549	64340	18412
56642	33741	39414	90403	73292	16829	23622	08151	26441	13082
67221	54218	04014	05277	13275	36237	27907	42026	85029	52925
78275	61062	38396	94122	96804	44598	17611	73266	13917	14891
53540	22046	16135	11382	64463	35922	25898	86128	01671	56094
31259	41406	08075	55901	90482	78326	57257	34443	93505	73759
21233	30216	57282	61804	58839	67292	54748	28729	21587	77884
81544	83335	49027	87070	26956	90371	31941	03124	51991	34456
81558	22733	28914	86826	74280	96029	68335	88725	66531	00236
38775	35036	48346	85297	97180	46019	89883	54565	14758	61910
19810	37407	24464	30206	61180	06477	69253	85553	62553	24885
53077	17339	16353	50472	49247	76025	66031	06703	63677	67469
12912	59635	38624	75181	96887	83911	03147	93289	15052	02065
29179	23246	03434	81480	12687	95994	64235	25776	46773	95126
02370	43727	87065	48389	22349	72275	35988	69986	06530	71373
74828	81431	32277	29967	35988	26030	02652	13052	81324	27007

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89038	22568	02172	05939	98536	95981	57904	48292	67075	76330
25549	66084	31933	64562	51514	75640	96763	50240	96603	95581
16233	11935	84721	14129	24445	54571	45505	47051	25822	73390
58632	55577	01918	69729	48116	45079	33939	42597	10285	10916
05159	22237	09981	08674	98725	23522	81276	34210	02617	52906
90542	18122	27816	54922	15412	17279	02708	05604	79370	65392
58103	87302	90382	22617	39139	57439	30510	14146	08056	60345
91023	39204	58685	18724	96733	92701	48196	78730	03390	75644
99834	04764	34186	12170	19493	50525	83553	69869	68731	93782
35552	39215	95529	14264	74277	24643	40842	71601	61813	09085
31769	36871	31925	59443	11039	21947	43609	80005	76185	44552
78594	11263	26326	00360	54812	85936	70540	93777	88589	91396
45415	10928	93539	34097	89743	44360	55596	86703	48997	49227
80503	40060	37349	88000	21559	78962	68259	66965	79629	84264
29840	84138	37928	71421	25651	03563	64830	67083	39064	21765
16623	75212	92251	82318	78409	66390	01332	66953	67014	39357
22600	37676	19272	76836	24860	07097	57521	93514	13790	59650
07954	01718	73751	63195	10995	29766	45916	11136	34162	54061
83984	27815	67029	93044	47499	45136	84816	04621	73099	19818
92348	19913	35777	23564	53621	03407	29939	06920	07060	56546
02593	15387	48955	07096	51176	85561	15506	04655	52402	32412
39230	35006	30839	13083	22239	76400	12650	84305	27793	40036
37103	92585	24672	83566	85683	04530	27416	52071	33563	05434
55591	97086	45181	23125	33074	46232	81621	60745	71956	59208
20133	58412	91260	40575	00259	83578	04015	91329	98492	25433
31341	47901	57093	40572	29327	63043	95707	00772	06690	80476
09543	54011	92903	96412	81572	18631	45103	41969	72379	98855
36723	04347	26015	89914	24080	95310	64903	22570	36221	28768
73506	73446	00737	47187	77735	37788	35305	21742	85288	28762
42973	17940	73093	58037	46306	13570	85320	96080	62396	60001
54912	08030	09526	90413	24196	83346	61179	84470	20631	80722
13070	55066	86205	75542	94272	76300	08980	91506	92956	18272
64315	65403	36935	99169	09051	75907	52557	28901	10314	09095
18033	68410	98551	00150	18664	25406	81712	98019	26489	87249
93877	59111	87588	79949	59255	15702	89033	46617	37350	02991
71275	80323	85249	54487	87512	16302	50229	18983	55663	75892
20172	90156	61541	31654	28224	50530	00279	16525	13113	65437
47846	08248	87092	67218	48055	43242	58831	70887	27629	47922
27541	02746	27965	64539	56557	05415	02811	49568	05694	50725
15614	30533	44804	22469	13147	86719	30969	81965	42073	48749
76833	94614	49018	31561	52707	88457	95068	47358	18885	59362
53364	86715	57978	81451	43272	98618	32943	97357	24469	40874
25640	68686	33941	03395	61099	04644	55202	64967	83625	35804
62849	58573	35187	35442	74871	25019	58045	46546	78763	99208
79944	79239	43709	16067	53231	02615	51162	69270	21784	41789
22180	76547	18341	76014	79500	66866	71039	03239	20452	59084
74588	19740	42424	45192	82550	34878	79226	03910	33888	33999
52182	06058	01191	23551	40180	04323	87583	62128	90797	17662
16732	70655	95547	25983	61306	01197	46952	69751	15086	48795
93137	58456	29718	09061	99298	37657	05271	49647	92068	96345

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33097	28876	16482	81017	45316	35888	50061	29682	03079	37037
65106	62570	28449	01257	95655	82868	72599	96873	21869	53725
41588	84023	89864	78092	54194	27156	41382	57761	62850	40381
56846	53003	27327	41424	12167	70159	29233	24381	35349	34033
11716	73038	97985	99309	85399	53955	66774	44163	08202	54607
25281	64158	90270	04141	99838	24509	85060	18197	87251	48683
99312	62671	18700	81387	64811	52361	86224	56234	12885	35044
89492	67189	67090	98860	24346	29753	61698	81267	06425	84066
40936	46226	67672	58279	76486	53109	12574	41789	25728	91281
71227	08509	47802	84697	59839	28049	38336	46711	83099	09377
87013	68923	87727	45233	86542	01301	21895	20259	25624	29183
10552	41429	99312	38031	58591	44838	49382	84300	44633	37784
37347	30205	01512	63952	73370	86366	85894	87489	94541	21572
85195	69947	32943	11028	19469	41306	29262	45849	57784	12311
02575	43148	68984	83259	84753	67316	23429	02777	17928	26837
91065	52939	82447	47771	90246	95568	76933	71979	17872	59303
09504	22829	41784	59045	51891	47641	46439	22839	22392	70652
47481	53744	60905	96096	78826	75699	89107	17446	02135	50789
11567	86337	22797	88223	55761	90713	16100	48400	70621	21091
69135	77341	54303	97177	90799	23101	21608	14252	00604	52052
30964	53691	14900	51651	65994	34674	38604	30755	85983	94656
84030	51962	00651	47918	85208	37604	46891	17407	71139	90974
55299	13888	77768	97201	81469	75591	09943	61035	47508	49701
66051	10561	33756	17036	76645	39060	52932	69950	61988	64273
23192	28709	19138	79504	14096	24698	96648	90461	67111	95299
41854	35482	29019	49061	31613	66023	21912	74706	66274	77184
85435	10446	47781	10671	40867	58622	01918	20101	60250	59097
01394	19438	13262	56360	75810	40025	77838	03384	63062	12565
63552	04703	37558	49875	85491	11044	96717	16859	12145	86499
92503	16118	20029	31385	76839	07261	89444	54766	66401	19865
84813	72657	72010	07017	02232	53466	13951	30832	51533	68181
22181	06134	53229	89409	85109	16932	84888	47326	00176	53178
73121	93609	67008	56906	02067	44563	78275	30190	26065	36310
09810	74015	40967	19525	53743	38806	39485	72188	29457	13699
89121	06981	92189	22368	15776	33531	00728	58640	74587	21348
72071	12449	62535	64357	32150	02900	58823	41819	85503	71878
44098	20120	20439	43369	18550	33509	59683	92171	10494	55991
16724	61862	07579	47456	88462	42694	91813	51543	82148	72138
46097	84756	85743	88843	98267	37925	93976	73258	81312	25558
42724	11175	94344	14294	45627	35655	02403	94106	76901	70347
67253	37815	35546	71790	03416	07667	07777	33965	87878	30188
78281	73425	05397	31217	28572	90074	96256	72456	14699	68858
72520	28555	57667	72767	44484	92965	13812	36434	61588	35992
50462	42047	72548	32952	14007	32840	96878	48265	15221	99948
71446	35178	65879	50638	86634	26746	69124	77991	89037	33068
97738	17077	11969	98629	52578	43908	04233	53333	84597	43006
25838	78507	86604	13472	60131	63897	42169	24970	79219	63254
07386	87618	08266	34763	32979	90723	35223	15963	97574	74394
43222	88236	68028	36006	10840	61116	36629	14231	04985	04062
61681	81357	23573	93085	35332	29730	78781	12117	31977	26242

