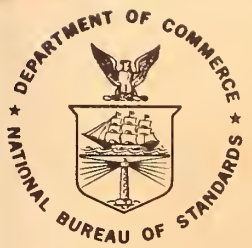

NBS HANDBOOK 133

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

CHECKING THE NET CONTENTS OF PACKAGED GOODS

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Checking the Net Contents of Packaged Goods

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PREFACE

This handbook supersedes National Bureau of Standards (NBS) Handbook 67 "Checking Prepackaged Commodities". Legislative authority for the handbook is the NBS Organic Act (15 U.S.C. 272), which states the NBS functions in part:

> "Cooperation with other Government agencies and with private organizations in the establishment of standard practices, incorporated in codes and specifications."
>
> "Advisory service to Government agencies on scientific and technical problems."
>
> and
>
> "...cooperation with the States in securing uniformity in weights and measures laws and methods of inspection..."

Although this handbook is intended as a procedural guide for Federal, State, and local regulatory agencies, it will be useful to packagers and manufacturers as well. In order to achieve a body of standard practices in sampling to check compliance with net contents regulations, NBS has met with the U.S. Department of Agriculture, the Food and Drug Administration, and the Federal Trade Commission for several years in the Interagency Committee on Net Weight. Although the objective of this committee has not yet been fully realized, several items of agreement have been reached and are incorporated in the present handbook.

In its advisory capacity, NBS offers the methods contained in this handbook as guidelines. Federal agencies as well as States that have regulatory authority may, if they so desire, adopt these guidelines in codes or specifications.

PURPOSE

The purpose of this handbook is to provide regulatory officials with methods to determine the compliance of packaged goods with net contents labeling regulations.

SCOPE

Compliance testing of packaged goods is the determination of conformance of the results (that is, the packages produced) of a packaging, distribution, and/or retailing process with specified legal requirements.

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

The labeled quantity may be of: weight; volume; linear, square, or cubic measure; count; or combinations thereof. The examination of packaged commodities may be to determine conformance with Federal, State, or local net contents labeling regulations. Most often, compliance testing of packaged goods is carried out to protect the consumer/purchaser against buying packages with less in them than the labeled quantity and to advise the manufacturer to improve delivered product quantities when necessary.

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.

This manual contains information on equipment, test methods, calculations, and test reporting. The handbook is divided into five chapters. The first chapter covers several items of an introductory nature which are directed primarily to the administrator of a package testing program. The remainder of the handbook is intended for use by the field testing official. The second chapter discusses fundamentals and general sampling procedures. 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. After the general test methods for packages labeled in a particular unit are described, methods for special commodities follow.

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CHAPTER 1. INTRODUCTION

1.1. REGULATORY AGENCIES
1.2. PACKAGE REQUIREMENTS
1.3. THE PACKAGE TESTING PROGRAM
1.4. SAMPLING INSPECTION
1.5. AUDIT TESTING
1.6. 100% TESTING
1.7. SAMPLING PLANS FOR THE AVERAGE REQUIREMENT
1.8. WHY THERE ARE TWO CATEGORIES OF SAMPLING PLANS
1.9. ALLOWANCES FOR VARIATIONS DUE TO MOISTURE LOSS OR GAIN
1.10. DECISIONS PRELIMINARY TO PACKAGE INSPECTION

CHAPTER 1. INTRODUCTION

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

1.1. REGULATORY AGENCIES

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

The Environmental Protection Agency promulgates requirements for packaged pesticides as part of the agency's responsibility under the Federal Insecticide, Fungicide and Rodenticide Act. The Bureau of Alcohol, Tobacco, and Firearms in the U.S. Department of the Treasury promulgates regulations for packaged tobacco and alcoholic products 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 B. Since Federal agencies have legislated authority which may dictate the extent of difference between regulations enforced by individual State agencies and themselves, it will be necessary for State agencies using this handbook to also keep abreast of Federal agency regulations the revisions of which may contain sampling or testing information not in the regulations at the time of publication of this handbook.

1.2. PACKAGE REQUIREMENTS

1.2.1. The Average Requirement

Although the regulations may differ somewhat in wording, the same operational interpretation has traditionally been applied for the purpose of testing packages for compliance with these regulations. This is known in the general terminology of package inspection as the "average requirement." The average requirement is really two requirements which the quantity of contents of packaged goods must meet. The first is a requirement that the average quantity of contents of packages in a lot, shipment, or delivery must at least equal the quantity printed on the label. The second requirement applies to the individual package; that is, 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. This handbook provides methods to test packages against both requirements. The limits of "reasonable variation" for individual packages are listed in tables of "maximum allowable variation" (Section 2.12.).

1.2.2. An Exception

The National Conference on Weights and Measures (NCWM), an organization of State and local weights and measures officials, has adopted voluntary standards upon which individual jurisdictions may model their laws and regulations. Several States have adopted that portion of the NCWM Model State Regulation for the Method of Sale of Commodities[1] which provides a tolerance for certain package label quantities. In this regulation, such a

[1]This regulation is part of National Bureau of Standards (NBS) Handbook 130, 1980, "Model State Laws and Regulations as adopted by the National Conference on Weights and Measures."

tolerance is called an "allowable difference." When packaged product quantities are given tolerances, the average and individual package requirements described above do not apply. This handbook provides procedures for testing these product quantities in Section 5.7.

1.3. THE PACKAGE TESTING PROGRAM

Several items are discussed in this section concerning the establishment of a broad and diversified package testing program.

1.3.1. Where to Test

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

From the viewpoint of efficiency, the best location to test any individual packaged product is at the location where the product is packaged. The official can sample from the largest number of packages available at one place, the packager can often recover and repackage the product from the packages that must be opened for testing purposes, and the official can immediately inform the manufacturer of the test results.

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.

Just as checking packages at the point of production has the greatest impact upon packaging processes in terms of the number of packages upon which decisions can be made, checking at wholesale has a greater impact than checking at retail. Therefore, warehouse-outlet package testing is a good alternative, wherever possible, to testing at the production point in terms of efficiency. There is a severe drawback to checking at wholesale, however. This is the problem of getting to the stacks of pallets, breaking down film-wrapped or wired skids, and finally, 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 C.6. to simplify selection of the package sample at wholesale outlets.

Package testing at retail checks the soundness of the manufacturing, distribution, and retailing processes of the widest variety of goods available at single locations. Package testing at retail locations checks the accuracy of the package label at the locations where consumers purchase the product.

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

Allowances for loss of moisture may have to be applied to packages and commodities when tested at wholesale and retail locations.

Retail package testing does not permit 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 his/her process is small. Therefore, at the very least, follow-up inspection of a particular brand or code number at a number of retail and wholesale outlets is extremely important in any retail checking scheme.

Package testing at production point cannot entirely replace that at wholesale or retail outlets. Since only manufacturing practices can be examined at production point, testing of packages at wholesale and retail outlets must also be part of a complete package inspection program. The results of distribution practices, possible tampering with the product, and environmental effects can only be monitored 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.

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 production point. Many of the disadvantages of retail inspection that are noted above are, of course, avoided in this instance. Allowances for moisture loss are not applied;

and any shortage may be immediately corrected.

1.3.2. What to Test

The decision as to what products to test can be made in a number of ways. For a State or local government agency, it can be a decision that is based on surveys and audit testing (see Section 1.5.) to cover as much product ground as possible at food stores; farm stuffs, drugs, hardware, or specialty outlets; and discount and department stores. Follow-up of possible problems detected in audit testing or based on a 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 the sales volume of individually inexpensive goods, the overall cost of which is considerable over an extended period to an individual purchaser. Items on special sale and special products produced for local consumption should not be overlooked.

Certain 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's decision as to what to test is made for him or her.

The testing of food, cosmetic, or drug products will require the inspector to observe all health standards and regulations in the handling of 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.

1.4. SAMPLING INSPECTION

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

It is possible to test packages for compliance with package requirements without using sampling techniques. In such case, the quantity of contents of all the packages available for test must be measured, averaged, and then compared with the labeled quantity and the variation from the labeled quantity of each individual package compared with the maximum allowable variation for that package type and size. If allowable differences are established, the quantity inside every package is compared against the labeled quantity plus or minus the allowable difference the regulation cites. This is a costly and time-consuming technique for regulatory agencies and, in certain instances, will require opening all of the packages inspected.

On the other hand, the techniques of sampling and of following a sampling plan provide many benefits. The first benefit is that of conservation of the inspector's time needed to test a single lot, thus minimizing the cost of such testing. Naturally, testing entails a certain amount of package destruction. Following a sampling plan, therefore, preserves the integrity of as many packages as possible.

A second benefit is the greater impact an inspector can have on the package production, distribution, and marketing sectors. In order to protect package purchasers who cannot check the quantity of contents themselves and to encourage good manufacturing and distribution processes among packagers and package sellers, the most effective and efficient method of marketplace surveillance is that of sampling according to prescribed sampling plans.

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

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

- The inspection lot, upon which action will be taken, is defined and the number of packages comprising the lot is counted. (This is discussed in Section 2.3.).
- A random sample is chosen. (Instructions for taking a random sample are given in Appendix C.)
- Measurements are made on each package in the sample (described in Chapters 3, 4, and 5.)

- Calculations are made using the individual measurements (described in Sections 2.6. and 2.7. and as part of the package checking routine in Chapters 3, 4, and 5.)

- A decision on the disposition of the lot, shipment, or delivery is made based upon the criteria established in the sampling plan (described in Sections 2.6. and 2.7. and as part of the package checking routine in Chapters 3, 4, and 5.).

1.5. AUDIT TESTING

In order to speed the process of detecting possible package net contents violations out of the broad array of packaged commodities available for testing at retail locations, officials often use some kind of audit testing procedure. These audit procedures may entail, for example, very small sample sizes or predetermined and catalogued tare weights.

These audit procedures are not definitive, but they are faster and enable an inspector to cover more products in a single location than he or she would otherwise be able to cover using the more rigorous techniques. This handbook does not dwell on audit methods 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.). It should be noted that Category B plans (Section 2.7.), because of the small sample sizes, can also easily be used in audit testing.

Although not intended strictly for audit testing, when packages are checked at retail, inspection lots may be defined as identically labeled packages that are mixed with respect to code or symbol (this will help indicate a manufacturer's process quality). If testing reveals poor quality, then segregation by lot code before further testing will simplify followup inspection.

If the official finds a possible violation, he or she 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.

1.6. 100% TESTING

Upon occasion, checking every package in a lot may be required.

No matter what the size of the lot, when every package in a lot is tested, no (zero) packages may fall below the limits set by the maximum allowable variation, and, at the same time, the average quantity of contents of the lot must equal or exceed the labeled quantity.

If a packager is using checkweighers, not only should the average of the lot equal (or exceed) the label, but under no circumstances should packages be accepted by the checkweigher that are short measure by more than the maximum allowable variation.

1.7. SAMPLING PLANS FOR THE AVERAGE REQUIREMENT

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

Sampling plans of Category A are made available for use when the severity of the consequences for the packager or retailer of a lot not passing the test is relatively great.

Sampling plans of Category B are provided for use when the consequences of a lot not passing the test are relatively minor for the packager or retailer.

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

A regulatory agency may require, for example, that its officials must always use only the sampling plans of Category A or only those of Category B. An agency can also require, for another example, that Category B be used as an audit method, which, when it reveals package shortages, must be followed by a Category A sampling plan before any action is taken.

As mentioned in Section 1.2., there are actually two requirements which packages must meet when they are subject to the "average requirement." The first, which applies to the whole inspection lot, is that the average net contents equal or exceed the labeled contents. The descriptions of the sampling plan categories have specific computations as part of each category which 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 maximum allowable

variations (MAV) in this handbook. When using sampling techniques for compliance testing of package goods, a very few packages in any given sample will be allowed to exceed the limits defined by the MAV.

1.8. WHY THERE ARE TWO CATEGORIES OF SAMPLING PLANS

Judgments based on less than complete information (samples) cannot be made with complete accuracy. There are risks of making wrong decisions; they are the risk of accepting lots that do not conform to the regulation and the risk of failing lots that do conform. Sampling plans can be designed to have predetermined risks of making the wrong decisions.

It has been traditional in package checking in the U.S. to use sampling plans like Category B. Such plans have a 50-50 risk of acceptance-failure for lots that do average at the labeled weight* (and when individual packages fit well within their allowed limits). This kind of plan in some way splits the risk between packer and consumer. For some possible consequences (called "of relatively great severity"), however, the 50% risk may be excessive for the packer who is indeed producing lots complying with regulation.

Therefore, other sampling plans (those of Category A) are given, which provide a much smaller risk for the packer when the lot average does equal the labeled weight. If small sample sizes were used, this kind of plan would not provide sufficient protection to the consumer. Therefore, Category A plans are given with larger sample sizes that will give better discrimination between conforming lots and underweight lots.

A Category B failure is not as strong an indication of an underweight lot as is a Category A failure; however, a Category B plan gives more consumer protection than a Category A plan of the same sample size.

1.9. ALLOWANCES FOR VARIATIONS DUE TO MOISTURE LOSS OR GAIN

Certain packaged products 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. When the Federal or State laws or regulations governing packaged products allow variations in individual packages for loss or gain of moisture, these allowances will have to be applied to individual packages and, thus, to the average net contents before a decision as to lot conformance can be made.

It is not possible for this handbook, on the basis of technical and regulatory information presently available, to provide definitive moisture allowances for determining compliance with those regulations that allow for quantity variations due to moisture loss or gain. In such cases, the inspection authority responsible for ascertaining package compliance is referred to the agencies responsible for such regulations (Table 1-1.).

Table 1-1. Agencies responsible for package regulations.

Agency	Product type
U.S. Department of Agriculture, Food Safety and Quality Service	meat and poultry
U.S. Department of Health and Human Services, Food and Drug Administration	food, drugs, cosmetics, or medical devices
U.S. Federal Trade Commission	household or consumer commodities which are not food, drugs, medical devices, or cosmetics
U.S. Environmental Protection Agency	pesticides, rodenticides, insecticides
U.S. Department of the Treasury, Bureau of Alcohol, Tobacco, and Firearms	alcohol and tobacco products
State Weights and Measures Offices	all packaged products

*Of course, the producer's risk is reduced when the lot averages greater than the labeled weight.

1.10. DECISIONS PRELIMINARY TO PACKAGE INSPECTION

Prior to conducting package inspections, the package testing official must, at the very least, be given preliminary guidance by his or her supervisor or the program administrator concerning:

- which sampling plan category
- what moisture allowance

is to be used under what circumstance in the jurisdiction.

CHAPTER 2. GENERAL CONSIDERATIONS

2.1. THE PACKAGE CHECKING ROUTINE
2.2. THE REPORT FORM AND WORKSHEET
2.3. DEFINITION OF THE LOT
2.4. PACKAGE ERRORS
2.5. SELECTING THE SAMPLING PLAN
2.6. SAMPLING PLANS IN CATEGORY A
2.7. SAMPLING PLANS IN CATEGORY B
2.8. INDIVIDUAL PACKAGES
2.9. RECORDING PACKAGE ERRORS
2.10. THE CRITERIA FOR WEIGHING PACKAGES NOT LABELED BY WEIGHT
2.11. TARE
2.12. MAXIMUM ALLOWABLE VARIATIONS
2.13. EXCEPTIONS TO THE MAXIMUM ALLOWABLE VARIATION
2.14. MOISTURE ALLOWANCE

CHAPTER 2. GENERAL CONSIDERATIONS

This chapter introduces several subjects that may require special study by the inspector prior to actual package testing. A thorough study of Appendix C 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 C, but not 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, the official will be expected to:

- decide location of test and packaged product to be tested (or this information will be provided to the inspector),
- identify the INSPECTION LOT to be tested,
- begin to fill out a REPORT FORM, including information from the product label and the MAXIMUM ALLOWABLE VARIATION (MAV),
- count the number of packages in the lot and record the LOT SIZE,
- refer to a SAMPLING PLAN, record SAMPLE SIZE, TARE SAMPLE SIZE, and ALLOWABLE NUMBER OF UNREASONABLE ERRORS,
- select a RANDOM SAMPLE and from it, the RANDOM TARE SAMPLE (using WORKSHEET),
- if label is not in terms of net weight, determine if WEIGHING METHOD may be employed (using the WORKSHEET),
- determine UNIT OF MEASURE and the MAV in DIMENSIONLESS UNITS,
- determine AVERAGE TARE (CORRECTED TARE if foam product aerosols are being checked) and PACKAGE ERRORS (CORRECTED PACKAGE ERRORS if MOISTURE ALLOWANCE is applied), (recording on WORKSHEET, and REPORT FORM),
- apply DECISION CRITERIA and determine whether lot does or does not conform to net quantity requirements.

Tables and other material in this chapter are referenced in Chapters 3, 4, and 5 when circumstances require their use.

2.2. THE REPORT FORM AND WORKSHEET

It will be necessary to document the results of package testing on some type of report form. An example of a form is shown on the next page. The report form heading is that portion of the form which is encircled with a dashed line. The official will be referred in the following sections to other locations on the report form indicated by circled numbers.

Two worksheets (Block A and Block B) are also provided on the following pages which will be explained as the items listed are discussed in the text.

The worksheets have several purposes:

- notation of random numbers for selection of sample and tare sample (Appendix C),
- recording individual tare weights (Section 2.11.3. and 2.11.4.),
- recording random package labeled weights (Section 3.6.),
- computations associated with packages labeled in units other than weight (Chapters 4 and 5),
- application of moisture allowance (Section 2.14.), and other corrections to the package weights.

For those reading the handbook for the first time, we suggest a copy of the report form and worksheets be kept at the reader's side at all times so that he or she may refer to them while reading the text. The various boxes on the report form are listed in Table 2-1 together with the sections of the text in which they are explained.

Reference will be made to the boxes on the report form and worksheet in the detailed procedures of Chapters 3, 4, and 5.

DEPARTMENT HEADING
PACKAGE CHECKING REPORT

REPORT NO. _____ DATE _____

Check Where Sample Obtained

	Packer	Address
	Distributor	Address
	Dealer	Address

Brand Name	Commodity	Labeled Contents
Other Identification Including Code Symbols	Container Description	

(1) Lot Size (N)	(5) MAV (units of weight)	(8) Average Tare (dimensionless units)	(11) Weight of Labeled Contents
(2) Sample Size (n)	(6) MAV (units of label)	(9) Test Allowance for Foam Aerosols (dimensionless units)	(12) Weight of Labeled Contents (dimensionless units)
(3) Tare Sample Size (n_t)	(7) MAV (dimensionless units) $= \frac{(6)}{(4)}$ or $\frac{(5)}{(4)} =$	(10) Corrected Tare (dimensionless units)	
(4) Unit of Measure			

		Total Errors	
		−	0,+
−			
+			
−			
+			
−			
+			
−			
+			
R			

(13) Allowable Number of Unreasonable Errors	(14) Actual Number of Unreasonable Errors	(15) Average Error (dimensionless units)	(16) Average Error (same units as label)

When (15) Is Minus and Category A Sampling Plan is Being Used:

(17) Average R = $\bar{R}$ =	(20) (n/N) x 100 =	(23) = (22) + (15) =	−	0/+
(18) Table 2-3, Column 2, =	(21) f (Table 2-4) =			
(19) d = (17) x (18) =	(22) T = (19) x (21) =		lot fails	lot passes

Remarks, Instructions, Other Calculations:

_____ Acknowledged Receipt of Report

_____ Inspector

_____ Title

WORKSHEET

Block Ⓐ

Cross out column headings which do not apply and fill appropriate headings in blank spaces

	Pkg. No.	MAV (Random Pack)	Labeled _____	Gross _____	Tare _____	Corrected Tare‡ _____	Net or Drained _____	Package Errors —	Package Errors 0/+
1									
2									
3									
4									
5									
	① R_t =			② R_c =					③ R_c/R_t = ④ (Table 2-7) n_t =
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

⑤ Average Tare or _____ =

Nominal gross wt = labeled wt + average tare corrected nominal gross wt = labeled wt + corrected tare † =_____

*Fill in Applicable Space:

Foam Aerosol Test Allowance _____

Receiving Pan Weight (for drained weight) _____

MAV for Random Pack _____

Flask Weight _____

Moisture Allowance _____

‡Corrected Tare = Average Tare — Foam Allowance

or

= Average Tare — Moisture Allowance

or

= Average Tare — Average Difference in Gross Weights (vacuum packed coffee)

WORKSHEET (Continued)

Block (B)

	1 Weight	2 Quantity	3 Weight / Quantity	4 Weight of Labeled Quantity	5 Liquid Temperature	6 _____	7 _____	8 _____
①								
②								
3								
4								
5								
6								
7								
8								
9								
10								

③ $\frac{MAV}{6}$ (in units of weight) = column 3 x $\frac{MAV}{6}$ = ☐

go on if this value is equal to or larger than 1/2 scale division, if not, measure package quantities directly, opening every package in sample.

④a If column 2 quantity is the same for packages ① and ② (e.g. fluid volume):

weight ① − weight ② = ☐

Table 4-2 value = ☐

If Table 4-2 value is equal to or larger than (weight ① − weight ②), go on to ⑤a . If not, measure package quantities directly opening every package in sample.

④b If column 2 quantity is not the same for packages ① and ② (e.g. length, area, count):

for package ① : $\frac{\text{weight (column 1)}}{\text{quantity (column 2)}}$ = (column 3 line ①) = ☐

(column 3 line ①) x labeled quantity = (column 4 line ①) = ☐

for package ② : $\frac{\text{weight (column 1)}}{\text{quantity (column 2)}}$ = (column 3 line ②) = ☐

(column 3 line ②) x labeled quantity = (column 4 line ②) = ☐

(column 4 line ①) - (column 4 line ②) = ☐

Table 4-2 value = ☐

If Table 4-2 value is equal to or larger than (column 4, line ① − column 4, line ②) go on to ⑤b .
If not, measure package quantities directly, opening every package in sample.

⑤a If column 2 quantity is the same for packages ① and ② :

$$\text{average weight of labeled quantity} = \frac{\frac{\text{weight ① + weight ②}}{2}}{\text{column 2 quantity}} \times \text{labeled quantity} = \square$$

⑤b If column 2 quantity is not the same for packages ① and ② :

$$\text{average weight of labeled quantity} = \text{column 4; } \frac{\text{line ① + line ②}}{2} = \square$$

⑥ Nominal gross weight = ⑤a or ⑤b + average tare = ☐

⑦ $$\text{MAV (in units of weight)} = \frac{\text{MAV x ⑤a or ⑤b}}{\text{labeled quantity}} = \square$$

Table 2-1. Guide to locations on the report form.

Box	Subject	Section
1	Lot Size (N)	2.3.3.
2	Sample Size (n)	2.5., 2.6., 2.7.
3	Tare Sample Size (n_t)	2.6., 2.7.
4	Unit of Measure	2.9.1.
5	MAV (in units of weight)	2.12.
6	MAV (in same units as labeled contents)	2.12.
7	MAV (in dimensionless units)	2.9.1.
8	Average Tare (dimensionless units)	2.11.3., 2.11.4.
9	Test Allowance (foams) (dimensionless units)	3.9.6.
10	Corrected Tare (dimensionless units)	3.9.5., 3.9.6.
11	Weight of Labeled Contents	4.4. (volume) 5.1.3. (count) 5.3.2. (linear or square measure)
12	Weight of Labeled Contents (dimensionless units)	
13	Allowable Number of Unreasonable Errors	2.6.1., 2.7.1.
14	Actual Number of Unreasonable Errors in Sample	2.6.1., 2.7.1.
15	Average Error (in dimensionless units)	2.6.2.
16	Average Error (in same units as label)	2.6.2.
17	Average Range ($\bar{R}$)	2.6.2.
18	Value from Table 2-3, column 2	2.6.2.
19	d (= box 17 x box 18) = column 2, Table 2-3 x $\bar{R}$	2.6.2.
20	(n/N) x 100	2.6.2.
21	f value from Table 2-4 based on box 20 value	2.6.2.
22	T (= box 19 x box 21) = Table 2-4 value x column 2, Table 2-3 x $\bar{R}$	2.6.2.
23	T + Average Error (= box 22 + box 15)	2.6.2.

2.3. DEFINITION OF LOT

The first step in package testing requires the official to define the lot, which is the collection of packages upon which action will be taken as a result of the official's tests. This lot is called the "inspection lot." The best way to define the inspection lot in each case depends on the particular factors that are likely to lead to variations in quantity of the product. The following guidelines form the bases for defining the inspection lot.

(i) The inspection lot should 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, 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, same label, and also, with the same packager's lot code number if inspection is done at the warehouse, or of packages from the same filling line packed during the same period if inspection is done on-line at the packing plant.

It will not always be possible to take both of these factors into account in forming lots.

Taking both the above factors into account may result, in fact, in making the inspection lot very small, which is undesirable. As large an inspection lot as possible should be formed without violating guideline (i) and taking into account the factors mentioned in guideline (ii).

If the official cannot get to certain packages because of some physical or other constraint, then such packages are not part of the inspection lot to be acted upon. In general, such restricted sampling should be avoided whenever possible.

2.3.1. The Inspection Lot of Standard Pack Packages

Standard pack packages are those packages which are put up with identical labels and only in certain selected quantity sizes. An example of a standard pack meat item would be canned hams labeled "5 pounds."

- When the location of test is a retail store, the inspection lot must consist of packages with identical labels. It is not necessary, but may at times be desirable, to segregate packages according to the same manufacturer's lot symbol or code.

- When the location of test is a warehouse, the inspection lot must consist of packages with identical labels and with the same manufacturer's lot symbol or code.

- When the location of test is on-line at a packing plant, the inspection lot must consist of packages with identical labels and manufacturer's 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 those packages that are put up with identical labels except for the labeled quantity. These packages are usually individually weighed and subsequently marked[1].

An example of a random pack meat item, say, would be whole chickens labeled by their various weights.

- When the location of inspection is a retail store, an inspection lot must consist of all the packages packaged at that location 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.

- Upon occasion, the official may wish to define a lot of only one kind of packaged goods (e.g., ground beef) for special reasons, such as the large number of packages of one kind of goods, prior history of product or store, the unit price of the product, or because the results of audit testing indicate the possibility of shortage in a particular item.

- When the 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

The number of packages in the lot to be tested (defined according to the guidelines given in the previous sections) should be counted. This is the size of the inspection lot, and is entered on the report form in box 1.

2.4. PACKAGE ERRORS

In general, the actual package quantities which the official measures will not equal the labeled quantity. Since it is the deviation from the labeled quantity that is of interest to the official, rather than the actual package quantity, reference will be made to positive or negative deviations from the label (called plus or minus errors or, in general, package error). See Sections 2.6.1. and 2.9.

2.5. SELECTING THE SAMPLING PLAN

Guidance is provided in Sections 1.7. and 1.8. on selecting the appropriate category of sampling plan for packages which must conform with the average requirement.

[1]The National Conference on Weights and Measures Model State Packaging and Labeling Regulation (NBS Handbook 130), defines a "random 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 packages apply to consumer and non-consumer packages with quantity declarations of weight or of other measure.

Sampling plans for packages given tolerances or allowable differences are presented in Section 5.7.

Special sampling plans must be used for packages labeled by count and containing less than 51 units per package. These plans are given in Section 5.2.

Each set of sampling plans (Table 2-2, 2-5, 5-1, or 5-2) is specified according to lot size. For any given lot size, the tables list that sampling plan with the minimum sample size to be used. The official may use a larger sample size at any time as long as he or she follows the entire sampling plan (all of any horizontal line including the decision criteria corresponding to that sampling plan and that line).

2.6. SAMPLING PLANS IN CATEGORY A

Table 2-2 lists seven sampling plans according to the lot size, indicated in column 1. Each plan indicates in column 2 the number of packages to be chosen at random from the lot; this is the sample size[2]. Appendix C describes several methods of obtaining a random sample. Column 3 indicates the number of packages to be chosen randomly from the sample upon which the determination of tare will be based; this is the tare sample size. Appendix C describes methods for tare sample selection.

As mentioned in Section 2.5., Table 2-2 lists the minimum sample size to be used for any given lot size. 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) he or she may use a larger sample size at any time. 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, he or she must also take 5 packages to determine the tare and cannot declare the lot out of conformance unless 3 or more packages in the sample are short measure by more than the MAV from the labeled quantity (or unless the sample fails the average requirement).

After recording the lot size in box 1 of the report form, the official should select a sampling plan and record the sample size in box 2. The corresponding tare sample size is recorded in box 3 and the allowable number of unreasonable errors (the number from column 4) is recorded in box 13.

After the quantity of contents in each sample package is measured using a method of test presented in Chapter 3, 4 or 5 of this handbook, the decision criteria of the plan are applied. The decision criteria indicate the conformance or nonconformance of the lot with the package requirements.

Table 2-2. Sampling plans of Category A.

1 Lot size (number of packages in lot) N	2 Sample size (number of packages in sample) n	3 Tare sample size[a] (number of packages chosen for tare determination) n_t	4 Allowable number of package errors exceeding the MAV[b]
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
15,001-50,000	200	10	7
50,001 and greater	315	10	10

[a]Special rules for tare sampling apply when Section 2.11.4. is followed (glass or aerosol packages).

[b]Maximum allowable variation for individual packages (Tables 2-8 through 2-11, Section 2.12.)

[2]Sample 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 2.6.1.), the lot must also pass the decision criterion for the average (Section 2.6.2.).)

2.6.1. Decision Criterion: Individual Packages

Firstly, conformance with the package requirement that permits individual packages to vary from the labeled quantity by a "reasonable" amount is checked. The package error (see Section 2.4.) for each individual package in the sample is compared against the maximum allowable variation (MAV) for that package type and size (See Section 2.12.). The minus errors that exceed the MAV are called "unreasonable errors." If there are more unreasonable errors than are indicated in column 4 of Table 2-2 (corresponding to the sample size), the lot fails to conform with the package requirements. No further testing of the lot is necessary. The allowable number of unreasonable errors from column 4 of Table 2-2 has been recorded in box 13 and the individual package errors in the checkerboard area of the report form (see Section 2.9.). Each package error that exceeds the MAV is circled on the report form and the number of circled package errors (the number of unreasonable errors) is recorded in box 14 of the report form.

If there are an equal number or fewer unreasonable errors in the sample than the number in column 4 corresponding to the selected sampling plan, (that is, the lot complies with this first requirement) the average error must be computed according to Section 2.6.2. before a final decision can be made as to the compliance of the lot with net quantity regulations.

2.6.2. Decision Criterion: The Average Error

The average error for the sample is equal to the sum of the individual package errors divided by the number of packages in the sample. (The use of the report form to compute the average error is described in Section 2.9.3.). The average error is recorded in boxes 15 and 16 on the report form (dimensionless units are explained in Section 2.9.1.). If the total error (and consequently the average error) is zero or a positive number, a final decision on the lot can be made at this point; that is, the lot conforms with the package net quantity requirements.

When the lot size is 30 or fewer, all packages are tested and the lot is found nonconforming if the total error has a minus value.

For lots of more than 30 packages, if the average error for the sample is a minus value, the "error limit" must be computed before a final decision on the compliance of the lot can be made. The error limit, which we will call "T", is calculated:

(i) First compute a value which will be called "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 F contains a detailed example of how to calculate $\bar{R}$.) For the convenience of the official, Table 2-3, column 2 gives values of $0.8598/\sqrt{n}$ for each sample size to use in the calculation of d once $\bar{R}$ is determined[3].

$\bar{R}$ is recorded in box 17 and the value from column 2 of Table 2-3 is recorded in box 18 on the report form.

For example, if the sample size is 30, and $\bar{R}$ = 2(in dimensionless units),

$$d = (0.1570) \times (2) = 0.3140.$$

d (= Table 2-3, column 2 value x $\bar{R}$) is recorded in box 19 on the report form and, as indicated on the form, is the value in box 17 times the value in box 18.

(ii) Calculate the percentage of the lot which the sample represents. This value is recorded in box 20 on the report form.

For example, say the lot to be acted upon consists of 50 packages and a

[3]Alternatively, a calculator which gives the standard deviation directly may be used to determine d. In this case, $d = 2s/\sqrt{n}$, 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 $2/\sqrt{n}$ for each sample size (column 1) to use in this calculation. Slightly different values for d will be obtained using the standard deviation rather than the average range. Since commonly available calculators may not have enough storage capacity to calculate s for large n, the average range method is preferred. If s is used in the calculation, the report form must be modified to indicate the Table 2-3, column 3 value in box 18.

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

1	2	3
n	$\frac{0.8598}{\sqrt{n}}$	$\frac{2}{\sqrt{n}}$
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
315	0.04844	0.1127

Table 2-4. Values of f for percent of lot sampled[a].

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		

[a]Percent of lot sampled = $\frac{\text{sample size}}{\text{lot size}} \times 100$.

sample of 30 packages is to be selected from the lot. The percentage of the lot which the sample represents is equal to 30/50 x 100 = 60%.

(iii) Other values, which will be called "f", are listed in Table 2-4 according to the percentage of the lot which the sample represents (calculated in the previous step), that is, according to the value recorded in box 20. Find the value of f in Table 2-4 corresponding to the percentage figure calculated above. The value of f from Table 2-4 is recorded in box 21 on the report form.

For the above example, the f value is 0.63.

(iv) Calculate the error limit = d x f (which will be called "T"). T is recorded in box 22 on the report form, on which it is indicated that T is the value in box 19 times the value in box 21.

Following the above examples, if d = 0.3140 and f = 0.63; T = d x f = 0.20.

(v) Compare T with the average error to determine lot conformance. When the average error (disregarding its minus sign) is larger than T, the lot does not conform with the package requirements.

On the report form, T plus the average error is computed and that value is entered in box 23. Box 23 is indicated to be the sum of the values in box 15 and box 22. If the value in box 23 is zero or positive, the lot conforms with the package requirements; if it is negative, the lot fails.

Following the above examples, if the average error is found to be -0.210, and T = 0.20, the lot in question would fail to comply with the package requirements, that is, T + average error = (0.20) + (-0.210) = (-0.01).

It is important to realize that the calculations in steps (i) through (v) above do not have to be made when the average error is plus, but only when it is minus.

2.7. SAMPLING PLANS IN CATEGORY B

According to the size of the lot, shown in column 1, Table 2-5 indicates in column 2 the number of packages to be chosen at random from the lot (the sample size) and column 3 shows the number of packages that must be opened to determine the average tare (tare sample size). The lot size is recorded in box 1 of the report form, the sample size in box 2, and the tare sample size in box 3.

After the quantity of contents in the sample packages is measured and recorded, it

Table 2-5. Sampling plans of Category B.

1 Lot size (number of packages in lot) N	2 Sample size (number of packages in sample) n	3 Tare sample size[a] (number of packages chosen for tare determination) n_t	4 Allowable number of package errors exceeding the MAV[b]
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]Maximum allowable variation for individual packages (Tables 2-8 through 2-11, Section 2.12.).

is then necessary to compare these measurements with the package requirements.

2.7.1. Decision Criterion: Individual Packages

Those individual package errors that are minus and that exceed the magnitude of the Maximum Allowable Variation (MAV) (Section 2.12.) are called "unreasonable errors." When Category B sampling plans are being used, a zero is entered in box 13 of the report form.

The actual number of unreasonable errors found in the sample is recorded in box 14 on the report form.

If there are any unreasonable errors in the sample (see column 4 of Table 2-5), the lot fails to conform with the package requirement.

If there are no unreasonable errors in the sample, the total error and the average error is calculated before a final decision on the condition of the lot can be made.

2.7.2. Decision Criterion: The Average Error

The average error of the sample is calculated from the values obtained from individual package measurements. The average error is equal to the sum of the individual package errors in the sample divided by the number of packages in the sample. 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 15 and 16 on the report form (dimensionless units are explained in Section 2.9.1.).

2.8. INDIVIDUAL PACKAGES

Even if the lot complies with the package requirements using a sampling plan, individual packages in the sample may be short by more than the maximum allowable variation from the labeled quantity. However, any individual package that is short by more than the MAV from the labeled quantity is considered defective and should be repacked, relabeled, or otherwise handled on an individual basis.

Disposition of such packages may be recorded on the report form under "Remarks".

2.9. RECORDING PACKAGE ERRORS

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

2.9.1. The Unit of Measure and Dimensionless Units

It is customary for the official to record package errors in terms of dimensionless integers. This may be done by choosing some increment of measure (called the "unit of measure") as the value by which all the integers must be multiplied in order to arrive at the actual package error. For example, say 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. Instead of recording an individual package error of, say, -0.022 lb, the official may record the unit of measure as 0.002 lb, count the number of divisions on the scale face, and then record this number as the individual package error, in this example, -11.

The report form is designed on the assumption that dimensionless units will be used.

It should be noted that any other values the official compares with the package errors recorded in dimensionless integers must also be converted to this integer notation as well (or else the package measurements must be converted back to the units of measure.) Following the previous example, let us say the maximum allowable variation (MAV) for these packages is 0.020 lb. For purposes of comparison with the recorded package errors, the official may convert the MAV to an integer using the same unit of measure used to record the package errors. With a unit of measure of 0.002 lb, the MAV in dimensionless units is (0.020 lb)/(0.002 lb) = 10.

The unit of measure is recorded on the report form in box 4 (e.g. 0.002 lb). The MAV in dimensionless units is recorded in box 7 (e.g. 10).

2.9.2. Choosing the Unit of Measure

The official should record package measurements in units of measure less than or equal

to the MAV/6. For example, the MAV for packages labeled 2.50 lb is 1 3/8 oz (Table 2-8 of Section 2.12.). MAV/6 is 0.229 oz. Since a 1/4 oz unit is larger than 0.229 oz, 1/8 oz units would be the largest unit of measure appropriate for recording measurements on these packages.

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

It should be kept in mind that the MAV's for packages labeled in units other than weight (Tables 2-9, 2-10, or 2-11) apply to such packages, even though weighing may be the means of package contents measurement. For example, packages labeled "48 fl oz" have an MAV of 10.0 fl dr (1.25 fl oz). In this example, say, the inspector finds that 32.00 fl oz of the product under test weighs 2.000 lb. Therefore, the MAV of 10 fl dr is equivalent to:

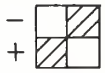
$$\frac{(1.25 \text{ fl oz})\ (2.000 \text{ lb})}{(32.00 \text{ fl oz})} = 0.0781 \text{ lb}$$

The MAV/6 is 0.013 lb or about 3/16 oz. In this instance, therefore, 1/8 oz units (or 0.008 lb units) are appropriate for testing the packages. If these same 48 fl oz packages had a weight of 1.000 lb for each 32 fl oz, the MAV of 10 fl dr 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 in measuring these packages.

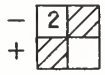
Equipment used to measure package quantities should be capable of discriminating measurements to 1/6 of the MAV for an individual package. With one exception, this handbook suggests equipment which meets this criterion.

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

Package errors are entered on the report form in the "checkerboard" area[4]. Five values are entered down the first columm, then the next five in the second column, and so on. This area of the form is designed to aid the official to sum the individual package errors as well as determine the range of package errors (computations are explained in Section 2.6. and Appendix F.). Each package error is associated with a four square block:

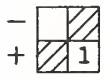


A minus package error is entered in the upper left square of the block:



This block indicates a package error of -2.

A plus error is entered in the lower right square of the block:



This block indicates a package error of +1.

When sample sizes greater than n = 80 are checked, additional report forms must be used to record the package errors.

In order to obtain the sum of package errors, add the individual package errors horizontally across the rows in the checkerboard area, recording the sum of each horizontal row in the "total error" column on the extreme right, and then add up the rightmost column. The average error of the sample is obtained by dividing the sum of the total error column by the number of packages in the sample.

2.10. THE CRITERIA FOR WEIGHING PACKAGES NOT LABELED BY WEIGHT

The preferred method of 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 to determine individual package errors. 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 can use a weighing technique:

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

If the recommended 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 must be used, the

[4]This 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).

smallest increment in the readout must be equal to or smaller than the MAV/6. (Most common liquid commodities will meet this criterion; see step 7 of Section 4.4.)

(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).

2.11. TARE

In compliance testing of packaged goods, the enforcement agency is interested in utilizing nondestructive tests as far as possible; that is, testing that requires opening as few packages as possible. For example, the net weight of a package can be determined by weighing the unopened package - called the gross weight - and subtracting from that weight the average weight of the packaging materials (and sometimes other materials) - called the average tare weight - as long as the actual tare weights of individual packages do not vary too much (see Section 2.11.4.) In more complicated situations, the official first determines whether the labeled unit of measure, if it is not weight, (say, volume) can be converted to a weight value (using the measured weight of a known volume, in the example of volume). If this is possible, the net contents of a package can be found by subtracting the tare weight from the gross weight (and if necessary, converting the resultant value from units of weight to the units on the package label)[5].

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

The average tare is recorded in box 8 of the report form in dimensionless units.

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. 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 in containers made of different materials or made by different manufacturers. The procedure of Section 2.11.4. will indicate if this tare variability is sizeable in comparison with the net weight variability, and indicate if the official should open more packages to obtain the average tare weight.

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

- Dry tare is composed of all packaging materials (including glue, labels, ties, etc.) that will contain or enclose the product but before the product is introduced into the container. Prizes, gifts, coupons, or decorations that are not part of the product are defined as part of the tare also.

- Wet tare is composed of all packaging materials that can be separated from the packaged product after packaging. Washing, scraping, ambient air drying, and other techniques involving more than "normal" household recovery procedures may be used but laboratory procedures such as oven drying the packaging material are not used. As in the dry tare definition, prizes and decorations and such are also part of the wet tare.

[5]In actual practice, a "nominal gross weight" value will be determined. The nominal gross weight is the sum of the average tare weight and the labeled weight. This weight value may then be easily compared on an equal-arm scale with the actual gross weight of each unopened package in order to arrive at the individual package errors. For example, see steps 14 and 15 of Section 3.5.