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74643	91686	64861	13547	47668	02710	11434	82867	40442	23126
30774	56770	07259	58864	02002	78870	29737	79078	03891	96198
52766	31005	71786	78399	41418	73730	44254	81034	81391	60870
30583	57645	02821	46759	21611	81875	75570	71403	95020	90567
11411	87781	95412	14734	68216	24237	64399	57190	62003	08072
65154	65573	06505	85246	28223	48663	84092	80996	62804	25062
71484	49166	54358	28045	90602	26369	18826	34129	11186	02587
36886	15978	25701	88856	99666	72497	28170	74573	66399	98915
31911	32493	55851	22810	77446	47338	58709	00366	76974	89213
57668	83978	67201	95886	02009	87160	63753	12256	84441	23567
20180	80993	05486	83908	29691	75989	16955	24709	66116	55376
29450	78893	24478	40084	96185	64091	74278	19220	59232	79651
10645	25607	05493	66388	14886	10433	13541	60814	84317	56135
86989	65289	55234	46428	57719	18708	88916	98692	40281	81694
81822	31790	27929	60106	04794	50792	52855	69708	54471	98480
57260	73820	40482	50328	08141	63218	92180	33241	88052	99353
03162	15444	20152	57789	87027	24196	69223	03376	28451	60351
03883	01325	75192	63458	69469	82978	39120	56925	58287	37961
20476	36163	49805	39896	40557	89825	99027	68148	68330	14547
04097	82269	13198	82429	30119	06488	40897	77511	82718	20536
03150	81213	38131	72824	38659	60749	64581	64225	07982	13359
41868	08277	15733	03512	66062	55144	42684	92562	95855	18976
19019	75509	82239	46407	80331	67153	97832	07365	78527	25388
66762	65374	73880	42723	52871	61036	35039	70330	19690	65487
56984	25574	51915	47671	32288	94925	46278	62789	66452	20813
62919	32771	60512	67786	62409	25006	15544	27585	41141	07056
80152	53210	58708	63052	29172	61110	50802	61103	31451	73705
14609	03458	36701	61286	55876	76651	12026	57579	63041	00518
69685	96134	85288	20667	85030	25703	24172	75414	94525	98963
37653	41665	23805	16495	50566	92923	58570	37989	14454	96483
97333	40313	38311	79632	88471	94287	18842	56481	10727	78168
46918	35923	43219	89408	42015	70960	39767	33981	00896	62632
77647	92375	95821	56223	20137	50993	01956	37476	65479	37315
84557	54389	92845	66027	25750	75426	74213	54278	87040	87720
50184	53941	77795	47527	99423	48280	94101	96132	65778	57536
62994	33610	61432	81063	07104	72979	67234	51208	58087	64686
74536	61392	54720	01452	23781	37295	24279	36401	84360	97841
24945	28226	08113	79223	78135	43679	40184	67041	13070	51304
76597	61745	07848	59773	88922	31500	89386	01970	31954	74586
21739	73880	84999	71712	20223	04734	05297	38494	57925	83158
76373	36578	07987	73464	86703	43769	38113	85094	76527	89307
75771	17498	31380	65347	86809	22856	80806	83634	08719	34906
37509	95478	66738	53649	66346	55218	73532	43708	97621	39974
26800	77759	78505	67784	64526	05422	54794	98671	74839	79856
65925	13968	71642	98512	87510	56434	93220	76328	53413	17961
50573	71610	48683	29869	32535	75387	22438	84636	94631	27382
83160	02118	84936	15513	18912	48738	72173	28797	17683	88883
80436	58377	66896	58495	27405	17933	89367	75965	93790	58615
74836	84165	82436	68509	32923	12254	28278	69602	49651	70140
80971	88014	58161	70037	08593	81048	90612	70159	47830	03778