Wet tare should be used wherever possible. In some cases (e.g., canned or glass- or plastic-packed goods) dry tare weights are equivalent to wet tare (within the measurement precision of field test scales). However, the net contents value which is obtained when a dry tare value is subtracted from the package's gross quantity will not always represent the amount of product which can subsequently be obtained from the package. For example, oils or moisture from the product may be absorbed by the packaging material when in contact with the product, increasing the weight of the packaging material and decreasing the weight of the product after packaging. Therefore, caution in the use of dry tare values is advised. (When it is available, the use of a dry tare value can be valuable in audit testing, however, in order to locate possible violations without opening any packages under test).

Direct measurement of net contents is necessary when the product cannot be checked by weighing. (For example, 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 cannot be used to adequately indicate the count of units inside the package.)

The direct measurement of net contents will also be 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 3.8., 3.11., and 3.12.

2.11.1. Choosing Packages for Tare

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

If dry tare is used, Appendix C procedures should be used to select the tare sample from the lot or lots of tare material. Tare values are determined by weighing the empty packages.

2.11.2. Cleaning Tare Materials

The cleaning of packaging material for tare weight determination will vary with the tare material and the product it contains. In general, a common-sense approach should be followed in cleaning tare materials. A bread bag, for example, may be turned inside out to remove all crumbs. Care should be taken in cleaning tare material such as metal cans with paper labels so that the labels are not wet with water or other solvent used to clean the container. The interior of the containers should be thoroughly dried with a clean, dry cloth or air dried, whichever is the most practicable. Butter or bacon wrappers, for example, should be scraped and wiped clean but no effort should be made to extract product contents absorbed by the tare. Caulking compound tubes should be cut open and scraped and wiped. Solvent may be used if the package is foil-lined, but every effort should be made 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.

These are just a few of the approaches to be used in cleaning packaging materials prior to determination of the tare weight.

2.11.3. Tare Neither Glass nor Aerosol

Table 2-2 or Table 2-5 indicates in column 3 how many packages to open or how many dry tare units to select at random in order to determine the average tare. The tare sample size is recorded in box 3 of the report form.

The weights of the individual tare units (after cleaning) are recorded in Block A of the worksheet and should be averaged. This average tare weight will be used together with the declared net weight (or other net quantity converted to weight units) to compare with the gross weight of unopened packages in the sample to determine the individual package errors. The average tare weight is entered in box 8 on the report form in dimensionless units.

2.11.4. Alternative Tare Procedure[6]

The following procedure must be followed for packages which are glass or aerosol. The procedure 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.

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

The total number of packages to be opened for tare will be determined by first obtaining the appropriate number of packages according to Table 2-6, determining their tare weights and net contents, obtaining the ratio of the range of net contents to the range of tare weights, and referring to Table 2-7 which shows the total number of containers to be opened. Block A of the worksheet may be used for recording measurements. The detailed procedure is as follows:

(i) An initial tare sample (see Table 2-6) is selected from the sample (see Appendix C for a description of of random sample selection).

(ii) The packages chosen for tare are gross weighed, (gross weights are recorded on the worksheet, Block A), and then emptied[7]. Glass packages may be opened, aerosol packages must not be opened. See Section 3.9.4. for instructions on emptying aerosol packages.

(iii) The tare weight is determined for each package. Tare weights are recorded on Block A of the worksheet.

(iv) The individual package errors are determined. Package errors are recorded in Block A of the worksheet.

(v) The range of tare weights is determined. (The range is the difference between the largest tare value and the smallest. See Appendix F for more complete instructions on determining the range.) This range of tare weights is R_t. R_t is recorded in Block A on the worksheet in box 1.

(vi) The range of the plus and minus errors (and thus the range of the net weights) is determined for the packages opened for tare determination. This range is R_c. R_c is recorded in Block A of the worksheet in box 2.

(vii) The ratio R_c/R_t is computed. R_c/R_t is recorded in Block A of the worksheet in box 3. (R_c and R_t must be

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

[6]Modification 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.
[7]For packages labeled in units other than weight, a determination is made of the suitability of using a weight value in place of the labeled measure. This determination is made 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 which can be checked by weight. For packages that cannot be checked by weight, net contents must be measured directly for all the sample packages and there is no tare determination.

in the same units of measure or both in dimensionless units.)

(viii) The value of n_t is read from Table 2-7 corresponding to the appropriate sample size, n, and the calculated value of R_c/R_t. The number in the table, n_t, indicates the total number of packages to be emptied to determine tare (n_t is recorded on the worksheet in box 4 of Block A).

For example, if R_c/R_t is 2.90 for n = 30, 10 package tare weights are necessary to determine the average tare. In this example, if five packages have 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 those for the packages that were chosen for tare determination. The tare weights are: 0.146 lb for the first package and 0.150 lb for the second.

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

The package net weights for these two packages are:

0.406 lb - 0.146 lb = 0.260 lb
0.400 lb - 0.150 lb = 0.250 lb

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

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

(ix) The number of additional packages equal to (n_t minus the initial tare sample size) is selected.

(x) Steps (ii), (iii), and (iv) are repeated for these additional packages.

(xi) The average of all the tare weights is used together with the labeled quantity (in terms of weight) to represent the "nominal gross weight" (unless all the packages in the sample have been opened). The average tare weight in dimensionless units is recorded in box 8 of the report form. The nominal gross weight is used to compare against the actual package gross weights to determine the package errors of the unopened packages in the sample (see Chapters 3, 4, and 5).

If the required number of packages to be opened for tare is more than half 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. There is space on the worksheet to record up to 30 individual package gross, tare, and net weights, and resulting package errors.

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 3.9.6.). This test allowance (provided in Table 3-2) is subtracted from the actual tare weight or the average tare weight. The resultant value is the "corrected tare" to be used in the determination of the individual package errors. The test allowance is recorded in box 9 and the corrected average tare recorded in box 10 of the report form. If all the foam aerosol packages are emptied, there is space on the worksheet to record the actual and corrected tares. In this instance, the official should note on the report form in box 10 to refer to the worksheet.

2.12. MAXIMUM ALLOWABLE VARIATIONS

The limits of reasonable individual package variations are called "Maximum Allowable Variations" (MAV) in this handbook. The MAV applies only to individual packages subject to the average requirement. Package quantities given a tolerence (or an allowable difference - see Section 5.7.) are not compared with the MAV.

Table 2-7. Total number of packages (n_t) to open 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=315
	n_t	n_t	n_t	n_t	n_t	n_t	n_t
0.2 OR LESS	10	30	50	80	125	200	315
0.21 - 0.40	10	29	49	77	121	193	303
0.41 - 0.60	10	28	46	74	115	184	289
0.61 - 0.80	9	26	44	69	108	173	272
0.81 - 1.00	8	24	40	64	100	160	252
1.01 - 1.20	8	23	37	59	92	148	232
1.21 - 1.40	7	21	34	54	84	135	212
1.41 - 1.60	7	19	31	49	77	122	193
1.61 - 1.80	6	17	28	45	69	111	175
1.81 - 2.00	5	15	25	40	63	100	158
2.01 - 2.20	5	14	23	37	57	91	143
2.21 - 2.40	5	13	21	33	52	82	130
2.41 - 2.60	4	12	19	30	47	75	118
2.61 - 2.80	4	11	17	28	43	68	107
2.81 - 3.00	4	10	16	25	39	62	97
3.01 - 3.20	3	9	15	23	36	57	89
3.21 - 3.40	3	8	13	21	32	52	81
3.41 - 3.60	3	8	12	19	30	48	75
3.61 - 3.80	3	7	11	18	28	44	69
3.81 - 4.00	2	6	10	16	25	40	63
4.01 - 4.20	2	6	10	15	24	37	59
4.21 - 4.40	2	6	9	14	22	35	54
4.41 - 4.60	2	5	8	13	20	32	51
4.61 - 4.80	2	5	8	12	19	30	47
4.81 - 5.00	2	5	7	12	18	28	44
5.01 - 5.20	2	4	7	11	17	26	41
5.21 - 5.40	2	4	7	10	16	25	38
5.41 - 5.60	2	4	6	10	15	23	36
5.61 - 5.80	2	4	6	9	14	22	34
5.81 - 6.00	2	3	5	8	13	20	32

Table 2-7 (continued). Total number of packages (n_t) to open 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=315
	n_t	n_t	n_t	n_t	n_t	n_t	n_t
6.01 - 6.20	2	3	5	8	12	19	30
6.21 - 6.40	2	3	5	8	12	19	29
6.41 - 6.60	2	3	5	7	11	17	27
6.61 - 6.80	2	3	5	7	10	16	26
6.81 - 7.00	2	3	5	7	10	16	24
7.01 - 7.20	2	3	5	6	9	15	23
7.21 - 7.40	2	3	5	6	9	14	22
7.41 - 7.60	2	2	5	6	9	13	21
7.61 - 7.80	2	2	5	5	8	13	20
7.81 - 8.00	2	2	5	5	8	12	19
8.01 - 8.20	2	2	5	5	8	12	18
8.21 - 8.40	2	2	5	5	7	11	17
8.41 - 8.60	2	2	5	5	7	11	17
8.61 - 8.80	2	2	5	5	7	10	16
8.81 - 9.00	2	2	5	5	6	10	15
9.01 - 9.20	2	2	5	5	6	10	15
9.21 - 9.40	2	2	5	5	6	10	14
9.41 - 9.60	2	2	5	5	6	10	14
9.61 - 9.80	2	2	5	5	5	10	13
9.81 - 10.00	2	2	5	5	5	10	13
10.01 - 10.20	2	2	5	5	5	10	12
10.21 - 10.40	2	2	5	5	5	10	12
10.41 - 10.60	2	2	5	5	5	10	11
10.61 - 10.80	2	2	5	5	5	10	11
10.81 - 11.00	2	2	5	5	5	10	11
11.01 - 11.20	2	2	5	5	5	10	10

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 which are used to compare with minus package errors only[8]. Positive deviations will in general be controlled by the competitive marketplace; this handbook, therefore, indicates MAV values which are intended to describe the limits of negative deviations only from the labeled quantity.

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

The MAV's for packages labeled by weight are the 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). When supplemental statements of drained weight or fill weight accompany the net weight statement on a package, the MAV listed in Table 2-8 applies to the net weight statement only, not to the accompanying drained weight or fill weight statement.

When checking standard pack packages for which the labeled quantity is in units of weight, the official should complete box 5 of the report form using that value from Table 2-8 corresponding to the labeled weight.

When checking standard pack packages labeled in units other than weight, the official should fill in box 6 of the report form using the appropriate value from Table 2-9, 2-10, or 2-11. Block A of the worksheet provides space for recording the MAV for random pack package weights. Block B of the worksheet provides space for calculating the MAV in units of weight for those instances in which weighing will be used to check packages labeled in units other than weight.

The MAV in dimensionless units (box 7) is obtained by dividing the MAV value from Table 2-8, 2-9, 2-10, or 2-11 (and recorded in box 5 or 6) by the unit of measure (box 4). See Section 3.6. for application of the MAV to random pack package lots.

2.13. EXCEPTIONS TO THE MAXIMUM ALLOWABLE VARIATIONS

When packaging practices or the nature of the product demands, MAV's exceeding those listed in Tables IV through VII are necessary.

Specific Product Exceptions to the MAV:

- Any individual thickness measurement of polyethylene sheeting may be -20% of labeled thickness.

  The average thickness of a single package of polyethylene sheeting may be -7% of the labeled thickness (see Section 5.4.3.)

- The National Conference on Weights and Measures Model State Packaging and Labeling Regulation lists the maximum allowable variation for textiles as the following:

  For those packages with no declared dimension less than 24 inches:
  -3% of the declared dimension
  +6% of the declared dimension

  For the packages with any declared dimension less than 24 inches:
  -6% of the declared dimension
  +12% of the declared dimension

2.14. MOISTURE ALLOWANCE

If a moisture allowance is to be applied to the particular packaged product under test, that allowance may be subtracted from the "nominal gross weight" (see Section 2.11. and step 13 of Section 3.5.) to obtain a corrected nominal gross weight. This corrected nominal gross weight is then compared with the gross weight of each unopened package in the sample in order to determine individual package errors. The nominal gross weight and corrected nominal gross weight may be recorded at the bottom of Block A of the worksheet.

Example of how to apply a moisture allowance:

Labeled weight = 12.00 oz.

Average tare weight = 0.16 oz.

The moisture allowance is assumed, in this example, to have been assigned by the regulatory agency as 2% of the labeled weight = 0.02 x 12.00 oz = 0.24 oz.

Therefore, the corrected nominal gross weight to use in comparing with the gross weight

[8]Note exception in Section 2.13. for textiles.

of unopened packages in the sample =

12.00 oz + 0.16 oz - 0.24 oz = 11.92 oz.

Thus, sample packages weighing more than 11.92 oz will have positive package errors and sample packages weighing less than 11.92 oz will have negative package errors.

Table 2-8. Maximum allowable variations 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 0.026 lb up to and including 0.41 oz	0.001		up to and including 0 to 11.6	0.5
0.026+[b] to[c] 0.04 lb 0.041+ to 0.64 oz	0.002	1/32	11.6+ to 18	1
0.04+ to 0.08 lb 0.64+ to 1.28 oz	0.004	1/16	18+ to 36	2
0.08+ to 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 (minus package errors)

[b]0.026+ means "greater than 0.026"

[c]"to" means "to and including"

Table 2-8. (continued). Maximum allowable variations for an individual package labeled by weight.

Avoirdupois units			Metric units	
Labeled weight	MAV		Labeled weight	MAV
Pounds	Decimal pounds	Fractional ounces	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+	1%		24.70+	1%

Table 2-9. Maximum allowable variations for an individual package labeled by volume - liquid or dry[a].

Inch-Pound				Metric	
Labeled quantity	Liquid MAV (dr or 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 mL[c]
		0.18+ to 0.49 cu in	0.06	3+ to 8 mL	1.0 mL[c]
		0.49+ to 0.92 cu in	0.09	8+ to 15 mL	1.5 mL[c]
0.50+[d] to[e] 0.75 fl oz	0.5 dr	0.92+ to 1.35 cu in	0.11	15+ to 22 mL	2.0 mL
0.75+ to 2.25 fl oz	1.0 dr	1.35+ to 4.06 cu in	0.23	22+ to 67 mL	3.5 mL
2.25+ to 4.25 fl oz	1.5 dr	4.06+ to 7.67 cu in	0.34	67+ to 126 mL	5.5
4.25+ to 5.75 fl oz	2.0 dr	7.67+ to 10.38 cu in	0.45	126+ to 170 mL	7.5
5.75+ to 7.50 fl oz	2.5 dr	10.38+ to 13.54 cu in	0.56	170+ to 222 mL	9
7.50+ to 11.75 fl oz	3.0 dr	13.54+ to 21.21 cu in	0.68	222+ to 347 mL	11
11.75+ to 17.00 fl oz (1 pt, 1 oz)	4.0 dr	21.21+ to 30.68 cu in	0.90	347+ to 503 mL	15
17.00+ to 21.00 fl oz (1 pt, 1 oz)	5.0 dr	30.68+ to 37.90 cu in	1.13	503+ to 621 mL	18
21.00+ to 27.00 fl oz (1 pt, 1 oz)	6.0 dr	37.90+ to 48.73 cu in	1.35	621+ to 798 mL	22

[a]Applies to shortages in package volume (minus package errors).

[b]Convert to metric units and use laboratory glassware.

[c]Use laboratory volumetric glassware.

[d]0.50+ means "greater than 0.50".

[e]"to" means "to and including".

Table 2-9. (continued). Maximum allowable variations for an individual package labeled by volume -liquid or dry.

Inch-Pound				Metric	
Labeled quantity	Liquid MAV (dr or fl oz)	Labeled quantity	Dry MAV (cu in)	Labeled quantity	Liquid and dry MAV (mL)
27.00+ to 31.00 fl oz (1 pt, 1 oz)	7.0 dr	48.73+ to 55.95 cu in	1.58	798+ to 917 mL	26
31.00+ to 39.00 fl oz (1 qt, 7 oz)	8.0 dr	55.95+ to 70.38 cu in	1.80	917+ mL to 1.153 L	30
39.00+ to 55.00 fl oz	10.0 dr	70.38+ to 99.26 cu in	2.26	1.153+ to 1.627 L	37
55.00+ to 69.00 fl oz	12.0 dr	99.26+ to 124.5 cu in	2.71	1.627+ to 2.041 L	44
69.00+ to 85.00 fl oz	14.0 dr	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 fl oz	153.4+ to 185.9 cu in	3.6	2.514+ to 3.046 L	59
103.00+ fl oz to 1.25 gal	2.5 fl oz	185.9+ to 288.8 cu in	4.5	3.046+ to 4.732 L	74
1.25+ to 1.45 gal	3.0 fl oz	288.8+ to 335.0 cu in	5.4	4.732+ to 5.489 L	89
1.45+ to 1.875 gal	3.5 fl oz	335.0+ to 433.1 cu in	6.3	5.489+ to 7.098 L	104
1.875+ to 2.125 gal	4.0 fl oz	433.1+ to 490.9 cu in	7.2	7.098+ to 8.044 L	118
2.125+ to 2.688 gal	4.5 fl oz	490.9+ to 620.8 cu in	8.1	8.044+ to 10.173 L	133
2.688+ to 3.063 gal	5.0 fl oz	620.8+ to 707.4 cu in	9.0	10.173+ to 11.593 L	148
3.063+ to 4.375 gal	6.0 fl oz	707.4+ to 1011 cu in	10.8	11.593+ to 16.561 L	177
4.375+ to 5.0 gal	7.0 fl oz	1011+ to 1155 cu in	12.6	16.561+ to 18.927 L	207
5.0+ to 6.25 gal	8.0 fl oz	1155+ to 1444 cu in	14.4	18.927+ to 23.659 L	237
6.25+ to 7.063 gal	9.0 fl oz	1444+ to 1631 cu in	16.2	23.659+ to 26.734 L	266
Over 7.063 gal	1%	Over 1631 cu in	1%	Over 26.734 L	1%

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. Maximum allowable variation for an individual package labeled by count[a].

Labeled count	MAV
up to and including 17	0[b]
18-50	1[b]
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% rounded off to the nearest whole number

[a]Applies only to shortages in package count (minus package errors).

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

Table 2-11. Maximum allowable variations for an individual package labeled by length (width) or by area[a]

Length		
Inch-Pound		Metric
Labeled length yards	MAV (expressed as a percentage of the labeled length)	Labeled length meters
up to and including 48	1.5%	up to and including 40
48+[b] to[c] and including 96	2%	40+ to 85
96+ to and including 154	2.5%	85+ to 140
154+ to and including 330	3%	140+ to 300
330+ to and including 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 (minus package errors).

[b]48+ means greater than 48

[c]"to" means "to and including"

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

CHAPTER 3. METHODS OF TEST FOR PACKAGES LABELED BY WEIGHT

3.1. WEIGHING EQUIPMENT
3.2. PREPARATION FOR TESTING
3.3. RECORDING PACKAGE WEIGHTS
3.4. READING THE PACKAGE TESTING SCALE
3.5. STANDARD PACK LABELED BY WEIGHT: GENERAL METHOD
3.6. RANDOM PACK LABELED BY WEIGHT
3.7. LARGE WEIGHTS AND THE SUBSTITUTION METHOD
3.8. THE DETERMINATION OF DRAINED WEIGHT
3.9. AEROSOL PACKAGES
3.10. SPECIAL COMMODITY: FROZEN FOOD AND OTHER FROZEN PRODUCTS
3.11. SPECIAL COMMODITY: DRAINED WEIGHT OF FROZEN FOODS
3.12. SPECIAL COMMODITY: GLAZED RAW SEAFOOD AND FISH
3.13. SPECIAL COMMODITY: CANNED COFFEE

CHAPTER 3. METHODS OF TEST FOR PACKAGES LABELED BY WEIGHT

Provided in this chapter are, firstly, descriptions of weighing equipment and conventions in weighing. There follows a step-by-step listing of the general method of test for packages labeled by weight to which reference will be made throughout the rest of the handbook.

Methods of test for special types of commodities labeled by weight (drained weight, random pack, etc.) and then for specific commodities (coffee, seafood) complete the chapter.

3.1. WEIGHING EQUIPMENT

The equipment recommended for use in checking packages labeled by weight is as follows:

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 recommended. On one face the division size should not be greater than 1/16 ounce and 0.002 pound on the other face. The minimum number of divisions should be 10 divisions on either side of zero on either tower face. The poise beams should have a zero notch in the center and notched divisions each equal to or less than the tower capacity on either side of zero with a span of at least 4 ounces or 0.24 pound. For example, a scale with 20 divisions (of 0.002 lb each) on the tower face should have notched divisions of 0.04 pound intervals on the poise beams. The scale should be fitted with a locking device to hold the lever during transit, with a handle for carrying, and should be provided with a protective cover or box. The sensitivity of this scale must be 1/2 scale division per 0.001 lb. The scale must meet all requirements of NBS Handbook 44 (H-44) for automatic indicating scales (see H-44 Scale Code T.3.1.) except that the accuracy should be 1/2 the acceptance tolerance given in H-44 Scale Code Table 4 with a maximum tolerance of two tower divisions.

Equal-Arm Scale (for small weights in metric units)[1]. - Similar in design to the avoirdupois weight scale with the exception that the maximum size of each tower division should be 1 gram and the poise beam should be provided with at least a 200-gram span with notched divisions each equal to or less than the tower capacity. The minimum sensitivity of this scale must be 1/2 scale division per 0.5 gram. The scale must meet H-44 requirements except that the accuracy should be 1/2 the acceptance tolerance given in H-44 Scale Code Table 4 with a maximum tolerance of two tower divisions.

Equal-Arm Scale (for larger weights in avoirdupois units). - For checking packages heavier than the capacity of the scale for small weights, an equal-arm scale with center tower and poise beams and with a capacity of approximately 20 pounds is recommended. One face of the tower should have a maximum division size of 1/8 ounce and the other face of the tower should show divisions not greater than 0.004 pound. There should be at least 10 divisions on either side of zero on either tower face. The poise beams should have a zero notch in the center and notched divisions each equal to or less than the tower capacity on either side of zero. One beam should have at least a 12-ounce span and the other side at least a 0.6-pound span. This scale should also be fitted with a locking device to hold the lever during transit, with a handle for carrying, and should be provided with a protective cover or box. The minimum sensitivity of this scale must be 1/2 scale division per 0.002 pound. The scale must meet H-44 requirements except that the accuracy should be 1/2 the acceptance tolerance given in H-44 Scale Code Table 4 with a maximum tolerance of two tower divisions.

Equal-Arm Scale (for larger weights in metric units)[1]. - Similar in design to the 20 pound scale with the exception that the tower should have maximum divisions of 2 grams and the poise beam provided with at least a 400 gram span with notched divisions each equal to or less than the tower capacity. The minimum sensitivity of this scale must be 1/2 scale division per 1.0 gram. The scale must meet H-44 requirements except that the accuracy should be 1/2 the acceptance tolerance given in H-44 Scale Code Table 4 with a maximum tolerance of two tower divisions.

Commercial Scale - Checking of packages heavier than the capacity of the equal-arm

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

scale for larger weights, or of those that cannot be accommodated on the platform of the equal-arm scale, may necessitate the use of an on-site device. Care must be exercised to insure that the device meets and is used in accordance with the criteria listed under the "substitution" method as discussed in Section 3.7.

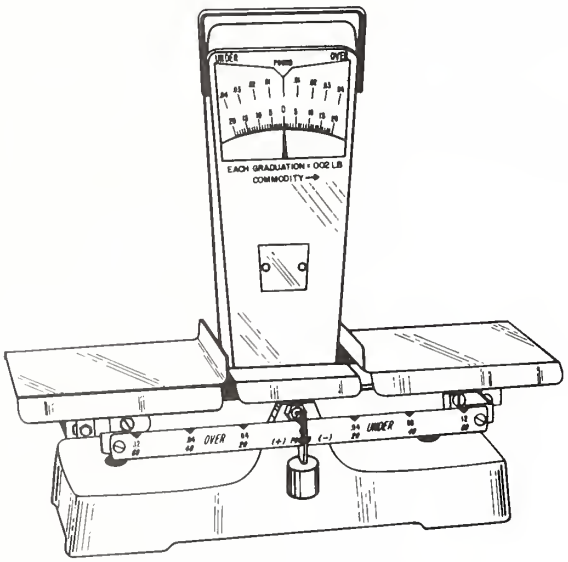


Figure 3-1. Equal-arm package testing scale for small weights (avoirdupois units).

Analytical Balance - In Section 2.9.2., it is noted that only scales that can weigh accurately to 1/6 the maximum allowable variation for an individual package should be used. For example, the MAV for a 10-gram package is 0.5 g; therefore, the accuracy to be used in weighing is 0.08 g, which is beyond the capacity of the small capacity metric package scale. Therefore, in this example, these packages must be weighed on an analytical balance. (This may require signing for packages and transporting to a laboratory, although portable balances are available with the required accuracy.)

Field Standard Weights[2] (Figure 3-2) - For weighing in avoirdupois units, two kits, one a collection of 31 pounds of standard weights from 2 pounds to 1/16 ounce denominations and another kit of weights varying from 0.3 pound to 0.001 pound are adequate for checking small packages; an additional 25-pound and two 50-pound standard weights will be sufficient for most large packages.

For weighing packages labeled in metric units, weights will include a total of 15 kilograms of standard weights with various denominations of weights ranging down to 0.5 gram for checking small packages; two 10-kilogram, and two 20-kilogram standard weights will be sufficient for most large metric packages.

Figure 3-2. Test weight kit.

3.2. PREPARATION FOR TESTING

The principal requirement for a testing location is convenience to both the official and store, warehouse, or plant personnel. If the checking is to be done in the customer area of the store, it 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 equal-arm scale should be placed on a firm support and leveled. Following Examination Procedure Outline No. 4 from NBS Handbook 112, the inspector should (a) observe the scale at zero-load indication, (b) test the scale with standard weights to capacity with equal loads on each pan, and (c) test the scale with small loads to test the tower indicator and poise beam. The scale should meet the requirements of H-44 except that its accuracy should be 1/2 the acceptance tolerance given in H-44 Scale Code Table 4 with a maximum tolerance of two tower divisions.

[2]Tolerances for field standard weights (avoirdupois and metric) are given in Appendix G, Table G-1.

If a commercial scale is to be used, the scale should be checked carefully to determine whether it has met H-44 requirements and used only if it is sufficiently sensitive to indicate changes in weight commensurate with MAV/6 (see Section 2.9.2.). Once the scale has been selected, it should not be released to commercial service until the testing has been completed.

3.3. RECORDING PACKAGE WEIGHTS

Table 3-1 lists the recommended units of measure with which the official should record weights according to the labeled weight of the package. See the discussion of procedures for recording weights in Section 2.9.

3.4. READING THE PACKAGE TESTING SCALE

For the greatest accuracy obtainable with an equal-arm package testing scale, the tower face readings should not be read directly to determine the package errors. Rather, the scale should be used as a "null-indicator" such that the field standard weights are used on the one weigh pan to exactly balance the other weigh pan containing the item to be weighed. The package errors may then be read exactly in terms of reference weights (rather than weight indications on the tower face).

When using the package checking scale as a "null indicator", if an exact balance cannot be achieved, the index of the indicator should point away from the product being weighed to determine the gross or net weights, and towards the material being weighed for tare.

When the package checking scale is being read directly, it will frequently be necessary to round off the indication shown on the tower face to the nearest division (or the nearest division which corresponds 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 and correspondingly, when greater than one half the distance, record the value corresponding to the next higher division. When the indicator is one half of the distance between two divisions, the official should record the value corresponding to the next higher division when recording the gross package weight, and should record the value corresponding to the next lower division when recording the tare.

Conventionally, neither packagers nor testing officials make air buoyancy corrections in the determination of package weights. For practicality, air buoyancy corrections are not applied in the procedures given in this handbook.

3.5. STANDARD PACK LABELED BY WEIGHT: GENERAL METHOD

The Decision Charts 1, 2, and 3 on the following pages briefly outline the flow of operations for standard-pack packages labeled by weight.

The steps to be followed, as shown on the charts, are described in greater detail in the remainder of this section. Decision Charts 1 and 2 are identical down through step 16; Chart 1 is appropriate when a sampling plan in Category A is to be used and Chart 2 is for Category B. Chart 3 is a supplement to either Chart 1 or 2 that describes the procedure to be followed when Section 2.11.4. is used for tare determination.

The description below references numbered boxes on the report form and locations on the worksheets (see Section 2.2.). Some of the report form boxes and worksheet spaces are provided for special procedures discussed in later sections of this chapter or in later chapters, and will not be mentioned in the description of the general method.

Steps with (a), (b), and (c) apply to different types of tare weight.

1. Fill out the report form heading and also the MAV (refer to Table 2-8) in units of weight (box 5 of the report form), the unit of measure (box 4), and the MAV converted to a dimensionless integer (box 7). (For packages labeled by weight, box 6 is not used.)

2. Determine the size of the inspection lot and record it in box 1 of the report form. Record the column 4 value from Table 2-2 or 2-5 (the allowable number of unreasonable errors) in box 13 of the report form.

3. Record the sample size, n, from column 2 of Table 2-2 or 2-5 in box 2 of the report form.

   Record the tare sample size, n_t, according to the type of tare to be measured:

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

Avoirdupois units			Metric units	
Labeled weight	Units of measure		Labeled weight	Units of measure
	(oz avoir)	(lb)		(kg)
Up to and including 1.92 oz (0.12 lb)	a	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]	0.002[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	0.004	Greater than 250 g to and including 900 g	0.002
Greater than 1 lb to and including 4 lb	1/8	0.008	Greater than 900 g to and including 2.5 kg	0.005
Greater than 4 lb to and including 8 lb	1/4	0.02	Greater than 2.5 kg to and including 30 kg	0.01
Greater than 8 lb to and including 25 lb	1/2	0.03	Greater than 30 kg to and including 60 kg	0.05
Greater than 25 lb to and including 75 lb	1	0.05	Greater than 60 kg	0.1
Greater than 75 lb to and including 150 lb	2	0.1		
Greater than 150 lb	4	0.2		

[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 a null-indicator for packages labeled from 1.92 to 5.44 oz or 82 to 250 g to eliminate effects of possible tower errors.

a. For wet tare, record tare sample size (from Table 2-2 or 2-5, column 3) in box 3 of the report form.

b. If the package container is glass or aerosol or for other reasons the alternative tare procedures will be used, record initial tare sample size from Table 2-6 in box 3 of the report form.

c. For dry tare, identify the lot (or lots) of tare materials (see Appendix C.6.) and record tare sample size (from Table 2-2 or 2-5, column 3) in box 3 of the report form.

4. a. For wet tare, select random numbers and from them, the sample packages (see Appendix C for a description of this method.)

b. For the alternative tare procedure, identify the sample packages in the order in which their corresponding random numbers were obtained. This is the order in which the packages will be opened for tare. Select the initial tare sample. See Appendix C.6.1. for an example.

c. For dry tare, select the tare sample and include all the materials used in or on the package. Refer to Appendix C.6.1. for a description of how to select the tare sample. Go to step 6.c.

5. a. or b. Determine the gross weight of each package in the tare sample (See Figure 3-3). The labeled and gross weights are recorded on the worksheet in Block A. (Fill in the blanks of the column headings with "weight".) Record gross weight in units of weight or dimensionless units.

6. a. For wet tare, empty the packages selected for tare and determine the tare weight and resultant package errors[3] of these packages.

net weight =
gross weight - tare weight

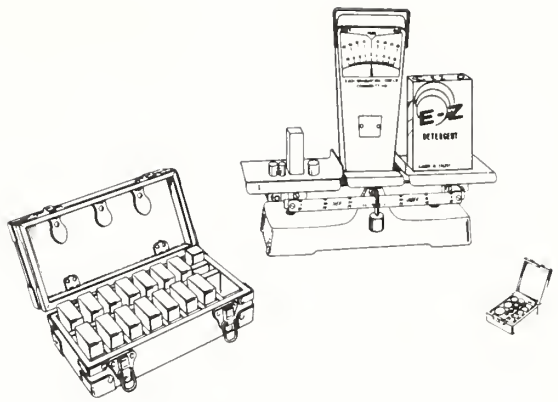


Figure 3-3. The determination of the gross weight of a package.

Package error =
net weight - labeled weight

Record net weights and package errors on the worksheet in Block A in units of weight or dimensionless units. Continue on to step 12.

b. For the alternative tare procedure, empty the tare packages, determine their tare weights and package errors[3]. Follow steps 7 through 11.

c. For dry tare, determine the weights of the individual units including all the materials used in or on the package. Record on the worksheet in units of weight or in dimensionless units in Block A filling in the tare heading blank as "dry". Go on to step 12.

7. Determine the range of tare weights, R_t, and record R_t in box 1 of Block A on the worksheet. (See Appendix F on determining a range.)

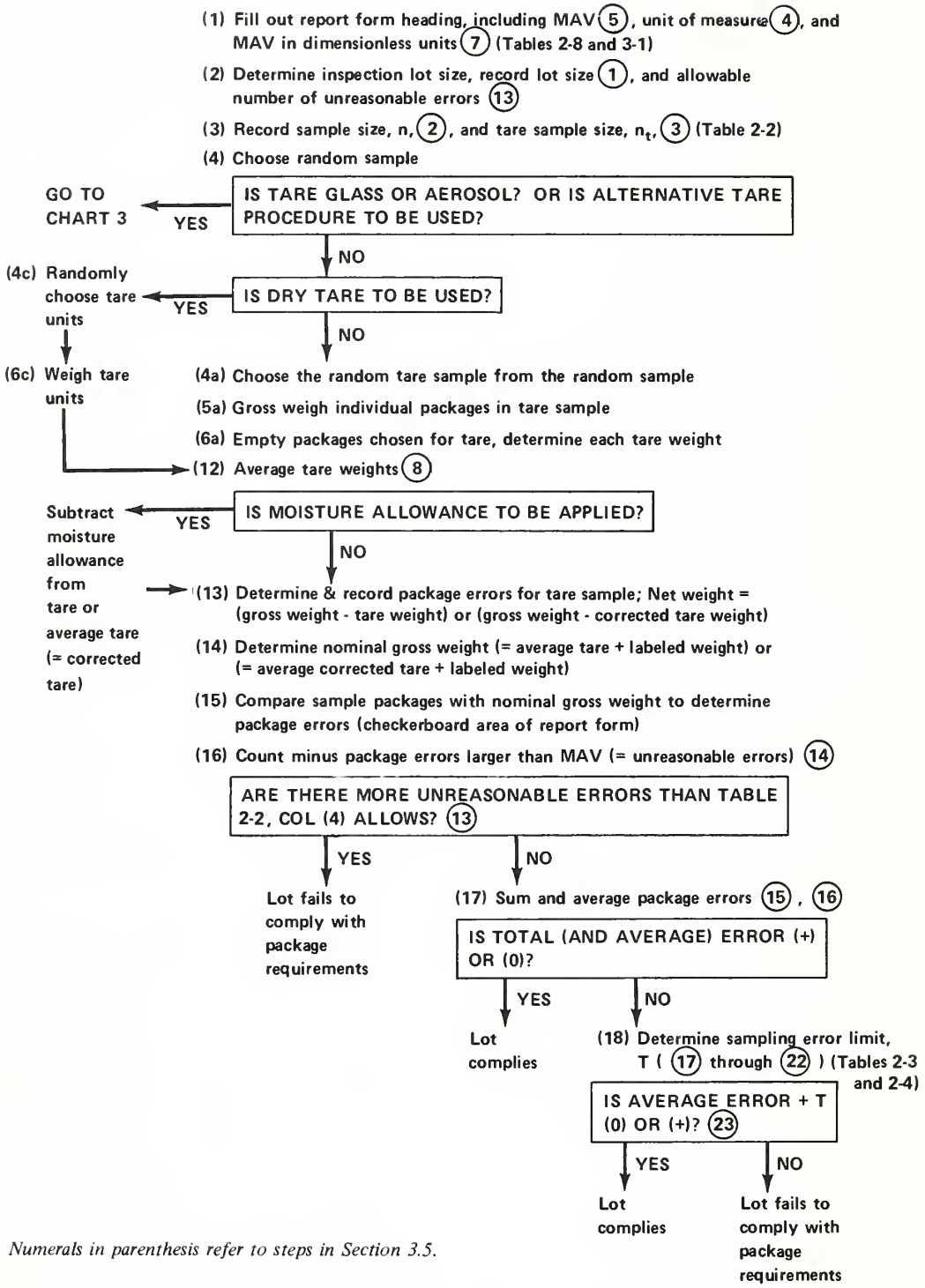
8. Determine the range of package errors, R_c, and record R_c in box 2 of Block A on the worksheet.

9. Compute the ratio R_c/R_t, record it in box 3 of Block A, and use Table 2-7 to

[3]If a moisture allowance is to be applied, convert the moisture allowance, if necessary, to units of weight or dimensionless units and subtract it from each tare weight to obtain a corrected tare weight. Use the corrected tare weight to compute the net weight and package error for the tare sample. (There is space in Block A of the worksheet to record a corrected tare value for each package opened for the tare determination when a moisture allowance is applied.)

Decision Chart 1
Standard Pack, Category A
Packages Labeled by Weight

(See Tables 2-2, 2-3, 2-4, 2-8, and 3-1)



Numerals in parenthesis refer to steps in Section 3.5.

Circled numbers refer to locations on the report form

determine whether more packages are required to determine tare. From Table 2-7, record the final tare sample size, n_t, in box 4 on Block A of the worksheet. If n_t is larger than the initial tare sample size recorded on the report form in box 3, the initial tare sample size may be crossed out and the n_t determined in this step recorded in box 3 in its place. If more packages are required for tare determination than the number of packages already opened, follow the next step. If no more packages are required, go to step 12.

10. Select from the sample the additional packages required to determine the tare as described in Appendix C.6.1.

11. Empty these additional packages and determine the tare weights and net weights[3] for each additional package opened. Record the additional gross weights, tare weights, and package errors in the appropriate spaces on the worksheet in Block A.

12. Unless all the packages in the sample have been opened, average the tare weights. Convert the average tare to dimensionless units (if not already converted) and record this in box 8 of the report form.

13. Using an appropriate unit of measure, record the package errors for the packages emptied for tare determination in the checkerboard area of the form in dimensionless units. This may be the entire sample if it is necessary to open all the packages in the sample. If all the packages in the sample have been opened for tare, go to step 16.

    If a moisture allowance is to be applied, subtract it (in terms of units of weight or dimensionless units) from the average tare weight. This is the corrected tare and is recorded in box 10 of the report form in dimensionless units.

14. The average tare weight (or corrected average tare) plus the labeled weight is the "nominal gross weight" to be used in determining package error.

    The nominal gross weight may be recorded in the lower part of Block A on the worksheet.

15. Place standard weights equal to the "nominal gross weight" on the left pan of the package weighing scale. Place the remaining packages of the sample individually on the right pan (see Figure 3-3) and record the individual package errors (plus, zero, minus differences from the nominal gross weight) in dimensionless units in the checkerboard area of the report form (as described in Section 2.9.3.).

16. Circle any minus package errors that exceeds the MAV (these are called "unreasonable errors") and record the number in box 14 of the report form. If the number of unreasonable errors exceeds that number recorded in box 13 the lot fails to conform with requirements. No further testing of the lot is necessary. If box 14 is equal to or less than box 13, go on to step 17.

17. Sum the individual package errors for the sample (with due regard for positive and negative package errors) and record the sum for each row in the spaces marked "Total Errors" on the report form. Add up these sums and enter the total at the foot of the Total Errors column. If the total error is zero or positive, the lot conforms with requirements. No further testing of the lot is necessary.

    If a Category B plan is being used, and if the total error is negative, the lot fails to conform to the package requirements. No further testing of the lot is necessary.

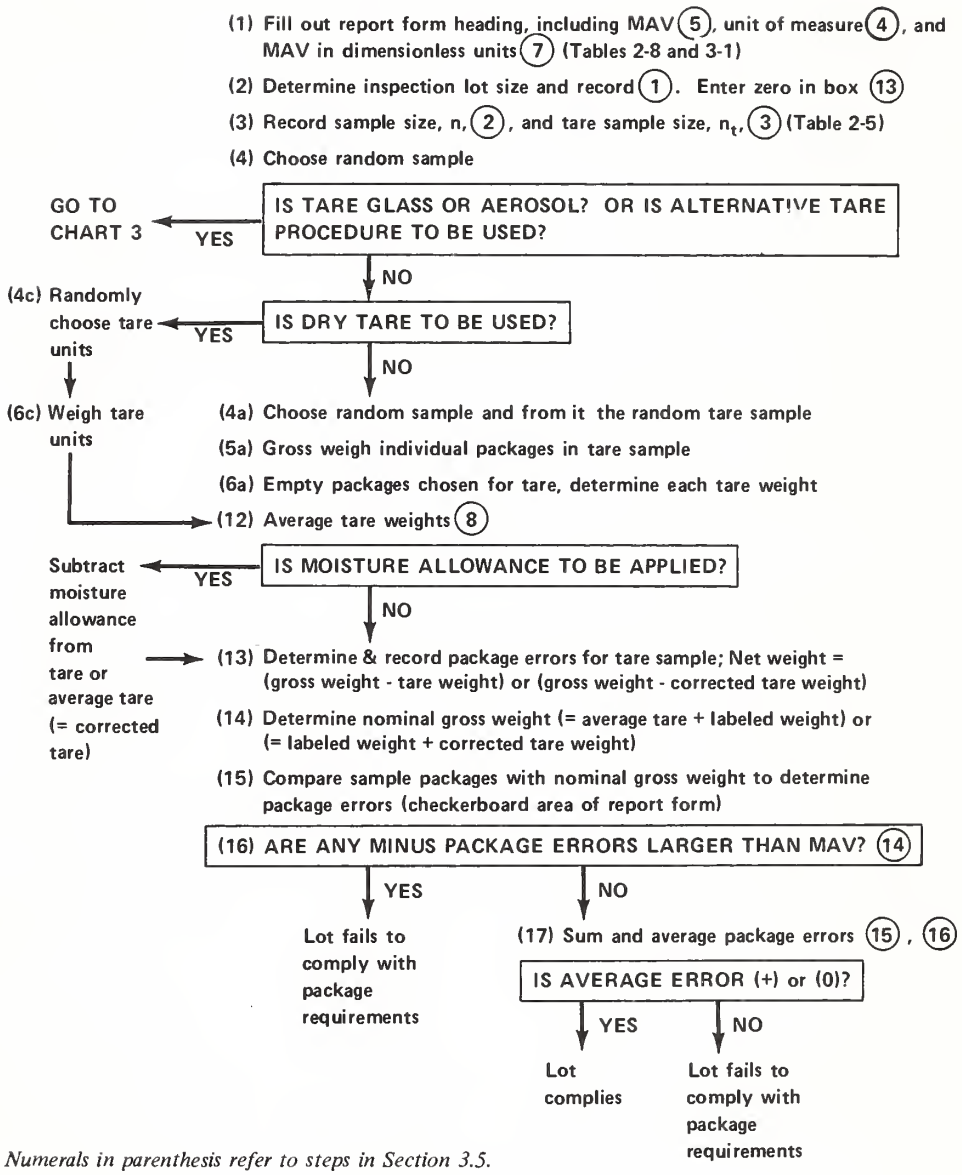
    Divide the total error by the number of packages in the sample to determine the average error and record that value (in dimensionless units) in box 15 of the report form. Record the average error in the same units of measure as the label in box 16.