TABLE OF RANDOM DIGITS

88473	86062	26357	01678	05270	80406	62301	23293	85734	32590
00677	42981	84552	44832	67946	61532	79109	32073	13354	78578
25227	51260	14800	19101	03146	12068	18261	06193	45909	65339
15386	68200	21492	71402	76801	35235	49676	75306	52969	77447
42021	40308	91104	34789	93269	77750	51646	95883	27282	26277
63058	06498	49339	33314	49597	95931	44854	67348	91633	79473
32548	69104	89073	32037	14556	70568	58821	37003	04390	86496
03521	52177	24816	01706	79363	84378	70843	02090	85945	64113
39575	90626	35889	82962	93759	92582	20979	57479	65739	11110
58252	56687	60412	05060	95974	50183	88659	76568	45373	54231
56440	69169	05939	57516	85127	74159	53295	29028	07409	28140
16812	18195	88209	39856	03187	05605	43348	65589	51283	68224
56503	14023	69475	37217	11465	15872	05551	37231	68175	18132
96508	90101	11990	61199	75399	78214	84891	01376	05039	43632
68958	56862	60433	07784	37721	96521	85412	13941	63969	45395
26721	12583	44793	12071	83645	44062	86684	80890	09152	60050
01476	19255	58656	26401	27356	38443	55210	61493	89832	07578
45924	27655	27730	78321	45402	46568	64053	39814	74960	60944
79516	79027	96227	72473	21231	68748	90204	92330	16216	09483
59946	54123	38645	56734	87427	38049	88471	07421	53080	28515
89056	71858	84058	44154	47929	94196	90847	40905	39151	12029
07056	34611	45456	68268	31718	09715	80414	64095	24464	52799
66189	03099	16595	30601	31691	38657	59600	24443	47978	35730
85281	53288	58972	51531	02406	72117	85547	27445	79581	61608
34761	22435	75006	61241	48628	62840	62633	34982	79051	76314
45549	16045	96353	80376	64802	46062	39519	08688	18254	09915
29337	45746	00844	79084	45838	22246	11095	05209	05113	83895
44509	72387	39414	01011	46568	25718	62591	00174	38633	52966
15068	41200	32705	47327	64665	50395	97110	31292	02965	37147
59253	23492	55166	76780	33945	90298	39736	62674	00787	98482
17140	07016	53376	07582	06899	32503	24412	29650	97759	02905
87048	20624	23285	78268	13122	78242	40515	18454	97122	29628
90254	79631	05936	68057	22760	38809	29233	81372	49252	28497
66090	41296	19263	10253	33878	80280	33407	44464	23229	60740
54672	30805	03962	93237	40900	90912	20746	63914	65456	32138
99080	08088	99211	80001	88691	58425	52324	11449	18830	45387
22859	21563	17374	20731	42124	17219	99392	63681	20452	19714
65013	58031	22092	79881	34695	01615	28233	68809	35091	82223
87296	05362	95779	54816	80032	94335	71581	72691	84058	39495
61336	19425	24408	74091	19730	39832	49166	84284	01851	29579
93134	41529	85992	45493	68165	02129	73858	54280	29281	12449
80388	28010	93018	21652	32608	88409	63041	77051	93107	68856
80214	71603	52837	90272	52141	58642	93933	25183	30994	54332
74165	63881	71261	69394	29194	25046	23948	13048	57594	58886
31361	68333	55171	96461	20694	31275	88884	71366	13054	03764
48570	53579	64703	97498	67888	07817	34223	61667	43474	29179
97894	36631	14389	59041	32600	08865	69364	99415	81194	82304
77563	53771	54527	83456	23914	57808	67250	92991	91474	96012
39903	34555	47585	70546	15704	61087	81728	03973	80652	22179
83877	07815	14813	40666	43906	85802	42125	07164	13056	83161

APPENDIX G. 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. number	pkg. error	pkg. number	pkg. error	pkg. number	pkg. 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, subtract 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, subtract 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, add 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 \bar{R} , as follows:

$$\bar{R} = \frac{\text{sum of all } R \text{ (step 3)}}{\text{number of groups}}$$

$$\text{In the example above, } \bar{R} = \frac{30}{3} = 10$$

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 $0.204 \text{ lb} - 0.199 \text{ lb} = 0.005 \text{ lb}$.

APPENDIX H. EXAMPLES OF COMPLETED REPORT FORMS AND WORKSHEETS

This section contains worked examples of worksheets and report forms for commonly encountered packages.

- o Category B, standard pack, labeled by weight, using an equal-arm package checking scale.
- o Category B, standard pack, labeled by weight, using an electronic scale.
- o Category A, standard pack, labeled by weight, using an equal-arm package checking scale.
- o Category B, standard pack, labeled by volume.
- o Category B, random pack.
- o Category B, standard pack, labeled by count.

Location of TEST (Name, Address)		<input type="checkbox"/> Retailer <input type="checkbox"/> Wholesaler <input type="checkbox"/> Packager		PRODUCT IDENTITY	BRAND	LOT CODE(S)	CONTAINER DESCRIPTION
Joe's Mkt 10252 Hiway 50 Jones, 00011				spaghetti	Generic	T2T241	Cardboard box
				1 LABELED WEIGHT 16 oz (1 lb)	2 UNIT OF MEASURE 0.001 <input checked="" type="checkbox"/> lb. <input type="checkbox"/> oz.	3 MAV Table 2-8 (p. B-9&10) 0.044 lb	4 MAV (dimensionless units) [3] ÷ [2] = 44
5 LOT SIZE (N) 89	a GROSS WEIGHT 1.083 lb	b TARE WEIGHT 0.061 lb	c NET WEIGHT (alternative tare only)				
6 SAMPLE SIZE (n) 10 <input type="checkbox"/> A (p. B-3) <input checked="" type="checkbox"/> B (p. B-5)	d PACKAGE ERROR [a] - [14] + .021 lb	e PACKAGE ERROR (dimensionless units) [d] ÷ [2] + 21					
7 TARE SAMPLE SIZE 2 <input type="checkbox"/> Alternative (p. B-6)							
8 Allowed Number UNREASONABLE ERRORS 0							
9 R _C (see [c]) Range of Net Weights	10 R _T (see [b]) Range of TARE Weights	11 R _C + RT [9] + [10] =	12 n _i (Table 2-7, p. (p. B-7&8))	13 AVERAGE TARE <input type="checkbox"/> unused <input checked="" type="checkbox"/> used <input type="checkbox"/> alternative	13a TARE CORRECTION <input type="checkbox"/> Moisture <input type="checkbox"/> Foam (p. B-17) <input type="checkbox"/> Vacuum Pack	14 NOMINAL GROSS WEIGHT 1.000 + .062 = [1] + [13] - [13a] = 1.062 lb	

PACKAGE ERRORS										TOTALS	
										(-)	(0/+)
21	18										39
15	8										23
16	12									4	
28	9										19
22	15									7	
RANGES										15	TOTAL ERROR
											+70

16 NO. UNREASONABLE MINUS ERRORS (Compare with box 4) 0	17 IS 16 Greater than 8 <input type="checkbox"/> YES: LOT FAILS <input checked="" type="checkbox"/> NO—CONTINUE	18 AVERAGE ERROR (Dimensionless Units) 15 ÷ 6 = +7	19 AVERAGE ERROR (labeled units) 18 × 2 = +.0070	20 IS 18 ZERO OR PLUS? <input type="checkbox"/> NO → Cat B, LOT FAILS <input type="checkbox"/> Cat A, go to 21 <input checked="" type="checkbox"/> YES → GO TO 28
21 AVERAGE RANGE	22 Use 6 to look up value in Table 2-3, Col. 2 (p.B-3)	23 d = 21 × 22 =	24 (n/N) × 100 = (6 ÷ 5) × 100 =	25 Use 24 to look up f in Table 2-4 (p.B-4) f =
26 T = 23 × 25 =				
27 Disregarding the signs, is 18 larger than 26? YES → LOT FAILS NO → LOT PASSES				

Comments:

26 DISPOSITION OF LOT:

☒ APPROVED

☐ REJECTED

DATE 5/10/90

STANDARD PACK REPORT FORM
WEIGHT ONLYREPORT NUMBER
1600400

Location of TEST (Name, Address)

Quality Foods
Rte 9

00122

☐ Retailer
☐ Wholesaler
☒ Packager

PRODUCT IDENTITY

Semi-sweet
Chocolate

BRAND

Veri-rich

LOT CODE(S)

4Y8

CONTAINER DESCRIPTION

cardboard +
8 paper wraps

1 LABELED WEIGHT

8oz (0.5 lb)

2 UNIT OF MEASURE

0.002

☒ lb
☐ oz

3 MAV Table 2-8

(p. B-9&10)

0.028

4 MAV (dimensionless

units)

3 - 2 = 14

5 LOT SIZE (N) 90	a GROSS WEIGHT 0.544 lb 0.536 lb				
6 SAMPLE SIZE (n) 30 <input checked="" type="checkbox"/> A (p. B-3) <input type="checkbox"/> B (p. B-5)	b TARE WEIGHT 0.038 lb 0.038 lb				
7 TARE SAMPLE SIZE 2 <input type="checkbox"/> Alternative (p. B-6)	c NET WEIGHT (only used for alternative tare)				
8 Allowed Number UNREASONABLE ERRORS 1	d PACKAGE ERROR a - 14 + .006 lb - .002 lb				
	e PACKAGE ERROR (dimensionless units) d + 2 + 3 - 1				
9 R _C (see c) Range of Net Weights	10 R _T (see b) Range of TARE Weights	11 R _C + R _T = 9 + 10 =	12 n _i (Table 2-7, p. (p. B-7&8))	13 AVERAGE TARE <input checked="" type="checkbox"/> unused <input type="checkbox"/> used <input type="checkbox"/> alternative .038 lb	13a TARE CORRECTION <input type="checkbox"/> Moisture <input type="checkbox"/> Foam (p. B-17) <input checked="" type="checkbox"/> Vacuum Pack
					14 NOMINAL GROSS WEIGHT 1 + 13 - 13a = .038 + .500 = .538 lb

PACKAGE ERRORS

TOTALS

(-) (0/+)

3 ⁺	9	11	3	7	1					6	
1	7	1	5	3	7					24	
3	3	3	3	1	5						4
1	17	5	3	3	1					16	
1	5	1	7	1	3						12
RANGES	6	22	16	12	10	12					
										15 TOTAL ERROR	-30

16 NO. UNREASONABLE MINUS ERRORS (Compare with box 4) 1	17 IS 16 Greater than 8 <input type="checkbox"/> YES LOT FAILS <input checked="" type="checkbox"/> NO-CONTINUE	18 AVERAGE ERROR (Dimensionless Units) 15 ÷ 6 = -30/6 = -5	19 AVERAGE ERROR (labeled units) 18 × 2 = -0.02 lb	20 IS 18 ZERO OR PLUS? <input type="checkbox"/> NO → Cat B, LOT FAILS <input checked="" type="checkbox"/> YES → GO TO 21
21 AVERAGE RANGE 13	22 Use 6 to look up value in Table 2-3, Col. 2 (p. B-3) 0.157	23 d = 21 × 22 = 2.041	24 (n/N) × 100 = (6 - 5) × 100 = 33	25 Use 24 to look up f in Table 2-4 (p. B-4) f = 0.82
				26 T = 23 × 25 = 1.674
27 Disregarding the signs, is 18 larger than 26? YES → LOT FAILS NO → LOT PASSES				

Comments:

26 DISPOSITION OF LOT:

☒ APPROVED
☐ REJECTED

DATE 3/11/89

STANDARD PACK REPORT FORM

REPORT NUMBER

14012-T

Location of TEST (Name, Address) Cash/Carry	<input checked="" type="checkbox"/> Retailer <input type="checkbox"/> Wholesaler <input type="checkbox"/> Packager	PRODUCT IDENTITY cold	BRAND Warble	LOT CODE(S) SNF2 PNG1 SNG1	CONTAINER DESCRIPTION can
		1 LABELED CONTENTS 12 fl oz	2 UNIT OF MEASURE 0.001 <input checked="" type="checkbox"/> lb. <input type="checkbox"/> oz.	3 MAV (same units as label) See Worksheet 1/2 fl oz	4 MAV (dimensionless units) See Worksheet 34

5 LOT SIZE (N) 96
6 SAMPLE SIZE (n) 10 <input type="checkbox"/> A (p. B-3) <input checked="" type="checkbox"/> B (p. B-5)
7 TARE SAMPLE SIZE 2 <input type="checkbox"/> Alternative (p. B-6)
8 Allowed Number UNREASONABLE ERRORS 0

This report form is designed for standard packages *not* labeled by weight: for example, liquid volume, count, area, etc.

Fill out report form heading, boxes **1** & **2**, and boxes **5** through **8**.

Go to appropriate worksheets, follow directions on the worksheet, recording data on the report form as directed by the worksheet.

9 R_C (See Worksheet) Range of Net Weights	10 R_T (See Worksheet) Range of Tare Weights	11 $R_C - R_T$ 9 10 =	12 n_i (Table 2-7 (p. B-7&8))	13 AVERAGE TARE See Worksheet 0	14 NOMINAL GROSS WEIGHT See Worksheet 0.892 lb
---	---	--	---------------------------------	---	--

PACKAGE ERRORS

TOTALS

(-) (0/+)

11 ⁺	3										14
6	2										8
6	7										13
3	6										9
6	8										14
RANGES										15 TOTAL ERROR	+58

16 NO UNREASONABLE MINUS ERRORS (Compare with box 4) 0	17 IS 16 Greater than 8 ? <input type="checkbox"/> YES: LOT FAILS <input checked="" type="checkbox"/> NO—CONTINUE	18 AVERAGE ERROR (Dimensionless Units) 15 ÷ 6 = +5.8	19 AVERAGE ERROR (labeled units) See Worksheet +0.857 fl oz	20 IS 18 ZERO OR PLUS? <input type="checkbox"/> NO → Cat B, LOT FAILS Cat A, go to 21 <input checked="" type="checkbox"/> YES → GO TO 28
21 AVERAGE RANGE	22 Use 6 to look up value in Table 2-3, Col. 2 (p. B-3)	23 $d = 21 \times 22 =$	24 $(n/N) \times 100 =$ $(6 \div 10) \times 100 =$	25 Use 24 to look up t in Table 2-4 (p. B-4) $t =$
26 $T = 23 \times 25 =$				
27 Disregarding the signs, is 18 larger than 26 ? <input type="checkbox"/> YES → LOT FAILS <input type="checkbox"/> NO → LOT PASSES				

Comments

28 DISPOSITION OF LOT:

☒ APPROVED
☐ REJECTED

TF MILKS

Acknowledged Receipt of Report

Official

John Doe

WORKSHEET FOR PACKAGES LABELED BY LIQUID VOLUME

NUMBERS WITH BOXES (eg $\boxed{3}$) REFER TO REPORT FORM (page A-1)
STEP NUMBERS (eg STEP 5) REFER TO WORKSHEET

Fill out report form up through box $\boxed{8}$, skip boxes $\boxed{3}$ and $\boxed{4}$.