    If a Category A plan is being used and the total (and thus the average) error is negative, go to step 18.

[3]If a moisture allowance is to be applied, convert the moisture allowance, if necessary, to units of weight or dimensionless units and subtract it from each tare weight to obtain a corrected tare weight. Use the corrected tare weight to compute the net weight and package errors for the tare sample. (There is space in Block A of the worksheet to record a corrected tare value for each package opened for the tare determination when a moisture allowance is applied.)

Decision Chart 2
Standard Pack, Category B
Packages Labeled by Weight

(See Tables 2-5, 2-8, and 3-1)



Numerals in parenthesis refer to steps in Section 3.5.

Circled numbers refer to locations on the report form

18. Determine the error limit T (See Section 2.6.2.):
$T = (0.8598/\sqrt{n}) \times \bar{R} \times f)$
by the following procedure:

Record the range of package errors in each column of the checkerboard area in the spaces beside the designation "R" on the report form.

Record $\bar{R}$ in box 17 of the report form.

Record the value of $0.8598/\sqrt{n}$ (from column 2 of Table 2-3) in box 18.

Record $d = (0.8598/\sqrt{n}) \times \bar{R}$ in box 19 (box 17 x box 18).

Record the percent of the lot which is the sample in box 20.

Record the f value from Table 2-4 in box 21.

Record, T(= box 21 x box 19) in box 22 of the report form.

Add T to the average package error and record this value in box 23.

If the value in box 23 is zero or positive, the lot complies with the package requirements. If the value in box 23 is a minus value, the lot fails to comply with reqirements.

3.6. RANDOM PACK LABELED BY WEIGHT

Random pack packages are those whose contents are measured, packaged, and labeled individually. As a group or lot, these packages do not occur, in general, in fixed or patterned quantities. They occur most frequently labeled by weight. Also, they are tested most frequently where they are packaged, usually at the retail store or wholesale warehouse.

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

The only difference between the checking procedure for random pack packages and standard pack (Section 3.5.) occurs in step 15. Each package in the random pack sample is compared against the weight marked on its label plus the average tare weight for that size and wrap category of packages (small tray, large tray, shrink wrap, etc.). This necessitates changing the weights placed on the left weighpan of the equal-arm scale according to the different labeled weights and tare weights of each package in the sample in order to determine the individual package errors. Record individual labeled weights, gross weights, tare weights, and net weights on the worksheet in Block A and transfer the resulting package errors to the report form. Otherwise, the entire procedure is exactly as in Section 3.5.

When an entire meat counter is audit tested (See Section 1.5.), the MAV to apply to a random pack lot is that MAV corresponding to the average labeled weight of the sample. If official action will be taken on an entire counter two alternatives may be followed. The official should either (1) separate the packages into inspection lots of different labeled weight categories as listed in Table 2-8 (for example, 0.94 to 1.08 lb as one lot, 1.08 to 1.26 lb as a second lot, and so on) or (2) select the sample from the entire counter (defined as the lot) and apply to each sample package the MAV associated with its labeled weight. Block A of the worksheet provides a column headed "MAV (random pack)" for this purpose.

When determining wet tare weights for random pack packages of meat, poultry, fish and similar products, the official may note large variability in the tare weights, stemming from, for example, a varying number of soaker pads in each package, or varying 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.

3.7. LARGE WEIGHTS AND THE SUBSTITUTION METHOD

Using a commercial scale (rather than the inspector's package checking scale), the substitution method may be used for the checking of large packages (random or standard pack), if the size and/or weight exceed the capacity of the equal-arm package-checking scales. The commercial scale should be used as a substitution weigher or null indicator only and not as a "direct reading" device because possible scale error and between division interpolation error would contribute to the uncertainty of results.

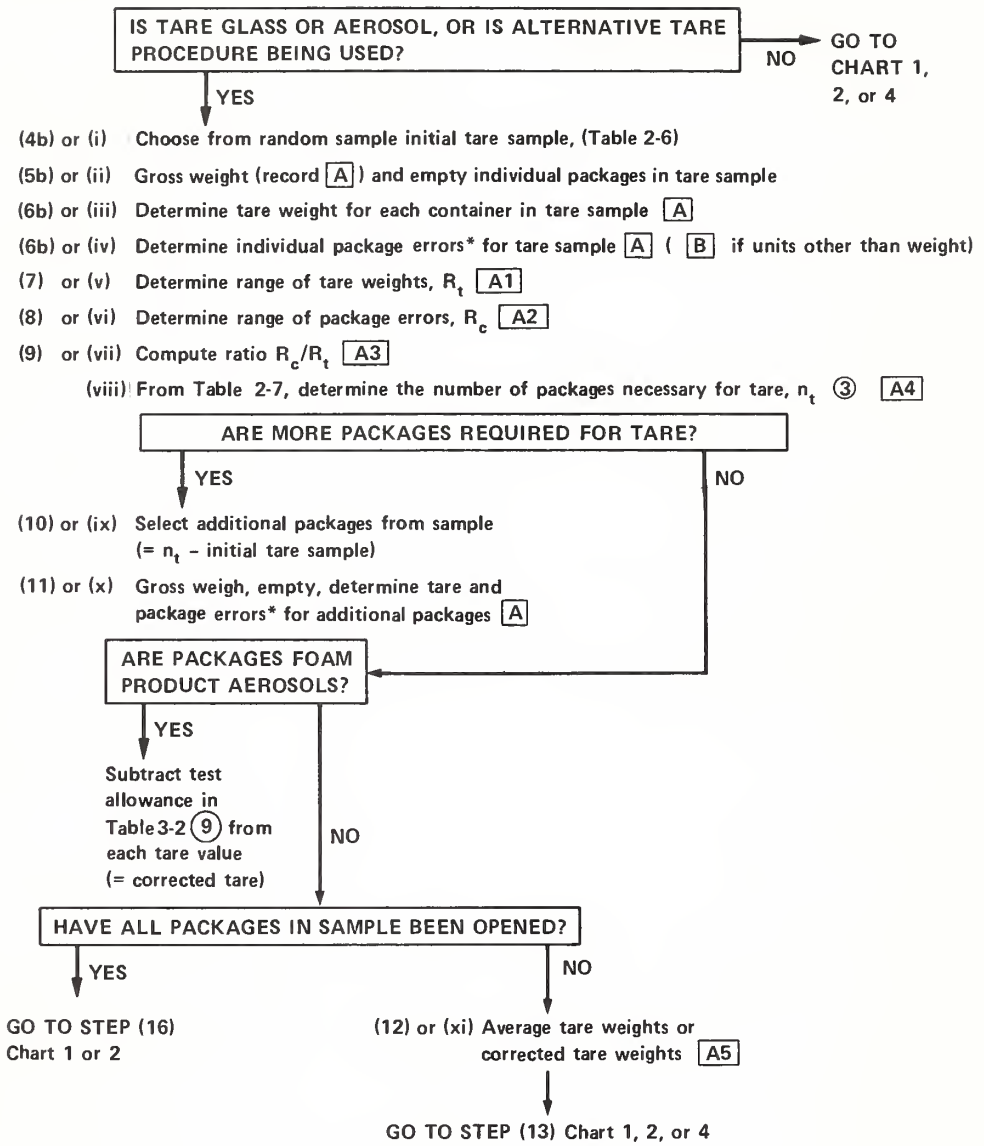
The following procedure refers to steps in Section 3.5. but does not follow any decision chart.

If the tare can be weighed on one of the testing official's equal-arm scales, follow substeps (a).

If the tare is too heavy or large to use the official's scales, or if product is liquid, follow substeps (b).

Decision Chart 3
Glass or Aerosol Tare Procedure
(Alternative Tare Procedure)

(See Tables 2-6, 2-7, and 3-2)



Roman numerals in parenthesis refer to steps in Section 2.11.4., letters to Section 3.5.

Circled numbers refer to locations on the report form.

Boxed letters and numbers refer to locations on the worksheet.

**If moisture allowance is applied, net weight = gross weight - corrected tare weight. (Corrected tare weight = tare weight - moisture allowance)*

1.- 4. Follow Section 3.5., steps 1 through 4 for instructions in filling out the report form and selecting the random sample and random tare sample.

5. a. Empty the first tare sample package and weigh the tare on one of the official's scales. (If packaged product is particulate material, empty package into a container.)

b. Place first package to be opened for tare determination on commercial scale and note scale indication. Remove package. (See Example.)

6. a. Place on commercial scale standard weights representing tare weight of first tare sample package plus standard weights representing labeled weight plus standard weights of about 3% of the labeled weight such that:

- If an analogue scale, the index of the indicator is coincident with a scale division.
- If a digital scale, a "balance" is obtained. Obtain a balance by adding a sufficient amount of small weights (in increments equal to 1/10 the value of the scale's minimum division) to attain the break-point between two consecutive indications[4]. (See Example.)

Record the amount of standard weights and the scale reading in Block B of the worksheet in columns 6 and 8.

b. Place on commercial scale standard weights equivalent to scale indication in 5b plus a small amount of additional weights (an additional 1%) so that a balance is obtained as described in step 6a for a digital or analogue scale. Record standard weights and scale reading in columns 6 and 8 of Block B on the worksheet.

7. a. Remove standard weights representing the tare and labeled weight. Place the sample package and contents on the commercial scale.

b. Remove standard weights from the scale. Place tare sample package on the commercial scale.

8. a. Add or remove weights until the scale indication recorded in 6a is duplicated. With an electronic digital scale, if weights must be removed, remove enough weights so the readout of step 6a 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 the total amount of weights added or removed in this step as the package error in Block A of the worksheet[5]. If weights are added, this is a minus package error; if weights removed, this is a plus package error.

b. Add weights until the scale indication recorded in 6b is duplicated. When using a digital scale, add weights in increments of 0.1 division until the breakpoint is reached. Record the standard weights on the scale in Block B of the worksheet in column 7. The gross weight of the package is equal to the amount of standard weights recorded in step 6b in column 6 of Block B minus the standard weights in column 7. Record the gross weight in Block A of the worksheet.

9. a. Repeat steps 5a through 8a for the rest of the tare sample using the tare weight corresponding to each tare sample package in step 6a.

b. Repeat steps 5b through 8b to determine the tare weight of the first tare sample package and to determine the gross weights and tare weights of the remaining tare sample packages.

10. If the alternative tare procedure is being used, follow steps 7 through 12 of Section 3.5., determining the package errors for all the packages opened for tare.

[4]For a discussion of error weight testing, see pages 120-122 of NBS Handbook 94.
[5]If 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, step 8a, a package error of 2.00 lb - 0.32 lb = +1.68 lb results.

Examples of substitution weighing

Step		standard weights on pans	scale reading
		(avoirdupois - decimal pounds)	
5a.	Scale reading with package on pan		101.1 lb
6a.	After placing standard weights on scale to balance (tare wt + labeled wt + 3% labeled wt (3.11 lb))	104.46 lb	104.5 lb
7a.	After removing standard weights (tare + labeled wt) and adding sample package	3.11 lb	104.2 lb
8a.	After adding or removing standard weights to duplicate step 6a scale indication	3.43 lb	104.5 lb
	Package error = (standard weights, 7a - 8a) = -0.32 lb		
5b.	After placing sample package on scale		101.1 lb
6b.	After placing standard weights duplicating step 5b scale indication + standard weights to obtain balance	101.94 lb	102.0 lb
7b.	After removing standard weights and adding sample package		101.1 lb
8b.	After adding standard weights to duplicate step 6b scale indication	.93 lb	102.0 lb
	Gross weight = (standard weights, 6b-8b) = 101.0 lb		

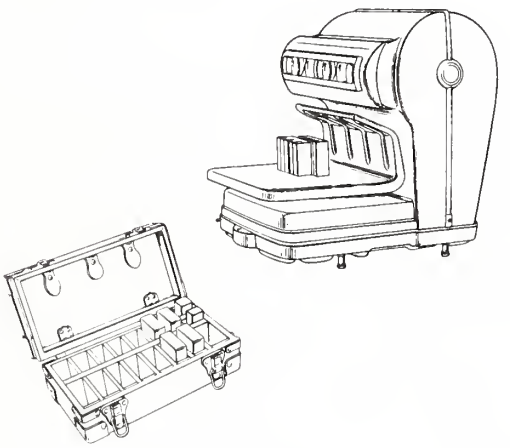


Figure 3-4. Average tare plus labeled weight (nominal gross weight) on scale, substitution method.

If the alternative tare procedure is not being used, average the tare weights and follow steps 6a through 8a to find the package errors for the remainder of sample. (In step 6a, use the average tare weight rather than the tare of the tare sample package.) Follow step 16 onward of Section 3.5. to determine lot conformance or nonconformance.

3.8. THE DETERMINATION OF DRAINED WEIGHT

3.8.1. Equipment

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

Sieves

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

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

3.8.2. Procedure

Since the weight per unit volume of a drained product is often similar to 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 following procedure is based upon a test method established by the Food and Drug Administration[6].

This procedure does not follow the steps outlined in any of the decision charts.

1. - 4. See Section 3.5., steps 1 through 4 for instructions on filling out the report form and selecting the sample. The tare sample is not needed because all the packages in the sample will be opened.

5. Determine the weight of the receiving pan and record it in Block A of the worksheet.

6. Determine and record the gross weight of each individual package of the sample (on the worksheet in Block A).

7. Pour the contents of the first package into the dry sieve with the receiving pan beneath it, incline sieve to 17-20° angle to facilitate drainage, and allow the product to drain into receiving pan for 2 minutes (do not shake or shift material on the sieve). Remove sieve and product.

8. Weigh the receiving pan, liquid, wet container, and any other tare material. (Do not include sieve and product.) See Figure 3-5. Record this weight in Block A of the worksheet under "tare."

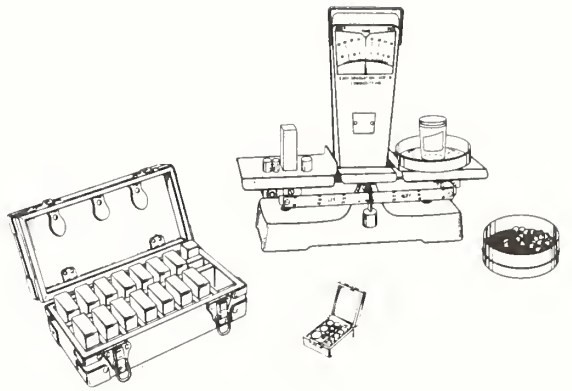


Figure 3-5. The determination of tare for packages labeled by drained weight (example: olives).

9. Subtract the weight of the receiving pan, step 5, from the weight obtained in step 8 to obtain the tare weight (which includes the weight of the liquid). Record this tare in Block A of the worksheet under "corrected tare".

10. Subtract the tare weight, found in step 9, from the appropriate package gross weight, step 6, to obtain the net weight of that package. Record the net weights in Block A of the worksheet under "net or drained".

11. Repeat steps 7 through 10 for the remaining packages of the sample, cleaning and drying the sieve and receiving pan between measurements on each package.

12. Determine and record the individual package errors on the worksheet and transfer them to the report form (using an appropriate unit of measure in box 4).

13. Go to step 16 of Section 3.5. for the determination of lot conformance or nonconformance.

3.9. AEROSOL PACKAGES

The testing of aerosol packaged products is described in the following sections. After

[6]See Method 32.002 of the Official Methods of Analysis of the Association of Official Analytical Chemists.

a list of equipment (Section 3.9.1.) and a description of the assembly of a portable test stand used when emptying the containers, (Section 3.9.2.), the details of the net contents determination are described in Sections 3.9.3. and 3.9.5. Methods for emptying the aerosol containers are given in Section 3.9.4. Test allowances to be applied to the average tare weight or individual tare weights of foam aerosols are given in Section 3.9.6.

3.9.1. Equipment

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

Portable test stand with adjustable valve depressor is assembled by the testing agency from components available from a scientific supply company and hardware store. The components are:

- support stand,
- utility clamp,
- gasoline can,
- two dishpans, and
- 1/2-inch carriage bolt (either 2 to 3 inches or 5 to 7 centimeters long) and nut.

3.9.2. Preparation for Test

To assemble the stand for foam and most other aerosol packages, thread the carriage bolt into the nut and use the jaws of the utility clamp to grip the nut tightly. Then mount the clamp on the rod of the support stand. See Figure 3-6.

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 3-7). 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.

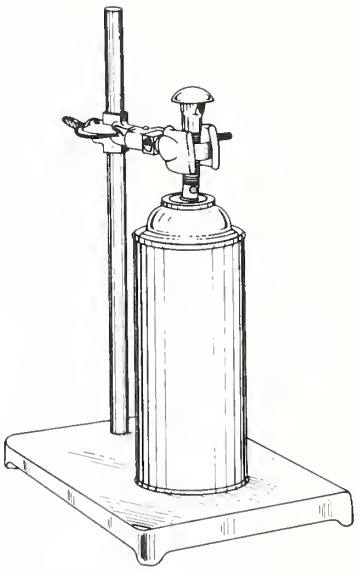


Figure 3-6. Portable test stand for all aerosol products except paints and coatings.

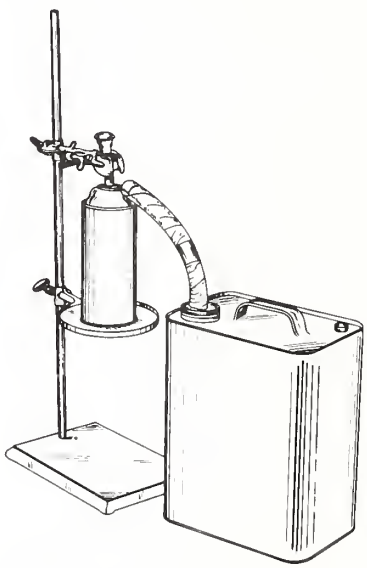


Figure 3-7. Portable test stand for aerosol paints and coatings.

Unlike conventional standard-pack packages, aerosol packages cannot 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 3.9.4. should be conducted in a well ventilated area, under 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 of the air with the sprayed product during the exhausting procedure. Use the gasoline can as a receiving vessel for paint and coating products. (See Figure 3-7).

3.9.3. 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 refrigerated products should be checked at product temperatures of 40 °F (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 (20 to 27 °C) range is suggested for non-refrigerated products and 40 to 45 °F (4 to 7 °C) for refrigerated aerosols. The temperature ranges have been selected as being 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.

The foam products category is the only category with a set of test allowances that are added to the delivered weight[7]. The allowance is made to compensate for differences in delivery between normal consumer usage and the exhausting procedure for compliance testing. Within the foam category, however, there will be some products that will deliver more completely than others. Thus, it is conceivable that a foam aerosol packaged product could deliver the stated quantity within the limits of the test allowance, and yet be short filled on a dry tare basis. It is emphasized that the test allowance should not be used by the packager as justification for packing less than the stated quantity on a dry tare basis.

Regulations under the Fair Packaging and Labeling Act[8], require that in the case of packages designed to deliver the product under pressure "...the declaration shall state the net quantity of the commodity when the instructions for use as shown on the container are followed. The propellant is included in the net quantity statement."

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

1. - 4. Follow Section 3.5., steps 1 through 4 for instructions in filling out the report form and selecting the random sample. As explained in Appendix C.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 for the size of the initial tare sample.

5. Gross weigh each package in the sample and record this weight on the worksheet in Block A under "gross." Follow Section 3.9.4. to empty the initial tare sample aerosol containers.

[7]In the testing procedure, the test allowance is subtracted from the tare, the effect of which is the same as adding the test allowance to the delivered weight.

[8]Regulations under the Fair Packaging and Labeling Act (PL 89-755) include 16 CFR §500.22(a), 21 CFR §701.13(g)(1), 21 CFR §201.62(f), 21 CFR §101.105(g). Also see the National Conference on Weights and Measures Model State Packaging and Labeling Regulation (Section 10.3) in NBS Handbook 130. Quotation above from NBS Handbook 130.

After following Section 3.9.4., go on to Section 3.9.5. for instructions on completing the procedure.

3.9.4. Exhausting the Aerosol Container

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

Do not shake unless shaking is specified. If shaking is specified, shake according to directions on the container. If no directions as to how the can should be shaken are given, 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:[9] Placing the container in the position specified in the instructions on the package, exhaust the selected containers by holding the valve wide open for 30 minutes. (See Figures 3-8 and 3-9).

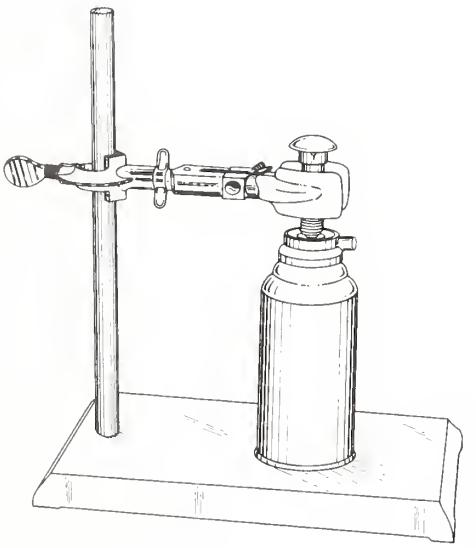


Figure 3-8. Portable test stand showing aerosol foam product expelling in upright position.

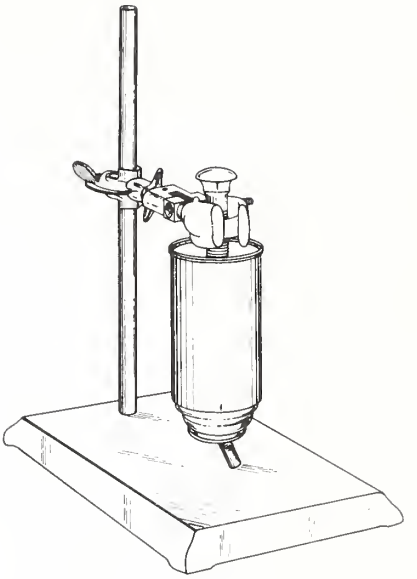


Figure 3-9. Portable test stand showing aerosol foam product expelling in inverted position.

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

b. Other products:[10] 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 the visible spray is interrupted. As soon as the 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. Agitate the container with a swirling motion for 30 seconds. Hold the container upright at approximately a 45 degree angle, 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 expelled 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 when the container becomes cold to the hand. Allow the container to return to test temperature of 68 to 80 °F (20 to 27 °C) before proceeding with 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.

3.9.5. The Determination of Net Contents: Part 2.

6. Rinse 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 the tare weights of the initial tare sample. Record on Block A of the worksheet. For foam product aerosols, an individual package net weight is equal to the package gross weight minus the individual tare weight plus the test allowance (See Section 3.9.6.).

   For other aerosols, an individual package net weight is equal to the package gross weight minus the package tare weight. Determine and record the individual package errors for the tare sample. (Package error is equal to package net weight minus the labeled weight.)

7. Determine the range of tare weights, R_t, and record in box 1 of Block A on the worksheet.

8. Determine and record the range of package errors, R_c, in box 2 of Block A on the worksheet.

9. Compute R_c/R_t and from Table 2-7, look up the total number of packages necessary for determining the tare; record n_t in box 4 of Block A of the worksheet and in box 3 of the report form.

10. If n_t is larger than the initial tare sample, select additional tare sample packages (those packages arranged in steps 1 through 4 of Section 3.9.3. corresponding to the order in which the random numbers were obtained). It may be necessary to empty all the packages in the sample.

11. Gross weigh, empty, and determine the tare[11] and package errors for additional packages selected in step 10. Record in Block A of the worksheet.

[10]Examples of other products: Frostings, syrups, cheese spread, hair sprays, colognes, window cleaners, starches and material finishes, insecticides, room deodorants, deodorants (personal), waterproofers, mothproofers, antiseptics and medicants, de-icers, ignition sprays, insect repellants, furniture polishes, dog and pet sprays, oil sprays, battery cleaners, shoe polishes and leather conditioners, wall cleaners, suntan lotions, spray-on bandages, run-stoppers, pre-shave lotions, nasal relief sprays, external analgesics, charcoal lighters, fire extinguishers, anti-static sprays, carburetor cleaners, plant foods, auto quick start sprays, whitewall tire cleaners, paints, enamels, lacquers, acrylic coatings, varnishes, undercoatings.
[11]Apply test allowance given in Section 3.9.6. if foam product aerosol is being tested.

12. If all the packages in the sample have been emptied, go to step 16 of Section 3.5. to determine lot conformance. If unopened packages remain in the sample, average the tare weights[11], record the average tare or corrected tare in box 5 of Block A on the worksheet, and go to step 14 of Section 3.5. to determine lot conformance.

3.9.6. Test Allowances for Foam Product Aerosols

Table 3-2 lists the test allowances to be subtracted from the average tare weight or individual package tare weight for foam product aerosols only. Block A of the worksheet has space for recording this allowance in units of weight. Record the test allowance in dimensionless units in box 9 of the report form. Record the corrected tare or corrected average tare (equal to the tare minus the test allowance) in Block A of the worksheet. If corrected average tare is used, record it in dimensionless units on the report form in box 10. If all the sample packages have been exhausted for tare, note this on the report form and refer to the worksheet. When packages in the sample are exhausted for tare determination, the test allowance is applied to each actual tare before determination of the net weight of each package.

3.10. SPECIAL COMMODITY: FROZEN FOOD AND OTHER FROZEN PRODUCTS

The complications of tare determination and, in certain instances, of net weight determination of products which must be maintained at low temperature in order to keep them frozen arise because of the difficulties of separating, while still frozen, the contents from the package, and 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 off the exterior of the package. This is often sufficient for most frozen prepared vegetables, fruits, and many convenience items. Although surface defrosting poultry has been used in order to remove the bird from its wrapping, and thus measure the tare, this method should be used with great caution since surface discoloration occurs

Table 3-2. Test allowances for foam products

Avoirdupois:

Labeled weight of package	Test allowance	
	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	5/16	0.020
1 lb 1 oz or more	3/8	0.023

Metric:

Labeled weight of package	Test allowance
	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

[11]Apply test allowance given in Section 3.9.6. if foam product aerosol is being tested.

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, if a U.S. Department of Agriculture seal is on the label, once the package is opened, the seal must be removed upon repackaging.

Frost found on the interior of frozen food packages should be considered part of the net contents, not part of the tare. In instances such as described above, the procedure to be followed for frozen foods labeled by weight are those given in Section 3.5. or 3.6.

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 3.11. are followed.

3.11. SPECIAL COMMODITY: 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 infer net weight from the package gross weight minus tare weight. The measurement is of the actual weight of defrosted product. As such, the method requires the defrosting of all packages comprising the sample. Since loss of quality, texture, and moisture will result if the product is refrozen, in general, the packages in the sample should not be refrozen after the test.

3.11.1. Equipment

Scales and weights recommended in Section 3.1.

Sieves

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

Stopwatch - mechanical or electronic, with a maximum error of 2 seconds in a 3 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 (-35 to +50 °C) range, 2 °F (1 °C) graduations, tolerance of ±2 °F (±1 °C).

3.11.2. Procedure

The procedure does not follow the steps given in the decision charts.

1. - 4. See Section 3.5., steps 1 through 4 for instructions on filling out the report form and selecting the sample. A tare sample is not needed.

5. Weigh the sieve and receiving pan. The receiving pan and sieve weight is recorded on the lower portion of the worksheet in Block A and under the column headed "tare".

6. If the sample packages are not water tight, the packages should each be placed in a plastic bag. While the plastic bag is being tied off, 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.

   Completely submerge the bag in a container of water using clamps or weights to keep them submerged. Maintain the water at 68 ± 4 °F (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 package.

7. 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.

8. 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 in Block A of the worksheet under "gross."

9. The weight determined in step 8 minus the weight of the empty sieve and receiving pan is the drained weight of the product (and may be recorded in Block A of the worksheet under "net or drained"). The package error equals the drained weight minus the labeled weight and may be recorded on the worksheet and transferred to the report form.

10. Clean and dry the sieve and receiving pan and repeat steps 6 through 9 for the remaining packages in the sample.

11. Go to Step 16 of Section 3.5. for the determination of lot conformance or nonconformance.

3.12. SPECIAL COMMODITY: 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.

3.12.1. Equipment

For equipment requirements, see Section 3.11.1. except:

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

3.12.2. Procedure

The method does not follow the steps outlined in the decision charts.

1. - 4. See Section 3.5., steps 1 through 4 for instructions on filling out the report form and selecting the random sample. A tare sample is not needed.

5. Weigh sieve and receiving pan. Record this weight in the lower portion of Block A of the worksheet and under the column headed "tare."

6. 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.

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

8. Place the product and sieve on the receiving pan and weigh. Record this weight in Block A of the worksheet under "gross."

9. The drained weight of product is equal to the weight of pan plus sieve plus product (recorded in the gross weight column) minus the weight of pan plus sieve (recorded in tare column). The product drained weight is recorded in the "net or drained" column of Block A on the worksheet. The package error is equal to the drained weight of the product as measured minus the labeled weight. The package error is recorded on the worksheet and transferred (using an appropriate unit of measure) to the report form.

10. Repeat steps 6 through 9 for each package in the sample, cleaning and drying the sieve and receiving pan between each package measurement.

11. Go to Step 16 of Section 3.5. to determine lot conformance.

3.13. SPECIAL COMMODITY: CANNED COFFEE

It should be noted that the variation in weight of the metal cans used to package ground coffee can often 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 lighter than the gross weight after breaking the seal and allowing air to enter the can. This difference in weight will be measurable using the recommended small capacity scale for two and three pound canned coffee. (The gross weight difference for 1 lb coffee is about 1/2 g.)

The checking procedure follows Section 3.5. In step 5 of Section 3.5., the official can correct for the gross weight determined from unopened cans in the following way.

Using the tare sample packages, the official should gross weigh each of the product-filled cans before and after breaking the vacuum seal. Add to the column headed "gross", the heading "sealed" and record the gross weight before breaking the vacuum seal in this column. Cross through the column heading "MAV (Random Pack)", label the heading "gross after breaking seal", and record the gross weight after breaking the vacuum seal in this column. Compute the average weight difference (open weight minus sealed weight). Record the average gross weight difference in the column headed "corrected tare" (cross through heading and fill in "gross weight difference").

The average weight difference is then subtracted from the average tare so that the nominal gross weight to be used in step 14 of Section 3.5. is equal to: the average tare weight minus(-) the average difference in gross weights plus(+) the labeled weight. Record the average tare minus the average difference in gross weights in box 5 of Block A of the worksheet (change heading to "corrected average tare").

For example:

(i) The gross weight of an unopened 3 lb can of coffee is 3.719 lb.

(ii) The gross weight of this same opened 3 lb can of coffee is 3.723 lb.

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

This difference and the other determination of the gross weight difference are averaged; 0.004 lb is found as the average value.

Therefore, 0.004 lb is, in this example, subtracted from the average tare weight (or individual tare weights in order to determine the package errors of the tare sample packages). This corrected average tare weight plus the labeled weight represents the nominal gross weight which will be compared with the unopened packages in the sample to determine their package errors.

Section 3.5. Step 14 onward is then followed to determine lot conformance.

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 VOLUME 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. SPECIAL COMMODITY: MILK
4.8. SPECIAL COMMODITY: MAYONNAISE & SALAD DRESSING
4.9. SPECIAL COMMODITY: PAINT, VARNISH, AND LACQUERS - NONAEROSOL
4.10. SPECIAL COMMODITY: VERY VISCOUS MATERIALS
4.11. SPECIAL COMMODITY: PEAT MOSS
4.12. SPECIAL COMMODITY: SOLIDS OR SEMISOLIDS
4.13. SPECIAL COMMODITY: GOODS LABELED BY CAPACITY

CHAPTER 4. METHODS OF TEST FOR PACKAGES LABELED BY VOLUME

This chapter first presents information on general problems and practices in measuring liquid volumes. The general procedure is broken into two sections. Tests are carried out to check the suitability of weighing the net contents of packages labeled by volume in the first section (4.4.). If weighing is found to be suitable, the second section (4.5.) is followed; this section describes a method which references techniques already covered in Section 3.5. The next section (4.6.) describes methods for use when weighing cannot be employed to check packages labeled by volume. Finally, methods for special types of commodities are described in the remainder of the chapter. Packages labeled by dry volume or cubic measure are included in this category.

Many of the procedures in this chapter are presented as modifications of that given in Section 3.5. Decision Chart 4 is provided as an outline for checking packages labeled by any quantity other than weight; this chart will be followed in parts of Chapter 5 as well.

Steps 1 through 4 in the procedures are not described in any detail in this chapter. The testing official is referred to steps 1 through 4 in Section 3.5. for a more complete description.

It should be noted that certain packages labeled by volume utilize containers which are required by law or regulation to hold certain 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 as such are covered by specific code requirements in NBS Handbook 44. This handbook does not describe the testing of the capacities of these containers. Containers in which such products as cottage cheese, sour cream, and yogurt are packaged may be tested using the techniques of Section 4.13.

4.1. MEASURING LIQUID VOLUMES

The volume which is occupied by a packaged product of any kind varies with the temperature of the product. This fact must be kept in mind when checking products labeled by liquid volume (and can be ignored when checking products labeled by dry volume.) For example, the volume of a certain 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 reference temperature represents that temperature at which the volume is required to comply with the regulation.

In general, the reference temperature is that 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 refrigerated foods, the reference temperature is 40 °F (4.4 °C)[2]. The reference temperature for all petroleum products is 60 °F (15 °C)[3]. For products sold unrefrigerated, the reference temperature is generally accepted as 68 °F (20 °C)[4].

The following discussion applies to packaged products which are liquids at their reference temperature (either 40 °F, 60 °F, or 68 °F).

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

Since many liquid products have a high water content, the following information on water will guide the testing official in a rough manner as to the errors that can

[1]Frozen 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)).
[2]21 CFR §101.105(b) (ii).
[3]16 CFR §500.8(b).
[4]16 CFR §500.8(b); 21 CFR §101.105(b) (iii); 40 CFR §162.10(2); 21 CFR §201.62(b); 21 CFR §701.13(b).

arise with variation in temperature and its effect 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).

In the same way, 1 gallon of water would weigh about
- 8.336 lb[5] 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 data suggest that the errors, although small, are detectable with the equipment recommended in this handbook. Moreover, if volumes are determined at temperatures higher than the reference, the results will systematically indicate a volume larger than actually existing at the reference temperature.

It is good practice to equilibrate the volumetric glassware to the same temperature as the liquid product. (The normal expansion or contraction of the glassware may be ignored by the testing official; however, he or she must never expose the glassware to a direct source of heat such as a flame.) 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.

It is also important to maintain the packaged goods which comprise the sample all at the same temperature. As will be described in Section 4.4., the testing official will deliver a certain 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 he or she can weigh the rest of the packages in the sample and avoid opening these 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[6]. Again, using the example of water, 1 gallon of water at 68 °C weighs 8.322 lb but at 70 °C weighs 8.320 lb.

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 given above, the 2 °F difference in product temperature is enough to account for a 0.002 lb difference in the weight of one gallon.

Measurements of product volumes at lower than the reference temperature normally will require the application of a density correction. Unless this correction is known, the official should measure the volumes or weights of a known volume of packaged products at or higher than the reference temperature.

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 on 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[7], 500 milliliters, 1000 milliliters, 2000 milliliters, and 5000 milliliters and a 50-milliliter cylindrical graduate, graduated to 1 milliliter should be used.

[5]Weighed in air.
[6]Alternatively, an agency may develop (or obtain from the packager) tables or formulae of volume/temperature variations which could be used to correct individual measurements to volume at the same temperature.
[7]250-milliliter flasks may also be used.

Tolerances for inch-pound and metric field standard flasks and cylinders are given in Appendix G[8].

If pesticides, herbicides, or similar products are to be tested, a separate set of volumetric measures should be clearly marked and reserved for such purpose. Detergent washing of each set of volumetric measures between tests will then be adequate for field care and use. If contamination of volumetric measures is suspected, they can be cleaned with a potassium dichromate and sulfuric acid solution in a laboratory, not in the field.

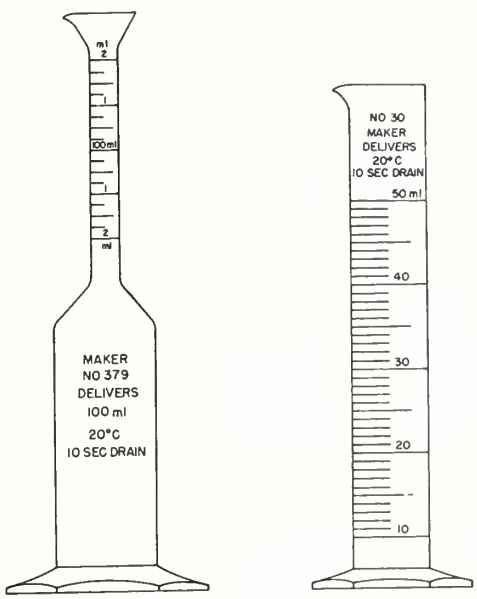


Figure 4-1. Standard measuring flask and graduate for testing packages labeled in metric units of volume.

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 when checking liquid commodities that effervesce or are carbonated, such as beer and soft drinks. Three such products are:

- Hexanol
- Octanol, (Capryl Alcohol), purified
- Antifoam B[9]
  Dow-Corning Corporation
  Midland, Michigan

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

Bubble level.

4.3. USING LIQUID VOLUMETRIC MEASURES

There are two ways volumetric flasks will be used in checking liquid products.
(i) A certain amount of product (not the entire package contents) will be poured into a flask exactly to a certain mark on the neck of the flask (and weighed). For example, the weight of the labeled volume of a package labeled as 32 fluid ounces may be measured by weighing the contents of a pint flask filled with liquid product.
(ii) The entire package contents will be poured into a flask or flasks. The liquid volume is measured by comparing the liquid level with the graduations on the neck.

Because of surface tension, the liquid surface is curved near the junction of glass and liquid. Therefore, the center of the liquid level is compared to the graduation marks with the inspector's eye level at the same level as the liquid surface. For liquids which are clear, the bottom of the liquid surface (which will appear to have some thickness) is matched to or compared with a graduation mark; for liquids which are opaque, the center of the top rim of the liquid surface is the point to be set or to which comparison is made. See Figure 4-2.

[8]It is possible to obtain from the flask manufacturer standard measuring flasks with extended graduations on their necks (rather than those listed in Appendix G, Table G-2). These graduations can extend to the maximum allowable variatons 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).
[9]The use of trade or brand names does not imply that they are endorsed or recommended by the Department of Commerce over other firms not mentioned.

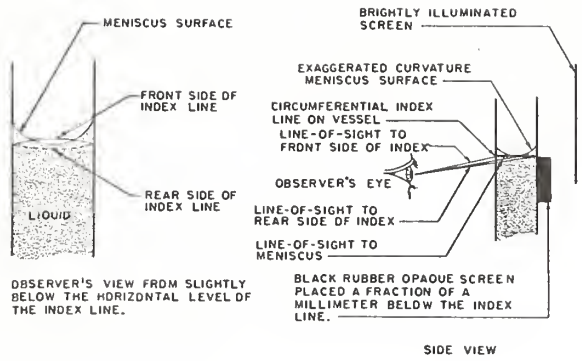


Figure 4-2. Reading the liquid level on the neck of a flask.

Of course, the flasks should be read on a level surface (a bubble level may be used to verify this).

For fluid volume measurements, the size 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 actual volume contained in or delivered from any individual package may be less than the minimum mark inscribed on the inspector's flask. Since it is very important to never mix liquids from two different packages, 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[10]. (See Section 4.7. for an exception.)

Immediately prior to use, the volumetric flask(s) or graduate should be filled with water[11] to a point slightly below the top graduation on the neck. The flask should be emptied in 30 seconds, by gradually inclining the flask so as to avoid splashing the flask walls as much as possible. When the main flow has ceased, the flask should be nearly vertical. Hold the flask in this position 30 seconds more and touch off the drop of water that adheres to the tip. The flask or graduate is then ready to accept product liquid from a package. This is called the "wet-down" condition.

The flask should be washed (with detergent if necessary) and rinsed between deliveries of liquid product from each package. The flask must be wet and drained as described each time it is to be used.

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

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

In order to avoid opening all of the packages comprising the sample and because measurements of volume are generally less precise than measurements of weight, the preferred method (described in this section and in 4.5.) involves a determination of the weight of a known volume that, together with a determination of tare, can be compared against the gross weight of the unopened packages. A decision chart (Chart 4) is provided that lists steps in the procedure for all packages labeled in units other than weight, including those labeled by volume.

The procedure is divided into two sections. In this section a check for the variability of the weight of a known volume is described. This procedure verifies whether a weighing procedure is suitable. If a weighing procedure can be used, the next section (4.5.) describes the use of a weight value for a known volume of product to determine package errors.

Most common consumer products labeled by liquid volume (food, cosmetics, cleaning fluids, and over-the-counter drugs) weigh from about 0.05 lb/fl oz (0.8 g/mL) to greater than 0.07 lb/fl oz (1.1 g/mL). This fact permits the testing official to refer to a list of appropriate weighing devices to use to check these products and thereby skip the step which checks that the scale can detect weights equivalent to MAV/6.

[10]The 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).

[11]The water should be at the temperature of the product.

Decision Chart 4
Packages Labeled in Units Other than Weight
Category A or B

(1) Fill out report form heading, including MAV (6) (Table 2-9, 2-10, or 2-11)

(2) Determine inspection lot size, record lot size, (1) and allowed number of unreasonable errors (13) (Table 2-2 or 2-5)

(3) Record sample size, n, (2) , and tare sample size, n_t, (3) (Table 2-2 or 2-5) (Tare sample may be initial tare sample if alternative tare procedure is used — See Tables 2-6 and 2-7.)

(4) Choose random sample and from it, the tare sample

(5) Gross weigh individual packages in tare sample [A]

(6) Determine the weight of a known quantity of product from the first package of tare sample [B1]

IS PACKAGE LABEL LIQUID VOLUME AND IS PRODUCT WT/VOL > 0.05 lb/fl oz(0.8 g/ml)?

NO

YES

(7) Calculate or determine weight of quantity corresponding to $\frac{MAV}{6}$ [B3]

IS WEIGHT OF $\frac{MAV}{6}$ AS LARGE OR LARGER THAN SCALE USED TO WEIGH CAN DETECT?

YES

NO

(8) Determine the tare of the first package [A]

(9) Determine the weight of a known quantity of product from second package of tare sample [B2]

(10) IS RANGE OF WEIGHTS OF KNOWN QUANTITY FROM THE TWO PACKAGES EQUAL TO OR SMALLER THAN TABLE 4-2 VALUE? [B4a or b]

NO

YES

(11) Open and determine actual quantity inside every package in sample and record package errors for entire sample.

GO TO STEP (16), Chart 1 (Category A) or Chart 2 (Category B)

(11) Calculate the average weight of the labeled quantity [B5a or b]

IS TARE GLASS OR AEROSOL, OR IS ALTERNATIVE TARE PROCEDURE TO BE USED?

YES

NO

GO TO Chart 3, Step (6b) or (iii)

(12) Determine tare for the rest of tare sample and average the tare [A]
Determine and record package errors for tare sample

(13) Calculate the nominal gross weight (= weight of labeled quantity + tare weight) [B6]

(14) Convert MAV to units of weight [B7] (5)

GO TO STEP (15) Chart 1 or 2
converting back to labeled units when completing report form

Numerals in parenthesis refer to steps in Sections 4.4. and 4.5. (volume), 5.1.3. (count), 5.3.2. (linear or area measure)

Circled numbers refer to locations on the report form

Boxed letters and numbers refer to locations on the worksheet

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 or 2-5.

If the inspection lot is composed of packages from different manufacturer's 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 of these different lots. It is possible that the official will find that certain lots of packages labeled by liquid volume must be sorted according to 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 range of net weights (R_c) is determined straightforwardly: the corresponding tare weights are subtracted from each package gross weight to give net weights for the initial tare sample (see step 11 below).

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

1. - 4. See Section 3.5., steps 1 through 4 for instructions on filling out the report form and selecting the random sample and random tare sample. Record the MAV in units of volume (Table 2-9, Section 2.12.) in block 6 of the report form and the labeled volume in the report form heading. (Note that procedures in Section 2.11.4., including Tables 2-6 and 2-7, should be used for fluids packed in glass.)

5. Select a flask and weigh the flask in the "wet down" condition described in Section 4.3. Gross weigh individual packages in the tare sample. Record these weights in Block A of the worksheet. (The flask weight is recorded at the bottom of Block A and in column 7, Block B of the worksheet.)

   If the liquid product requires mixing for uniformity, this should be done before each package is opened. If the product is of a type that effervesces or foams when opened or poured, such as beer or carbonated beverages, add one drop of a defoaming agent to the product and one drop 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.

6. Weigh the flask filled with product (record this weight in column 6 of Block B) and subtract the weight of the flask (step 5) to obtain the weight of the product. (See Figure 4-3). Record the weight, volume, and temperature of the contents from the first package in Block B of the worksheet under columns 1, 2, and 5. Calculate the weight of a unit of volume and record this value in column 3. The units of column 3 are weight per unit volume, as for example lb/fl oz. For another example, if 500 mL weighs 450 g, record 0.900 g/mL in column 3.

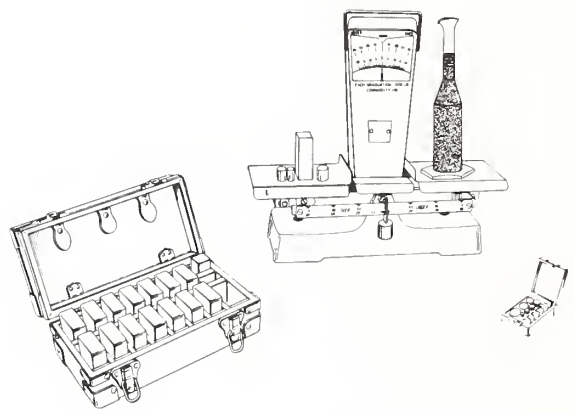


Figure 4-3. Weighing a known volume of liquid.

7. If the liquid product is a common consumer item (food, cosmetic, cleaning fluid, or over-the-counter drug), refer to Table 4-1, measure and record the liquid temperature in the flask, and go on to step 8.

   If the weight of a given volume of liquid product is outside of the range 0.05 to 0.07 lb/fl oz (0.8 to 1.1 g/mL) (see column 3 in Block B of the worksheet), the following procedure is given.

   Determine MAV/6 in terms of weight using either (a), which involves a manipulation of the product, or (b), which involves a calculation, to determine whether the scale is sensitive enough to detect individual package errors.

a. Add the volume corresponding to MAV/6 (see Table 2-9 for MAV values) to the flask already filled with product and weigh again. Record this weight in column 8 of Block B of the worksheet. The weight corresponding to MAV/6 is equal to the column 8 value minus the column 6 value. This may be recorded in box 3 in Block B of the worksheet.

b. Calculate the weight of that volume corresponding to MAV/6 from the data obtained in step 6. This calculation may be recorded in the box 3 in Block B of the worksheet.

The weight of MAV/6 as determined in either (a) or (b) must be at least as large as 1/2 the size 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.)

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.).

In the instance of (a) above, for example, a package labeled 8 fl oz has a weight of 0.440 lb for a 4 fl oz flask filled with product to the 4 fl oz mark. The MAV for a labeled volume of 8 fl oz is 3 fl dr. After adding 0.5 fl dr more to the flask, the inspector finds the flask now weighs 0.442 lb. The difference in weight is 0.002 lb, which is equal to the smallest scale division of the small capacity equal-arm scale, thus passing the first test of determining the suitability of a gravimetric procedure.

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

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

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

Measure and record the temperature of the product from the first package.

8. Empty clean and dry the package container. Weigh the package container and record this weight in Block A of the worksheet under the "tare" column.

9. Clean the flask and repeat steps 5 and 6 on the second package chosen for tare determination. Determine tare weight for this second package. Only two packages are opened for the determination of the weight of the known volume. Even if more than 2 packages are required for tare, do not determine the weight of a known volume on these other packages. Record the weight of the liquid volume from the second package, the volume, and the temperature in columns 1, 2, and 5 of Block B of the worksheet.

10. In order to weigh packages labeled by volume, the two values for the weight

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	Greater than 126 mL to and including 1 L
Greater than 32 fl oz to and including 3 gal	large capacity equal-arm scale	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. 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		0.05
Equal arm scale for small weights	0.002	1.0
Equal arm scale for larger weights	0.004	2.0
Commercial scale up to and including 30 lb (14 kg)	0.01	5.0
Commercial scale above 30 lb (14 kg) up to and including 100 lb	0.02	9.0

of a known volume should not differ by more than the amount given in Table 4-2. Record appropriate Table 4-2 value in box 4a on Block B of the worksheet.

For example, from a sample of ten packages labeled 1/2 gallon two packages are chosen for determination of the tares and for the determination of their weights 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. Therefore, in order to use a weighing procedure (using a package testing scale for small weights), the weight of the 1-quart flask plus 32 fl oz of the liquid from the second package may not differ from 3.050 lb by more than 0.002 lb (that is, it may weigh 3.052 to 3.048 lb).

Record the difference between the weights of the first two packages in Block B of the worksheet in box 4a.

If the difference in weights between the determinations for the two packages meets 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. Go on to step 11. If the difference in weights does not meet the above criterion, then volumetric measurements must be made on all the packages in the sample following one of the procedures given in Section 4.6.

11. Compute the weight of the labeled volume of the product.

The weight of the labeled volume =

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

The weight of the labeled volume may be obtained by multiplying the average of the two values in column 3 of Block B on the worksheet by the labeled volume. For example, if the average of column 3 values is 0.900 g/mL and the labeled volume is 1 L, then the weight of the labeled volume is 0.900 g/mL x 1000 mL = 900 g. Note that the units of the weight of the labeled volume are units of weight only.

To avoid round-off errors as much as possible, carry over at least two extra decimal places in any calculation until the final weight of the labeled volume is obtained.

Determine tare for the rest of the tare sample.

If the alternative tare procedure of Section 2.11.4. is to be used, subtract the corresponding tare weight from each package gross weight to determine the "net weight" (record in Block A of the worksheet). Calculate R_c (which is the range of net weights), R_t (the range of tare weights), R_c/R_t, and compare with Table 2-7 to decide if more packages in the sample must be opened to determine tare. (See steps 7 through 11 of Section 3.5. for more detail.)

Record the weight of the labeled volume in box 5a, Block B, of the worksheet and in box 11 of the report form. Appropriate units of measure for common consumer products (foods, cosmetics, cleaning fluids, over-the-counter drugs) labeled by liquid volume and checked by weight are given in Table 4-3. Record the unit of measure in box 4 of the report form. Go on to Section 4.5.

Table 4-3. Recommended 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 (oz avoir)	Units of measure (lb)	Labeled volume	Units of measure (g)
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	0.03		
Greater than 4.375 gal to and including 9 gal	1	0.05		
Greater than 9 gal to and including 18 gal	2	0.1		

[a] use analytical or other high accuracy balance.
[b] use package checking scale as null indicator.

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

After the official has determined whether packages labeled by volume can be checked by weighing (as described in the previous section), he or she should complete the checking procedure on the sample as described below. The following steps are intended to lead into Section 3.5., the general method for packages labeled by weight.

12. In steps 8 and 11 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, and open them, clean the containers and weigh them. Average the tare weights determined from all opened containers (unless the entire sample has been opened). Record tare weights in Block A of the worksheet under "tare" and "average tare."

13. The average tare plus the weight of the labeled volume of the product (step 11 of Section 4.4.) is equal to the nominal gross weight to be used to compare with the actual gross weights of the remaining unopened packages of the sample. (See step 14 of Section 3.5.). Record nominal gross weight in box 6, Block B of the worksheet.

In order to determine the net volume for those packages opened for tare, divide the net weight of each package (gross weight (-) tare weight) by the weight of the labeled volume (determined in step 11 of Section 4.4.) and multiply that value by the labeled volume (carry over at least 2 extra decimal places to avoid round off errors.) For example, the net weight of a package labeled 10.5 fl oz is 0.690 lb. The weight of the labeled

volume is found to be 0.6825 lb. The net volume is:

$$\frac{0.690}{0.6825} \times 10.5 = 10.615 \text{ fl oz.}$$

The package error is therefore equal to net volume minus labeled volume; in this example 10.615 fl oz - 10.5 fl oz = +0.12 fl oz (rounded).

14. Convert the MAV in units of volume (see Table 2-9) to units of weight and record it in box 7, Block B of the worksheet and in box 5 of the report form.

    Convert all measurements and comparison values to weight and to dimensionless units, and follow Section 3.5. step 15 onward, converting back to units of volume when completing the report form (box 16 and under "Remarks" section).

4.6. OTHER METHODS OF LIQUID VOLUME MEASUREMENT

If the packaged product fails either criterion in Section 4.4. (step 7 or 10), it will be necessary for the official to use one of the following methods of liquid volume measurement in this section.

All three methods require opening all of the sample packages. The methods describe how to determine an individual package error. After the package errors for all the packages have been determined, Section 3.5., step 16 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 be used on homogeneous liquids also.

None of the methods in the rest of this chapter follow the decision charts.

4.6.1. Method A: Determining the Volume at the Liquid Level of Fill.

When the test in step 7, 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. The step numbers refer to the procedures which would follow step 7 in Section 4.4.

Equipment:

Micrometer depth gage (ends of rods fully rounded)[12] 0-9 in or 0-225 mm.

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

Laboratory pipets and/or buret:
Buret meeting type 1, style 1, class A, Fed Spec NNN-B-782.
Pipets meeting type 1, style 1, class A, Fed Spec NNN-P-395, calibrated "to deliver".

Procedure:

8. Select another package randomly to replace the package opened in steps 5 and 6 of Section 4.4. Cross out "corrected tare" and insert "depth gage" in blank space heading of column at top of Block A of the worksheet.

9. Open the first package in the sample on a level surface, and use the depth gage to determine the level of fill of the package before product is removed.

   Record the depth gage reading in Block A of the worksheet.

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

11. Duplicate the level of fill determined in step 9 above with distilled water delivered from pipets or buret. Record the resulting water volume as the packaged goods volume in Block A of the worksheet under the column heading "net or drained" ("volume" may be added in the blank space).

12. Subtract the labeled volume from the package volume (step 11) to arrive at the individual package error. The labeled volume and the package error are recorded in the appropriate columns in Block A of the worksheet, and the package error transferred to the report form using an appropriate unit of measure in box 4 of the report form.

13. Repeat steps 9 through 12 for each package in the sample. Follow step 16 onward of Section 3.5. to determine lot conformance.

[12]The rods will have to be custom ground.

4.6.2. Method B: Measuring 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. Taking advantage of product homogeneity, this method uses the weight of a known volume to calculate the weight of the labeled volume. Since weighing is used to determine errors in volume, the scale must be capable of distinguishing volumes equivalent to MAV/6 (See Section 4.4., step 7.).

Equipment is the same as that listed in Section 4.2.

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 4-2 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 step numbers refer to the procedures which would follow step 10 in Section 4.4.

Block B of the worksheet contains enough space in it to record the individual measurements and calculations for 10 packages. Block A of the worksheet may be used to record gross and tare weights. Cross out "corrected tare" heading in Block A and fill in "weight of labeled quantity". Cross out "net or drained" and insert "pkg errors (wt)".

11. Compute the weights of the labeled volume for the first two packages opened from the tare sample. Do not average the weights. Each weight is calculated, for example:

    The weight of the labeled volume for package 1 =

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

    where the weight of the known volume is that weight determined for package 1 only. Record this weight in column 4 of Block B on the worksheet and in Block A.

12. Subtract the sum of the actual tare weight (determined for the first package in step 8 and for the second package in step 9 in Section 4.4.) plus the weight of the labeled volume computed in step 11 (above) from the appropriate gross weight determined in step 5 of Section 4.4. to arrive at the individual package errors in terms of weight for the first two packages opened for tare in Section 4.4.

    Package error (in units of weight) =
    (gross weight) -
    (tare weight + weight of labeled volume).

    The package error in units of weight may be recorded in Block A.

    Calculate the package error in units of volume.

    Package error (in units of volume) =
    (package error in units of weight) x
    (labeled volume/weight of labeled volume for each package)
    and is recorded in Block A under the column headed "package errors".

    For example, the tare weight of package 1 is 0.075 lb and the weight of the labeled volume (32 fl oz) for package 1 is 2.156 lb. The gross weight of package 1 is 2.245 lb. The package error in units of weight is therefore: (2.245 lb) - (0.075 lb + 2.156 lb) = +0.014 lb. In units of volume, the package error is (+0.014 lb) x (32 fl oz)/(2.156 lb) = +0.01 fl oz.

13. Gross weigh the rest of the packages comprising the sample (only the tare sample packages were weighed in step 5 of Section 4.4.).

14. Determine the weight of a known volume for each package in the sample (see steps 5 and 6 of Section 4.4.).

15. Clean, air dry, and weigh each package container (see step 8 in section 4.4.).

16. Repeat steps 11 and 12 above for the entire sample.

17. Record package errors on the report form (using an appropriate unit of measure in terms of volume).

    Go to step 16 of Section 3.5. 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 6 and 9 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 10 that these weights differ too much from each other, the following method may be followed to determine package errors.

It will be 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 6 and 9 of Section 4.4. do not differ by more than 5%. 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 6 and 9 of Section 4.4. differ by more than 5%, the 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. (The results of steps 6 and 9 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 volume of product remaining in an emptied container is obtained by determining the weight difference between the wet container and the container after drying (this is attributed to the weight of liquid remaining in the package container) and converting this weight to volume:

$$\frac{\text{(wet tare - dry tare) x known volume}}{\text{weight of known volume}}$$

This resultant volume (step 15 below) is then added to the volume of product delivered (step 12 below) from the package to obtain the total product volume (step 16 below).

For example, the first package was opened from a sample labeled 40 fl oz, and following Section 4.4., step 6, part of the product was poured into a 1-qt flask to the 1-qt mark.

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

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

The weight of the wet package container is 1.012 lb (step 12 below) and after air drying, 1.000 lb (step 13). According to procedures followed in steps 6 and 9 of Section 4.4., it was found for this first two tare sample packages that 32 fl oz weighs 2.123 lb (average weight).

Therefore, one fluid ounce weighs
2.123 lb/32.00 fl oz = 0.06634 lb.
And,
0.012 lb/(0.06634 lb/fl oz) =
0.18 fl oz.
This is the volume of product remaining in the package.

The total product volume is
39.94 fl oz + 0.18 fl oz = 40.12 fl oz
The package error is
40.12 fl oz - 40.00 fl oz = +0.12 fl oz

The step numbers below refer to procedures which follow step 10 in Section 4.4.

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

11. Calculate the average weight of the labeled volume as described in step 11 of Section 4.4. Divide the difference in weights for the first two package volumes (recorded in Block B of the worksheet in box 4a) by the average weight of the labeled volume (recorded in Block B, box 5a). 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 15. If this 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 15.

12. Returning to the first package opened in step 5, Section 4.4., deliver the rest of the package contents into graduated flask(s) and/or a graduate and

record the remaining volume delivered in column 2 of Block B of the worksheet (where the first volume was recorded in Section 4.4.).

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

13. Weigh the empty (but wet) package container.

14. Clean, dry, and weigh the package container.

15. Record the difference in weight between wet and dry tare in column 6 of Block B on the worksheet, filling in the heading of Column 6 as "wet tare - dry tare".

    Calculate the volume of liquid left in the package. If the ratio calculated in step 11 above is 0.05 or smaller, the remaining volume of liquid in the package is calculated from values in Block B of the worksheet, and

    $$= \frac{\text{column 6 x labeled volume}}{\text{value in box 5a}}$$

    If the ratio is greater than 0.05 in step 11, the remaining volume of liquid (from values in Block B of the worksheet)

    $$= \frac{\text{column 6}}{\text{column 3}}$$ for each package.

    Record remaining volume in the package in column 7, Block B of the worksheet.

16. Add the volume remaining in the package as determined in step 15 to the volume poured from the package determined in step 12 (and recorded in column 2 of Block B of the worksheet) to arrive at the total volume.

    Total product volume

    = column 2 + column 7

    In Block B of the worksheet, record the total volume in column 8 filling in the heading as "total volume".

    Record total volume under "net or drained" in Block A.

17. Subtract the labeled volume from the total package volume (step 16) to arrive at the individual package error.

    Package error in units of volume = total product volume - labeled volume.

    Record package errors in Block A of the worksheet and in the checkerboard area of the worksheet (identifying an appropriate unit of measure in box 4).

18. Repeat steps 12 through 17 above for the second package opened. If the ratio calculated in step 11 is greater than 0.050, the weight of a known volume of product from this package would already have been determined in Step 9 of Section 4.4. This weight of a known volume can be used in step 15 above for this package only.

    If the ratio calculated in step 11 is 0.050 or smaller, the average weight of the labeled volume may be used (already calculated in step 11.)

19. If the ratio calculated in step 11 above is greater than 0.050, determine a 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 12 through 17 above.

    If the ratio calculated in step 11 is 0.050 or smaller, open each package in the sample, deliver its contents into flask(s and a graduate) as described in step 12 above, and repeat steps 13 through 17 using the average weight of the labeled volume already determined in step 11. Repeat for every package in the sample.

    After package errors have been determined, go to step 16 of Section 3.5. to determine lot conformance.

4.7. SPECIAL COMMODITY: MILK

Because of the homogeneity of milk within the production lot, as long as the inspector is careful to define the inspection lot as that product from a single production lot (as identified by the packager's lot code or symbol), certain steps in Section 4.4. are eliminated.

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

Sections 4.4. and 4.5. are followed except:

- In step 5 of Section 4.4., if product delivered from a container does not

fill the flask to a graduation line, milk from another package may be added to bring the liquid level up to a graduation.

° Steps 7, 9, and 10 of Section 4.4. may be skipped. This means only one package is used to determine the weight of the labeled volume of the product in step 11 of Section 4.4.

4.8. SPECIAL COMMODITY: MAYONNAISE AND SALAD DRESSING

The following method is also suitable for 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.

4.8.1. Equipment

Volumetric measures recommended in Section 4.2.

Plastic disks and the procedure of fill described in Section 4.13.

4.8.2. Procedure

1.- 4. Follow the procedure in Section 3.5., steps 1 through 4, for filling out the report form heading and selecting a random sample. A random tare sample is not needed.

In Block A of the worksheet, cross out column heading "tare" and insert "headspace". Cross out "gross" and insert "container volume" in space below it.

5. Open the first package and place a disk larger than the package container opening over the opening. Deliver water from a graduate onto the top of the product until the container is filled (as described in step 6 of Section 4.13.2. on the use of the plastic disks.) Record the volume of water added in column "headspace" in Block A of the worksheet.

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

7. With the disk over the opening, fill the package container again with water from flask(s) and graduate(s). Record this volume of water in column headed "container volume" of Block A on the worksheet.

8. Subtract the volume recorded in step 5 from the volume recorded in step 7. This is the volume of product in this individual package. Record this volume in the column headed "net or drained" in Block A of the worksheet.

9. Subtract the labeled volume from the package volume determined in step 8 to arrive at the individual package error. Record package error in Block A and in the checkerboard area of the report form using an appropriate unit of measure in box 4.

10. Repeat steps 5 through 9 for the remaining packages in the sample.

Go to step 16 of Section 3.5. to determine lot conformance.

4.9. SPECIAL COMMODITY: PAINT, VARNISH, AND LACQUERS - NONAEROSOL

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

Although the procedures are suitable for use with products labeled by volume and packaged in cylindrical containers with separate lids which can be resealed, the various steps have been set forth using paint as the example. A worksheet 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)[13], 0 to 9 in (0 to 225 mm).

[13]The rods will need to be custom ground.

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					

1 cu. in. = 0.004329 gal.

1 cm^3 = 0.001 L

Volume (10) = 0.7854 x (6) x (6) x (9)

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 = $(6) + \left[\frac{(3)}{(7)} \times (6)\right]$

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

Spanning bar, 1 by 1 by 12 in (2.5 by 2.5 by 30 cm).

Paint solvent or other solvent suitable for the product being tested.

Level.

Rule, 12 in (30 cm).

Cloth, 12 in (25 cm) square.

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

Rubber mallet.

Circular metal disc, ¼ in (0.65 cm) thick and slightly smaller than package container diameter.

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 gallon (4 L) in capacity. Step 5a can be used with any sized containers and 5b with gallon (4 L) containers only. The method checks the volume of only one can in the sample, after selection of that can likely to have the smallest volume of product inside it.

Because of 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, there is an estimated uncertainty of at least ±0.6 percent to this auditing procedure. Therefore, this method is recommended solely for eliminating from more rigorous testing packaged products that appear to be full measure. Section 4.9.4. is recommended when the volume determined in step 12 of this section is less than the labeled volume or in any case where short measure is suspected.

1.- 4. Following Section 3.5., steps 1 through 4, identify the lot and select a random sample. A tare sample is not needed.

5. a. Any sized container up to 1 gal (4 L):

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

Set the containers on a level surface and record the range in heights on the worksheet under column 1 in the audit section. If the range of outside diameters exceeds 0.005 in (0.125 mm) or the range in heights exceeds 0.0625 in (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. This may be 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 the section of wood on lid and hammering on the wood with the rubber mallet. Tip the cans upside down momentarily to complete the resealing operation. Continue with step 6 below.

5. b. Gallon (4 L) cans:

This test is appropriate when the weight of the paint is much greater than the weight of the can, and is, therefore, applicable for gallon (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.

6. Measure the outside diameter of the selected container near its top, middle (already measured if step 5a was used), and bottom, to the closest 0.001 in (0.02 mm), using a direct reading diameter steel tape, and record these measurements in columns 2, 3, and 4 on the paint worksheet in the audit section.

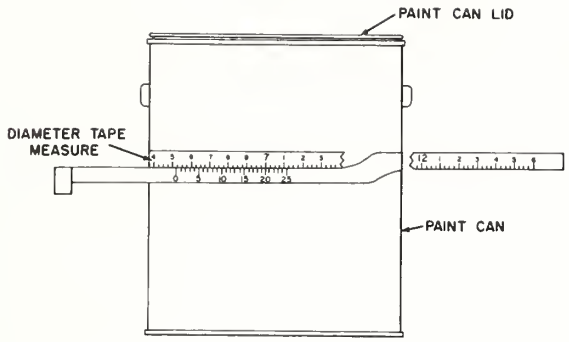


Figure 4-4. Measuring the diameter of a paint can.

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

7. 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.

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

8. Using 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.

9. Place the spanning bar and depth gage across the top of the paint can as shown in Figure 4-5. Mark the location of spanning bar on rim of paint container. Measure the depth of the liquid level to the nearest 0.001 in (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, on either side and at the center of the can as shown in Figure 4-6 (1/2 in from the rim for can diameters exceeding 5 in). 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 depth of the liquid level in the container. Record the average liquid level in column 7 of the audit section on the paint worksheet.

10. 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 9. Sum the three readings and divide by three to

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.

obtain the average depth of the container and record the average depth in column 8 of the paint worksheet in the audit section.

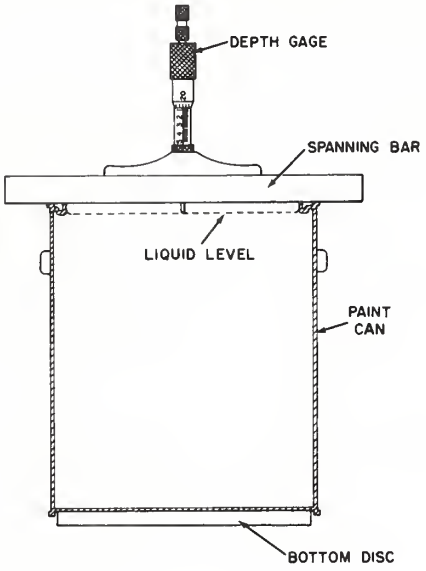


Figure 4-5. Measuring the depth of the liquid level.

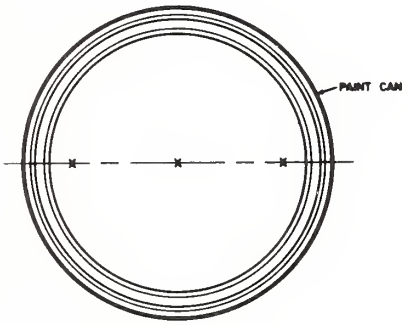


Figure 4-6. Top view of paint can showing locations at which depth measurements are made.

11. Subtract the average depth of the liquid level (step 9) from the average depth of the container (step 10) to obtain the average height of the liquid column and record it in column 9 of the paint worksheet.

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

Volume = $0.7854\ D^2H$ or
$0.7854 \times D \times D \times H$

Where D = average liquid diameter (step 7)
H = average liquid depth (step 11)

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.

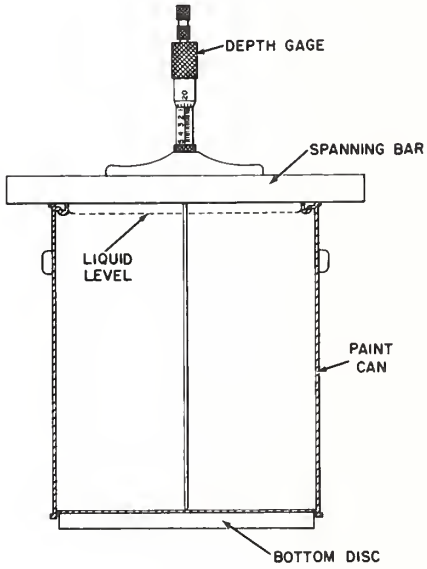


Figure 4-7. Measuring the distance to the bottom of a container.

4.9.3. In-Plant Auditing Procedure

In this method, a container is selected which is likely to have the smallest volume of product inside it, and the level of fill of a can of the same dimensions as the one under test is duplicated with water. The method is not restricted to gallon cans or smaller (as was Section 4.9.2.) but can be used to check any size package as long as the liquid level is within 9 inches of the top of the container.

Follow steps 1 through 8 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.

9. Place the spanning bar and depth gage across the top of the paint can. Measure the depth of the liquid level at the center of the surface and record the depth in the audit section of the paint worksheet in column 7.

10. Select an empty can with the same bottom configuration and with diameter and height within ±0.001 in (±0.025 mm) for 1-pt (500 mL) cans, ±0.002 in (±0.05 mm) for 1-qt (1-L) cans, ±0.003 in (±0.075 mm) for 1/2-gal (2-L) cans, and ±0.004 in (±0.1 mm) for 1-gal (4-L) cans, of the container under test. Set up the empty can in the same manner as step 8 of Section 4.9.2. and step 9 above. Fill the container with water from a volumetric measure of the same volume as the labeled volume. Measure the depth of the liquid level at the center of the container and record this level in column 7 below the reading recorded in step 9. If this depth is equal to or greater than the depth determined in step 9, assume the package satisfactory. If the depth is less than the depth determined in step 9, short measure may be suspected. Use the possible violation procedure given in Section 4.9.4. when short measure is suspected.

4.9.4. Possible Violation Procedure

The following method may be used as long as 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 it 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. - 4. See Section 3.5., steps 1 through 4, for instructions on filling out the report form and selecting the random sample and random tare sample.

5. 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". Set up the first package selected for tare in the same manner as in step 8, Section 4.9.2. Remove the lid. If paint is clinging to the side walls, scrape it down into the can with the spatula.

5. a. If paint is adhering to the lid (and it cannot be removed completely by scraping the paint into the can), determine the weight of the lid plus any paint adhering to the lid. Clean the lid of paint and weigh again. Subtract the clean lid weight from the paint-filled lid weight to determine the weight of the paint adhering to the lid. Record this weight in column 3 on the lower portion of the paint worksheet.

6. 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 depth of the liquid level at the center of the container to the nearest 0.001 in (0.02 mm). Record the depth in column 4 of the paint worksheet.

7. Empty and clean the sample container of paint with a suitable solvent; dry and weigh the container.

8. Set up the container in the same manner as in step 5 above.

9. Place the spanning bar at the same location on the rim of the paint container as marked in step 6. With the depth gage set as described in step 6, deliver water into the container in known amounts[14] 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 on the lower portion of the paint worksheet. This is the volume occupied by the paint in the container.

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

10. Subtract the tare of the container (step 7) from the gross weight (step 5) to arrive at the net weight of paint in the selected container. Record the net weight in column 7 on the lower portion of the paint worksheet.

11. Calculate the weight of the labeled volume of paint =

$$\frac{\text{net weight (step 10) x labeled volume}}{\text{volume of paint in can (step 9)}}$$

$$= \frac{\text{column 7 value x column 1 value}}{\text{column 6 value.}}$$

Record this value in column 8 of the worksheet

11. a. Calculate the package volume =

volume in can (step 9) +

lid paint weight (step 5a) x

$$\frac{\text{can volume (step 9)}}{\text{net weight (step 10)}}$$

Record it in column 9 of the worksheet.

12. Calculate package error.

Package error =

column 6 value (-) labeled volume

12. a. Package error =

column 9 value (-) labeled volume

13. Repeat steps 5 through 12a (above) for the second package chosen for tare.

In order to use weighing to check the sample (and assuming the tare is not so variable as to require opening more than two cans[15],) 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 4-2 (See Section 4.4.). If this criterion is met, the rest of the sample may be checked by weighing; the nominal gross weight is equal to the sum of the average weight of the labeled volume plus the average tare. Go to step 15 of 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, that is, if the criterion of Table 4-2 is not met, follow steps 5 through 11a and 12a (skip steps 11 and 12) if paint is adhering to the lid or steps 5 through 9 if paint is not adhering to the lid for all the packages in the sample. When package errors have been determined in this manner, go to Step 16 of Section 3.5. to determine lot conformance.

4.10. SPECIAL COMMODITY: VERY VISCOUS MATERIALS[16]

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), but if used in the field, a well ventilated area to conduct the test should be chosen if solvents other than soap and water must be used.

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".

Make a 150-mL or 5-fl oz density cup (see Figure 4-8) by cutting off the lip of a 150-mL beaker with an abrasive saw and grinding the lip flat on a lap wheel. The slicker plate can be purchased commercially.

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)

[15]See Section 2.11.4., steps (v) through (xi).
[16]Derived from a method devised by Mr. James Little, NBS.

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 pycnometer manufacturer may be necessary in order to calibrate a pycnometer (if it has not already been calibrated). It is not necessary to reweigh or recalibrate for each test; however, the pieces of each unit should be marked to prevent interchange of cups and slicker plates.

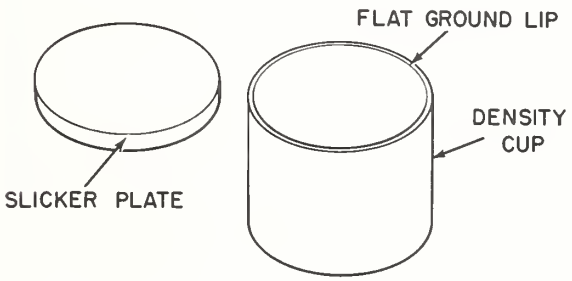


Figure 4-8. Empty density cup and slicker plate.

4.10.3. Procedure

The following measurements must be made on each package in the sample.

1. - 4. See Section 3.5., steps 1 through 4 for instructions on filling out the report form heading and selecting the random sample. A tare sample is not needed.

5. Weigh a calibrated pycnometer or density cup and slicker plate and record the weight in column 7 of Block B of the worksheet, filling in the heading as "pycnometer" or "cup and plate weight". The pycnometer or cup volume is recorded in column 2 of Block B.

6. Weigh and then open the first package. Record the gross weight in Block A of the worksheet. 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, weigh it (record this weight as tare weight in Block A of the worksheet).

7. If pycnometer is used, cover with lid and screw cap down tightly. Excess material will be forced out through hole in lid. Clean exterior surfaces.

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

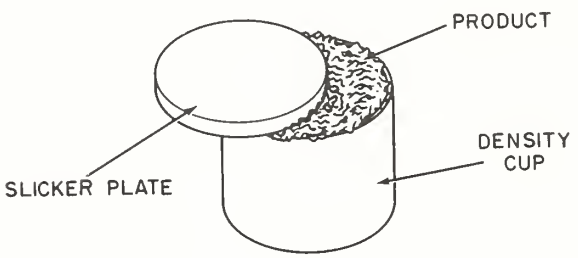


Figure 4-9. Density cup filled with product.

8. If pycnometer is used, weigh filled pycnometer or if using density cup, weigh the filled density cup with slicker plate at least to the nearest 0.002 pound or nearest gram. Record this weight in column 6 of Block B on the worksheet filling in the heading as "filled weight." Subtract the weight of the empty pycnometer or cup and plate (column 7 of Block B) from the filled weight to arrive at the weight of the product contained in the pycnometer or density cup. Record this weight in column 1 of Block B on the worksheet.

9. 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.

   The weight of product in the pycnometer or density cup is found in column 1

and the pycnometer or density cup volume in column 2 of the worksheet. Carry over at least two extra decimal places in each calculation until the weight of the labeled volume is obtained. Record the weight of the labeled volume in column 4 of Block B of the worksheet.

10. The gross weight of the package minus the weight of the package container (in Block A of the worksheet) is the actual weight of product in the individual package being measured. Record this weight difference in the "net or drained" column of Block A on the worksheet. Subtract the weight of the labeled volume from this actual weight of product to arrive at the individual package error in units of weight.

    Convert the package errors to units of volume.

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

    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 error on the report form (using an appropriate unit of measure).

11. Clean the pycnometer or density cup and slicker plate and repeat steps 6 through 10 for the rest on the packages in the sample. Go to Step 16 of Section 3.5. to determine lot conformance.

4.11. SPECIAL COMMODITY: PEAT MOSS

ASTM D 2978-71, "Standard Method of Test for Volume of Peat Materials", is the reference standard for the following 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 for peat moss listed below (mulches, etc.); therefore, separate the materials by hand (to compensate for packing and settling of the product after packaging) before filling the test measure (see step 5 below).

4.11.1. Equipment

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

Wooden or metal container, with inside dimensions of 12 by 12 by 12 in marked off in 1-in horizontal lines on the inside (1-cu ft container) or of 50 by 50 by 40 cm marked off in 5-cm horizontal lines (0.1-m^3 container). This container will have to be constructed.

Straight edge, 20 in (75 cm) in length.

Sheet for catching overflow of material.

Bubble level.

4.11.2. Procedure

1. - 4. See Section 3.5., steps 1 through 4 for instructions on filling out the report form heading and selecting the random sample. No tare sample is needed.

5. Open each package in turn, removing the contents and passing the contents through the sieve allowing the package contents to go 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 and 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 in Block A in the column headed "net or drained" on the worksheet[17].

6. Compute the package errors (= actual measurement minus the labeled measurement) and record each in Block A of the worksheet. Transfer the package errors to the report form using an

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

appropriate unit of measure in box 4 of the report form. Go to step 16 of Section 3.5. to determine lot conformance.

4.12. SPECIAL COMMODITY: SOLIDS OR SEMISOLIDS

The following procedure can only be used to test packaged products which are solid or semisolid and which will not dissolve in, mix with, absorb, or be absorbed by the fluid into which the product will be immersed.

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.

4.12.1. Equipment

Either of the following:

- Graduate or volumetric flask of capacity larger than the labeled volume of package being tested;
- 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 which will not dissolve or mix with package contents.

Bubble level.

4.12.2. Procedure

1.- 4. Follow Section 3.5., steps 1 through 4 for instructions on filling out the report form heading and selecting the random sample. A tare sample is not needed.

5. On a level surface, follow either (a) or (b) below.

   a. Select a graduate of a larger capacity than the labeled volume of the package and 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 in the column labeled "tare" on Block A of the worksheet. Open the first package and submerge the product by pushing the product down with the wire. Record the resulting volume in the column labeled "gross" on Block A of the worksheet. The difference in liquid level before and after adding the product to the graduate is the volume of the product (record in "net or drained" column of Block A on the worksheet.)

   b. Fill container with an overflow spout to overflowing with water or other liquid and 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 in "net or drained" column of Block A on the worksheet.

6. The volume of the product (as determined by 5a or 5b above) minus the labeled volume is the individual package error. Record the package error in Block A of the worksheet and transfer to the report form using an appropriate unit of measure. Repeat steps 5 and 6 (as appropriate) with the remainder of the packages in the sample. Go to step 16 of Section 3.5. to determine lot conformance.

4.13. SPECIAL COMMODITY: 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.

4.13.1. Equipment

Volumetric Flasks and graduate as described in Section 4.2.

500-milliliter buret meeting Type 1, Style 1, Class A requirements of Federal Specification 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.

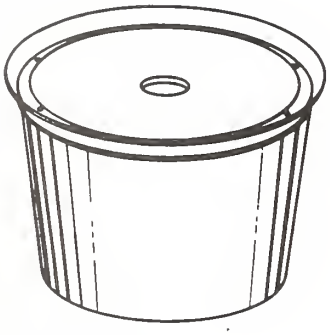


Figure 4-10. Plastic disk (beveled edge upward) inserted in the seat of a container to be tested.

4.13.2. Procedure[18]

The following procedures are divided into (a) determination of flush fill to brim or (b) determination of capacity to seat. A level working surface must be used for all test procedures. At the end of the procedure, there is information on testing a container to a marked capacity. This test does not use the plastic disks.

1. - 4. See Section 3.5., steps 1 through 4 for instructions on filling out the report form heading and selecting the random sample. A tare sample is not needed.

5. 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.

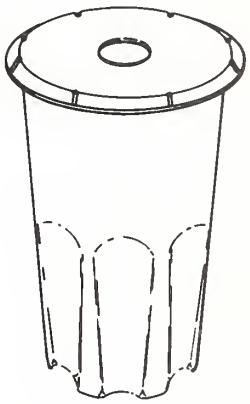


Figure 4-11. Disk in place for flush fill (or brim-full) capacity determination.

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

6. Add water to the container using flask (or flasks), graduate, or buret corresponding to label capacity. (If the flask appears likely to overfill the container, do not deliver that apparent overfill). 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.

[18]Plastic disk procedure provided by the American Can Co., Neenah, Wisconsin.

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

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

7. Record the amount of water used to fill container (in the "gross" column of Block A on the worksheet) 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 in the "net or drained" column of Block A in the worksheet.

8. Repeat this procedure on the remaining packages in the sample. Compute the package errors (= package capacity minus the labeled capacity), record them in Block A of the worksheet, and transfer them to the report form using an appropriate unit of measure. Go to step 16 of Section 3.5. to determine lot conformance.

When testing containers with markings of capacity on the side wall of the container, follow steps 1 through 4 above. Water from a buret, flask, or graduate should be added to each container such that a level of fill is obtained corresponding to the markings. The inspector 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 8 above to complete the test.