Report 14012-T
3/11/89

	(1st Pkg)	(2nd Pkg)	(3rd)	(4th)	(5th)
1. Gross Weight	0.904 lb	0.899 lb			
2. Tare Weight	*R _T = 0.080 lb	0.081 lb			
Net Weight	*R _C =	(only use for alternative tare)			
3. Flask Weight (full)	1.126 lb	1.125 lb			
4. Flask Weight (empty, wetted)	0.584 lb	0.584 lb			
5. Weight of Liquid (Step 3 - Step 4)	0.542 lb	0.541 lb			
6. Volume of Flask	8 fl oz	8 fl oz			
7. Temperature of Liquid	75°F	75°F			

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 box is checked, open all packages in sample and determine each package error by volume (see Section 4.6.).

NO ☒ If this box is checked, continue below.

9. AVERAGE WEIGHT OF LIQUID IN FLASK = AVERAGE OF STEP 5 =

0.5415 lb

10. AVERAGE WEIGHT OF LABELED VOLUME = $\frac{\text{LABELED VOLUME}}{\text{FLASK VOLUME}} \times \text{AVG. WEIGHT OF LIQUID IN FLASK}$

$$= \frac{\text{box } \boxed{1}}{\text{Step 6}} \times \text{Step 9} =$$

0.81225 lb

$$= \frac{12 \text{ fl oz}}{8 \text{ fl oz}} \times 0.5415 \text{ lb}$$

*11. (R_C/R_T = _____) (n₁ = _____)[†] See Table 2-7 (pages B-7 and 8)

(alternative tare only)

12. AVERAGE TARE = AVERAGE OF STEP 2 (or average of Step 2 and additional tares)*

= 0.0805 lb

Record in box $\boxed{13}$ 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.

$$13. \text{NOMINAL GROSS WEIGHT} = \frac{\text{AVERAGE TARE}}{\text{AVERAGE WEIGHT OF LABELED VOLUME}}$$

$$= \text{Step 12} + \text{Step 10} = \boxed{0.893 \text{ lb}}$$

Record in box 14 on report form

$$= 0.0805 \text{ lb} + 0.81225 \text{ lb}$$

14. For packages opened for Tare:

$$\text{PACKAGE ERROR (weight)} = \text{GROSS WEIGHT} - \text{NOMINAL GROSS WEIGHT}$$

$$= \text{Step 1} - \text{Step 13}$$

$$= 0.904 - 0.893 = 0.011 \text{ lb}$$

1	2	3	4	5
+ 0.011 lb	+ 0.006 lb			

$$15. \text{PACKAGE ERROR (dimensionless units)} = \frac{\text{PACKAGE ERROR (weight)}}{\text{UNIT OF MEASURE}}$$

$$= \text{Step 14} \div \text{box 2}$$

$$= \frac{0.011 \text{ lb}}{0.001 \text{ lb}} = 11$$

1	2	3	4	5
+ 11				

Record package errors on report form in crosshatched area.

$$16. \text{MAV (volume)} = \frac{\text{MAV (weight)}}{\text{UNIT OF MEASURE}}$$

$$= \frac{0.5 \text{ fl oz}}{12 \text{ fl oz}} = 0.041667$$

Record in box 3 on report form.

$$17. \text{MAV (weight)} = \frac{\text{MAV (volume)} \times \text{AVERAGE WEIGHT OF LABELED VOLUME}}{\text{LABELED VOLUME}}$$

$$= \text{Step 16} \times \frac{\text{Step 10}}{\text{box 1}}$$

$$= 0.041667 \times \frac{0.81225 \text{ lb}}{12 \text{ fl oz}} = 0.0028 \text{ lb}$$

$$18. \text{MAV (dimensionless units)} = \frac{\text{MAV (weight)}}{\text{UNIT OF MEASURE}}$$

$$= \text{Step 17} \div \text{box 2} = \frac{0.0028 \text{ lb}}{0.001 \text{ lb}} = 2.8$$

Record 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:

$$\text{AVERAGE PACKAGE ERROR (volume)} = \frac{\text{AVG. PACKAGE ERROR (dimensionless units)} \times \text{UNIT OF MEASURE}}{\text{AVG. WEIGHT OF LABELED VOLUME}}$$

$$= \text{box 18} \times \text{box 2} \times \frac{\text{box 1}}{\text{Step 10}} = \frac{2.8 \times 0.001 \text{ lb} \times 12 \text{ fl oz}}{0.81225 \text{ lb}} = 0.041667 \text{ fl oz}$$

Record in box 19 on report form

(Boxes above with "3", "4", "5" in corners are for larger tare sample sizes.)

DATE

4/20/89

RANDOM PACK REPORT FORM
(Page 1 of 2)

REPORT NUMBER

TT-15-89

LOCATION OF TEST (Name, Address)

Qual Hi

☒ Retailer
☒ Wholesaler
☒ Packager

1 LOT SIZE (N)

57

2 SAMPLE SIZE (n)

10

☐ A (p B-3)
☒ B (p B-5)

3 TARE SAMPLE SIZE

2

☐ alternative
(p B-6)4 ALLOWED NUMBER OF
UNREASONABLE ERRORS

0

5 UNIT OF MEASURE
(size of scale div.)

0.002

☒ lb
ozTARE ☒ DRY ☒ actual tare
WET (page 2 for alternative)7 PRODUCT DESCRIPTION, LOT CODE
UNIT PRICE8 LABELED
WEIGHT9 PACKAGE ERROR
- 0/+10 MAV
(Weight)
(p B-9&10)11 MAV (dimen-
sionless) 10-5

PACKAGE 1

PACKAGE 2

brick cheese

0.47

4

14

4/16/89

0.48

2

\$3.99/lb

0.51

12

0.52

10

0.58

3

0.62

12

0.63

14

0.63

15

→ 16

0.82

2

0.87

2

LOT DISPOSITION
(B only; see page 2 for A)14 IS ☒ 13 GREATER THAN ZERO?☒ YES → LOT FAILS
☒ NO → CONTINUE15 AVERAGE = TOTAL ÷ NO OF
ERROR ERROR PACKAGES

= 12 ÷ 2 = -5

16 AVERAGE = AVERAGE × UNIT OF
ERROR in units of weight ERROR in Scale div MEASURE

= 15 × 5

= -0.010 lb

17 IS AVERAGE ERROR 0/+?

☐ YES → GO TO 18☒ NO → LOT FAILS18 ☐ LOT ACCEPTED ☐ LOT REJECTED

COMMENTS

12 TOTAL ERROR

-50

13 NUMBER OF MINUS
PACKAGE ERRORS
EXCEEDING MAV

0

Sekman Thomani

Acknowledged Receipt of Report

Official

John Doe

RANDOM PACK REPORT FORM
Page 2 of 2

REPORT NUMBER

ALTERNATIVE TARE CALCULATIONS

a	GROSS WEIGHT					
b	TARE WEIGHT					6b $R_T =$
c	NET WEIGHT					6a $R_C =$
d	PACKAGE ERROR <div style="border: 1px solid black; padding: 2px;">a - 6e - 8</div>					6c $R_C \div R_T =$ <div style="border: 1px solid black; padding: 2px;">6a \div 6b</div>
e	PACKAGE ERROR (in scale div) <div style="border: 1px solid black; padding: 2px;">d \div 5</div>					6d n_1 (Table 2-7 p. B-7&8)
Additional Tare weights:	GROSS WT					6e AVERAGE TARE
	TARE WT					