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

5.1. PACKAGES LABELED BY COUNT WHEN THE LABELED COUNT IS 51 OR MORE UNITS PER PACKAGE
5.2. PACKAGES LABELED BY COUNT WHEN THE LABELED COUNT IS 50 OR FEWER UNITS PER PACKAGE
5.3. PACKAGES LABELED BY LINEAR OR SQUARE (AREA) MEASURE
5.4. SPECIAL COMMODITY: POLYETHYLENE SHEETING
5.5. SPECIAL COMMODITY: PAPER PLATES
5.6. SPECIAL COMMODITY: SANITARY PAPER PRODUCTS
5.7. SPECIAL COMMODITY: PACKAGES GIVEN TOLERANCES

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 its length, width, and area. Polyethylene sheeting is sold by its length, width, area and thickness. Disposable paper plates are sold by the number of plates in the package and by their diameter.

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

Certain packaged goods are labeled by several units, usually count and some other quantity such as dimension, capacity, etc. In such instances, all labeled quantities must individually meet the average requirements unless other requirements are in force. The National Conference on Weights and Measures (NCWM) Model State Method of Sale of Commodities Regulation (MOS)[1] has provided an exception to this general situation: pressed and blown tumblers and stemware are given tolerances. When tolerances apply to packaged goods, the average requirement does not apply. A special sampling plan and test procedure is provided for pressed and blown tumblers and stemware (Section 5.7.).

Another exception to the average requirement is for packages labeled by low count (less than 51 units per package). For statistical reasons, the count of such packages cannot be held to an average requirement. 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 for the determination of count without opening all the packages which comprise the sample are presented here. Both use the weight of a counted number of packaged articles. One of these methods is intended as an auditing procedure only. Of course, when the weight of each discrete unit or number 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. Auditing Procedure

The following method does not follow the steps outlined in the decision charts. The accuracy of the method is ±1 percent, therefore any action based on shortages of count must use either actual count or Section 5.1.3. as the basis for determining compliance. This method is, however, useful for auditing packages labeled by high unit counts (in excess of 100).

1. - 4. See Section 3.5., steps 1 through 4 for instructions on filling out the report form heading and selecting the random sample and random tare sample.

5. Gross weigh the first package for tare determination. Record this weight in Block A of the worksheet.

6. Select that number of items from the first tare package which weighs the greater, either (a) or (b):

   a. 10 percent of the labeled count,

   b. a quantity sufficient to indicate at least 50 minimum divisions on the package checking scale. For example, using the package checking scale with 1/16-oz divisions, the selected count must weigh at least 3 1/8 oz. For the package checking scale with 1-g divisions, the selected count must weigh at least 50 g. Record the count and weight in Block B in columns 1 and 2 of the worksheet.

[1]The NCWM MOS is a voluntary standard for State regulatory use which is periodically revised by State agency representatives. Not all 50 States have regulations based on this model.

7. Calculate the weight of the labeled count =

$$\frac{\text{labeled count x weight (col. 1)}}{\text{count (col. 2)}}$$

Record the result in column 4 of Block B on the worksheet and in Block A of the worksheet under the column headed "labeled" filling in the space with "count weight".

8. 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 this in Block A of the worksheet.

9. The weight of the labeled count plus the tare weight represents the "nominal gross weight" to be used to compare with the actual gross weights of unopened packages in the sample.

Package error (in units of weight) = actual gross weight (-) nominal gross weight.

Record the package errors in Block A of the worksheet.

10. Convert the package errors in units of weight to units of count:
Package error (count) =
Package error (weight) x

$$\frac{\text{labeled count}}{\text{weight of labeled count}}$$

Round up all fractional counts computed in this manner to whole units. Record the package error in units of count in the checkerboard 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

The following method follows the steps outlined in Decision Chart 4.

The measurement of the weight of a number of packaged units is combined with the determination of tare and, therefore, will not require more packages to be opened than that number designated in Table 2-2 or 2-5, column 3.

If Section 5.1.2. has been used, this procedure can be followed without taking a new sample if package contents can still be counted and the contents have been kept separate.

1.- 4. See Section 3.5., steps 1 through 4 for instructions on filling out the report form heading and selecting the random sample and random tare sample.

Record the MAV from Table 2-10 in units of count in box 6 on the report form.

5. Gross weigh the packages selected for tare determination and record their gross weights in Block A of the worksheet. Open these packages.

6. Determine and record the weight of the exact number of items in the first opened package.

Record the weight in column 1 and the count in column 2 of Block B on the worksheet.

7. In order to determine whether the scale used to weigh the packages is able to discriminate differences in count, add or subtract that number of units corresponding to the MAV/6 (or at least one unit)[2] to or from the units already on the scale in step 6. The difference between this weight and that determined in step 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 readout on/a digital scale).

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 8.

8. Determine and record (in Block A of the worksheet) the tare weight of the first package opened.

[2]Alternatively, the weight corresponding to MAV/6 may be calculated as described in step 7b of Section 4.4.

9. Determine and record the weight and the count of the items in the second package opened for tare.

10. Calculate the weights of the labeled counts for the first two packages.

    Weight of labeled count =

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

    Record these weights in the appropriate boxes of 4b and in col. 4 of Block B 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 weight of the labeled count between the two packages must not exceed that value given in Table 4-2 (see Section 4.4.).

    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, go on to step 11.

11. Average the weights of the labeled count (record in box 5b, Block B of the worksheet).

12. Determine the tare for the rest of the tare sample (if any); record the tare values in Block A of the worksheet. Average the tare weights. Record package errors for the tare sample packages.

13. The average weight of the exact number of items in the package as labeled (step 11) plus the average tare weight (step 12) equals the "nominal gross weight" to be used to compare against the gross weight of the unopened packages in the sample. Record the nominal gross weight in Block A of the worksheet.

14. Calculate the MAV in units of weight; MAV (in units of weight) =

    $$\text{MAV (in units of count)} \times \frac{\text{average weight of labeled count (5b,B)}}{\text{labeled count}}$$

    Record MAV in units of weight in box 7 of Block B of worksheet and in box 5 of the report form. Select an appropriate unit of measure in terms of weight (see Section 2.9.2.), convert the MAV to dimensionless units and record in box 7 of the report form.

    With all measurements converted to weight and then to dimensionless units, go to Step 15 of Section 3.5., converting back to count when completing the report form.

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

A special sampling plan[3] 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 required number of packages for the sample and the allowable number of undercount packages are given in Table 5-1. No check on the average count is made.

1. - 4. Follow the procedures in Section 3.5., steps 1 through 4, <u>except</u> sample size and tare sample size are found in Table 5-1. Record the column 4 value from Table 5-1 (the number of packages which are allowed to contain fewer than the labeled count) in box 13 of the report form.

    The MAV in units of count is found in Table 2-10 and recorded in box 6 on the report form.

5. - 12. Follow steps 5 through 12 of Section 5.1.3.

13. If it is possible to weigh to determine count, compare the gross weight of the unopened packages in the sample with the "nominal gross weight" (the average weight of the labeled number of items in the package (step 11) plus the average tare weight (step 12).) Each package error is equal to the actual gross weight minus the nominal gross weight.

[3]No distinction is made as to the severity of consequences of a lot being found out of conformance with the requirements. If the labeled count is 50 or fewer, this is the only sampling plan to be followed.

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

1 Lot size (number of packages in lot) N	2 Sample size (number of packages in sample) n	3 Tare sample size (number of packages chosen for tare determination) n_t	4 Number of packages allowed to contain fewer than the labeled count.
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.

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.

14. Circle and count the number of minus package errors. If this number is larger than the number in box 13 of the report form, the lot fails to comply with the package requirements. If the number of minus package errors is equal to or less than that number recorded in box 13 of the report form, the lot complies.

For example, an inspector 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.

Since only one package contains fewer than 50 balls, the inspector declares the lot to have passed the test.

The MAV's listed in Table 2-10 for packages labeled by count and fewer than 51 units per package define the limits of reasonable variation for an individual package even though the MAV is not used directly in the sampling plan. Individual packages which are undercount by more than the MAV from the labeled count are, however, considered defective (even if the lot as a whole passes inspection) and should be repacked, relabeled, or otherwise handled on an individual basis. Following the previous example, the package containing 47 balls should be individually handled even though the lot complies with the package requirements.

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

The weight of the labeled linear or area measure may be used together with the tare weight as the nominal weight value against which unopened packages in the sample may be compared 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 4-2. Decision Chart 4 may be used as a guide.

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 inspector is referred to the following standards suitable for in-plant inspection combined 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 which 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 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[4] with 1/2 mm divisions, overall length tolerance of 0.4 mm.

For labeled dimensions greater than 40 cm, 30 m tape[4] with 1 mm divisions, overall length tolerance of 2.5 mm.

5.3.2. Procedure

1. - 4. See Section 3.5., steps 1 through 4 for instructions on filling out the report form and selecting the random sample and tare sample. Separate report forms and worksheets should be filled out for packages labeled by separate dimensions and/or area.

   Record the MAV in units of length or area measure (given in Table 2-11) in box 6 of the report form.

5. Gross weigh and open the packages selected for tare determination. Record in Block A of the worksheet.

6. Determine the measurements (to the nearest division of the appropriate tape or rule being used to measure) 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 in columns 1 and 2 of Block B on the worksheet. Calculate the weight of the labeled measurement using boxes in 4b in Block B of the worksheet.

   Weight of the labeled measurement =

   labeled measurement x

   $$\frac{\text{contents weight (col. 1)}}{\text{contents measurement (col. 2)}}$$

   Record this weight in column 4 of Block B on the worksheet.

7. Add or subtract the length or area of packaged product corresponding to MAV/6 from the product already on the scale[5]. The difference between this weight and that determined in step 6 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, for a package labeled 200 sq ft, the MAV of 3% is 6 sq ft and MAV/6 is 1 sq ft. Therefore, adding or subtracting 1 sq ft of product to the scale should change the scale indication by at least 1/2 the minimum scale division (or smallest readout increment if a digital scale.)

   If this criterion is met, go on to the next step. If not, all the packages in the sample must be opened in order to measure the contents.

8. The tare weight of the first package opened is determined and recorded in Block A of the worksheet.

[4]The markings specified for the equivalent metric rule and tape may be incorporated in the inch-pound rule and tape.
[5]Alternatively the official may calculate the weight corresponding to MAV/6 (knowing the exact length or area in the package) and compare this value with 1/2 the minimum division on the scale being used. For example, an inspector finds 200 sq ft of product weights 2.000 lb, therefore 1 sq ft must weigh 0.010 lb. If the small capacity scale is being used, this is 5 times the usual minimum division on this scale (0.002 lb); therefore, this first criterion would be met.

9. Determine the measurements of the product in the second package chosen for tare determination. Determine the tare weight of this package and record in Block A of the worksheet. Calculate the weight of the labeled measurement for the second package (see formula in step 6). Record this calculation in the appropriate boxes of 4b in Block B of the worksheet and the final weight of the labeled measurement in column 4 of Block B.

10. The difference between the weights of the labeled measurement for two packages must not exceed that value given in Table 4-2 (Section 4.4.). If the weights do differ by more than that value in Table 4-2, all the packages in the sample must be opened, measured individually and compared against the labeled measure to determine the package errors. If Table 4-2 criterion is met, go on to step 11.

11. Calculate the average weight of the labeled measurement and record in 5b in Block B of the worksheet.

12. Determine the tare weights of the rest of the tare sample (if any). Record the tare in Block A of the worksheet. Average the tare weights. Record the package errors for the tare sample packages.

13. The average weight of the labeled measurements (step 11) plus the average tare weight (step 12) equals the "nominal gross weight" to be used to check the gross weight of the unopened packages in the sample. Record the nominal gross weight in Block A of the worksheet.

14. Convert the MAV to units of weight.

    MAV (in units of weight) =

    $$\frac{\text{avg. wt of label meas.}}{\text{labeled measurements}} \times \text{MAV (length, area)}$$

    Record MAV in units of weight in box 7 of Block B on the worksheet and in box 5 on the report form.

    Select an appropriate unit of measure in terms of weight (see Section 2.9.2.). With all measurements converted to weight, go to step 15 of Section 3.5. to determine lot conformance. Convert package errors in weight to length or area when completing the report form.

5.4. SPECIAL COMMODITY: POLYETHYLENE SHEETING

Polyethylene sheeting is sold not only by its linear or area measurement, but also by its thickness. The procedure to check thickness is based on the NBS Voluntary Product Standard PS 17-69, "Polyethylene Sheeting (Construction, Industrial, and Agricultural Applications)."

First the dimensions of the sheeting are checked, as in Section 5.3.2. which follows Decision Chart 4. If the 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.

5.4.1. Equipment

Scales and weights recommended in Section 3.1.

Micrometer:

- A deadweight dial micrometer (see Figure 5-1) equipped with a flat anvil, 1/4-in (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 themselves. 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 lbf (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).

WORKSHEET FOR CHECKING POLYETHYLENE SHEETING

Labeled Length ____

Labeled Width ____

Labeled Thickness ____

0.8 × Labeled Thickness ____ Compare with All Thickness Measurements

0.93 × 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															
Sample Average															

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).

- Electronic or motor-driven comparator with same specifications as above.

Steel tape rules recommended in Section 5.3.1.

T-square.

5.4.2. Preparation for Test

Gage blocks covering the range of thicknesses to be tested should be used to check the accuracy of either the micrometer or the comparator and should be maintained without rust, tarnish, or scratches. The micrometer or comparator should be operated in an atmosphere free from drafts and fluctuating temperature and should be allowed to stabilize at ambient room temperature before use.

Place the deadweight dial micrometer or comparator on a solid, level table, free from excessive vibration. Check the weight of the deadweight used with the spindle head. It should have a weight of about 3.6 oz.

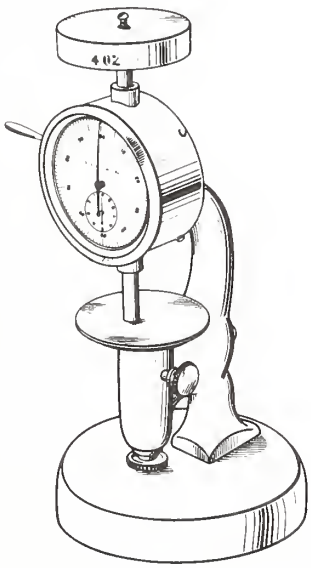


Figure 5-1. Deadweight dial micrometer.

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 and check to see if it indicates zero each time. If it does not, find the cause and correct it before proceeding. The accuracy of the micrometer or comparator should be checked with appropriate gage blocks 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 6a and 8a below apply to rolled product, 6b and 8b to folded product. Steps 10a and b apply to a two-stage MAV and therefore both steps 10a and 10b are followed for any single product test.

1. - 4. See Section 3.5., steps 1 through 4 for instructions on filling out the report form heading and selecting the random sample and random tare sample. Separate report forms for length (width), area, and thickness should be appended to one another. The MAV for dimensions is found in Table 2-11. The MAV's for thickness are listed in Section 2.13. and in step 10a and b below.

5. Gross weigh the packages chosen for tare, open them, and record the gross weights in Block A of the worksheet.

6. Weigh the first package net contents and record in column 1 of Block B. 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 in the polyethylene worksheet. Compute the average length and width and record on the special 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. In the case of a product that is folded, 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.

7. Follow steps 7 through 14 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.

8. 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 of 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 readout becomes stationary. This procedure minimizes small errors present 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. Care should be taken not to raise the spindle head or probe 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 polyethylene worksheet. Compute the average thickness for the individual package and record this thickness.

9. Repeat step 8 on the remaining packages in the sample.

10. In Section 2.13., the MAV for polyethylene was described to apply in two stages. Follow both a and b below.

    a. No single measurement of thickness should be less than 80% of the labeled thickness.

       Circle any value in the thickness columns of the worksheet which is smaller than (0.8 x labeled thickness). If the number of values circled exceeds the number recorded in box 13 of the report form, the lot fails to conform to requirements.

       No further testing of the lot is necessary. If this number of circled thickness measurements is equal to or less than the box 13 value, go on to step 10b.

    b. The average thickness for any single package should be at least 93% of the labeled thickness.

       Circle any package average thickness value which is smaller than (0.93 x labeled thickness).

       If the number of package average thicknesses circled[6] exceeds the number recorded in box 13 of the report form, the lot fails to conform to requirements. No further testing of the lot is necessary. If this number of circled package average thicknesses is equal to or less than the box 13 value, go to step 17 of Section 3.5. to determine lot conformance with respect to average thickness.

5.5. SPECIAL COMMODITY: PAPER PLATES[7]

The plate count is first checked against requirements for the average, then the plate size is checked. The procedure does not follow a decision chart.

[6]Count circled average thicknesses only; do not include circled individual thicknesses in this count.

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

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 (centimeter) line from the top and left size of base plates: 1,2,3, etc.

5.5.3. Procedure

1. 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 2 below.

2. 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, and a category B plan will be used to check dimensions, Table 5-1 permits a sample size of 10 packages for packages labeled by low count but Table 2-5 requires a sample size of 30 packages for this lot size for checking dimensions.

   For low count packages, check sample size required according to Table 2-2 or 2-5 and if necessary, select additional packages for the sample. A tare sample is not needed in this part of the procedure.

   Select one plate from each package to represent that package[8].

3. Place each plate to be measured eating surface down on the measuring base plate. Locate the plate in the corner of the measuring base so that two sides of the plate are touching the two vertical side pieces (See Figure 5-2).

   Rest the palm of your hand on the plate to ensure that plate is flat and read the plate diameter.

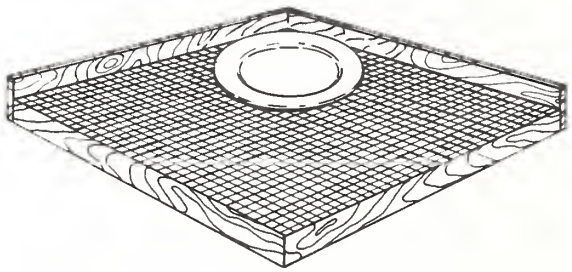


Figure 5-2. Preparing to measure the dimensions of a paper plate.

4. The package error is equal to the plate diameter minus the labeled diameter. Record the package error on Block A of the worksheet and, using an

[8]Certain 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. If three sizes are declared, for example, three plates are selected from each package. Upon occasion, packages of plates declared to be of one size may contain plates which can visually be seen 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, all the different sizes of plates in the package will have to be checked and the average dimensions of the package calculated. For example, if 5 plates measure 8 7/16 in and 15 measure 8 9/16 in, the average dimension for this package of 20 plates is 8.53 in.

appropriate unit of measure, transfer to a report form (separate from the form used to record count).

5. Repeat steps 3 and 4 for all the packages in the sample. Go to step 16 of section 3.5. to determine lot conformance.

5.6. SPECIAL COMMODITY: SANITARY PAPER PRODUCTS[9]

The labeled count is first checked and is followed by a check on the linear measurements. The procedure does not follow a decision chart.

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

Scales and weights recommended in Section 3.1.

Plastic sheet, 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, 0.01 in (0.5 mm) divisions.

The measurements are easier to make if two rules are inlaid flush with a working surface, perpendicular to each other.

5.6.2. Procedure

1. 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, place the product between the working surface and the plastic plate (removing creases if necessary) and measure and record its dimensions.

4. The package error is equal to the actual dimension minus the labeled dimension. Record the package errors on Block A of the worksheet, and using an appropriate unit of measure, transfer them to a report form separate from the form used to record count.

5. Repeat steps 3 and 4 for all the packages in the sample. Go to step 16 of Section 3.5. to determine lot conformance.

5.7. PACKAGES GIVEN TOLERANCES

The package requirement that the average quantity of a lot (shipment or delivery) meet or exceed the labeled quantity is not applied to that category of products to which a "tolerance" or "allowable difference"[10] has been provided by regulation. When a

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

[10]The National Conference on Weights and Measures (NCWM) Model State Method of Sale of Commodities Regulation (MoS) is a voluntary standard for State regulatory use which is periodically updated by State agency representatives. The 1980 edition of NBS Handbook 130 which contains the current NCWM model regulations lists the following "allowable differences". Individual State regulations may permit or not permit the following or other allowable differences.

Product	Allowable difference	Reference to the NCWM MoS
pressed and blown tumblers and stemware labeled by count and and capacity	inch-pound: ± 1/4 oz for items less than or equal to 5 oz; ± 5% for items greater than 5 oz. metric: ± 10 mL for items less than or equal to 200 mL; ± 5% for items greater than 200 mL.	Section 3.2.1.

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 certain amount, then the average net quantity of those packages cannot be expected to meet some higher value.

The sampling plans in Table 5-2 are provided for all such products.

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

1 Lot size N	2 Sample size n	3 Tare sample size n_t	4 Number of package errors which may exceed allowable difference
Up to and including 500	10	2	0
501-5,000	30	2	1
5,001 and over	50	5	2

To use the sampling plans in Table 5-2 the inspection lot is identified and a random sample following Appendix C methods is selected according to the size of the lot.

The packages in the sample are measured following an appropriate procedure (Section 5.7.1. is provided for tumblers and stemware.) 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 above, the lot conforms. No calculation of the average package error is made. The lot conforms or fails based on the individual package errors only. Individual packages exceeding the allowable difference are acted upon individually even though the requirements for the lot may be met.

5.7.1. Tumblers/Stemware

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. The procedure does not follow any of the decision charts. Equipment is the same as recommended in Section 4.13.1.

1. 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.

   Keep the packages in the order in which the random numbers were recorded from the random number table.

   If the lot conforms to requirements for count, go on to step 2 below.

2. The same packages selected for the sample to be tested for count may 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, 15 count, plastic glasses is composed of 500 packages. A Category B plan is used to check the count. Referring to Table 2-5, a sample size of 30 is selected to be checked for count. The lot is found to conform to the average requirements for count. Referring to Table 5-2, a sample size of 10 is adequate for checking the labeled capacity. Therefore, the 10 packages which are associated with the first 10 random numbers that were selected from the random number table become the sample to be checked for capacity.

   Every package is checked. (No tare sample is needed.)

   Unless the tumbler or stemware is glass, one tumbler per package is sufficient to determine capacity of all units in that package. If the

tumbler, etc. is glass, the capacity of all the containers in the package is determined.

3. Follow Section 4.13.2., steps 5, 6, and 7 on each item to be checked (either one tumbler or piece of stemware from each package in the sample or, if glass, all the tumblers or pieces of stemware from each sample package). Use separate worksheets from those used to record labeled count.

4. The package (or tumbler) error is equal to the volume capacity as measured minus the labeled capacity. Record the package error on the report form. If capacity has been measured for every unit in the package, note on the report form to refer to the worksheet(s) for the appropriate individual unit error.

5. Compare each package (or if glass, each tumbler/stemware) error with the allowable difference. If any package or tumbler/stemware error exceeds the allowable difference (either positive or negative errors), circle that 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, one package or tumbler/stemware error in the sample can 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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APPENDIX A: GLOSSARY OF TERMS
APPENDIX B: PACKAGE NET CONTENTS REGULATIONS
APPENDIX C: SELECTION OF A RANDOM SAMPLE
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APPENDIX A. GLOSSARY OF TERMS

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 given an allowable difference in capacity. (See Section 5.7.)

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 3.7.)

AUDIT TESTING. Preliminary tests designed to quickly seek out a potential case of 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 for berries and small fruits in capacities of 1 dry quart or less.

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 3.7.)

CATEGORY A (CATEGORY B). A set of sampling plans provided in this handbook for use in checking packages which must meet the average requirement (defined). (See Section 1.8. See Section 2.6. for Category A, and Section 2.7. for Category B.)

CODE NUMBER. 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.

COMBINATION QUANTITY DECLARATIONS.[2] 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 3.9.6. and Table 3-2.)

DECISION CRITERIA. The rules for deciding whether a lot is in conformance with package requirements or not based on the results of checking the packages in the sample. (See Sections 2.6.1., 2.6.2., 2.7.1., and 2.7.2.)

DELIVERY. A quantity of identically labeled product received at one time by a buyer.

DIMENSIONLESS UNITS. The integers in terms of which the official records package errors. The dimensionless units must be multiplied by the unit of measure (defined) to obtain package errors in terms of weight, length, etc. (See Section 2.9.1.)

DISPOSABLE CONTAINERS. A package container designed to be used only once.

DIVISION[1] (on a scale). A defining line, or one of the lines defining the subdivisions of a graduated series.

DRAINED WEIGHT. The weight of solid or semisolid product representing the contents of a package obtained after a prescribed method for excluding the liquid has been employed. (See Section 3.8. and 3.11.)

[1]NBS Handbook 44, 1980.
[2]NBS Handbook 130, 1980, Model State Method of Sale of Commodities Regulation.

DRY MEASURES.[3] Rigid containers designed for general and repeated use in the volume measurement of particulate solids.

DRY TARE. All packaging materials (including glue, labels, ties, etc.) that will contain or enclose the product but before the product is introduced into the container. Prizes, gifts, coupons, or decorations which are not part of the product are defined as part of the tare also. (See Section 2.11.)

ERROR. See PACKAGE ERROR.

ERROR LIMIT. In Category A sampling plans, the value that is calculated if the average error of the sample is a minus value. The error limit (denoted as "T") is then added to the sample average error before applying the decision criterion on the average. (See Section 2.6.2.)

FOAM PRODUCT AEROSOL. A product that forms a foam at the container valve or on impingement with a surface, the foam volume not being substantially reduced for at least 20 seconds.

FLUSH FILL CAPACITY. The capacity of a cup or container as defined by the volume contained by it when a flat plate (such as a slicker plate (defined)) rests on its rim.

GROSS WEIGHT. The weight of the package including contents, packing material, labels, etc.

HEADSPACE. The container volume not occupied by product.

INDEX OF AN INDICATOR. That particular portion of an indicator (as, for example, on a weighing scale) that is directly utilized in making a reading (e.g., the tip of a movable pointer on a dial) (See Section 3.4.)

INCH-POUND UNITS. Units based upon the yard, gallon, and the pound commonly used in the United States of America. Some of these units have the same name as similar units in the United Kingdom (British, English, or UK units) but are not necessarily equal to them.

INITIAL TARE SAMPLE. The first packages (either two or five) selected from the sample to be opened for tare determination in the alternative tare procedure. Depending upon the variability of these individual tare weights as compared with the variability of the net contents, this initial tare sample may be sufficient or more packages may be needed to determine the tare. (See Section 2.11.4. and Table 2-6.)

INSPECTION LOT. The collection of identically labeled (except for actual quantity in the case of random pack) packages available for inspection at one time. This collection will pass or fail as a whole based on the results of tests on a sample drawn from this collection. (See Section 2.3.)

LABEL.[4] "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 official finds the package that he or she will examine. Broadly defined as three general locations: (1) where the commodity was packaged, (2) a warehouse or storage location; or (3) a retail outlet.

LOT. See INSPECTION LOT.

LOT SIZE. The number of packages in the inspection lot (defined). (See Section 2.3.3.)

LUBRICATING OIL BOTTLES.[5] 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 (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.

[3]NBS Handbook 44, 1980.
[4]NBS Handbook 130, 1980, Model State Packaging and Labeling Regulation.
[5]NBS Handbook 44, 1980.

MEASURE CONTAINERS.[6] Measure containers are containers whose capacities are used to determine quantity. They are of two basic types, (a) retail and (b) prepackaged. Retail containers are packaged at the time of retail sale and prepackaged containers are packaged in advance of sale. An example of a prepackaged measure container is an ice cream package.

METERED VALVE. A push-button operated aerosol delivery device that meters a pre-determined quantity of product when depressed and then shuts off automatically. No additional product will be expelled until the push button is released and depressed again to repeat the procedure.

MILK BOTTLES.[6] A container that is designed as a measure container (defined) for repeated use in the measurement and delivery of milk and other fluid dairy products at retail.

MINUS OR PLUS ERRORS. Negative or positive deviations from the labeled quantity of the actual package quantities as measured. (See PACKAGE ERRORS.)

MOISTURE ALLOWANCE. That variation in weight of a packaged product permitted in order to account for loss of weight due to loss of moisture during good package distribution practices. (See Sections 1.9., 2.14., Step 13 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.[6] "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 13 of Section 3.5.)

NOMINAL TARE WEIGHT. The quantity designated as tare (defined) and used in the determination of the nominal gross weight. It may be an average tare value or a corrected average tare value.

NULL INDICATOR. A device or portion of device used to indicate a "zero" or load-balanced condition.

OBSERVED VALUE. A particular quantity determined as the result of an observation, test, or measurement.

PACKAGED GOODS.[7] "Product or commodity put up in any manner in advance of sale suitable for either wholesale or retail sale."

PACKAGE ERROR. The difference between the actual net contents of an individual package as measured and the declared net contents on the package label; (-) minus for less than the label and (+) plus for more than the label. (See Section 2.9.)

POISE.[5] "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."

PRINCIPAL DISPLAY PANEL.[8] "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 and usually defined as those packages produced within a certain 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

[6]NBS Handbook 44, 1980.

[7]16 CFR §500.2(h).

[8]NBS Handbook 130, 1980, Model State Packaging and Labeling Regulation.

determined for the material. (See Section 4.10.)

RANDOM PACK.[9] That type of package in which a commodity is measured, packaged and then labeled individually in a variety of quantity sizes and with no fixed quantity pattern. In many cases these packages are put up in the retail store or central distribution point. Although commonly labeled by weight (e.g., meat), linear or square measure (e.g., yard goods) is also encountered.

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 C, D, and E).

RANGE. The difference between the largest and the smallest of a set of measured values. (See Appendix F.)

REASONABLE VARIATIONS. The amount by which individual package net contents may vary from the labeled net contents. This term is found in most Federal and State laws and regulations governing packaged goods. (See Appendix B.) This handbook defines the limits of reasonable variation only in terms of negative deviations from the label and terms these limits "Maximum Allowable Variations."

ROUNDING. To round a numerical value is the process of omitting certain of the end digits of a number and adjusting the last digit retained 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.

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 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 4.13.)

SENSITIVITY (of scale). The relative displacement of an index of an indicator with respect to a graduated scale for a given change in weight. (See Section 3.1.)

SHIPMENT. A quantity of identically labeled product 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.)

STANDARD DEVIATION. A measure of the scatter of the individual package contents around the mean contents. (See Section 2.6.2.)

STANDARD PACK. That type of package in which a commodity is put up with identical labels and only in certain selected quantity sizes. Examples 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); that is, the weight of the package or product is determined by using the official's test weights (defined) with the commercial scale serving merely as an indicator for a "zero" or load balanced condition and not as an indicating device. (See Section 3.7.)

[9]NBS Handbook 130, 1980 in the Model State Packaging and Labeling Regulation defines random package as the following, "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."

SUPPLEMENTARY QUANTITY DECLARATIONS.[10] "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.[11] Flexible steel linear measures.

TARE. The weight of a container, wrapper, or other material (see discussion in Section 2.11.) that is deducted from the gross quantity to obtain the net quantity.

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 3.9.6.)

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 allowable 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, (whereas 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. (See step 16 of Section 3.5.)

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. Field standard measuring flasks, graduates, cylinders, etc. for use in the measurement of volumes of liquids. (See Section 4.2.)

WET TARE. All packaging materials that can be separated from the packaged product after packaging. Washing, scraping, ambient air drying, and other techniques involving more than "normal" household recovery procedures may be used but laboratory procedures such as oven drying the packaging material are not used. As in the dry tare definition, prizes, decorations, and such are also part of the wet tare. (See Section 2.11.)

[10] 16 CFR §500.20.
[11] NBS Handbook 44, 1980.

APPENDIX B. PACKAGE NET CONTENTS REGULATIONS

Certain portions of the Federal and State regulations which refer specifically to labeled net contents on packages are listed below.

B.1. FEDERAL REGULATIONS

References are taken from the July, 1980, Code of Federal Regulations.

B.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.

B.1.2. U.S. Department of Agriculture, Food Safety and Quality Service

Meat
9 CFR §317.2

(h)(2) The statement as it is shown on a label shall not be false or misleading and shall express an accurate statement of the quantity of contents of the container exclusive of wrappers and packing substances. Reasonable variations caused by loss or gain of moisture during the course of good distribution practices or 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.

B.1.3. Federal Trade Commission

Non-food consumer commodities are covered under the Fair Packaging and Labeling Act
16 CFR §500.22.

(a) The statement of net quantity of contents shall accurately reveal the quantity of the commodity in the container exclusive of wrappers and other material packed therewith: Provided, That in the case of a commodity packed in a container designed to deliver the commodity under pressure, the statement shall declare the net quantity of the contents that will be expelled when the instructions for use are followed. The propellant is included in that net quantity statement.

(b) Variations from the stated weight or measure shall be permitted when caused by ordinary and customary exposure, after the commodity is introduced into interstate commerce, to conditions which normally occur in good distribution practice and which unavoidably result in change of weight or measure.

(c) Variations from the stated weight, measure or numerical count shall be permitted when caused 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.

B.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 permissable only to the extent that it represents deviation unavoidable in good manufacturing practice. Variation below a stated minimum is not permitted. In no case shall the average content of the packages in a shipment fall below the stated average content.

B.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 bottles 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.

B.2. STATE REGULATIONS

The National Conference on Weights and Meaures, an organization of State and local weights and measures officials, has adopted voluntary 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 National Conference on Weights and Measures Model State Packaging and Labeling Requirements[1] quoted below.

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.

[1]NBS Handbook 130, 1980.

APPENDIX C. SELECTION OF A RANDOM SAMPLE

C.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.

To select a random sample requires some care. The procedures which follow present several methods of obtaining a random sample, and a randomly selected subsample for tare. However, they are not the only techniques which may be used. (See Section C.5.)

For the discussion which follows, there are N packages in the inspection lot and there are to be 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 as they sit on the shelf or in the warehouse or as they come off the packaging line. Then it is necessary to obtain n random numbers from a table of random numbers. These n random numbers indicate exactly which packages in the lot shall be taken for the sample.

C.2. LOT NUMBERING SYSTEMS

A numbering system or scheme for the lot must be decided upon before getting the random numbers for the sample. There are many methods of numbering the lot, two of which are outlined below.

C.2.1. Serial Lot Numbering System

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; he or she may imagine each package as having a number associated with it. The official may straighten the packages on the shelf before beginning if it helps to clarify the numbering system in his mind. 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, like this (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.

The official can use any numbering scheme he or she wishes as long as each of the N packages has a number associated with it, so that he or she knows where to go to find any particular numbered package. In the 3-layer scheme suggested above, for example with N = 30, package number 26 would be in the third layer, second row from the front, first package on the left.

C.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. For example, the official may choose some convenient lower left corner of the stack as a "zero point" (starting place). He or she 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. Unit No. 4-1-5, for example, would be located 4 units to the Right of the zero point, 1 unit Up, and 5 units towards the Back. (See Figure C-1).

C.3. THE RANDOM NUMBER TABLE

C.3.1. General

The random number table in Appendix E contains all 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.

C.3.2. Random Starting Place.

a. Starting Page. - The pages of Appendix E are numbered E1 through E31. Use the day of the month to determine the starting page. For example, if the inspection is being done 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. - Use the auxiliary table, Appendix D, to get the starting column and row.[1] This table consists of two pages. On each page there are 600 pairs of numbers. Each pair is shown in parenthesis. The first number of a pair indicates the starting column in Appendix E, and the second number the starting row. The first pair at the upper left hand corner of the first page may be used the first time. After a pair is used, it may be crossed out and another pair used the next time, proceeding systematically either across or down the page.

For example, assume that testing takes place on the 11th day of the month. Start with page 11 of the random number table in Appendix E. Use the auxiliary table in Appendix D to get a starting place on page 11. If the auxiliary table is being used for the first time, use the first pair of numbers (22, 45). Start using the random number table of Appendix E, on page 11, column 22, row 45. That number is 3.

If 1-digit random numbers are needed, record them, going down the column to the bottom of the page and then to the top of the next column, and so on. Ignore duplicates and record zero (0) as ten (10). Following on from the last example, these numbers are 3, 5, 7, 10, 4, etc. If two-digit random numbers are needed, rule off the page, and further pages if necessary, in columns of two digits each. If there is a single column left on the page, ignore this column, and rule the next page in columns of two. Again, ignore duplicate numbers and record 00 as 100. For example, using the same starting place as in the last example, (page 11, column 22, row 45) the two-digit numbers recorded would be 31, 58, 72, 2, 46, 71, 43, etc. When three-digit numbers are needed, rule the page in columns of three. Record 000 as 1000. Starting on page 11, column 22, row 45, the numbers recorded would be 316, 585, 722, 24, 461, 715, 376, 244, 921, 289, etc.

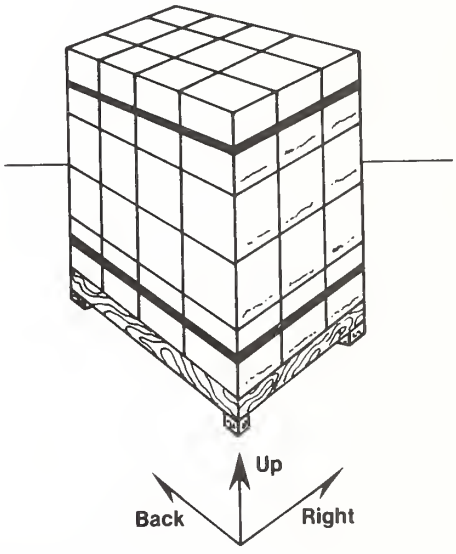

Figure C-1. Choosing a starting place for a three-dimensional lot numbering system.

C.4. OBTAINING RANDOM NUMBERS FOR THE SAMPLE

C.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 which will correspond to those packages which will become the random sample. If the lot contains 100 packages or less, use two-digit random numbers. If the lot consists of more than 100, but not more than 1000 packages, use three-digit random numbers.

[1] Alternatively, the inspector may choose a starting page in the random number table, and closing his or her eyes, drop a pencil anywhere on the page to indicate a starting place in the table.

Using the random number table (Appendix E), rule the table off in columns if desired. Read off each successive number which is less than or equal to N until n different numbers have been recorded in Block A of the worksheet in the column headed "Pkg. No.". These correspond to the packages to be selected for the sample.

The testing official, of course, may rearrange these random numbers in a serial fashion to facilitate actual package selection (or mark through the random numbers on the worksheet as he or she selects the package); in any event, the order in which the numbers come out of the random number table indicate the order in which packages in the sample are used to determine 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: 31, 58, 72, 2, 46, 71, 43, 82, 79, 40. (If a duplicate appears in the table, it is ignored--e.g., 72 appears twice.) If 00 had appeared, it would have been ignored in this case (it would usually be recorded as 100). The packages to be taken for the sample are the packages in the serial numbering system corresponding to these 10 random numbers.

Example of package selection using a serial lot number system

Sample package in the sequence to be used for tare determination	Package number in lot[2]	Order in which packages will be selected
1	31	2
2	58	6
3	72	8
4	2	1
5	46	5
6	71	7
7	43	4
8	82	10
9	79	9
10	40	3

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.

C.4.2. Three-dimensional Lot Numbering System

The official should choose some convenient lower left corner of the stack as a "zero point" 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.

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

Package Selection Worksheet for a Three-Dimensional Lot Numbering System

Sample package in the sequence to be used for tare determination	Package location		
	Right	Up	Back
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
↓			

(continue if larger sample size is required)

Dimensions of stack = $\bar{R}$ $\bar{U}$ $\bar{B}$

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 numbers larger than this are not usable. Beginning at a random starting place in Appendix E, go down that column of Appendix E filling in the first column of the work table by using every random number 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 E, begin at the top of the next column. If all the dimensions of the stack are 10 or less, use one-digit columns of the random number table; if any

[2]This is the column headed "Pkg. No." in Block A of the worksheet.

dimension is greater than 10, but not greater than 100, use two-digit columns; if greater than 100, but not greater than 1000, use three-digit columns, and so on.

In the case of a three-dimensional lot numbering system, it is not necessary to ignore duplicates in the table since there is very little chance of duplicating all three numbers required. (Of course, if a set of three numbers is found to have been duplicated, it should be deleted and replaced by three additional random numbers.)

If any maximum dimension happens to be "two", a random selection can be made by tossing a coin rather than by using random numbers; or a selection may be based on identifying the number "one" with even random numbers found in the table and "two" with odd.

For example, suppose that the dimensions of the stack are 10 by 7 by 3. The official wants to select 10 packages at random. He or she needs three one-digit numbers to indicate the location in the stack of each of the 10 samples. Assume that the random starting place is the 22nd column and the 45th row on page 11 of Appendix E.

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.)

C.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 dice 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 Company[3]
P. O. Box 8711
San Jose, California 95155

Technovate[3]
910 Southwest 12th Avenue
Pompano Beach, Florida 33060

The random number dice could be used to get random numbers for the sample for serial lot-numbering systems if the lot contained 1000 packages or less, or for three-dimensional lot-numbering systems if no dimension were larger than 1000.

Other types of random number tables than Appendix E may be helpful in choosing a random sample especially in the instance of lot sizes for which N is the number 5 or smaller in the first digit. For example, consider a lot of 200 packages which is serially numbered 1 to 200. Using the random number table in Appendix E would require searching for three-digit numbers less than 200. Since the numbers 0 to 9 occur with equal frequency, many of the random numbers found by going

Completed example of package selection using 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	5	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
Dimensions of Stack =	10	7	3
	R	U	B

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

through the table must be rejected because they are larger than 200. 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 which correspond to N with a small first digit (e.g., N = 10, 25, 50, 100) are provided which reduce the time to search (and reject) many random numbers.

C.6. OTHER CONSIDERATIONS WHEN SELECTING THE SAMPLE

C.6.1. Selecting the Tare Sample

- The order in which random numbers come out of the random number table indicate those packages in the sample which are the tare sample.

  The worksheet provides a column labeled "Pkg. No." in Block A. The random numbers are recorded in this column in the order in which they come from the random number table. The testing official will want to select the packages in the order corresponding to a serial arrangement of the numbers. One way of doing this and not forgetting the order of the packages for the tare sample (which, if glass or aerosol, could amount to a large proportion of the sample) is to associate each random number with the number printed to the left of it on the worksheet in Block A (1 to 30) and to order or mark the packages which are selected with this latter number. This latter 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 C.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 will 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 package is the first package he or she should open for tare determination.

  It is very important, when testing glass or aerosol packages, 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.

- 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 official should collect or watch the collection of the dry tare components (empty container) if at all possible, with the major contribution to the tare weight (the can, cardboard box, etc.) 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 which will constitute the finished package (solder, ties, glue, labels, caps, etc.) may be selected from the lot without regard to rigorous random selection; but, such materials should be visually identical to and selected from the same batch as other such materials being used on the packaging line.

C.6.2. Selecting the Sample at Different Locations

- When the lot consists of packages on a retail shelf, if, while the official is choosing his sample, a customer should remove packages from the lot, the official should continue to choose the sample as if that missing package were not there in the first place (that is, select the next adjacent package).

- It is permissible to eliminate individual packages from the sample (and from the inspection lot) if they can be seen to be defective from visual examination alone, e.g., cut boxes, empty bottles, torn wrappers, etc. Such packages can be treated individually and should not be 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 while 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 convenient, the official may select another random number in order to determine which package to use to replace the defective one in the sample.

- 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. That is, if there were 24 packages on display and 220 packages in the storeroom, then 1/10 of the sample should be from packages on display and 9/10 of the sample from packages in the storeroom. If there are to be 30 packages in the sample, 3 should come from the display and 27 from the storeroom.

- When the lot consists of cartons in a storage area or warehouse, the random sample can be obtained by using the three-dimensional lot numbering system. However, it may be extremely difficult to select a random sample from a warehouse since the packages may be 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 which will comprise the sample. Each step will usually have a different number of units from which the pallet, carton, or package is chosen.

- 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 D: AUXILIARY TABLE FOR RANDOM STARTING PLACE

Table provided by James F. Filliben, Statistical Engineering Division, National Bureau of Standards. Derived from A Million Random Digits by the Rand Corporation, copyright, 1955, The Free Press.

(22,45)	(4,49)	(40, 7)	(44,20)	(21,45)	(17 42)	(10,26)	(27,26)	(20,31)	(1,13)	(18,42)	(50,20)
(26,44)	(50,38)	(23,35)	(9, 9)	(20,11)	(24,50)	(28,43)	(8,36)	(36,47)	(13,26)	(12,33)	(23,35)
(47,12)	(5,44)	(16,21)	(42,22)	(41, 2)	(1,20)	(33,34)	(43, 4)	(33,25)	(8,33)	(14, 2)	(12, 6)
(8,20)	(8, 9)	(47,30)	(47,48)	(5,30)	(18, 9)	(15,35)	(42,10)	(34, 8)	(23,20)	(32,48)	(32, 4)
(2,33)	(14,49)	(8,49)	(30,25)	(14,43)	(3,12)	(36,14)	(11, 3)	(29, 9)	(47,43)	(35,22)	(10, 6)
(4,24)	(31,15)	(50,16)	(22,21)	(33,13)	(41, 9)	(27,42)	(18,13)	(24,42)	(5,46)	(45,32)	(3, 1)
(42,18)	(19,14)	(11,27)	(35,27)	(32, 5)	(34,49)	(9,19)	(47,32)	(16, 5)	(47,12)	(6,31)	(42,22)
(2,38)	(28,41)	(8,43)	(19,19)	(37, 4)	(39,11)	(25,28)	(7,42)	(26, 4)	(20,50)	(7,26)	(4,26)
(14,49)	(29, 3)	(4,29)	(50,16)	(40, 7)	(20,35)	(15,46)	(37,21)	(37,48)	(1,35)	(48,36)	(28,35)
(28,15)	(22,41)	(5,25)	(5, 5)	(2, 8)	(43,38)	(19,23)	(6,14)	(47,43)	(32, 1)	(9, 1)	(28,48)
(40,27)	(10,19)	(48,29)	(15, 6)	(20,20)	(9, 5)	(43,23)	(19,12)	(34,42)	(38,34)	(23,42)	(12,35)
(9,41)	(38,44)	(49,30)	(49, 7)	(41, 3)	(35, 9)	(6,26)	(35,50)	(10, 2)	(19,11)	(7,50)	(9,18)
(29,11)	(20,14)	(9,39)	(18,35)	(9,46)	(16,14)	(36,48)	(50,13)	(8,47)	(44,43)	(29,37)	(34,12)
(38,10)	(21,19)	(30,33)	(11,13)	(5,15)	(37, 2)	(6,13)	(50,16)	(8,20)	(3,12)	(16,44)	(31,27)
(23,28)	(47,43)	(40,25)	(47,48)	(18,20)	(34,17)	(39, 8)	(24,13)	(6,22)	(37,31)	(14, 4)	(1,39)
(6,28)	(18,29)	(18,11)	(7, 8)	(31,10)	(49,28)	(43,42)	(19,16)	(41,26)	(6,42)	(1,36)	(26,42)
(14,17)	(38,37)	(35,37)	(35,34)	(21,27)	(34,43)	(50,10)	(11,12)	(13,30)	(8,33)	(15, 1)	(46,49)
(33,17)	(15,18)	(23,21)	(12,10)	(22,15)	(25,36)	(18,34)	(25,28)	(35,19)	(18,21)	(2,22)	(50,38)
(23,11)	(22, 3)	(5,18)	(24,34)	(18,48)	(20,22)	(10,31)	(31,45)	(47,43)	(29,39)	(35,23)	(19,35)
(39,47)	(47,31)	(38,31)	(1,39)	(7,26)	(47,20)	(17,14)	(44,15)	(3, 4)	(23,38)	(23,16)	(32,13)
(28,19)	(35,45)	(44, 9)	(16, 6)	(46, 3)	(26, 8)	(37, 7)	(9,21)	(46,38)	(15,42)	(33,46)	(24,18)
(5,27)	(29,28)	(34,25)	(44,48)	(42, 8)	(12,46)	(27,24)	(49,34)	(17,12)	(15,12)	(19,41)	(44,42)
(19,48)	(39,40)	(2,41)	(44,23)	(46,26)	(27, 4)	(32,22)	(43, 4)	(27, 3)	(6, 8)	(20,28)	(4, 9)
(15,17)	(17,19)	(45,29)	(21,16)	(34,27)	(15,29)	(8,19)	(41,32)	(29,48)	(14,30)	(27,11)	(17,49)
(9,38)	(43, 7)	(25,38)	(9,29)	(33, 3)	(38,38)	(27,16)	(2,17)	(3,16)	(9,24)	(25,19)	(9, 8)
(17, 9)	(44,49)	(23, 6)	(13,13)	(48,30)	(44,30)	(30,28)	(19,47)	(13,37)	(25,33)	(25,39)	(7,10)
(14,24)	(35,17)	(22,45)	(49,12)	(8,24)	(3,33)	(2,48)	(41,47)	(40,27)	(47,10)	(12,18)	(14, 1)
(19,27)	(26,21)	(49,37)	(2,48)	(1,48)	(31, 6)	(1,39)	(17,20)	(28, 6)	(42,26)	(3,18)	(16,18)
(34,42)	(30,17)	(21, 5)	(7,10)	(36,40)	(13,23)	(33,40)	(5,44)	(47, 5)	(19,39)	(24, 2)	(31,40)
(5,18)	(36,15)	(14,18)	(25, 5)	(15,50)	(18,13)	(22,48)	(28,26)	(48,32)	(32,23)	(16,26)	(8, 4)
(4,15)	(34,27)	(43,15)	(42,19)	(45,14)	(25, 1)	(15,37)	(50,29)	(32,28)	(36,22)	(1,11)	(19,37)
(1, 6)	(33,45)	(10,21)	(34,50)	(32, 6)	(46,34)	(35, 9)	(7, 9)	(46,39)	(30, 2)	(48,21)	(44,33)
(8,38)	(15,50)	(19,44)	(50,47)	(33,16)	(49,27)	(5,23)	(50,32)	(44,50)	(14, 2)	(29,46)	(6,43)
(9,27)	(18, 7)	(29,19)	(46,39)	(28,46)	(20,45)	(48,48)	(8,49)	(26,16)	(48,16)	(20,24)	(6,11)
(2,27)	(33,13)	(25,26)	(24,43)	(21,12)	(10,31)	(21,16)	(15,35)	(26,16)	(44,22)	(46,44)	(5,16)
(37,23)	(27,26)	(29,49)	(47,45)	(16,42)	(29,37)	(47,29)	(1,36)	(38,37)	(41,47)	(49,35)	(35, 5)
(27, 1)	(40,49)	(28,32)	(3,10)	(36,16)	(44,38)	(27,47)	(15,27)	(1, 7)	(25, 5)	(28, 4)	(28,41)
(32,37)	(23,36)	(20, 4)	(34,48)	(33,37)	(47,39)	(14,30)	(27,28)	(24, 5)	(44,11)	(29,36)	(14, 7)
(9,34)	(26,10)	(46,20)	(41,20)	(24, 4)	(13, 4)	(33,10)	(19,14)	(28, 8)	(42,41)	(3,41)	(2,30)
(1,19)	(37,35)	(10,25)	(17,37)	(23,10)	(31, 5)	(42,30)	(32, 3)	(22,37)	(17,18)	(3,25)	(1,13)
(25,38)	(14,10)	(25, 3)	(42,20)	(21,50)	(10, 9)	(24,23)	(10, 6)	(17,15)	(26,49)	(24,45)	(19,40)
(21,37)	(25, 8)	(48,49)	(39,19)	(42,42)	(18, 8)	(27,48)	(27,48)	(1,27)	(20,37)	(34, 6)	(28, 3)
(33,11)	(20,10)	(37,32)	(31,21)	(4,45)	(11,42)	(27,28)	(35, 1)	(50,10)	(47,26)	(13,23)	(35,31)
(13,26)	(28, 7)	(8, 2)	(2, 7)	(24,29)	(16,31)	(5,22)	(38,19)	(44,10)	(19,23)	(41,25)	(12,11)
(18,13)	(42, 7)	(19,40)	(6,48)	(46,39)	(6,10)	(40,24)	(29,23)	(38,23)	(8,18)	(27,37)	(32,22)
(31,12)	(46,33)	(26,31)	(15,23)	(19,39)	(9,33)	(5,28)	(17, 6)	(9,42)	(17, 7)	(2, 1)	(11,42)
(19,36)	(11,33)	(31,18)	(3,30)	(49,26)	(27, 9)	(48,44)	(30,19)	(19,38)	(18,41)	(9,42)	(46, 3)
(48, 8)	(3,14)	(32,28)	(50,48)	(43,33)	(7,22)	(25, 7)	(49,19)	(10,40)	(21,50)	(28,32)	(46,19)
(19,21)	(15,25)	(47,26)	(40,23)	(47,23)	(44, 9)	(45,23)	(31,30)	(19, 2)	(23, 9)	(38, 4)	(21,38)
(8,43)	(20,27)	(31,46)	(44,34)	(32,48)	(37,40)	(44,34)	(3, 5)	(36,45)	(34,21)	(23,21)	(25, 6)

(50,33)	(6,14)	(16,45)	(37,11)	(50,36)	(49,11)	(28,18)	(7,21)	(21,38)	(13, 9)	(47,41)	(11,21)
(31,16)	(44,37)	(21, 1)	(47, 9)	(49,15)	(23,20)	(25, 4)	(48,32)	(49,40)	(27,19)	(37, 2)	(14,22)
(44,11)	(28, 7)	(19,36)	(37, 6)	(42,43)	(5, 3)	(13,29)	(10,10)	(28,13)	(42,31)	(47, 6)	(2,31)
(4,46)	(6,14)	(9,48)	(37,50)	(47,37)	(35, 3)	(15,29)	(33,33)	(34,40)	(46,48)	(37,39)	(50,40)
(7,21)	(30,34)	(23,47)	(37,27)	(17,25)	(47,38)	(20, 1)	(41,45)	(30, 5)	(6,42)	(20,28)	(32, 2)
(23,32)	(34, 9)	(17,24)	(13,15)	(16,14)	(50,19)	(14, 7)	(19,24)	(3,25)	(17,26)	(36,26)	(15, 7)
(37, 2)	(28,11)	(35,11)	(18,47)	(46,11)	(31,18)	(5, 1)	(30,27)	(10,15)	(27,16)	(33,28)	(41,37)
(5,15)	(39,43)	(19,28)	(49,49)	(47,12)	(29,31)	(8,22)	(30,44)	(14, 9)	(44,36)	(7, 9)	(22,17)
(14,13)	(21,49)	(46,19)	(2,29)	(14,40)	(49, 7)	(9,33)	(31, 2)	(40,46)	(22,39)	(22,50)	(41,36)
(35,44)	(37,44)	(23,19)	(47, 6)	(21,47)	(40,33)	(46, 9)	(17,47)	(38,38)	(38, 5)	(14,31)	(31, 7)
(13,14)	(45,32)	(23,20)	(15,35)	(44,21)	(14,18)	(9,11)	(50,46)	(5, 3)	(28,40)	(2,24)	(43,15)
(27,11)	(35, 5)	(24,23)	(39,20)	(40,23)	(47, 3)	(9,31)	(31,45)	(16, 9)	(44,42)	(19,17)	(9,35)
(35,34)	(27,13)	(9,27)	(32,30)	(36,32)	(15, 7)	(49, 6)	(47,39)	(28,33)	(6, 6)	(41, 6)	(35,16)
(24,28)	(38, 3)	(11,24)	(9,46)	(27,40)	(17,23)	(19,38)	(35,30)	(6,50)	(33,16)	(32,15)	(49,17)
(37,27)	(40, 6)	(40,38)	(35,32)	(42,45)	(7,48)	(34,29)	(13, 3)	(26,14)	(9,23)	(38,18)	(29,11)
(29,13)	(13,28)	(15, 1)	(25,22)	(36,42)	(34,39)	(32,33)	(14,21)	(24,42)	(29,28)	(42,10)	(24,20)
(33,36)	(7, 9)	(28,24)	(49,39)	(45,32)	(50,45)	(7,33)	(38,47)	(50,31)	(49,25)	(17, 6)	(27,49)
(39,17)	(28,42)	(45,25)	(20,46)	(4,28)	(44,48)	(26,20)	(18,10)	(47,48)	(17,43)	(8, 4)	(27,45)
(17,16)	(9,20)	(38,45)	(23, 1)	(45,34)	(10, 1)	(34,50)	(35,42)	(4,30)	(14, 3)	(46,41)	(42,28)
(42, 1)	(40,42)	(28,28)	(42,23)	(15,32)	(9,17)	(4,16)	(40,15)	(36,24)	(3,35)	(34,12)	(27,36)
(24,16)	(41, 7)	(16, 7)	(45,35)	(1,23)	(25,29)	(38,20)	(43,29)	(30,43)	(29,31)	(17,30)	(18,36)
(34,23)	(44,22)	(15,25)	(23,25)	(18,18)	(36,17)	(20,15)	(5,34)	(49,14)	(9,11)	(44,41)	(29,44)
(11,44)	(16,41)	(29,31)	(44,19)	(45,18)	(30,16)	(24,42)	(7,15)	(19,47)	(7,26)	(50,43)	(27,19)
(22, 6)	(3,30)	(26,36)	(38,33)	(40,34)	(39,48)	(14,40)	(28,16	(13,10)	(37,20)	(28,13)	(35,34)
(28,43)	(44,48)	(32,38)	(41,35)	(8, 4)	(11,42)	(20,33)	(41,23)	(30,32)	(9, 2)	(44,41)	(4,30)
(43,39)	(43,44)	(12,13)	(7, 1)	(3, 2)	(2,38)	(15,47)	(17,44)	(15,14)	(10,32)	(27,14)	(35,24)
(13,35)	(17,19)	(17,12)	(37,12)	(33,36)	(41,26)	(4,12)	(39,14)	(23,37)	(4, 6)	(19,40)	(26,41)
(22,34)	(12,30)	(20, 2)	(19,34)	(20,26)	(6,30)	(25,29)	(19,29)	(48,49)	(49,11)	(6,14)	(14,27)
(26, 4)	(8,29)	(36,23)	(18,10)	(30,25)	(34,12)	(48,42)	(41,24)	(11,32)	(28,31)	(29,43)	(39,17)
(21, 1)	(40,49)	(15,15)	(5,50)	(36,41)	(35,36)	(9,31)	(25,36)	(9,10)	(47,18)	(11,41)	(23,21)
(12, 5)	(43,39)	(4,29)	(23,19)	(19,48)	(4,32)	(28,32)	(38,16)	(44,50)	(39,47)	(36,25)	(50,33)
(24,15)	(27,38)	(14,15)	(33,20)	(25,37)	(38, 1)	(47,48)	(14,13)	(45,18)	(32,44)	(37, 6)	(38,37)
(17,41)	(7,41)	(30,27)	(36,44)	(50,20)	(10, 4)	(3,22)	(20,30)	(32,49)	(3,30)	(33,12)	(16,36)
(19,30)	(10,26)	(49,40)	(31,18)	(1,20)	(21,11)	(11,13)	(16,45)	(46,12)	(4,40)	(44,38)	(22, 2)
(38,38)	(11,41)	(34, 1)	(12,10)	(44,42)	(41,38)	(3,49)	(11, 4)	(39,24)	(28,38)	(15,46)	(46,31)
(31,28)	(30,21)	(2,20)	(8,34)	(39,48)	(3,50)	(28,17)	(41,49)	(11,12)	(29, 7)	(13,19)	(48,40)
(30,14)	(6,35)	(31,20)	(5, 2)	(15,11)	(24,28)	(27,12)	(7,20)	(23, 2)	(14,32)	(25,13)	(49, 6)
(50,39)	(29,30)	(2,23)	(24,36)	(17,30)	(20,45)	(22,22)	(46,16)	(6,37)	(28,10)	(14,30)	(27,25)
(20, 8)	(38,42)	(16,16)	(36, 1)	(47,48)	(3, 1)	(13,46)	(12,14)	(15,17)	(25,24)	(12,30)	(2,29)
(5, 8)	(20, 7)	(27,12)	(10, 8)	(6,42)	(27, 6)	(15,27)	(50,27)	(1,43)	(44,45)	(44,39)	(47, 9)
(34,41)	(34,12)	(27,33)	(26, 5)	(46,11)	(7,25)	(20,30)	(7,47)	(50,46)	(13,30)	(13,43)	(11,23)
(5,15)	(50,15)	(4,19)	(25, 5)	(33,11)	(41,36)	(44,16)	(38,28)	(9,42)	(47, 5)	(2, 3)	(3,36)
(7,50)	(47, 7)	(41,36)	(24,34)	(12,18)	(14,47)	(11,24)	(27,31)	(48,20)	(31,25)	(14,47)	(43,19)
(23, 8)	(24,18)	(36,16)	(33,39)	(12,50)	(29,24)	(8,45)	(40,28)	(6,45)	(36,14)	(22,11)	(50,27)
(32,40)	(41,41)	(1, 6)	(3,48)	(46,21)	(15,41)	(39,21)	(46,20)	(38,16)	(37,49)	(25, 2)	(34,35)
(20,11)	(18,50)	(21,46)	(9,42)	(11,11)	(42, 5)	(9, 1)	(33,19)	(20,28)	(15,13)	(46, 1)	(24,10)
(20,49)	(29,46)	(40,49)	(42,50)	(30,19)	(14,33)	(6,13)	(48,35)	(14,27)	(2,41)	(37,49)	(41,37)
(9,38)	(15,39)	(47, 4)	(1,25)	(30,31)	(45,17)	(28,35)	(49,36)	(46,25)	(10,47)	(7,11)	(48, 2)
(3,15)	(24,20)	(14, 4)	(27,19)	(3,29)	(21,17)	(46,34)	(15,49)	(26,11)	(6, 9)	(47,18)	(26,24)
(2,23)	(5,39)	(44,19)	(21,32)	(23,21)	(19,21)	(44,20)	(19,19)	(25, 5)	(36,15)	(3, 5)	(25,27)

APPENDIX E: RANDOM NUMBER TABLE

TABLE OF RANDOM DIGITS

31000	63837	17813	08076	19164	95508	17513	29416	61238	25818
87014	83331	56364	32768	85680	08844	59844	68794	32783	60318
47293	97023	35804	69886	47494	94574	45842	67221	77115	43398
33898	89236	06100	68848	08674	87786	42425	92091	86274	82166
26877	95856	65227	25165	01752	99463	15216	28719	04716	80246
53984	87855	70753	80386	78600	39244	76967	83263	57849	85890
97809	03548	00574	21143	11605	30245	87395	80966	28721	11095
85683	79483	74858	87491	57785	61270	51111	50490	40940	02832
07758	57784	22934	17165	37776	33361	79191	97398	40881	98552
13995	74006	90843	85761	89037	13567	67089	47435	75156	70217
89630	94575	64517	80897	04861	50564	15287	94279	69154	75473
20355	08661	11092	19682	84287	23597	48246	74325	66320	90155
13496	74367	32701	87819	29050	90959	99765	59374	45204	87750
68419	49317	30340	62744	45214	79826	34043	73218	72788	26143
61481	09786	08768	93715	43847	68901	51249	35382	67776	06271
71877	53924	09630	62975	64470	46832	40591	23477	21063	31229
99283	86530	86819	38955	91744	89632	64623	84986	85990	47639
09047	83453	12775	32000	60098	98862	93422	66212	86413	82884
83724	89682	53950	41500	16023	83862	88274	68301	99673	40945
56126	46618	87708	91994	38384	27047	91550	18903	45535	45586
13810	51503	55122	22997	82556	22697	54985	64852	58775	66737
85630	22794	81623	10927	52252	27384	03122	17454	03250	23232
93350	28643	39097	00914	69844	06450	32818	88752	28722	94656
05002	71178	15414	99874	58046	35461	56349	81936	14964	83638
70358	57182	45747	30830	70542	25932	16298	23521	72454	11640
98169	51114	18115	40718	46082	75847	15678	22842	44615	97810
28010	95831	94028	57041	75137	55128	99785	33467	33834	04860
05576	47156	09300	11197	97670	20064	98145	84774	07907	10992
80748	66311	79421	00202	68501	40422	07368	26795	24358	78969
39746	23690	67845	83962	09451	21501	75317	09049	69440	16137
39380	72397	88106	07851	67756	58042	44218	52775	49082	54400
55865	70318	58189	35340	91500	80940	39231	54836	18038	03557
34223	72744	83926	40078	80791	42723	68340	47452	17443	69289
91312	44474	09925	41416	96671	11213	60979	04130	72380	73582
51010	08021	53914	37499	40228	92606	07225	18014	71063	50111
48890	58264	18790	91535	04933	56656	76389	37904	98017	07663
24876	93198	77444	53782	48866	65614	11410	90637	63675	43554
49408	42923	28162	09789	15155	66742	66785	79065	93573	19853
56307	90901	18117	36505	01598	68997	96338	40823	96247	55573
48320	09322	13457	84931	54701	14878	05422	65358	85636	31948
51083	00619	05548	25431	15175	82428	00637	41814	68871	31688
43249	71593	85595	59834	01488	06917	32858	80134	01832	25905
00370	17413	75537	79824	24428	28941	58659	66731	99940	27156
55737	45462	12484	64858	43581	06220	07507	39119	38024	99720
39551	38058	10445	18463	80812	51243	22351	63266	94057	06573
02369	11289	99499	32922	88429	90484	42010	53308	33206	36137
92788	62546	26147	83529	10012	77611	78925	86071	66344	35705
98650	95898	74254	45173	17430	73882	03411	88447	43279	35057
95591	85858	51058	26140	00995	16881	87372	72646	18796	58537
67853	23563	41063	63355	72454	16016	72229	54720	09846	81392

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32942	95416	42339	59045	26693	49057	87496	20624	14819	48667
07410	99859	83828	21409	29094	65114	36701	25762	12827	45692
59981	68155	45673	76210	58219	45738	29550	24736	09574	35036
46251	25437	69654	99716	11563	08803	86027	51867	12116	38469
65558	51904	93123	27887	53138	21488	09095	78777	71240	87225
99187	19258	86421	16401	19397	83297	40111	49326	81686	40601
35641	00301	16096	34775	21562	97983	45040	19200	16383	68739
14031	00936	81518	48440	02218	04756	19506	60695	88494	58501
60677	15076	92554	26042	23472	69869	62877	19584	39576	18290
66314	05212	67859	89356	20056	30648	87349	20389	53805	85243
20416	87410	75646	64176	82752	63606	37011	57346	69512	56464
28701	56992	70423	62415	40807	98086	58850	28968	45297	80419
74579	33844	33426	07570	00728	07079	19322	56325	84819	48754
62615	52342	82968	75540	80045	53069	20665	21282	07768	60375
93945	06293	22879	08161	01442	75071	21427	94842	26210	95002
75689	76131	96837	67450	44511	50424	82848	41975	71663	79656
02921	16919	35424	93209	52133	87327	95897	65171	20376	13475
14295	34969	14216	03191	61647	30296	66667	10101	63203	75144
05303	91109	82403	40312	62191	67023	90073	83205	71344	96216
57071	90357	12901	08899	91039	67251	28701	03846	94589	88403
78471	57741	13599	84390	32146	00871	09354	22745	65806	78187
89242	79337	59293	47481	07740	43345	25716	70020	54005	23973
14955	59592	97035	80430	87220	06392	79028	57123	52872	94991
42446	41880	37415	47472	04513	49494	08860	08038	43624	46013
18534	22346	54556	17558	73689	14894	05030	19561	56517	96479
39284	33737	42512	86411	23753	29690	26096	81361	93099	33868
33922	37329	89911	55876	28379	81031	22058	21487	54613	81052
78355	54013	50774	30666	61205	42574	47773	36027	27174	44830
08845	99145	94316	88974	29828	97069	90327	61842	29604	47994
01769	71825	55957	98271	02784	66731	40311	88495	18821	12463
17639	38284	59478	90409	21997	56199	30068	82800	69692	45133
05851	58653	99949	63505	40409	85551	90729	64938	52403	56841
42396	40112	11469	03476	03328	84238	26570	51790	42122	40874
13318	14192	98167	75631	74141	22369	36757	89117	54998	87031
60571	54786	26281	01855	30706	66578	32019	65884	58485	10909
09531	81853	59334	70929	03544	18510	89541	13555	21168	81318
72865	16829	86542	00396	20363	13010	69645	49608	54738	17894
56324	31093	77924	28622	83543	28912	15059	80192	83964	61904
78192	21626	91399	07235	07104	73652	64425	85149	75409	67104
64666	34767	97298	92708	01994	53188	78476	07804	62404	34828
82201	75694	02808	65983	74373	66693	13094	74183	73020	31086
15360	73776	40914	85190	54278	99054	62944	47351	89098	26735
68142	67957	70896	37983	20487	95350	16371	03426	13895	42170
19138	31200	30616	14639	44406	44236	57360	81644	94761	92813
28155	03521	36415	78452	92359	81091	56513	88321	97910	22235
87971	29031	51780	27376	81056	86155	55488	50590	74514	58791
58147	68841	53625	02059	75223	16783	19272	61994	71090	78416
18875	52809	70594	41649	32935	26430	82096	01605	65846	65228
75109	56474	74111	31966	29969	70093	98901	84550	25769	82586
35983	03742	76822	12073	59463	84420	15868	99505	11426	62723

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12651	61646	11769	75109	86996	97669	25757	32535	07122	76763
81769	74436	02630	72310	45049	18029	07469	42341	98173	79260
36737	98863	77240	76251	00654	64688	09343	70278	67331	98729
82861	54371	76610	94934	72748	44124	05610	53750	95938	01485
21325	15732	24127	37431	09723	63529	73977	95218	96074	42138
74146	47887	62463	23045	41490	07954	22597	60012	98866	90959
90759	64410	54179	66075	61051	75385	51378	08360	95946	95547
55683	98078	02238	91540	21219	17720	87817	41705	95785	12563
79686	17969	76061	83748	55920	83612	41540	86492	06447	60568
70333	00201	86201	69716	78185	62154	77930	67663	29529	75116
14042	53536	07779	04157	41172	36473	42123	43929	50533	33437
59911	08256	06596	48416	69770	68797	56080	14223	59199	30162
62368	62623	62742	14891	39247	52242	98832	69533	91174	57979
57529	97751	54976	48957	74599	08759	78494	52785	68526	64618
15469	90574	78033	66885	13936	42117	71831	22961	94225	31816
18625	23674	53850	32827	81647	80820	00420	63555	74489	80141
74626	68394	88562	70745	23701	45630	65891	58220	35442	60414
11119	16519	27384	90199	79210	76965	99546	30323	31664	22845
41101	17336	48951	53674	17880	45260	08575	49321	36191	17095
32123	91576	84221	78902	82010	30847	62329	63898	23268	74283
26091	68409	69704	82267	14751	13151	93115	01437	56945	89661
67680	79790	48462	59278	44185	29616	76531	19589	83139	28454
15184	19260	14073	07026	25264	08388	27182	22557	61501	67481
58010	45039	57181	10238	36874	28546	37444	80824	63981	39942
56425	53996	86245	32623	78858	08143	60377	42925	42815	11159
82630	84066	13592	60642	17904	99718	63432	88642	37858	25431
14927	40909	23900	48761	44860	92467	31742	87142	03607	32059
23740	22505	07489	85986	74420	21744	97711	36648	35620	97949
32990	97446	03711	63824	07953	85965	87089	11687	92414	67257
05310	24058	91946	78437	34365	82469	12430	84754	19354	72745
21839	39937	27534	88913	49055	19218	47712	67677	51889	70926
08833	42549	93981	94051	28382	83725	72643	64233	97252	17133
58336	11139	47479	00931	91560	95372	97642	33856	54825	55680
62032	91144	75478	47431	52726	30289	42411	91886	51818	78292
45171	30557	53116	04118	58301	24375	65609	85810	18620	49198
91611	62656	60128	35609	63698	78356	50682	22505	01692	36291
55472	63819	86314	49174	93582	73604	78614	78849	23096	72825
18573	09729	74091	53994	10970	86557	65661	41854	26037	53296
60866	02955	90288	82136	83644	94455	06560	78029	98768	71296
45043	55608	82767	60890	74646	79485	13619	98868	40857	19415
17831	09737	79473	75945	28394	79334	70577	38048	03607	06932
40137	03981	07585	18128	11178	32601	27994	05641	22600	86064
77776	31343	14576	97706	16039	47517	43300	59080	80392	63189
69605	44104	40103	95635	05635	81673	68657	09559	23510	95875
19916	52934	26499	09821	87331	80993	61299	36979	73599	35055
02606	58552	07678	56619	65325	30705	99582	53390	46357	13244
65183	73160	87131	35530	47946	09854	18080	02321	05809	04898
10740	98914	44916	11322	89717	88189	30143	52687	19420	60061
98642	89822	71691	51573	83666	61642	46683	33761	47542	23551
60139	25601	93663	25547	02654	94829	48672	28736	84994	13071

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42902	51104	38993	54071	75033	43897	24684	62233	05749	76653
82989	95401	97093	57790	09271	05895	27692	65558	28890	75645
13523	66327	39522	83279	50432	88392	37826	81599	97612	34122
74785	72548	36886	97749	52364	78430	15990	86418	53689	73170
77739	44753	03957	53267	13225	89471	59481	53923	52588	54986
58236	98093	81969	21510	20727	91655	23601	77178	43468	77172
94641	38922	76016	66041	92109	76430	07105	45987	62177	37542
15317	99242	46970	58119	15178	10125	89295	83401	28737	53214
00624	09824	83319	26428	69711	71980	77666	57012	83722	06961
23295	02389	05795	70981	05664	32846	99935	81786	90285	03818
70292	13217	90859	05792	09833	49409	45496	62194	98232	59969
08550	22580	43519	51755	50308	68330	70244	27806	33662	90457
94981	10727	29544	37001	02751	82481	33622	89729	10488	54507
70318	46657	73496	92074	63918	13428	13249	68163	31082	72138
27510	92421	43020	79733	81369	11801	43094	91733	79865	67010
41289	29535	33408	05708	76999	37772	97740	44905	16840	25538
37586	71952	19967	77327	45052	16811	52264	09700	08766	08450
65737	05451	24726	95840	89663	37418	31034	44631	02044	89446
87473	53058	80611	24464	50379	93555	80327	29829	75884	69962
89920	40997	03736	00992	80443	12071	57996	42605	92034	89189
10203	39157	90207	07120	19280	37862	96041	66652	05173	59475
63864	57186	93586	52497	32459	85507	19646	80758	31519	71022
45006	51623	30675	56395	67037	33850	94000	57166	88739	92350
01839	83286	87159	72173	69624	75457	95469	48064	31695	17608
07708	41627	62416	05579	87013	84309	56068	84979	78592	36446
17655	18629	94121	20967	82561	65520	87874	72484	86640	33610
96137	55079	15672	21474	22403	74557	10290	39575	62266	10125
66495	22010	73641	70391	31391	43927	45219	38479	80100	82717
54585	37425	12794	71143	65025	74706	30555	42290	45357	08567
28180	01067	68577	99878	01960	86209	95045	62490	34554	65505
44655	45433	72815	11383	27507	80064	26860	44549	42538	48425
31321	57930	02748	46178	27490	65081	97037	67297	54273	67483
36218	26166	64389	39466	53435	89404	45328	34152	24787	98162
06853	28955	15516	22467	54482	70997	37271	13166	32827	29958
45231	95235	00120	85500	41753	36053	04285	77365	33273	97811
60484	63181	83125	42402	86905	40988	25091	68407	18356	62600
83577	81518	87638	08719	84819	15068	60067	48628	46522	78010
09724	39466	80440	69636	37481	20907	90064	06280	57942	71723
58504	66886	64596	23484	25596	43400	04787	54631	05421	50230
37033	02248	28174	29215	51118	04863	23752	10000	33331	62358
28026	12852	46235	15058	00222	26478	73671	81592	18436	67676
12831	55496	60299	47364	52600	02906	93295	27011	42904	33856
14507	71736	33817	42164	89793	67645	06609	22483	49017	99946
82424	22539	73202	32091	97375	11126	75877	89720	88213	65129
59133	35497	25135	24968	93294	12442	89020	11700	42936	43010
72031	14923	44610	70690	35644	97897	16835	41673	63777	90758
65161	59905	40133	95680	78737	93726	95312	18215	20184	84289
50062	64153	20669	81461	80140	88536	24552	78781	39807	00018
18116	19026	22965	39908	30649	91235	27259	08470	77321	12795
29105	00954	71562	10193	41802	53790	85828	60565	09835	42761

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43398	79666	37687	36431	34822	00779	38828	71137	85054	64660
78711	15270	42232	87128	31711	77482	85873	17317	94357	78210
54489	52503	11005	00067	23146	44973	39257	65815	13929	77081
17324	40078	14214	19160	25276	05125	52020	97099	77116	45921
67297	25163	16386	62687	07398	18963	60035	35598	14404	14872
56959	16184	32709	57507	92221	82925	46064	94665	73523	23638
78207	34228	39440	67765	80627	08869	05514	24215	65237	82139
99508	47528	01328	67220	50824	47847	69726	75453	08780	53120
66199	99811	13887	31301	41034	63717	10310	33607	01858	28266
91987	73491	22639	94096	01702	48093	35976	93334	17638	65818
80125	84984	47804	90908	11106	43995	83182	39647	41504	23286
69743	16618	59364	73113	89143	89412	39331	84989	92091	01383
41686	85487	91526	28591	54635	77149	59117	30291	68266	65760
80967	75537	81999	02257	62232	00956	24954	88932	90733	35767
24148	95247	12340	39407	71596	53961	61089	68699	38891	87153
22989	64262	12716	32910	32303	18783	65166	56622	93342	14032
54147	01638	95954	66666	30544	67089	04524	19251	57440	69100
07529	10668	23743	02743	10252	47893	83969	54252	47327	31685
36379	13588	44587	31015	34971	25146	33188	05218	17157	65663
38653	73761	61363	95667	03372	35800	58711	15872	33342	02963
72327	65811	53782	01608	38741	58353	51594	48982	85028	75444
41133	06312	13340	18870	27204	83187	91970	91498	17234	52283
15039	81095	50787	28452	61100	39538	25225	92624	18517	77361
40499	67587	16761	25929	43836	43466	80409	95407	46777	22668
46910	72907	18515	12710	11580	52823	95769	71506	39644	66877
15009	81751	07942	14046	54993	68001	13782	91933	61130	61752
10538	10295	62995	16527	55334	05736	92168	35393	01026	26984
70204	91225	78307	55577	78715	54507	21486	26920	52995	98095
30403	98849	55318	99947	23625	74643	85157	45893	49287	03567
75147	49930	47054	08485	91397	25614	83669	08353	61573	49629
20770	53498	05412	19184	25997	06100	27128	43137	77812	13101
51096	90416	18721	42390	31517	28366	30073	89021	40881	36162
05027	43924	37581	31418	57010	05808	75544	68156	75440	64496
22013	11299	76690	92730	10867	12748	58655	44844	11933	16752
50232	30821	45382	85723	15635	85910	19874	61262	74598	41321
20724	99075	91270	13936	74962	15346	05181	52254	42138	18237
65692	61084	48856	34766	09098	87381	29763	65051	91174	80750
81215	08824	06387	10900	83463	19773	83029	81689	66067	38729
86127	96878	53819	10715	67213	53160	17249	44596	76354	33601
26483	16992	89421	15216	71632	83429	96263	16342	15595	48978
84697	87543	67935	72389	18299	93559	90668	86972	42632	40502
89691	53802	42595	31089	20914	80542	96241	14487	84488	74117
20295	92548	68410	15006	02091	78176	67889	32552	62792	30147
98925	64297	94922	26349	58805	55911	80640	74650	71207	14412
53560	52945	68649	31696	69387	62573	15635	23958	75948	59883
45034	92695	98157	83536	55140	91189	98557	21505	89477	32010
35222	86197	20082	60378	05392	41064	08418	28472	39593	19710
08071	77462	20243	55151	02607	78441	12897	76800	62801	62770
54802	07781	29975	44720	62534	16601	78043	70078	13691	09599
84209	92329	32234	11385	09067	99793	84549	50498	13340	41986

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07018	31172	12572	23968	55216	85366	56223	09300	94564	18712
52444	65625	97918	46794	62370	59344	20149	17596	51669	47429
72161	57299	87521	44351	99981	55008	93371	60620	66662	27036
17918	75071	91057	46829	47992	26797	64423	42379	91676	75127
13623	76165	43195	50205	75736	77473	07268	31330	07337	55901
27426	97534	89707	97453	90836	78967	00704	85734	21776	85764
96039	21338	88169	69530	53300	29895	71507	28517	77761	17244
68282	98888	25545	69406	29470	46476	54562	79373	72993	98998
54262	21477	33097	48125	92982	98382	11265	25366	06636	25349
66290	27544	72780	91384	47296	54892	59168	83951	91075	04724
53348	39044	04072	62210	01209	43999	54952	68699	31912	09317
34482	42758	40128	48436	30254	50029	19016	56837	05206	33851
99268	98715	07545	27317	52459	75366	43688	27460	65145	65429
95342	97178	10401	31615	95784	77026	33087	65961	10056	72834
38556	60373	77935	64608	28949	94764	45312	71171	15400	72182
39159	04795	51163	84475	60722	35268	05044	56420	39214	89822
41786	18169	96649	92406	42773	23672	37333	85734	99886	81200
95627	30768	30607	89023	60730	31519	53462	90489	81693	17849
98738	15548	42263	79489	85118	97073	01574	57310	59375	54417
75214	61575	27805	21930	94726	39454	19616	72239	93791	22610
73904	89123	19271	15792	72675	62175	48746	56084	54029	22296
33329	08896	94662	05781	59187	53284	28024	45421	37956	14252
66364	94799	62211	37539	80172	43269	91133	05562	82385	91760
68349	16984	86532	96186	53893	48268	82821	19526	63257	14288
19193	99621	66899	12351	72438	99839	24228	32079	53517	18558
49017	23489	19172	80439	76263	98918	59330	20121	89779	58862
76941	77008	27646	82072	28048	41589	70883	72035	81800	50296
55430	25875	26446	25738	32962	24266	26814	01194	48587	93319
33023	26895	65304	34978	43053	28951	22676	05303	39725	60054
87337	74487	83196	61939	05045	20405	69324	80823	20905	68727
81773	36773	21247	54735	68996	16937	18134	51873	10973	77090
74279	85087	94186	67793	18178	82224	17069	87880	54945	73489
34968	76028	54285	90845	35464	68076	15868	70063	26794	81386
99696	78454	21700	12301	88832	96796	59341	16136	01803	17537
55282	61051	97260	89829	69121	86547	62195	72492	33536	60137
31337	83886	72886	42598	05464	88071	92209	50728	67442	47529
94128	97990	58609	20002	76530	81981	30999	50147	93941	80754
06511	48241	49521	64568	69459	95079	42588	98590	12829	64366
69981	03469	56128	80405	97485	88251	76708	09558	86759	15065
23701	56612	86307	02364	88677	17192	23082	00728	78660	74196
09237	24607	12817	98120	30937	70666	76059	44446	94188	14060
11007	45461	24725	02877	74667	18427	45658	40044	59484	59966
60622	78444	39582	91930	97948	13221	99234	99629	22430	49247
79973	43668	19599	30021	68572	31816	63033	14597	28953	21162
71080	71367	23485	82364	30321	42982	74427	25625	74309	15855
09923	26729	74573	16583	37689	06703	21846	78329	98578	25447
63094	72826	65558	22616	33472	67515	75585	90005	19747	08865
19806	42212	41268	84923	21002	30588	40676	94961	31154	83133
17295	74244	43088	27056	86338	47331	09737	83735	84058	12382
59338	27190	99302	84020	15425	14748	42380	99376	30496	84523