LOT DISPOSITION CATEGORY A

NOTE: PACKAGES SHOULD NOT BE ARRANGED FROM LIGHTEST TO HEAVIEST WHEN FOLLOWING A

<p>19</p> <p>ON PAGE 1, THE NUMBER OF MINUS PACKAGE ERRORS EXCEEDING THE MAV IS RECORDED IN BOX 13 BOX 4 CONTAINS THE ALLOWED NUMBER. IS 13 Greater than 4 ? YES \rightarrow LOT FAILS NO \rightarrow GO TO 20</p>	<p>20 AVERAGE ERROR (Scale div) = TOTAL ERROR \div NO. OF PACKAGES $= \frac{12}{2}$ $=$</p> <p>21 AVERAGE ERROR in units of weight = AVERAGE ERROR in no. of scale div \times UNIT OF MEASURE $= \frac{20}{1} \times 5$ $=$</p> <p>22 IS 20 MINUS? NO \rightarrow LOT PASSES YES \rightarrow GO TO 23</p>																						
<p>23</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">GROUP</th> <th style="width: 80%;">RANGE OF PACKAGE ERRORS FOR EACH GROUP OF 5 PACKAGES</th> </tr> </thead> <tbody> <tr><td>1</td><td></td></tr> <tr><td>2</td><td></td></tr> <tr><td>3</td><td></td></tr> <tr><td>4</td><td></td></tr> <tr><td>5</td><td></td></tr> <tr><td>6</td><td></td></tr> <tr><td>7</td><td></td></tr> <tr><td>8</td><td></td></tr> <tr><td>9</td><td></td></tr> <tr><td>10</td><td></td></tr> </tbody> </table>	GROUP	RANGE OF PACKAGE ERRORS FOR EACH GROUP OF 5 PACKAGES	1		2		3		4		5		6		7		8		9		10		<p>25 TABLE 2-3 Col. 2 value (page B-3)</p> <p>26 $d = \frac{24}{25} \times 25 =$</p> <p>27 $(n/N) \times 100 = \frac{2}{1} \times 100 =$</p>
GROUP	RANGE OF PACKAGE ERRORS FOR EACH GROUP OF 5 PACKAGES																						
1																							
2																							
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							
<p>24 AVERAGE $= \frac{\text{SUM OF } R}{R} \div \text{NO OF GROUPS}$ $\bar{R} =$</p>	<p>28 Use 27 to look up f in Table 2-4 (page B-4) $f =$</p> <p>29 $T = \frac{26}{28} \times 28 =$</p> <p>DISREGARDING THE SIGNS, IS 20 larger than 29 ? Yes \rightarrow Lot Fails No \rightarrow Lot Passes</p> <p>Record final lot disposition on page 1 in box 18</p>																						

DATE 6/20/90		STANDARD PACK REPORT FORM			REPORT NUMBER 6-581-90	
Location of TEST (Name, Address) Al's		<input checked="" type="checkbox"/> Retailer <input type="checkbox"/> Wholesaler <input type="checkbox"/> Packager		PRODUCT IDENTITY beer	BRAND Happy's	LOT CODE(S) 22 PT 86
		CONTAINER DESCRIPTION one way glass metal screwcap		1 LABELED CONTENTS 12 fl oz	2 UNIT OF MEASURE 0.002 <input checked="" type="checkbox"/> lb. <input type="checkbox"/> oz.	3 MAV (same units as label) See Worksheet 0.5 fl oz
				4 MAV (dimensionless units) See Worksheet 16		

Go to appropriate worksheets, follow directions on the worksheet, recording data on the report form as directed by the worksheet.

9	R _C (See Worksheet)	10	R _T (See Worksheet)	11	R _C ÷ R _T	12	n, (Table 2-7 (p. B-788))	13	AVERAGE TARE	14	NOMINAL GROSS WEIGHT
	Range of Net Weights 0.004 lb		Range of Tare Weights 0.000 lb		9 - 10 = 4		2		See 0.039554 Worksheet		See 1.181 lb Worksheet

(-)

2 ⁺	3										1	
3	2											1
3	1											4
0	1											1
0	1										1	
RANGES											15	TOTAL ERROR
												+4

16	NO UNREASONABLE MINUS ERRORS (Compare with box <u>4</u>)	17	IS <u>16</u> Greater than <u>8</u> <input type="checkbox"/> YES - LOT FAILS <input checked="" type="checkbox"/> NO - CONTINUE	18	AVERAGE ERROR (Dimensionless Units) <u>15</u> ÷ <u>6</u> = <u>1.4</u>	19	AVERAGE ERROR (labeled units) See Worksheet <u>0.012 fl oz</u>	20	IS <u>18</u> ZERO OR PLUS? <input type="checkbox"/> NO → Cat B, LOT FAILS <input type="checkbox"/> Cat A, go to <u>21</u> <input checked="" type="checkbox"/> YES → GO TO <u>28</u>
21	AVERAGE RANGE	22	Use <u>6</u> to look up value in Table 2-3, Col. 2 (p.B-3)	23	d = <u>21</u> × <u>22</u> =	24	(n/N) × 100 = (<u>6</u> ÷ <u>5</u>) × 100 =	25	Use <u>24</u> to look up f in Table 2-4 (p.B-4) f =
27	Disregarding the signs, is <u>18</u> larger than <u>26</u> ? <input type="checkbox"/> YES → LOT FAILS <input type="checkbox"/> NO → LOT PASSES								

28 DISPOSITION OF LOT:

☒ APPROVED
☐ REJECTED

Official John Doe

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

Report 6-581-90
6/20/90

Fill out report form up through box 8, skip boxes 3 and 4.

	(1st Pkg)	(2nd Pkg)	(3rd)	(4th)	(5th)
1. Gross Weight	1.184 lb	1.187 lb			
2. Tare Weight	*R _T = 0.001	0.396 lb	0.345 lb		
Net Weight	*R _C = 0.004	0.788	0.792		
3. Flask Weight (full)	1.109	1.108			
4. Flask Weight (empty, wetted)	0.585	0.585			
5. Weight of Liquid (Step 3 - Step 4)	0.524	0.523			
6. Volume of Flask	8 fl oz	8 fl oz			
7. Temperature of Liquid	70°F	71°F			

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 box is checked, open all packages in sample and determine each package error by volume (see Section 4.6.).

NO ☒ If this box is checked, continue below.