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29257	36060	81080	67493	23666	22251	17616	60716	77125	18653
04426	95304	83272	18379	46498	60045	80649	35179	03185	57068
72622	55513	82844	85553	16852	57931	84063	57516	46529	47030
63755	08166	33097	46244	16769	48531	56618	90035	88363	04097
23931	55916	48477	33067	76572	84835	96208	68558	23560	89245
96443	13697	61186	63971	20547	14846	77137	62636	88927	34322
33595	83707	92545	83866	06895	28019	08547	04275	79277	28833
87400	72301	05172	25637	13665	86725	45970	42670	35291	22685
10716	35521	73850	99275	97475	11064	93492	05362	57562	99582
81465	80905	77978	42899	65518	48688	96755	83554	76916	15224
77706	53575	16463	00350	44697	94868	22697	33740	60701	04034
75622	35864	56564	40277	66044	78417	52968	52982	82340	92970
18418	16826	26355	51841	01235	15986	65898	74181	51391	11313
02205	51273	87582	80276	88583	30633	50721	65017	48735	04476
08345	03180	15659	86285	09579	07969	17850	88197	14309	25013
43734	89733	87697	28098	70926	22790	79293	01093	72673	60257
89981	80872	87829	56857	78208	85949	60249	30159	45499	29735
20660	70109	01273	42633	77445	02439	03144	12100	12971	59574
48210	18773	36169	60470	37941	68015	76627	38973	81699	34262
65433	21735	36444	40569	32023	60078	31045	99679	76253	81056
09638	39323	55045	58988	30967	16461	57491	58625	14327	19825
89418	30419	67738	14877	17948	30083	54764	62024	68310	21207
23083	08913	59531	11403	96757	23468	57382	48057	70725	59933
30343	01516	78510	15138	49538	58588	06080	23844	44412	87882
18284	64484	57502	80120	95894	34977	74098	73551	81743	58364
47943	40974	82162	34485	44930	27794	66180	76055	69035	91186
55480	50090	91328	09979	23824	71199	65640	69121	12071	46595
29905	46328	06091	12419	35540	09817	63102	80393	76848	09779
82268	73981	37205	65249	07751	92537	92368	09251	29892	53919
42183	74789	78645	68686	12399	27592	36651	05904	45764	11336
82178	50120	06396	62927	27126	40350	87365	28918	39266	22549
49836	15424	10577	89926	89407	37622	38430	48356	93062	86591
96881	32775	85851	60822	08530	83330	99819	24740	34199	90176
20414	02812	65040	27108	34291	90243	18207	85800	53786	28723
62174	64315	82589	31761	26476	95984	54304	13061	77554	92988
48808	13755	89592	43057	35053	58853	20086	12130	90105	26139
93162	69261	87781	82538	75030	08496	25862	41090	06267	07824
81009	59154	63054	77841	35348	61706	27750	03274	64051	62435
11796	19222	73310	68903	54526	56338	54017	47320	67925	40813
48728	67741	07718	37592	95126	68160	55907	46168	06840	96853
73347	09803	63349	39332	23487	69045	51759	99114	86318	60963
34704	15020	45067	29373	24970	94427	23023	88559	65920	94063
24147	47285	01070	86152	20380	13113	60138	69612	38184	41601
38113	53850	17580	01850	33698	60239	84065	82019	52464	11886
01435	59660	45587	96635	57407	97292	15584	05498	54391	33149
76230	93764	38424	43810	11252	02843	64856	71551	66186	36921
76698	49005	35125	73104	93675	83189	38168	69103	75653	64780
21081	41735	47975	16487	37540	89936	16311	78716	51188	87349
25671	32206	93142	93930	57886	14113	18177	97474	32669	21337
03245	76312	63143	57914	10925	61894	91043	64156	61020	55339

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12304	04213	03857	77012	84959	53863	21679	49848	20212	95997
59502	54256	54169	18949	00578	72749	86070	61699	19657	21066
52525	24721	81450	99816	07524	29159	99127	49280	66476	22569
06066	38128	36539	68551	74800	30921	23803	32781	20508	10456
31362	41206	88773	78930	14709	25123	82601	48698	86804	39779
55291	39114	43274	08119	42433	53045	29083	18310	02445	83490
51077	99516	90497	26100	79144	28324	78290	22654	79424	93171
29369	93401	32750	04395	63773	29493	73060	05438	78848	21222
42533	89580	38883	55304	05990	22509	58052	94655	59881	73803
04754	07817	51857	38035	00758	84795	46887	37543	12070	01151
32520	68082	07089	28568	15498	00217	74945	29306	71156	07467
18689	25625	09537	43720	39550	47209	02896	40180	52349	02624
57766	90922	46815	02604	10651	47538	30491	39659	19233	00997
16644	40236	98798	16895	47562	30781	89366	72890	83027	49302
54973	61336	84051	15680	61130	44605	42552	09081	57256	55053
18843	01926	08340	63318	39291	68949	86588	81732	61205	98340
30789	48386	59732	94241	28859	07370	25804	52349	20145	54183
23835	05112	17169	92771	81220	68367	14568	66179	63268	15912
99348	87514	12386	12568	79923	56581	59255	48255	03675	88717
52403	25537	61636	84602	75830	34897	64019	80421	94358	83868
94954	12924	25669	91119	51663	92889	25249	10664	31461	37253
28337	02935	11644	94210	85920	78117	31536	38256	97799	78542
02045	59831	38770	48734	87524	74387	85480	33475	43352	00890
39668	61855	36871	50775	30592	57143	17381	68856	25853	35041
77174	97729	23913	48357	63308	16090	51690	54607	72407	55538
84205	12639	79348	36085	27973	65157	07456	22255	25626	57054
31893	11224	92074	54641	53673	54421	18130	60103	69593	49464
82986	90226	06873	21440	75593	41373	49502	17972	82578	16364
06252	31044	12478	37622	99659	31065	83613	69889	58869	29571
39097	59195	57175	55564	65411	42547	70457	03426	72937	83792
54053	73645	91616	11075	80103	07831	59309	13276	26710	73000
92640	43265	78025	73539	14621	39044	47450	03197	12787	47709
95234	80109	27587	67228	80145	10175	12822	86687	65530	49325
48122	50637	16690	20427	04251	64477	73709	73945	92396	68263
89174	38509	70183	58065	65489	31833	82093	16747	10386	59293
16862	18929	90730	35383	15679	99742	50866	78028	75573	67257
76054	03096	10934	93242	13431	24590	02770	48582	00906	58595
39901	38669	82462	30166	79613	47416	13389	80268	05085	96666
39221	64403	27463	10433	07606	16285	93699	60912	94532	95632
14704	78488	02979	52997	09079	92709	90110	47506	53693	49892
35052	59679	46888	69929	75233	52507	32097	37594	10067	67327
01514	33319	53638	83161	08289	12639	08141	12640	28437	09268
59723	91330	82433	61427	17239	89160	19666	08814	37841	12847
75249	58952	35766	31672	50082	22795	66948	65581	84393	15890
82558	71239	10853	42581	08792	13257	61973	24450	52351	16602
80822	66731	20341	27398	72906	63955	17276	10646	74692	48438
41067	39859	54458	90542	77563	51839	52901	53355	83281	19177
13008	65442	26337	66530	16687	35179	46560	00123	44546	79896
36084	99076	34314	23729	85264	05575	96855	23820	11091	79821
37741	50156	28603	10708	68933	34189	92166	15181	66628	58599

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00958	98267	66194	28926	99547	16625	45515	67953	12108	57846
30346	26957	78240	43195	24837	32511	70880	22070	52622	61881
14056	57841	00833	88000	67299	68215	11274	55624	32991	17436
96789	22551	12111	86683	61270	58036	64192	90611	15145	01748
12633	15075	47189	99951	05755	03834	43782	90599	40282	51417
25893	57092	76396	72486	62423	27618	84184	78922	73561	52818
13092	50817	46409	17469	32483	09083	76175	19985	26309	91536
72872	54109	74626	22111	87286	46772	42243	68046	44250	42439
20724	19944	34450	81974	93723	49023	58432	67083	36876	93391
37009	52173	36327	72135	33005	28701	34710	49359	50693	89311
25961	70386	74185	77536	84825	09934	99103	09325	67389	45869
73962	47022	12296	41623	62873	37943	25584	09609	63360	47270
63164	76372	90822	60280	88925	99610	42772	60561	76873	04117
05366	00082	72121	79152	96591	90305	10189	79778	68016	13747
15902	61363	95268	41377	25684	08151	61816	58555	54305	86189
53845	17851	92603	09091	75884	93424	72586	88903	30061	14457
31694	55633	18813	90291	05275	01223	79607	95426	34900	09778
23016	96567	38840	26903	28624	67157	51986	42865	14508	49315
17292	18430	05959	33836	53758	16562	41081	38012	41230	20528
75465	99837	85141	21155	99212	32685	51403	31926	69813	58781
89013	86492	75047	59643	31074	38172	03718	32119	69506	67143
44551	77837	30752	95260	68032	62871	58781	34143	68790	69766
49675	13139	22986	82575	42187	62295	84295	30634	66562	31442
40789	73539	99439	86692	90348	66036	48399	73451	26698	39437
64086	82765	20389	93029	11881	71685	65452	89047	63669	02656
79143	31528	39249	05173	68256	36359	20250	68686	05947	09335
28231	07703	96777	33605	29481	20063	09398	01843	35139	61344
76327	50155	04860	32918	10798	50492	52655	33359	94713	28393
05428	65225	64285	86579	77447	75313	35762	45824	21535	48707
56800	69853	75583	38682	55733	98453	35129	73541	62087	36549
96180	50261	88659	11717	88909	87891	16709	97814	26600	79266
52712	95148	66393	07111	89741	03758	42184	67000	66680	61277
76869	19027	12764	32712	60671	98845	81227	38052	48243	91867
50472	24399	17313	79665	07409	73900	66673	58861	08168	10289
77168	64382	26927	54318	51043	03483	76777	27319	78196	16909
79482	10156	87785	49603	85048	63090	60719	29756	10696	75713
97826	82559	69027	41569	05422	47286	97825	15559	43482	07676
00872	36839	01840	14860	76529	55890	12228	33910	26878	88758
68457	71054	94300	18582	55813	26346	68685	24920	36374	87702
35973	75910	16921	48284	48074	01401	10518	25359	52702	82966
32091	50229	65799	13777	93030	53615	17057	07212	75930	56604
81440	18180	68025	89261	65881	32138	73735	78459	74164	18466
83893	89983	95140	40089	21441	39173	46895	16136	92301	33754
64000	19357	74288	60608	49826	78374	72191	94337	24234	44821
48420	68527	28646	44721	81925	48579	35499	63475	95235	51410
96237	34204	08890	41795	28507	83735	82390	49173	80738	89279
13429	41773	59936	30327	76898	96866	22721	96619	20297	01714
20753	53940	49246	73092	81744	00189	60064	57631	77199	82742
63752	93547	77926	16709	05242	91269	52190	47481	82784	61238
44413	49199	55899	09790	70636	19057	51986	69657	97293	47729

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57278	28133	04340	19889	27266	77468	02509	27534	00342	30727
97953	43227	41110	86887	19559	64945	54520	90528	18850	43610
07431	45121	73187	80431	57245	77311	44596	23531	63637	47042
20930	54735	95568	86799	49721	89049	01791	81084	03284	24096
78003	86322	23893	19483	18624	78634	31967	06395	34924	67283
48541	02641	89681	97881	69919	24170	85386	25834	75946	90965
52684	87995	43702	10623	95580	75795	59360	87848	83250	44168
44032	67360	54462	31774	01629	03406	81878	92801	27984	89892
40757	07266	13231	93527	51509	19550	24785	11136	35905	44879
42290	21749	34505	46547	03354	83574	17762	07646	66469	61568
37592	08604	53542	99986	26017	84967	86696	19155	88259	03612
32583	59967	64315	84822	74950	80322	10037	19425	96714	97330
75625	48032	05891	58701	91532	81253	87706	42235	44799	58271
91808	34409	59390	38399	09462	07373	19799	04132	31531	16485
11926	91034	26756	37752	47276	70856	94741	55372	50250	48775
78782	17338	68884	04609	03479	59241	39569	13351	64340	34108
54319	43047	73502	30408	94554	18640	91396	16242	96184	64191
34359	78839	55454	08551	19021	56584	84609	26286	31079	89061
52871	79550	40787	87299	70144	45090	45199	80127	21304	88681
69226	39419	66757	59927	04968	56061	66103	59708	36607	79140
07575	58710	92577	67823	52832	36514	56137	11321	62025	09049
91682	48619	15333	05876	20802	39128	75562	10170	72858	07010
62040	64062	70625	57559	46143	46638	37861	12551	58076	87218
80099	81346	54688	70326	22662	08106	82354	94331	29618	38043
77758	41609	69027	03208	28505	06689	61270	67122	45496	30345
20009	11788	77442	46535	09576	24905	46353	63277	36064	58249
52091	84347	27681	24853	68826	04138	83340	96698	89529	46622
19569	02594	04226	93412	36370	16393	05509	43349	01135	99264
48286	19309	39931	61597	95916	59340	30322	56291	45847	85836
44400	82261	21889	89837	64397	05508	31365	36334	08765	89749
19322	99470	86311	96458	84173	06386	39946	49558	80223	69513
21704	81386	35499	57991	05992	47982	01949	50203	45471	18610
59506	33660	80198	19429	26262	42605	64807	29526	50672	49761
69876	11749	18876	54051	71446	40239	42174	14601	61255	24318
47268	55681	53952	54010	24425	21284	90929	05499	37739	88835
80651	73964	85491	79648	30293	31305	96030	25760	85013	03763
91894	81410	81245	09998	80494	86183	01343	82296	80842	58427
40239	16519	23159	32970	91162	40386	81829	16582	45640	07032
88212	51975	93468	83446	94238	48988	63226	05278	32797	27430
55103	14461	92774	26397	46587	51470	41598	29070	26690	69567
15360	93359	86173	53747	03141	75425	69947	37198	30936	99987
70678	38035	89688	64524	08530	87826	82214	05660	04461	28460
23620	33295	98309	16475	26722	92523	62702	02103	38482	28012
71594	59029	79559	67497	56559	05538	38354	61813	04816	66451
63723	62966	40545	65085	77086	03427	62353	77932	81281	32626
24852	88450	99212	80393	72573	59370	75741	05229	43644	29794
80184	48999	76580	84648	04210	76599	43704	21301	06957	66554
46973	78646	73852	44752	50849	07905	65120	48320	23223	96491
18043	96840	23148	89768	10865	45987	55568	08478	73137	03867
84956	48341	26773	23897	70640	75961	04522	09761	81718	63357

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83183	15461	88997	96634	39343	76187	51649	69036	04387	43933
86561	67600	87081	76544	08982	44799	33555	05868	05527	41848
27512	89046	61975	79250	64579	21693	78499	77459	73214	50062
61330	11838	37496	74484	83272	89275	10818	38111	87939	44211
45991	21942	34406	28785	41740	84445	77205	84394	40760	73845
17361	67790	10353	36885	34317	44264	62994	23179	86523	35982
11374	46345	40639	19572	34159	12518	86926	65650	14931	57011
13487	32387	76475	72583	57269	02420	57224	07061	28379	21115
17471	44765	26548	66533	61231	65829	31960	22771	61051	03459
23375	29913	24245	78402	03791	21882	77019	79658	47396	86300
79409	54902	27283	19483	87369	81683	54726	46546	95474	54716
40624	97378	15645	87183	08818	44776	41489	12313	88860	09769
47740	49996	90997	40690	73062	99417	84362	36977	56369	33825
76063	24841	77021	90894	16615	13830	51094	31691	97311	47805
85552	39430	08275	29116	76537	95406	02098	86244	47511	92035
73400	98752	94428	82470	70234	73327	08371	99302	13947	18310
41227	45475	89941	82220	08842	19485	79705	80566	50682	96893
66320	30514	47330	42274	93579	79302	54240	24684	30781	01110
00073	79317	11694	06965	89006	94316	48751	43521	95198	95046
19931	62537	55575	41981	08748	11998	42525	51396	77505	85222
87074	08966	20423	48407	68906	90485	99587	62608	73296	11785
74563	92361	75481	22882	22919	01961	57961	65696	97895	34882
33982	03375	06982	00338	60557	16906	95057	64678	84564	58282
95867	32783	17767	06580	69379	21304	54385	57337	66048	41470
09816	65864	15555	43592	80089	40820	92984	23197	14041	50563
13779	17566	55197	55767	30887	28696	06354	94094	43299	10142
96515	24730	14411	98243	03526	00286	94458	84907	43064	89119
06581	66943	72967	97927	81196	15864	14293	68163	50903	35519
78198	10415	16231	82188	84332	40420	93463	00800	72462	56395
72217	51940	16252	86297	68166	83136	84292	30992	22657	93321
36602	57329	94716	80613	52102	02741	25523	50508	03878	62175
35220	00526	97050	74475	93497	39667	48890	38895	43131	11725
37659	02508	02161	82227	82576	00971	96152	59703	45999	66196
06123	81274	09518	38568	99416	66646	19522	92783	06648	37495
32472	45765	64687	06419	90828	54913	04257	20390	70620	34744
41937	54184	53475	57677	92683	77875	53562	73074	68772	17265
64203	17781	64522	40751	98591	63881	77361	50224	90595	94544
54748	28150	09088	95562	66008	41668	61055	12113	41145	33638
89617	19797	18631	16868	32211	97243	07806	86319	56303	25722
63114	46266	86924	42113	16959	35570	07168	74833	90074	40452
48797	96322	89434	67288	17497	11072	03346	07911	13655	47458
94761	68684	54663	56219	14889	90785	42384	79738	90052	02784
22523	08100	38128	66588	06899	61628	56409	32917	81762	33800
77245	32835	57649	06567	40270	86475	00593	52298	73492	48076
94958	53811	06706	05420	43164	20010	55845	23310	24208	17860
64716	84933	35061	22454	65854	62172	19370	08400	77516	80402
18339	99156	94403	32952	27225	48489	42531	46612	62830	18599
82150	89664	56067	07766	90242	77855	53638	48039	14134	68254
71143	09316	84551	48576	04613	17628	05044	83303	38751	74867
00944	53807	43766	59023	77152	34989	00924	75152	03837	81996

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57516	33747	06831	96252	31779	10830	69091	08241	98420	89517
39268	60588	27898	69882	64019	03284	50134	04387	46535	32736
75711	82466	24904	58171	13871	59513	35837	46135	70004	46840
48817	14059	89377	19670	05642	83284	22117	98269	10607	19187
08090	69146	68347	94073	69418	28633	74369	67856	89800	35908
23561	85971	37362	10657	30353	70564	17859	34684	45661	08168
23013	91122	18394	69196	27019	79767	91568	01829	29434	82946
17388	59294	21118	87103	28468	51339	40972	81840	34466	81721
78371	28385	72092	71887	49109	92668	77129	07083	97824	08008
65182	72610	38508	96133	90349	86078	10011	23017	14121	27827
55368	14100	57714	36082	10900	20721	60285	61376	70801	42474
32794	67872	24227	40195	61483	16991	23910	31528	97545	02971
93934	48600	76694	01622	57474	87900	34055	05896	50650	90034
33249	37997	95991	63797	39089	36203	25421	78775	44706	45433
93142	22835	73003	10659	78861	90887	57965	02598	75896	77513
54096	83219	64260	62543	03437	60288	68706	14510	90539	01072
86772	63897	16313	30365	60525	78336	76362	99969	74452	40354
34028	97995	33534	06819	83492	66904	16966	44818	85952	45129
99224	17222	62766	26166	54482	55713	20898	28709	70042	46466
48806	36559	28718	52823	99285	59135	39405	48174	59856	05918
96947	64653	47928	25269	42939	14792	16077	92751	11545	83261
64208	04451	98807	63587	50222	53976	36325	28225	33873	54328
42406	33938	82822	81613	05879	88394	50918	28786	66090	51554
17682	89917	69167	21525	04531	41654	38625	97558	70167	96943
05984	30315	05185	07689	28325	42983	43613	52850	78155	32843
81910	01465	48825	56146	39554	52239	09311	01939	05749	45215
39518	98704	05209	57436	33376	93929	20810	03834	28747	31626
24524	30021	29832	70231	96077	79507	49340	47646	08538	69998
07701	33187	24591	35234	08884	10487	48859	24720	49469	89057
92150	05739	57410	03567	24486	49071	64766	71131	94851	11508
67765	74112	44661	51925	04791	83512	99167	88659	33617	30832
22564	50040	81638	15428	41173	14877	79072	26097	48719	25670
05855	02164	74386	26018	79774	99563	73684	70620	26498	21037
00234	25133	07565	49325	12328	33723	91221	24353	60670	35342
98118	71680	04099	57757	88140	07208	76309	48330	91264	77936
39302	64683	95388	20259	20924	88534	34087	90000	07900	73540
02982	13503	28033	50836	66941	26823	44999	40571	19446	74690
53872	27988	77575	71142	35977	52543	13091	27754	88593	82162
29658	00175	67827	88394	04665	76107	50790	60307	85075	39935
58387	81275	92390	37895	11137	64692	01908	12630	16171	18874
04755	78939	34888	84796	72315	04347	78733	43658	95853	77314
38916	03129	90039	33356	62300	57453	13940	45965	61549	36957
76087	79901	49755	33329	45412	31415	43951	55925	36356	44826
82251	11028	82521	02331	11273	57294	26579	38440	51046	03887
98250	26658	63587	88638	82529	62334	82773	03684	26806	53635
38852	56056	91833	78352	44200	12426	48964	62341	53454	05451
15651	92455	37352	64350	09494	70331	69104	36612	46798	40145
50467	46033	44649	12306	06171	39750	66480	80649	02547	22140
76233	62364	28025	12444	52077	27402	92194	15167	99322	87689
07000	64530	09973	35046	11135	14382	90667	23626	72881	40503

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40681	27353	22597	88915	79178	81568	96319	51098	71270	63812
89713	63020	45133	71152	54318	33657	45481	41509	04687	33262
94563	84957	44619	79713	09949	65244	53466	55985	27077	81993
43027	68321	02813	47446	08517	28803	96663	86674	67775	55543
51194	79763	80567	62318	21541	41301	24034	29986	79315	61613
67373	65291	63392	50049	64763	77384	69945	86642	49238	31727
13011	44976	94731	44841	58114	02487	68308	63610	64436	79719
75053	10760	56728	67907	73573	06858	89809	12729	13637	70054
00416	07842	61398	82483	92684	53713	96476	13096	08892	29976
08104	19067	07653	11476	57271	28172	20924	86795	80075	74483
03614	04739	91340	60151	25949	13799	24239	37699	61160	65534
51781	71407	97071	01707	52119	71110	83590	08030	00655	26829
74840	30355	24811	91014	44450	53425	76329	88396	25471	24939
17855	86540	13831	52245	61860	99428	74067	55408	52533	50065
01207	28820	12109	62958	47884	88218	55819	09726	67161	38420
29475	55575	37654	91091	33918	95562	68096	03709	34564	53896
87008	92552	81623	12154	48696	96053	47245	69520	09495	97197
24644	01087	32311	77807	56658	93684	33336	01512	39831	85626
46326	03892	41967	94372	32998	58406	24326	88509	63328	21618
35039	82275	32560	11945	50878	87600	66917	92413	00939	75858
51940	44169	83459	88888	07752	23211	26260	08693	29368	99956
65375	34741	99245	09156	82529	61952	83897	09931	76427	69486
93919	72535	35297	38351	69774	61954	52808	51707	61318	15122
32641	23240	37301	36135	25186	02274	25956	08937	31372	06943
40131	51356	32702	75474	84559	53684	28758	39890	72112	15426
65093	45655	00947	97180	35175	46277	19665	24873	75652	72660
91020	86594	87835	53859	50205	22739	94579	69359	17526	57074
89051	71343	26912	15341	31812	05179	17404	23642	30470	35331
66627	47292	87259	27395	34567	98159	40764	95925	13833	63765
07313	43774	88701	56132	36069	16027	05491	37788	27276	57333
13840	83975	89909	88547	08856	37066	42128	07117	10909	68721
56422	38011	10458	65809	15295	99155	01271	36612	93163	18865
75812	82841	99809	33958	03468	98967	60237	86604	34209	87042
78396	28235	26532	83318	77096	36217	99285	32993	85093	53164
77050	98159	56449	08000	65445	38130	72304	32656	58223	09472
45534	45029	84611	04753	49955	10020	56276	90596	89037	18424
97612	39593	89037	03471	76022	08527	21418	56626	24739	06594
95835	42224	66513	35514	19282	86647	84339	33670	50372	38939
34916	94718	93210	03218	92353	34164	55546	57339	89379	94890
46632	41268	35295	93493	61016	32761	10767	22685	50950	78485
01487	64386	02269	15196	93712	61311	10786	18485	81751	28908
44214	71437	59039	12657	80005	17106	78682	91223	82971	78688
90468	99815	78139	69224	02220	59965	69932	79094	04080	66786
74232	24251	70330	91262	09355	68912	96661	67153	13462	29941
92253	94384	36540	11770	76555	77366	83318	75211	83624	32330
53662	22108	08697	50312	91726	37906	10009	28915	25505	75795
15458	76661	02770	47195	68630	08611	30428	16774	55857	73460
53020	68646	01282	42227	39343	72195	32849	66381	88405	87540
28256	03411	92796	77002	07332	05353	45197	37779	89154	38303
87490	35299	62241	27197	04170	36179	59465	39318	01340	85298

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77365	84989	17521	86996	40216	38060	22038	50035	54179	99247
98564	09578	08118	11418	42906	78422	47268	88311	82475	95915
37171	91202	13275	49335	22201	62982	63361	20829	66849	36574
00487	70218	83995	05943	43636	75253	22841	62327	24613	64369
83115	05326	40730	17580	37854	63229	91647	92765	92632	23253
79092	71196	44676	33512	01394	11927	22321	90070	38307	99723
86555	33377	40446	57482	58101	26629	12257	00015	53614	32100
93351	85950	99349	11620	62284	33313	93210	92284	93675	88780
77773	19056	25171	18153	59858	13337	70529	67141	76775	39334
76172	13078	84800	47831	82640	02881	18501	15704	93947	66994
91260	90776	06058	42048	48396	82962	69114	75762	94297	98514
89420	52217	44050	86788	46110	71987	95231	96141	15210	36768
08916	58309	95173	47126	66805	81178	63576	01825	18772	54169
63352	95840	49426	31106	26577	40801	67358	37237	04742	30815
02415	34941	23716	59285	75770	06360	49221	97070	20811	93055
34367	38621	74880	85545	47343	02245	62915	46770	76906	30021
35893	44454	79677	08449	12614	21128	37971	99205	27334	50597
23779	16329	55800	02894	85378	78085	61601	85516	80368	16427
27758	86488	00731	24755	13278	87658	93411	61897	23215	43797
26314	47193	73823	63567	62403	53768	83621	16593	81942	19120
84758	66959	40133	78418	60601	57108	44953	55535	47182	76583
88548	80290	36501	07586	31538	62513	46903	05660	59653	95970
88657	43247	42762	39627	73595	60282	53768	72987	59165	93598
96504	29518	41121	27162	41884	38587	37312	11860	32383	28128
69659	67267	11682	64014	16865	08293	64331	61993	86565	47534
24976	56101	61342	33229	84141	71359	04153	29544	73101	27893
49443	25755	35350	82605	09294	27207	90180	61397	21835	03109
43174	84438	58429	55588	18290	77373	47873	41884	81234	06291
15378	84917	59806	93088	43400	17930	30694	05331	93144	39782
02761	77455	10139	41627	92800	83302	32455	27882	21304	98277
99323	87911	42880	08801	91694	93650	38343	64739	03637	12498
68112	17668	69472	43554	66423	37308	20955	58759	44993	01751
52709	33577	43011	55471	96838	86833	20257	84274	12632	77578
28178	81438	03102	37690	44973	46333	37079	81345	47852	40187
23042	05483	65965	03410	22330	00437	77864	75060	03518	14869
94292	75630	73995	08657	04090	67839	36670	42546	47662	85563
44200	88766	51670	30853	70096	09340	60882	56796	39238	82325
41949	26318	85345	82316	47684	11315	17236	11016	77153	39994
77096	45556	98245	41062	45512	50660	39978	68138	66138	55839
64554	70172	95784	94559	56008	13110	54077	63713	83761	29785
77870	10750	59312	20509	84899	63090	78224	59536	85265	47072
84475	42203	41706	78431	51870	47386	20719	40068	47075	07306
28460	69216	62943	82915	46264	05619	74543	75570	15802	87269
39485	15469	00253	81603	64997	55681	95636	07712	25046	11466
75513	78863	31109	00306	86477	05800	78575	44646	04731	73909
35914	77883	12256	14994	95956	64968	79781	69739	59711	25704
02840	55140	50096	81588	30186	46222	12502	74890	63559	99159
34617	36056	99441	20370	76848	72598	26487	84515	61891	84437
70620	16369	93716	18983	66488	48841	20819	75031	52307	05976
70445	63247	35139	47988	28156	04077	63015	04896	13605	34246

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61721	03748	38841	69166	01752	51219	78247	70734	10493	25093
98963	01854	20841	52865	31500	09283	07363	71612	77927	61691
23932	43062	33464	15924	24387	75728	31074	53262	70995	42071
15671	70400	88477	85686	91199	11089	56188	53946	30159	59284
73782	89043	22541	79933	57728	87000	97222	97795	16128	55709
83102	95333	74207	71472	52329	37785	52626	28600	13567	45016
46384	82071	00261	22133	43136	74270	98330	82464	44016	03638
58386	47279	85564	56751	02884	47595	53203	37306	69859	22351
31677	34913	92024	95851	73195	55542	52537	17487	95617	64009
90341	27029	35388	10015	54091	25240	28945	51638	55394	00151
53694	56321	51780	85766	24303	91130	08054	93015	83580	78969
14321	34850	57577	81552	88279	30410	36607	00387	97499	10178
05124	43526	80602	08431	39622	90293	58612	37471	28521	98765
04292	67049	37226	77648	62162	92421	33333	76923	38256	78580
09273	84395	97382	42955	25730	55790	91405	34801	64616	44550
15183	69840	80256	57175	06706	71873	79425	03789	29375	04018
88721	47483	15683	85491	46116	03661	47229	63104	29262	61523
43140	44368	16104	46863	53687	53452	78524	02933	56326	83043
91908	49963	85656	41706	18596	42334	71506	69013	64856	48793
96335	20856	03851	47753	99980	24449	39005	58497	03063	68636
87866	14100	55056	01560	58002	26742	43174	30123	39842	37466
78236	79903	57595	30611	49302	87218	77848	38069	70385	36871
36780	08641	20571	13793	09612	27066	20227	50363	44940	38920
18366	06852	71154	94608	70392	04956	21448	09296	19038	61598
45576	91644	74141	23815	82267	28271	81891	31523	20613	46854
89567	21054	47503	25472	75618	13071	81465	31184	23883	03637
23892	65090	87940	33934	31962	59572	77446	83552	31265	38746
31487	44209	43610	01733	05897	66428	34733	44085	58254	37004
46686	41250	54473	98489	59263	22269	45986	60634	51370	17736
71833	75595	31885	08056	46018	99133	90402	28771	43275	34353
72439	98123	65087	40454	51519	56816	30889	15487	81497	75570
77297	37843	69199	76739	18081	58820	85890	87243	84176	35053
33099	33358	55914	34239	47499	14384	13438	39943	86175	28198
95151	61859	09679	83413	91905	36927	18890	57426	28948	02750
74862	50549	49476	62215	87910	43389	28230	64566	36542	10223
10078	82651	08775	29037	36499	33125	98741	71329	21150	07281
56261	21774	62041	84210	04967	23023	88794	40799	96828	01518
06678	84070	69595	48871	86757	92546	81373	54006	67649	56869
34845	41877	95482	84017	32677	11746	69577	07078	12507	58072
80515	53345	11650	03594	64422	97801	26586	82586	54104	26852
32368	38947	68635	82913	60872	11703	40814	67598	28132	64838
80379	42553	16780	91837	61799	70339	45738	71862	56776	15540
72433	90816	97471	61115	17983	26639	45691	24106	42228	00493
87540	87245	61508	31508	36613	00978	03175	34398	14783	88859
92059	84967	49256	33531	79632	66030	15062	01204	23499	32555
12060	41495	77722	23111	04569	70487	87652	27892	93641	51367
39434	85821	57004	00302	24395	67592	50929	27203	56495	44117
49351	81841	20972	12359	52778	14954	28085	90846	75750	72350
87831	38461	72475	26174	54460	45191	88378	78906	57966	61603
25764	17666	45682	74833	92963	48400	13993	70089	69582	82222

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26437 80025	68310 83961	94972 15323	72315 71272	28132 54926
69541 94346	81840 32370	25073 32979	45546 37772	75378 11422
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65898 34643	46340 07789	14195 77031	94179 76270	46504 04596
61946 15619	41994 19126	79120 28489	13988 02027	30324 97010
26191 58514	42860 57235	13474 07138	13510 41715	08805 00892
32411 39136	58948 60268	99980 17465	42040 49687	31346 42819
64051 48551	64819 31103	49883 62627	81967 38604	68547 96808
47127 02361	38690 70982	29182 55610	49353 56290	60863 64983
39329 05966	85612 37608	56042 38353	37995 59683	00731 18332
42828 19215	93119 74749	01231 43201	64648 15674	91649 11914
80874 41559	70657 00870	33446 43475	14629 31571	80282 89053
90700 42746	17453 07672	63371 01001	89043 83404	07292 13587
22966 26175	15085 40523	28129 18961	59020 34377	10435 11318
23185 09653	59384 54389	40749 20996	17178 64876	78199 93162
19215 35070	48941 81116	75687 39424	98603 35416	80076 50499
73472 47371	80840 87165	01834 64836	85357 16813	04063 35411
52175 00848	56107 33893	95933 78114	71504 44275	28933 17598
86051 97054	19618 14530	89367 44812	67239 81440	83040 22263
27156 24240	12949 53482	82244 56538	00025 57788	49861 26344
87998 56428	79586 36404	01007 80414	81540 93191	81564 14721
85669 46650	58994 33647	46647 95550	95293 35374	00024 03356
72948 48729	73049 80584	47339 61586	31920 94022	13529 44566
21540 36102	51421 11801	11312 91129	05602 96582	58783 33707
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74956 08278	00668 48373	85984 69808	04818 44925	83510 31342
65867 59252	81216 25148	56346 20317	06429 04568	08591 54958
82246 24061	78800 42684	94864 13041	27643 65513	73024 19866
43654 12830	16350 56222	94856 41992	73954 19394	36346 99028
73611 86402	78501 21602	96956 51555	18508 31283	56948 64203
52567 15912	21393 69577	76935 28055	93910 80495	48749 74114
50320 89614	49467 38904	31027 94219	94105 58822	03309 94930
03104 14551	42975 40220	48905 85275	35319 46262	04313 64939
58228 39598	51245 66151	59983 41788	61760 11584	78088 10077
66624 52596	31664 89494	30520 71663	52906 79316	57414 97817
59329 92875	19662 94247	27551 93414	99318 36369	85615 01150
27090 08032	58956 52673	42640 42215	63610 37716	47706 33887
43337 88990	66282 52586	98011 47748	14571 55132	98953 01724
64398 88518	37040 85102	15091 31282	81875 82755	65581 88838
24318 18295	38575 53256	87648 18675	68553 36497	83240 86151
58004 95558	76439 94755	27424 92032	24447 86028	58404 23965
55007 48908	54214 58152	73361 68394	83714 71766	11334 18851
30257 96593	06269 70026	97970 93436	82123 06026	98997 19558
69056 32439	09380 93591	30233 22169	72085 88986	24298 80625
72705 98991	08381 34348	01119 64586	81159 69887	78278 74752
87729 35885	64989 89065	34309 99902	44016 00553	16017 96010
70255 49084	73091 12425	40711 21218	35389 49504	44067 28793
89559 81801	83568 98061	73902 76354	39879 14777	64156 17614
43423 81125	64492 96563	18382 09479	68388 01048	72345 42563
66858 41507	53732 93995	68111 55100	64316 39013	32661 14126

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23930	04508	62244	35048	50242	67999	31536	25407	71989	45433
76128	69326	37504	75663	63223	43107	70135	10378	25207	30192
66520	29819	17478	56335	99276	92993	88457	18868	31188	41704
50626	20047	80318	92908	49020	16209	54947	20890	60384	32642
00692	11580	38646	09263	76877	05817	36856	13889	39609	55619
09979	34936	58781	30207	03578	22544	97243	55121	47763	61195
35083	82010	24906	04993	46431	41556	02842	16480	44772	65857
56834	11647	47412	10572	55006	78730	58522	66328	42258	91830
37013	23432	90997	73642	14550	51046	53319	51538	33494	74826
19205	64255	10816	06173	56554	41501	47109	14426	28435	57887
23344	07507	96976	48154	34808	28032	15431	28988	76876	45657
67901	03113	19937	54883	25893	91665	36071	66144	39757	97250
61769	41018	13717	67506	32708	34848	65378	43245	87766	56871
77088	87453	04413	30695	69255	20314	23215	99511	84106	59064
96232	51504	53689	76181	33408	69036	07589	74822	88940	65460
13738	24068	02481	10387	29920	74600	28080	75677	70120	52635
92218	25408	54086	32515	35057	92867	31816	86812	99924	16795
94886	07353	15406	50642	92785	59257	34168	98153	28959	30017
20527	69166	80257	83628	72616	91592	85581	67641	75999	32625
48816	15453	91191	25441	48827	90870	16846	32853	57113	76232
57916	36540	48876	24557	94154	74998	21646	08100	96762	54421
51631	88447	43773	49579	42127	85113	63840	02946	26197	18268
48501	25356	64351	53802	01042	04500	41752	50272	47869	87046
77281	26539	49593	44291	30014	42832	78505	19022	48837	07545
79287	83125	22088	83259	28143	61286	87926	14350	22476	63834
35196	81343	68565	02702	36712	97281	20012	41738	86025	77694
83317	90112	93949	49559	09920	90831	75864	52587	23624	34060
93588	29091	50338	02219	97553	75374	63667	94437	83366	28182
90384	84218	25670	91824	04963	06594	70740	57504	24616	74417
00774	58476	01209	56541	64937	80996	04156	27801	70923	31497
70484	24645	50762	15430	91115	48699	09595	55122	11918	33482
36071	66109	17267	28105	63786	21373	37358	24697	56603	67418
95880	51665	89278	42437	91040	81053	79349	18214	40130	49031
89442	29442	59700	87168	14045	73824	91945	07276	35416	85776
73187	98680	81961	98681	65301	84131	60475	18786	78258	17631
13497	95157	50069	43395	87718	51044	24251	02261	81792	91891
12561	99033	53230	11211	20685	15939	93411	57389	00048	37763
94780	81716	18045	36600	82148	00724	63963	49418	12463	14246
87633	82307	51079	78530	00767	22316	71326	50810	69267	67190
94324	25247	02977	79492	35727	87555	97651	30440	98015	91648
12909	54789	99445	31740	68137	14130	40593	42443	36383	99755
25781	26751	46328	49251	70727	77363	80826	31876	06019	57262
92210	18463	27662	18257	87027	77851	15603	18574	30742	65091
84392	93948	64429	71724	41328	20478	20518	38000	44084	88870
49969	24028	18581	07574	70122	94993	63242	75960	46855	76179
97371	03322	13236	81729	94425	27380	91797	40621	00048	22858
81498	08934	00375	44786	82428	12842	30514	77783	97002	96731
44151	94920	14290	96262	49573	09113	22271	27549	87724	09543
88498	00338	26288	63688	67312	82285	02392	96123	44800	12062
43279	25288	06209	91206	74234	52353	64708	76276	40513	44461

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16143 15307	50265 76233	08046 36409	87769 39700	44162 23558
03846 93854	13457 40936	09703 09718	22800 46020	84646 79401
05481 18913	85765 73483	11991 62233	31671 70640	11517 26546
14909 88639	21584 77470	66581 44108	19740 67126	23723 69366
07291 52235	24020 95439	39620 57106	98477 29360	50462 22377
13324 85026	98436 69226	06544 73800	31358 45762	00454 23428
23411 99184	68997 75425	48601 18018	91475 04419	41441 92740
98802 50684	82295 12312	60781 08689	12095 65696	13488 97462
28060 15375	29832 71902	37012 10019	36654 65721	48462 27592
47301 25731	95695 86757	96576 28880	18521 12846	16133 56442
61764 12059	32220 76922	27086 30022	39196 44522	60531 68531
41843 36863	24696 13344	53985 84182	68559 14620	20946 97051
34437 51523	82974 62369	99430 47260	38625 72945	95553 69333
84817 89509	92780 01660	85577 17764	66912 53757	99671 84159
59605 17571	54922 33311	75864 09351	89218 76965	91485 26744
89635 61029	72451 90971	62924 24284	34634 11531	12874 06277
48096 83826	24547 82738	98562 03080	28191 34920	20068 19067
33191 88105	03651 75057	79761 69868	43959 24762	89638 33247
28362 10330	85125 41800	08578 25986	24552 26271	90431 91558
92725 44352	66605 15579	65096 75214	42124 90038	99074 11543
28601 58253	63801 49976	77579 91011	37335 53079	68790 75934
53565 80880	61494 39794	33080 99793	66299 20081	65463 30600
14142 23014	84170 89253	36367 29919	33035 98671	96636 58251
35625 08967	20656 76386	29496 77953	20616 08143	32555 23412
91469 95135	40981 32231	74311 74301	90476 45777	43715 80636
39610 00784	49950 60606	42324 89429	24015 79070	69930 66076
22675 39720	34632 11489	09422 86423	48673 03361	50734 57896
04343 03434	41010 42467	28999 21845	20251 28101	16065 30954
72636 92860	90188 95428	90558 48449	88727 00786	90574 33788
10301 65954	08799 77258	07810 20140	37852 59924	02888 60316
28438 12095	22965 33139	14569 24160	20492 39242	99794 27796
52538 68238	89072 73444	84575 74705	42750 20850	48382 09514
57042 12043	56241 84032	70442 43052	48890 34388	02735 08872
93696 55833	27957 53862	28742 25154	87392 29767	32673 97938
59275 56115	90556 41624	14841 01759	97059 49260	23410 50693
00307 76848	59984 46071	97803 02422	57169 12474	30230 51684
15150 12559	24342 07676	92101 23120	09604 37234	01601 44892
43666 41823	39934 27109	16890 86490	64789 32920	45216 59786
02334 73021	57179 07476	26154 59669	91271 31977	08111 65098
77728 21112	34408 47343	91372 33612	15480 32292	04091 70727
79880 99857	28188 29120	78933 50385	79907 01952	83105 51730
83366 17999	27584 49771	29353 33312	06852 70904	18721 38085
66957 59801	14572 37202	52985 43897	38701 32250	73246 07933
39432 17914	52773 73471	89296 99236	87597 48164	55813 74212
10322 76444	40009 54067	90786 20574	88185 13537	71910 85616
44486 13991	66374 93852	79968 78530	55120 81504	20705 15996
10932 84684	87105 06788	77313 42102	24390 72157	25382 94252
47561 37322	03015 18570	12228 04807	50568 70866	62122 98417
20176 77793	34817 84437	85348 65949	00879 50989	75404 70551
80157 94845	08468 28975	79089 88325	93917 50656	31696 77981