9. AVERAGE WEIGHT OF LIQUID IN FLASK = AVERAGE OF STEP 5 =

0.5235 lb

10. AVERAGE WEIGHT OF LABELED VOLUME = $\frac{\text{LABELED VOLUME}}{\text{FLASK VOLUME}} \times \text{AVG. WEIGHT OF LIQUID IN FLASK}$

$$= \frac{\text{box } \boxed{1}}{\text{Step 6}} \times \text{Step 9} =$$

0.78525 lb

$$= \frac{12 \text{ fl oz}}{8 \text{ fl oz}} \times 0.5235 \text{ lb}$$

*11. (R_C/R_T = 4) (n_t = 2)[†] See Table 2-7 (pages B-7 and 8)

12. AVERAGE TARE = AVERAGE OF STEP 2 (or average of Step 2 and additional tares)*

= 0.3955 lb

Record 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

$$13. \text{NOMINAL GROSS WEIGHT} = \frac{\text{AVERAGE TARE}}{\text{AVERAGE WEIGHT OF LABELED VOLUME}} +$$

$$= \text{Step 12} + \text{Step 10} = \boxed{1.181 \text{ lb}}$$

Record in box **14** on report form

$$= \boxed{0.3955 \text{ lb} + 0.78525 \text{ lb}}$$

14. For packages opened for Tare:

$$\text{PACKAGE ERROR (weight)} = \text{GROSS WEIGHT} - \text{NOMINAL GROSS WEIGHT}$$

$$\boxed{1.184 - 1.181} = \text{Step 1} - \text{Step 13} = \boxed{1.187 - 1.181}$$

$$= \boxed{+0.003 \text{ lb}}^1 \boxed{+0.006 \text{ lb}}^2 \boxed{\phantom{0.000 \text{ lb}}}^3 \boxed{\phantom{0.000 \text{ lb}}}^4 \boxed{\phantom{0.000 \text{ lb}}}^5$$

$$15. \text{PACKAGE ERROR (dimensionless units)} = \frac{\text{PACKAGE ERROR (weight)}}{\text{UNIT OF MEASURE}}$$

$$= \text{Step 14} \div \text{box } \boxed{2}$$

$$\boxed{\frac{+0.003 \text{ lb}}{.002 \text{ lb}}} = \boxed{+2}^1 \boxed{+3}^2 \boxed{}^3 \boxed{}^4 \boxed{}^5$$

Record package errors on report form in crosshatched area.

$$16. \text{MAV (volume)} = \text{from Table 2-9 (pages B-11\&12)}$$

$$\boxed{0.5 \text{ fl oz}}$$

Record in box **3** on report form.

$$17. \text{MAV (weight)} = \frac{\text{MAV (volume)} \times \text{AVERAGE WEIGHT OF LABELED VOLUME}}{\text{LABELED VOLUME}}$$

$$= \text{Step 16} \times \frac{\text{Step 10}}{\text{box } \boxed{1}} = \boxed{0.0327 \text{ lb}}$$

$$= \boxed{0.5 \text{ fl oz} \times \frac{0.785 \text{ lb}}{12.5 \text{ fl oz}}}$$

$$18. \text{MAV (dimensionless units)} = \frac{\text{MAV (weight)}}{\text{UNIT OF MEASURE}}$$

$$= \text{Step 17} \div \text{box } \boxed{2} = \boxed{16}$$

Record in box **4** on report form

$$= \boxed{\frac{0.0327 \text{ lb}}{0.002 \text{ lb}}}$$

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:

$$\text{AVERAGE PACKAGE ERROR (volume)} = \frac{\text{AVG. PACKAGE ERROR (dimensionless units)} \times \text{UNIT OF MEASURE} \times \text{LABELED VOLUME}}{\text{AVG. WEIGHT OF LABELED VOLUME}}$$

$$\boxed{+0.4 \times 0.002 \text{ lb} \times 12 \text{ fl oz}} = \text{box } \boxed{18} \times \text{box } \boxed{2} \times \frac{\text{box } \boxed{1}}{\text{Step 10}}$$

$$\boxed{0.78525 \text{ lb}} = \boxed{+0.012 \text{ fl oz}}$$

Record in box **19** on report form

(Boxes above with "3", "4", "5" in corners are for larger tare sample sizes.)

WORKSHEET FOR PACKAGES LABELED BY COUNT

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 through box [8], skip boxes [3] and [4]

	(1st Pkg)	(2nd Pkg)	(3rd)	(4th)	(5th)
1. Gross Weight	0.136 lb	0.120 lb			
2. Tare Weight	0.002 lb	0.002 lb			
3. Count in Each Package	109	97			
4. Weight of Counted Items	0.133 lb	0.117 lb			
5. Weight of Labeled Count	0.122 lb	0.121 lb			
= Labeled Count $\times \frac{\text{Step 4}}{\text{Step 3}}$ =					

6. MAV from Table 2-10 (count) (page B-13) = 3 Record in box [3] on the report form

7. MAV/6 (weight) = MAV/6 (count) $\times \frac{\text{WEIGHT OF COUNTED ITEMS}}{\text{COUNT IN PACKAGE}}$

$$= \frac{\text{Step 6}}{6} \times \frac{\text{Step 4 (for first package)}}{\text{Step 3 (for first package)}} = \text{0.0006 lb}$$

Handwritten calculation: $0.5 \times \frac{0.133 \text{ lb}}{109} =$

8. If using an equal-arm package checking scale, is value calculated in Step 7 equal to or larger than 1/2 the smallest graduation?

If using an electronic package checking scale, is value calculated in Step 7 at least as large as the smallest increment?

NO ☒ If this box is checked, open all packages in sample and determine each package error by actually counting the items inside the packages.

continue as audit test

YES ☐ If this box is checked, continue below.

9. Do the weights recorded in Step 5 above differ from each other by more than the value in Table 4-3 (page B-20)?

YES ☐ If this box is checked, open all packages in sample and determine each package error by counting items inside packages.

NO ☐ Average Weight of Labeled Count = average of Step 5 =

$$\frac{0.122 + 0.121}{2} = 0.1215$$

0.1215 lb

10. AVERAGE TARE = AVERAGE OF STEP 2

=

0.002 lb

Record in box [13] on report form.

11. NOMINAL GROSS WEIGHT = AVERAGE TARE + AVERAGE WEIGHT OF LABELED COUNT

$$= \text{Step 10} + \text{Step 9} =$$

0.124 lb

Record in box [14] on report form.

12. For packages opened for Tare:

$$\text{PACKAGE ERROR (weight)} = \text{GROSS WEIGHT} - \text{NOMINAL GROSS WEIGHT}$$

$$\begin{aligned} & \text{Step 1} - \text{Step 11} \\ & 0.126 \text{ lb} - 0.124 \text{ lb} = 0.120 \text{ lb} - 0.124 \text{ lb} \\ & = \begin{array}{|c|c|c|c|c|} \hline +0.012 \text{ lb} & -0.004 \text{ lb} & & & \\ \hline \end{array} \end{aligned}$$

$$\text{PACKAGE ERROR (dimensionless units)} = \text{PACKAGE ERROR (weight)} \div \text{UNIT OF MEASURE}$$

$$\begin{aligned} & \text{Step 12} \div \text{box } 2 \\ & \frac{+0.012 \text{ lb}}{0.002 \text{ lb}} = \frac{-0.004 \text{ lb}}{0.002 \text{ lb}} \\ & = \begin{array}{|c|c|c|c|c|} \hline +6 & -2 & & & \\ \hline \end{array} \end{aligned}$$

Record these package errors on report form in crosshatched area.

$$\text{MAV (weight)} = \text{MAV (count)} \times \frac{\text{AVERAGE WEIGHT OF LABELED COUNT}}{\text{LABELED COUNT}}$$

$$\text{Step 6} \times \frac{\text{Step 9}}{\text{box } 1} = 0.00364 \text{ lb}$$

$$\frac{3 \times 0.01215 \text{ lb}}{100}$$

$$\text{MAV (dimensionless units)} = \text{MAV (weight)} \div \text{UNIT OF MEASURE}$$

$$\text{Step 14} \div \text{box } 2 = 2$$

Record in box 4 on report form

$$\frac{0.00364 \text{ lb}}{0.002 \text{ lb}} = 1.82$$

16. Compare unopened packages with nominal gross weight (Step 11 or box 14).

Record package errors for remaining packages in sample directly on report form in crosshatched area.

Compare minus package errors with MAV (Step 15 or box 4).

Average package errors (box 18). Convert back to units of count as given below:

$$\text{AVERAGE PACKAGE ERROR (count)} = \text{AVG. PACKAGE ERROR (dimensionless units)} \times \text{UNIT OF MEASURE} \times \frac{\text{LABELED COUNT}}{\text{AVG. WEIGHT OF LABELED COUNT}}$$

$$= \text{box } 18 \times \text{box } 2 \times \frac{\text{box } 1}{\text{Step 9}}$$

$$= \frac{4 \times 0.002 \text{ lb} \times 100}{0.01215 \text{ lb}}$$

$$= 6.6 \text{ clips}$$

Record in box 19 on report form.

(Boxes above with "3", "4", and "5" in corners are for larger tare sample sizes)

APPENDIX I. EQUIPMENT TOLERANCES

Table 1-1. Tolerances for field standard weights (avoirdupois and metric).^a

CLASS F TOLERANCES FOR FIELD STANDARD WEIGHTS (Avoirdupois)			CLASS F TOLERANCES FOR FIELD STANDARD WEIGHTS (Metric)		
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.			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 (lb)	Pounds (lb)	Grams (g)	Kilograms (kg)	Grams (g)	
10,000	1.00	454	500	50.0	
5,000	0.50	227	300	30.0	
3,000	0.30	136	200	20.0	
2,500	0.25	113	100	10.0	
2,000	0.20	90.5	50	5.00	
1,000	0.10	45.5	30	3.00	
500	0.05	22.5	20	2.00	
100	0.010	4.5	10	1.00	
50	0.005	2.3			
30	0.003	1.4			
20	0.002	0.91	5	Milligrams (mg) 500	
10	0.001	0.45	3	300	
			2	200	
			1	100	
	Micropounds (μ lb) ^b	Milligrams (mg)			
5	500	227			
3	300	136			
2	200	91			
1	154	70			
0.5	100	45			
0.3	60	27			
0.2	40	18			
0.1	20	9.1			
0.05	10	4.5			
0.03 ^c	6	2.7			
0.02 ^c	4	1.8			
0.01	3.20	1.45			
0.005	2.58	1.17			
0.003	2.18	0.99			
0.002	1.92	0.87			
0.001	1.54	0.70			
Ounces (oz)	Micropounds	Milligrams (mg)			
	(μ lb) ^b				
8	100	45			
4	50	23			
2	25	11			
1	12	5.4			
(1/2) 0.5	6.2	2.8			
0.3 ^c	3.92	1.78			
(1/4) 0.25	3.70	1.68			
0.2	3.44	1.56			
(1/8) 0.125	2.96	1.34			

Table I-1. Tolerances for field standard weights (avoirdupois and metric) (Continued).

Denomination	Tolerances	
	Micropounds	Milligrams (mg)
	(μ lb) ^b	
0.1	2.76	1.25
(1/16) 0.0625	2.38	1.08
0.05	2.20	1.00
(1/32) 0.03125	1.90	0.86
0.03	1.87	0.85
0.02	1.65	0.75
0.01	1.32	0.60

^aNBS Handbook 105-1, Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures. 1. Specifications and Tolerances for Field Standard Weights and Measures, in preparation.

^b1 μ lb = 0.000001 lb

^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.

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 on each side of nominal	Minimum graduation
Gill	1/2 fl dr	1/4 fl dr
1/2 Pint	1 fl dr	1/4 fl dr
Pint	2 fl dr	1/2 fl dr
Quart	4 fl dr	1 fl dr
1/2 Gallon	6 fl dr	1 fl dr
Gallon	8 fl dr	1 fl dr

Tolerances for inch-pound field standard flasks and cylinders
(with conversions to milliliters)

Nominal capacity at 68 °F	Tolerances at nominal capacity	Tolerances at total or partial capacity (i.e. graduated portion)
1 Gill	3 Minims (0.18 mL)	1.0 Minims (0.06 mL)
1/2 Pint	4 Minims (0.25 mL)	1.5 Minims (0.09 mL)
1 Pint	7 Minims (0.43 mL)	3.0 Minims (0.18 mL)
1 Quart	12 Minims (0.74 mL)	5.0 Minims (0.31 mL)
1/2 Gallon	16 Minims (0.99 mL)	5.0 Minims (0.31 mL)
1 Gallon	20 Minims (1.23 mL)	5.0 Minims (0.31 mL)
2 Fluid Ounce Cylinder	5 Minims (0.31 mL)	5.0 Minims (0.31 mL)

Scale units for metric flasks

Size	Graduated range on each side of nominal	Minimum graduation
100 mL	2 mL	0.5 mL
200 mL	4 mL	0.5 mL
250 mL	4 mL	0.5 mL
500 mL	8 mL	0.5 mL
1000 mL	15 mL	1.0 mL
2000 mL	25 mL	1.0 mL

Tolerances for metric field standard flasks
and cylinders

Capacity	Tolerance at nominal capacity	Tolerance at total or partial capacity (i.e. graduated portion)
10 mL ^b	---	---
100 mL	0.2 mL	0.08 mL
200 mL	0.3 mL	0.10 mL
500 mL	0.3 mL	0.10 mL
1000 mL	0.5 mL	0.20 mL
2000 mL	1.0 mL	0.30 mL
50 mL cylinder	0.3 mL	0.30 mL

^aNBS Handbook 105-2, Specifications and Tolerances for Reference Standard and Field Standard Weights and Measures. 2. Specifications and Tolerances for Field Standard Measuring Flask, revision in preparation.

^bTolerance of 10 mL graduate is 0.08 mL calibrated "to contain" and 0.10 mL calibrated "to deliver".

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