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22719 92549	10907 35994	63461 83659	24494 53825	97047 79069
17618 88357	52487 79816	74600 50436	88823 19806	33960 30928
25267 35973	80231 60039	50253 63457	97444 13799	35853 03149
88594 69428	66934 27705	51262 63941	77660 66418	84755 29197
60482 33679	03078 08047	39891 34068	81957 02985	83113 36981
30753 19458	02849 30366	83892 80912	91335 41703	79401 97251
60551 24788	35764 57453	06341 10178	91896 70819	46440 98356
35612 09972	98891 92625	70599 95484	34858 13499	28966 88287
43713 18448	45922 55179	18442 31186	91047 37949	76542 79361
73998 97374	66685 06639	34590 17935	79544 15475	74765 11199
14971 68806	49122 16124	61905 22047	17229 46703	39727 16753
78976 48382	25242 97656	51686 15537	73857 35398	91783 92825
37868 82946	73732 63230	85306 56988	15570 98029	42208 00190
01666 48114	95183 02628	05355 97627	74554 91267	31240 34723
56638 70054	19427 24811	37164 71641	50515 88231	99539 75745
43973 07496	17405 08966	65989 68017	56975 94080	93689 98889
05540 72301	36504 00187	90375 22891	22205 27777	84803 39220
95141 07885	94399 41145	50210 92423	13303 09621	94153 18691
75954 68499	42308 38387	52163 64563	02843 45577	93125 25294
97905 05301	98496 20682	68082 68537	70220 78282	02396 10002
23458 57782	67537 38813	00377 93873	97813 10039	25457 28716
03954 14799	63187 46191	22805 50502	08810 19572	48024 58206
52251 06804	85959 20974	73104 15009	25486 09306	24721 04187
62361 59105	39338 59358	69193 15586	57695 89518	59788 04215
54954 90337	99346 60442	90933 58323	83183 90041	44236 90815
70773 03331	84228 01405	61494 72064	24713 39851	01431 60841
68702 08331	08923 83173	67081 87472	47980 08802	95495 78745
39599 33465	96705 41458	34670 55385	25484 71068	15155 85371
54958 34935	16858 16523	54262 63310	50348 53457	39440 80411
98124 08864	36485 78766	52802 56315	43523 06513	50899 86432
43099 88373	80091 35058	35755 47556	98602 71744	70442 92312
88667 44515	80435 17140	32588 98708	93010 98590	23656 85664
87009 95736	76930 71090	27143 95229	24799 02313	17436 20273
70581 40618	16631 54178	44737 02544	81368 08078	46740 52583
03723 25551	03816 97612	99833 06779	47619 12901	60179 23780
49943 30139	07932 29267	01934 19584	13356 35803	90284 97565
71559 30728	83499 65977	37442 72526	53123 99948	59762 19952
75500 16143	79028 81790	57747 87972	54981 10079	17490 15215
59894 59543	13668 27197	51979 38403	23989 38549	82968 53300
29757 26942	08736 15184	73650 51130	59167 89866	06030 88929
87650 08162	90596 70312	84462 07653	80962 96692	07030 62470
84094 70059	86833 23531	31749 23930	04763 89322	67576 38627
92101 17194	06003 99847	12781 38729	88072 92589	61828 36504
26641 99088	65294 37138	75881 12627	19461 69536	64419 82106
04920 91233	46959 14735	15153 28306	76351 28109	86078 45234
25417 97570	91045 09929	75140 43926	90282 99088	93605 03547
98874 96989	84371 87624	74090 71983	62424 62130	44470 74725
82127 82000	84618 58572	56716 79862	59896 50702	31938 18336
26311 59516	98602 47197	31139 27631	64619 01504	77617 30219
76176 03499	17999 84361	63898 97861	63620 23931	87903 91566

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13962	70992	65172	28053	02190	83634	66012	70305	66761	88344
43905	46941	72300	11641	43548	30455	07686	31840	03261	89199
00504	48658	38051	59408	16508	82979	92002	63606	41078	86326
61274	57238	47267	35303	29066	02140	60867	39847	50968	96719
43753	21159	16239	50595	62509	61207	86816	29902	23395	72640
83503	51662	21636	68192	84294	38754	84755	34053	94582	29215
36807	71420	35804	44862	23577	79551	42003	58684	09271	68396
19110	55680	18792	41487	16614	83053	00812	16749	45347	88199
82615	86984	03290	87971	60022	35415	20852	02909	99476	45568
05621	26584	36493	63013	68181	57702	49510	75304	38724	15712
06936	37293	55875	71213	83025	46063	74665	12178	10741	58362
84981	60458	16194	92403	80951	80068	47076	23310	74899	87929
66354	88441	96191	04794	14714	64749	43097	83976	83281	72038
49602	94109	36460	62353	00721	66980	82554	90270	12312	56299
78430	72391	96973	70437	97803	78683	04670	70667	58912	21883
33331	51803	15934	75807	46561	80188	78984	29317	27971	16440
62843	84445	56652	91797	45284	25842	96246	73504	21631	81223
19528	15445	77764	33446	41204	70067	33354	70680	66664	75486
16737	01887	50934	43306	75190	86997	56561	79018	34273	25196
99389	06685	45945	62000	76228	60645	87750	46329	46544	95665
36160	38196	77705	28891	12106	56281	86222	66116	39626	06080
05505	45420	44016	79662	92069	27628	50002	32540	19848	27319
85962	19758	92795	00458	71289	05884	37963	23322	73243	98185
28763	04900	54460	22083	89279	43492	00066	40857	86568	49336
42222	40446	82240	79159	44168	38213	46839	26598	29983	67645
43626	40039	51492	36488	70280	24218	14596	04744	89336	35630
97761	43444	95895	24102	07006	71923	04800	32062	41425	66862
49275	44270	52512	03951	21651	53867	73531	70073	45542	22831
15797	75134	39856	73527	78417	36208	59510	76913	22499	68467
04497	24853	43879	07613	26400	17180	18880	66083	02196	10638
95468	87411	30647	88711	01765	57688	60665	57636	36070	37285
01420	74218	71047	14401	74537	14820	45248	78007	65911	38583
74633	40171	97092	79137	30698	97915	36305	42613	87251	75608
46662	99688	59576	04887	02310	35508	69481	30300	94047	57096
10853	10393	03013	90372	89639	65800	88532	71789	59964	50681
68583	01032	67938	29733	71176	35699	10551	15091	52947	20134
75818	78982	24258	93051	02081	83890	66944	99856	87950	13952
16395	16837	00538	57133	89398	78205	72122	99655	25294	20941
53892	15105	40963	69267	85534	00533	27130	90420	72584	84576
66009	26869	91829	65078	89616	49016	14200	97469	88307	92282
45292	93427	92326	70206	15847	14302	60043	30530	57149	08642
34033	45008	41621	79437	98743	84455	66769	94729	17975	50063
13364	09937	00535	88122	47278	90758	23542	35273	67912	97670
03343	62593	93332	09921	25306	57483	98115	33460	55304	43572
46145	24476	62507	19530	41257	97919	02290	40357	38408	50031
37703	51658	17420	30593	39637	64220	45486	03698	80220	12139
12622	98083	17689	56977	56603	93316	79858	52548	67364	72416
56043	00251	70085	28067	78135	53000	18138	40564	77086	49557
43401	35924	28308	55140	07515	53854	23023	70268	80435	24269
18053	53460	32125	81357	26935	67234	78460	47833	20498	35645

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42013	25126	49296	38839	98092	96100	44205	85129	46749	47707
66261	56987	46342	70656	04614	26422	32479	41453	82281	65793
99218	43326	71220	47549	69609	05780	01070	70739	29282	98507
60246	70506	12969	83611	57725	10209	67627	07864	05937	31892
36193	05504	57510	24880	43433	20377	33928	54749	73464	40652
00531	71458	96341	59955	54799	63186	22416	45953	94761	58992
74737	91290	58472	75246	44996	62216	27970	50154	44759	77127
53061	21680	80352	70951	15425	12816	51622	32075	85276	14589
08614	40071	68920	64920	23340	05380	28335	25114	61683	57618
96656	96439	54118	52156	52621	13824	59450	01023	11607	67538
62095	88876	35524	81750	08680	17349	89230	03916	67328	28455
77889	92840	57213	80607	03600	58153	38089	99100	73014	31305
16918	23456	81198	75611	25074	48084	03581	64703	27349	74763
46268	35453	53423	93232	96635	01540	07102	35254	17330	03758
55888	65437	40317	22775	57810	31889	32922	03784	05018	37517
25423	35242	78919	09390	37512	13982	05485	86728	34392	30716
89078	42669	29644	78077	72494	16407	04518	27476	60810	25292
13192	42580	66330	68901	44233	62951	29750	39622	68054	11176
70931	04040	92715	84711	50352	92935	37042	56655	97889	87259
77128	77829	88384	34423	38977	88885	79735	22965	69877	98333
37100	95870	34423	68405	52871	15661	85110	84313	99862	10238
10308	26146	30767	59839	47405	18099	88450	98937	72828	61186
01822	07742	73964	01142	16459	36271	07333	02936	50903	53965
07393	92846	14103	35259	30109	60824	52938	31191	27402	55803
50735	71154	23048	03035	08385	61502	23161	94518	63237	16715
07419	04879	07820	33621	56625	85884	49636	57122	98079	14220
50087	54480	86002	35638	98404	27118	02877	02755	85210	29357
71772	45715	74504	54733	80412	18241	88087	40118	06232	93326
45714	59014	12114	18042	90519	52413	93567	24945	85998	17555
59220	80301	51824	76885	85646	16102	74986	65006	53715	19746
10764	53574	99564	08495	80459	85802	76505	36292	40744	19788
17678	48295	83757	65027	35491	46418	67883	72615	65192	84193
25137	13748	72617	05969	41288	08094	72739	95361	06969	94802
73983	90100	48318	64269	19759	81850	24789	55982	30526	22676
99383	86972	98698	53377	78399	75624	77124	78996	42364	04273
81463	95646	47319	48775	93940	51645	60109	18278	29681	77883
47218	25488	68262	21410	61186	89952	11764	79953	56457	95497
81348	41579	58825	22003	49490	30865	37291	68696	04454	88205
87900	38409	86023	52902	65419	63324	88553	23217	25332	21388
55171	74690	78509	82507	74217	61944	45093	20674	95483	23757
72273	88384	07084	32642	58395	87752	57079	29525	06486	47759
31315	92691	65161	01439	80177	42240	87554	50096	89808	01816
14727	40472	08302	00582	81954	46590	43884	17637	88473	20390
83748	71311	64473	73025	90187	37261	38389	62432	31440	59825
88824	06478	50725	76185	50468	38948	23682	11328	77542	88781
15674	10172	11670	56256	01649	07564	38895	01649	51479	65397
27554	23402	41542	24214	93388	67693	29967	67477	04991	12243
37635	96312	73891	16729	11725	76610	39574	99565	36190	32008
07476	42396	95670	49941	51549	07010	53100	48997	33188	29414
66005	72644	19812	65399	48215	09132	25707	73648	60225	30702

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52534	82857	47299	48748	72888	31705	13867	62620	68513	79149
88602	31385	63436	43035	10815	07119	35964	30360	63656	60661
91400	63007	97273	32057	91951	46330	12893	86602	03710	56516
80753	34577	58421	51026	28514	06233	70431	42107	97639	90818
35885	86909	61780	30921	33258	12960	84640	11301	05409	32044
93990	99581	70584	49811	43933	14954	49446	70379	27056	95378
09614	57360	60566	71263	39899	98163	43014	09500	47266	43147
06856	28724	93988	77589	22748	32910	14649	52967	34718	90217
79287	76856	85097	14422	94957	02732	73579	31711	52065	41789
63180	07117	50802	57008	72837	88961	86536	54036	01747	59887
09472	93904	79062	09699	06683	39134	22416	66211	31214	81730
15627	05471	52308	78528	25876	82840	20825	22134	94528	53834
31677	96908	03890	21314	64503	80250	90814	92145	73283	60898
65093	27865	69792	50778	30718	32243	52658	83178	67131	95642
01874	79890	73607	21145	65168	05079	55896	97865	93480	92630
70378	46175	35976	11715	13058	69755	45829	86870	86083	32591
27728	79685	87000	81766	13756	29480	63335	37586	03953	15324
39542	43035	24562	93335	00849	57574	20158	04989	41399	84132
15083	24701	87498	56370	41122	66845	35060	75773	07576	75952
38208	12759	03955	72612	18824	70458	73336	17085	22792	20258
15282	40571	74608	54511	01418	63856	60915	16317	60816	49287
36061	06128	71126	47235	87258	98985	91898	29157	53154	15095
66755	02682	33789	88898	29899	03361	80922	66412	36269	15562
36558	16521	10515	82211	47412	59691	15381	93119	31477	83235
48090	82667	87063	61246	10231	39794	18043	04686	49861	88349
63465	99694	98810	44399	90063	42883	40735	95238	44447	54255
96395	05290	86695	34823	17766	89280	86992	56403	48722	89742
82253	29278	46716	17803	16278	67634	46388	46708	48283	64313
22288	14812	38440	61537	68293	68072	81028	50708	40678	75296
35481	12317	84403	27489	14825	68187	86422	66783	00748	81409
05628	23186	49976	51151	27859	53810	50390	21892	36258	76361
23071	52184	85989	74678	20590	84137	25824	33136	56998	20918
77886	44504	48977	07431	29133	31306	19685	45540	78390	39250
99517	36561	13069	73593	96267	34628	01825	11804	67831	49082
55302	19261	76761	17529	76210	13943	25544	59446	50749	55514
44083	43083	43603	48769	75463	96623	84077	66487	06917	78976
98302	35491	15837	75768	25722	66625	73375	40050	29995	30804
56887	14082	29531	46695	63224	79911	69596	81584	80995	33835
67921	91143	53255	79854	08527	13399	74312	58701	71350	85986
29088	87873	31377	59474	68647	31290	64092	04332	60435	15943
75682	95072	81979	08783	39007	64506	38531	09770	69281	78108
17748	60659	16166	41789	99067	79611	16400	73810	00030	39514
75168	24241	75997	82268	18396	35742	22967	65975	60427	04488
75091	41347	29533	69180	76810	13149	36522	70276	69792	30860
93673	57951	74687	75747	48063	07832	99227	52971	09475	71006
69834	52374	59616	91240	18688	84379	31381	99735	95153	94818
96128	64581	02975	98263	59500	96218	18273	30260	04603	41966
08609	81146	56638	77827	28671	58102	92651	24204	25081	50459
49501	76986	33488	89038	45521	26386	07564	31116	06500	51750
84477	65814	16334	14684	25142	48115	52182	04834	70368	69631

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77012 07384	73077 58917	90883 74805	32390 45582	23330 69756
99688 96577	36515 53327	27830 78936	03391 93326	41244 81366
20302 92144	50915 29248	36120 11778	86630 76882	41739 17986
87101 03409	76898 41137	43948 86332	51689 07086	70734 05550
81969 35233	89022 76526	43304 36463	83480 59540	47470 69287
34807 08126	85164 30912	62625 53139	16842 09266	52532 46581
80291 09797	06976 65531	94969 71925	26860 95874	35446 71293
00849 40816	97682 40753	67140 09518	54907 73276	11899 98687
34082 67803	78386 96338	90435 33261	72133 88780	99020 97004
48144 36678	28842 99910	91250 19469	81431 72494	37623 22987
71923 97743	68311 35887	84390 02619	02411 43127	51406 68460
97766 61888	77653 78082	32839 10269	29426 55488	01517 88955
18801 39524	79790 74616	77609 74732	61525 92718	25394 51080
09013 01087	80078 15951	91875 76013	13021 62817	71591 97002
13048 51611	74386 99985	44431 12773	90146 38524	22724 27506
41789 61818	51838 46690	75215 86387	93567 37939	30734 19879
58001 25588	78572 27581	72758 45851	25995 26819	21913 10179
75657 91363	06883 63767	13608 42773	63539 18529	31925 28668
59445 80665	88151 12051	63428 35053	01179 05254	68537 42581
44889 04294	07799 67874	79841 92780	71505 06464	76839 63347
81237 64397	68539 66659	52781 60654	84232 53804	65075 27220
10679 50334	11422 02765	29241 22632	91788 67316	68237 64200
58973 65467	38950 87853	16905 90671	57147 30893	06623 41475
49234 68411	12338 15153	83208 25784	40268 38287	73891 27376
36185 81850	31507 60906	23892 59827	67797 62799	91022 79253
02697 19279	56989 81942	80964 67913	08399 73386	94867 67321
55830 02431	93205 79197	74599 87585	74438 83704	21945 15137
23957 75773	68884 31936	81490 45020	55818 24592	84987 50474
06343 44395	48564 42993	65735 44594	57843 70724	92870 32617
39485 98566	02373 23953	30520 93264	31347 23349	38934 45635
48876 74880	49887 86365	18299 97041	31641 05984	88948 70140
13551 41581	09044 56419	16195 46709	05714 53352	19679 87224
74692 76567	86266 19132	45849 02131	74225 04155	43997 62830
29131 83732	75242 65232	08872 43279	00809 97046	28851 15337
38528 48380	94012 44693	53843 24203	04579 95053	43817 62309
45021 72055	37371 44018	98373 48304	90618 42059	97379 10602
06474 23471	13782 32396	97506 53770	03116 51076	66798 64104
83575 05580	81439 06635	02816 51003	78830 02038	76344 89083
17007 74305	01821 41041	42674 44803	36700 74785	25617 68049
37606 40561	54302 99589	22671 34258	26432 06732	00600 93367
17936 91024	84985 03289	07721 39729	45809 80821	39587 07684
34330 18439	69577 37771	68254 90970	10173 35598	82336 74141
69074 10171	17991 65383	51863 38535	01224 10097	14548 98917
16723 63250	14038 39436	46531 29073	50638 25920	04575 78448
97324 63679	10177 05637	62994 20462	61271 21702	84168 46679
02085 54343	26238 58376	39827 35866	33987 79586	29719 47766
56224 99229	54362 76943	13980 83508	22616 15862	84824 89884
96214 94020	06341 78763	62643 83854	16712 91383	15935 82958
67058 61329	23706 22885	44251 27633	82942 79253	40230 07629
95044 15713	92819 23532	40332 49307	57167 24892	63015 43145

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88115	59359	88857	19687	34108	33685	47395	85450	74431	53889
28073	71635	12335	70915	34263	46352	13003	75724	91414	70539
32924	78792	18933	91796	63082	95063	10456	61652	81171	64157
79599	42519	05201	17045	39382	85426	78979	45796	77853	37515
67006	80140	74512	12408	64096	48444	88584	30026	86203	69963
53957	07994	42002	12668	50178	10182	60719	91408	52581	31505
49498	88978	17442	68378	54770	03452	35732	66049	71522	78488
18990	45671	72172	37095	63197	35698	27050	80879	22214	17387
56316	57505	67778	56592	42765	46357	21105	62470	27862	30463
90133	09824	25398	50303	93421	45316	67491	08712	49107	89776
53760	25900	43391	18319	08120	63323	15314	18931	06321	67593
24233	68519	57668	89044	21821	50937	98675	93242	03575	52357
11980	81333	87078	85924	87322	71992	37385	89058	03613	58247
72173	21019	66804	98240	86312	94275	65750	39800	89690	79511
55332	13184	41987	81401	08589	19763	15911	62758	90384	08462
57607	25649	41487	81745	25535	45433	38792	67984	14297	03353
69686	81509	19028	75140	03866	82198	64457	32441	90153	47008
34130	16327	81730	80949	11124	64870	04745	32499	40333	61195
85721	82231	09293	43409	80316	68520	05796	57927	49096	43765
40694	73282	88363	23493	66853	05007	88903	89201	38588	74264
28790	73555	39872	82425	67586	04692	58763	73089	62844	07701
01488	66532	81456	26070	54050	21033	34261	62446	04251	88138
95499	75165	80569	89454	25994	26350	81331	66392	22865	38179
23246	93026	49835	68011	46709	97573	41406	87120	23019	76957
54372	71661	98259	03429	90265	78363	79075	69264	01258	25346
50667	67447	12042	93977	84144	57085	92362	17519	44003	00728
39015	09690	22308	55079	46001	52100	62325	34030	86493	05479
30848	98916	84404	69121	62466	64858	20484	41417	70154	54470
03889	22848	43778	74537	75257	60289	91993	33513	47265	92628
94392	05327	45485	23672	49212	4070	27590	45199	41120	28897
68181	66796	01111	81046	03106	02797	46778	06137	74457	17698
54283	10083	48124	66874	40560	20775	77508	24814	42647	61096
48823	58942	76779	11831	71291	30891	75550	08406	35640	97312
24114	27526	36778	52558	03349	27244	32784	31944	04514	79805
58250	09433	49922	73517	05749	29521	11486	35378	02951	19991
53805	24698	90621	44865	30020	79181	27710	77898	18641	25822
67094	32424	78081	01866	06524	15797	50526	19737	46728	47806
96327	08369	01352	81145	76239	27756	92892	40249	12677	20351
96304	17442	26193	50470	40080	45962	27413	52596	74767	15419
14320	29318	35603	67402	11237	10278	34135	11550	08956	78074
17503	66734	92657	25594	48869	45477	07566	01028	98648	11852
78373	76435	19095	11690	87307	86055	69098	79807	32699	21694
78058	96964	06841	98848	17419	09237	80180	37075	15571	75381
74417	70127	90585	33464	32119	49159	97364	98803	41313	52271
05478	71773	34259	73504	17136	90957	04215	79673	59041	58532
95594	70376	56991	94958	73025	72241	18772	83987	66214	96335
86317	76771	66837	10831	54982	29193	64089	48005	22480	35522
71728	32787	76084	68568	38031	65199	70118	82010	63048	89269
39979	10146	27776	94907	33324	37254	91599	06189	53170	95295
15592	60403	42603	96773	89004	87192	57567	05696	98464	98800

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70926	14068	90617	51352	05865	25126	21435	69981	06479	54942
38294	02507	86133	46888	21711	98619	05872	54301	87716	26002
51447	00598	36601	60566	32418	06444	18754	79000	29678	33535
33733	65492	09115	87007	43944	90683	36936	70086	26343	44499
98578	16717	53459	98243	68053	14785	94556	24145	73756	02966
98045	35229	65436	97032	90692	92839	48741	46015	60649	78986
11030	27678	40435	23421	30446	68355	41264	56845	25972	24239
06398	01268	40461	42165	76730	80605	64851	45178	40698	45023
66982	99502	99638	32288	81444	22186	99057	35949	63798	62111
49990	41133	65203	58173	33477	09119	34541	41143	46943	46256
22975	87537	49981	83262	55604	56229	84786	38692	16164	86948
56363	46172	55878	38017	28757	23228	36018	72170	51051	75235
25239	51964	68059	75456	39179	09456	92300	65626	48879	31402
59897	48512	00334	45937	19369	41725	17979	02825	84411	90936
07445	43199	11331	84333	24530	07944	18773	94012	01441	40655
52821	36525	86483	01485	27152	22479	34278	29029	82444	32543
04483	39213	14609	02255	65310	22945	48013	36887	71101	33008
85207	37425	35526	59376	85614	97070	30842	27193	62451	28179
36385	78567	05346	74610	26141	87177	19154	53851	05824	59090
55407	39812	30331	60144	17516	98353	69388	48352	58137	77898
46331	84545	74655	37810	71052	47561	38516	00995	29132	67466
04897	76974	58825	06219	35829	94137	86723	33959	58960	78467
66731	13895	78598	34046	33819	31321	28214	15552	79956	93786
43230	46708	41391	27181	83392	83917	50354	06317	82244	64964
66454	90538	67155	16330	47634	26177	91044	95720	98046	97875
15390	36462	55477	37908	88709	79835	02268	34899	43576	94090
46247	72875	26162	79014	84536	95251	08529	38081	20459	00237
55637	15060	33992	51861	89417	48441	81158	34236	95130	56722
02487	37297	82484	66076	52244	52682	24153	95903	16598	18839
42610	30603	43360	37782	74207	42717	30680	04798	49349	80247
76181	27103	98753	17717	75804	70789	38568	18708	96245	97479
24240	59688	23292	40949	74821	74395	15182	28469	39961	16523
81005	08991	34680	03514	44197	25382	59596	78425	98515	94769
56871	37208	97581	82371	26370	49617	59215	38569	14739	48414
33208	81662	43605	20558	79985	90844	17530	99091	10285	21540
43803	95466	93094	97246	31204	85156	37718	08525	91170	63419
39723	01384	22765	93642	60124	99086	45153	32542	47145	48575
62515	76499	84234	06259	51069	60919	55124	78419	58554	94540
45055	24644	30258	39939	53071	26932	18676	19285	62417	63764
69681	82442	84755	30753	38850	46942	61530	59202	11087	18121
83385	60015	99787	68177	43030	09512	56402	52055	69511	95801
04458	50325	13625	59771	52638	03817	31659	90880	61424	19064
35754	46420	40662	91784	10383	86003	18461	37487	07663	29044
10162	66613	00105	17031	85743	46022	84098	48084	05707	94180
89831	87771	78854	87869	25562	86955	25525	10040	73737	96766
55684	77321	42361	69034	44115	03720	97262	71890	16199	59265
52365	07152	28678	69439	55376	06525	59029	29933	27542	74515
33636	30300	46185	47790	80994	17002	12405	42203	99491	54380
38313	14021	53007	04659	93128	86269	29475	28220	71108	33211
12929	16404	65222	46174	52721	30713	10441	13115	06313	78985

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11767	41715	96921	39440	91713	01252	95477	90091	74570	47814
10209	39469	04395	96949	68306	59930	43058	74922	84796	25716
88035	86619	10325	12403	59223	80176	03721	42071	86811	58308
01488	22623	75963	52672	08033	94360	23673	80897	68904	98109
85453	72323	32385	04738	68076	97592	19285	41760	42244	51078
94870	60073	79608	75998	05122	18855	98943	26426	84879	74388
92793	48899	87556	46924	20939	72246	53768	14024	09495	40912
02048	90603	58746	02696	73115	25929	51870	61184	65085	78295
99402	91657	18017	77315	39059	24381	21328	36197	89852	69923
52804	36184	32274	65204	35397	44192	06055	60314	10940	34627
74967	53533	93594	69969	16216	97183	95154	37719	90074	06928
15360	86221	06240	68606	05993	28257	80451	90422	20624	31777
53092	10820	71341	56926	48072	70936	33884	63004	81011	90241
78293	43707	65260	46559	21593	61172	05802	48592	96801	88425
24698	22898	26339	77971	47433	41759	74193	54506	04385	71026
36341	31972	45946	23649	94999	27633	01609	19345	83854	65117
70032	05924	91583	26358	42395	85283	36548	48571	90295	65056
58505	19927	12491	29716	88554	84748	75150	20811	92332	52934
73594	99247	47006	04316	15214	68184	50502	00906	58323	81340
76445	56970	29913	49346	49418	89565	90371	02911	18781	49995
25906	22504	11638	73444	50364	29434	37229	81270	17091	08384
30906	29090	62259	64926	45247	63145	97190	79048	25472	63993
65174	27188	78410	88819	89691	71654	85623	76958	93888	34121
95707	46159	04585	08264	31148	55333	66354	20732	83733	71859
86800	89098	64605	45971	11658	89650	14679	29076	11295	26756
27050	19535	80967	86429	53087	24524	45176	58099	21062	93277
10321	30484	20157	44523	17221	52332	02171	69984	24729	45615
81688	67931	83947	92274	47572	05921	73696	13267	12007	36060
87754	63269	20414	97007	85234	02765	25037	08013	58209	32893
61003	95084	61292	17324	93461	48671	92398	73811	32577	03895
92634	41808	82881	62269	33586	15206	06382	92818	07525	18506
43023	46101	12756	91289	97832	03007	11112	83193	38078	10928
56571	76602	83541	73035	54212	82112	39610	98224	02571	03610
02277	75958	49212	59055	91260	88372	70664	91292	17350	78812
26333	27670	05556	64366	57386	17327	60852	92021	15754	55988
58163	45678	12771	96906	76195	16623	54681	38763	44930	12599
24866	01275	00882	31104	25970	06468	59772	11493	25244	57906
86997	96175	69773	38015	23916	94438	43706	85667	87188	72475
64237	20191	40654	96516	81157	18779	32641	89064	70199	22278
50601	68108	35854	45951	96090	18262	21094	13284	03783	47529
76183	41550	85252	38048	61986	96431	58408	90223	36116	13558
59038	73354	29214	64984	42285	99793	79106	35548	59039	40442
08430	83898	82979	99138	72201	37238	62822	29049	66756	80217
28493	94724	84455	17948	67633	89500	41013	08398	42274	57451
00322	75838	71501	37001	36824	74950	60632	11372	43392	66804
99942	82603	23184	26296	50994	21524	46967	28332	19674	32822
97872	36870	47178	69926	36075	93302	04530	10172	04809	96867
64219	06580	26192	82666	74607	31539	77593	73076	41422	56992
58098	55623	26057	28619	79776	69449	97532	09986	68865	92882
89624	83227	06730	16023	23771	51774	40547	13335	80053	88160

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99275	48612	21216	65329	47006	81802	25488	71983	53254	49130
93487	83437	17776	85952	25025	36775	48054	51516	34250	80153
77638	96966	33408	52567	97394	44738	82972	74641	10629	27328
13771	86099	85457	58571	84468	13977	68318	67241	81211	50595
82422	08792	07864	18509	17314	57017	41471	01334	83346	52276
79394	17748	90396	44781	82857	73286	98281	05360	64793	89261
15053	36157	18243	03108	81691	95429	61175	63251	51012	30760
30831	20830	21955	49948	55957	13305	47123	90904	83261	63990
61512	40712	24620	52733	44361	69509	14503	27507	11978	53166
52270	08623	15054	40687	92854	34969	25843	05886	23848	37815
69103	56560	84932	19661	06307	56052	78502	97906	53173	20703
73582	54875	08117	98969	71713	04025	91705	35226	26130	20635
91009	80511	72733	51864	93842	41062	34805	54917	58877	06764
57300	92584	28176	93034	51982	67445	81231	35754	08862	16353
92344	93509	93644	67316	55786	46115	81226	81580	56533	28894
92749	83442	68882	04917	60100	60970	89024	26833	22520	14141
42831	12508	45484	77529	12684	74732	97088	83012	10059	29112
07745	53194	02923	61074	63854	76031	53621	82550	48493	04735
45498	56291	87859	53926	31865	91287	32266	51667	11757	85115
09182	74356	98937	05305	44177	41774	56282	83432	18409	59954
66926	27548	13360	74005	81863	47185	45649	98578	33918	26819
29434	65828	22535	71027	81963	89151	85892	46253	32153	62668
42571	68007	13720	72268	36932	83209	50630	86254	99242	84871
44191	51743	00755	11342	96156	70667	92793	64207	00908	20585
74446	78425	06622	18035	10454	00769	82604	23280	31513	80496
01361	80115	72935	17163	22449	53094	44751	89764	63157	10031
12978	51982	49118	56362	57711	86799	99400	99659	94439	72369
61774	37757	07413	39789	32552	79649	50218	18721	43988	44445
38043	01415	45193	84171	52383	92519	94553	32365	46859	74074
15829	42557	52816	20654	41230	92652	20289	18515	59762	77168
65919	70072	05256	51571	82292	43086	03342	00323	34974	27538
42819	32053	60657	82161	35440	03414	06554	36616	95862	14257
23139	91838	52934	54293	84798	35913	01191	24708	34713	37519
19405	64597	82153	40667	49899	84924	49530	56359	42477	08924
07288	45243	60807	81236	70539	14403	92228	85675	29187	93505
69116	89344	12029	01539	93894	65818	59005	07675	24657	68510
63194	11499	17269	88825	33188	65639	63508	66633	68749	38774
45783	92486	36117	48960	28351	14145	10509	87554	58285	72322
07396	88455	49617	31643	59540	77294	84426	31160	54194	05018
89360	23385	55210	93043	02738	29451	16953	50118	05254	65817
73831	35096	11635	69913	59826	49421	30885	99775	94291	39334
52665	80524	66871	10050	20685	15957	17210	61591	80857	13700
65846	39590	21711	76563	70545	01898	13150	61557	28181	68003
53627	91900	09405	76537	98930	77889	57807	75958	91341	58920
70669	44663	26954	84605	51598	23696	28725	09031	66099	05956
62677	12248	24848	02140	01131	56569	13528	24145	45199	09776
83555	56534	67758	71368	26859	95717	28288	18551	30987	20330
83697	77759	52073	04864	55059	94511	15250	26670	78996	64549
44903	84173	97008	84837	53936	01667	37797	55720	19801	69681
49014	65018	85266	95013	10543	74324	00370	44692	12436	62278

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48891	10539	77297	06672	60476	03209	56167	45544	78258	21422
73871	02158	64630	46343	47332	15481	71394	96315	73568	80645
34170	02175	09960	18993	17807	66444	32730	21212	46076	25920
71583	99318	45044	48166	87077	55556	63659	33391	85205	13101
01108	73834	09699	74820	30068	86921	78110	28980	24355	68185
20522	12904	93684	21725	57411	71846	80425	00453	19748	21457
79608	42670	40653	95662	12532	49174	48503	67040	69216	27753
68090	48226	92873	37646	30421	74228	35929	44178	28348	91363
19084	66561	09518	45488	31864	35233	62351	49727	02447	07250
07646	32173	72941	15268	61602	62354	27853	58697	90386	37514
63196	74349	39550	70915	83488	07746	17894	50004	91058	41346
86398	28564	87112	86288	97693	26056	17915	82559	35381	75027
63642	03881	57412	19351	27350	31510	45854	15923	02510	43820
71121	53702	40309	92143	20328	65330	63967	19131	85795	53721
13701	53089	57760	40693	34610	98600	45016	71126	59165	50190
71134	32621	80057	67356	89035	65907	57480	04850	92464	32201
33767	36215	39791	72287	29800	67640	97975	74758	46021	73423
33146	61482	78422	55628	18394	48569	51299	86059	19323	41580
36625	32972	51316	64412	82599	79023	38452	03155	74595	13130
63621	36578	05384	34537	25673	58665	29591	66953	98274	34545
22624	74007	67711	37494	37526	00412	47081	69740	38591	44042
56577	81154	72712	59626	77020	40221	70415	21555	13815	15986
68561	00765	43531	76052	72134	75017	93077	40022	29505	76950
29278	37732	91524	28083	49045	23812	81820	66774	33620	64598
05725	26121	68788	96440	70878	63396	59123	86114	46700	98438
12415	12423	39879	62843	88286	04293	49225	20626	61318	10872
56651	39944	91948	87327	20492	92155	94288	75984	73002	78618
48493	98522	25685	40367	43342	52382	28333	30879	59352	86497
25123	62925	33514	71567	65553	97229	55058	40209	62112	18160
85607	00506	63005	26044	87342	39708	30757	75972	54177	31864
16373	13846	52495	45645	10162	39115	45771	25100	16356	37750
40801	68181	06980	50698	26657	94736	02366	84979	18942	84572
32100	76474	58798	77166	31884	50951	29955	94471	53066	46180
76932	16642	68834	38684	07709	97540	70822	32654	85262	92296
57106	64646	95365	10663	32804	72795	25166	79078	26789	51843
05418	98621	75977	52630	27675	96279	13152	44711	46961	45757
37221	69111	23417	17803	11075	66454	95453	60328	68808	98125
23823	99934	93432	05912	93150	84781	99233	03767	24838	94955
84321	03554	23836	64544	27469	23266	57244	28275	82170	07575
02344	23656	61016	09765	19867	21790	46457	25411	03500	46762
70325	88171	23685	97217	76585	88384	51221	31272	17338	80422
22987	01461	15898	25857	74145	84101	90051	36721	45737	65918
83159	50055	54172	05122	07096	55938	95953	33901	54679	64178
68181	68525	53187	92984	58323	41389	66592	56584	14326	07823
65843	69659	40222	34435	50890	24504	70304	43227	29870	44698
54251	76480	23860	30082	69132	08840	98017	54350	66249	75725
42504	70709	53223	89394	66872	79919	06862	25977	42529	78046
56201	69520	52851	03783	60280	27101	07911	12147	97079	52817
25284	80305	76573	14254	56770	83548	44466	06063	04232	62838
00702	10030	47850	44094	84878	51686	39037	19661	73877	24708

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57045	08074	88727	91303	10880	90387	03049	44649	41682	07161
92889	33197	04117	79760	15336	25030	73686	24054	08666	24607
06135	40078	34575	82871	86196	69883	71312	99329	34122	63290
27526	09658	27405	99448	02380	71414	48311	18536	45957	52546
32443	44984	94521	49020	45683	50812	57968	56310	97631	88709
34091	84585	92750	72213	03810	84047	17607	87085	12607	62564
68190	21907	52999	14903	80020	49368	63721	86548	80086	51686
05191	64586	50535	20491	87132	18487	34210	66368	58881	83704
78088	71769	13917	08311	88957	91965	22411	52575	44377	32138
34271	03646	95035	67881	17645	34452	47064	84451	57918	48975
76667	51400	93187	10311	92693	97380	61008	83243	01776	05137
80232	15879	47748	03011	38553	29224	76115	36026	01249	61250
53017	39124	84777	80739	87900	74156	54184	24003	45929	23730
28699	18974	35297	40752	31285	02656	34584	71261	28462	33431
35394	84361	77346	21801	39236	24825	77081	88028	12544	07565
84813	25422	08800	36063	94441	88637	50780	79144	71908	51899
39900	30333	13938	22799	30507	56296	43120	47179	26489	54531
99174	36078	79599	06223	38520	31678	97203	14143	17457	41301
53762	31370	73669	10523	08875	22489	69203	49879	77277	81867
72787	78482	19585	45029	31822	85128	29960	54344	44851	75381
82163	23362	09644	74123	06831	83252	16929	33737	19381	21302
62357	13766	93851	27009	42621	13612	18873	76885	78819	55665
62350	73856	33253	02353	42231	21028	27646	23292	94705	70722
84764	94194	97699	27029	32935	51595	04454	91100	67131	09041
78327	42124	56300	93706	75936	67290	59600	20201	83979	73231
39284	08465	61364	37573	18285	64619	20079	85596	81849	81686
73507	00339	10678	66490	22653	10032	68648	79622	98925	99635
77675	53001	74015	20232	61900	50260	60094	57780	02739	55069
55144	58892	57952	65272	56004	41356	00190	17413	64296	60680
69545	93269	67239	96561	07443	72133	62418	17791	02994	02665
24029	31914	39122	68971	26865	01521	49285	71212	00822	25330
44665	26518	13219	61450	13321	52526	22629	78390	30087	17735
13196	84012	09819	55245	97721	11900	04586	91248	15214	61259
66401	50382	14549	66579	77859	30100	79010	32512	29816	07127
61962	67996	12828	22706	72646	79669	72214	52460	89227	49089
06771	43014	92202	23860	29456	38047	44988	15786	03658	25037
56042	94875	92991	24042	92395	30212	52225	50280	12944	79124
98428	13542	85663	66158	57744	41097	56298	84834	81051	10048
85814	29832	59007	57398	01033	52085	17512	32395	98564	82408
99657	30745	72197	03217	11839	73768	49206	96954	94375	70130
61069	54986	13341	89688	70977	32056	81627	56776	12859	44176
61108	30705	46984	74866	65173	80340	43903	66334	27757	95664
25672	31476	55896	46337	25418	76725	33877	16903	03276	13106
11136	98716	28020	28414	92289	22989	45797	16935	49843	98385
88537	12364	87867	50446	37446	35919	69387	82296	37350	25132
83003	85363	97045	18857	67214	15043	05498	97716	85302	70414
82128	04345	08532	69206	36560	04641	64006	28763	89057	22560
21388	13394	80549	87537	11673	98421	34723	30630	67516	99516
29672	42547	26085	15173	44457	13154	98748	31213	87025	16793
65120	17193	77381	48198	72074	08512	43387	27964	86082	57332

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14541	36678	54343	94932	25238	84928	30668	34992	69955	06633
88626	98899	01337	48085	83315	33563	78656	99440	55584	54178
31466	87268	62975	19310	28192	06654	06720	64938	67111	55091
52738	52893	51373	43430	95885	93795	20129	54847	68674	21040
17444	35560	35348	75467	26026	89118	51810	06389	02391	96061
62596	56854	76099	38469	26285	86175	65468	32354	02675	24070
38338	83917	50232	29164	07461	25385	84838	07405	38303	55635
29163	61006	98106	47538	99122	36242	90365	15581	89597	03327
59049	95306	31227	75288	10122	92687	99971	97105	37597	91673
67447	52922	58657	67601	96148	97263	39110	95111	04682	64873
57082	55108	26992	19196	08044	57300	75095	84330	92314	11370
00179	04358	95645	91751	56618	73782	38575	17401	38686	98435
65420	87257	44374	54312	94692	81776	24422	99198	51432	63943
52450	75445	40002	69727	29775	32572	79980	67902	97260	21050
82767	26273	02192	88536	08191	91750	46993	02245	38659	28026
17066	64286	35972	32550	82167	53177	32396	34014	20993	03031
86168	32643	23668	92038	03096	51029	09693	45454	89854	70103
33632	69631	70537	06464	83543	48297	67693	63137	62675	56572
77915	56481	43065	24231	43011	40505	90386	13870	84603	73101
90000	92887	92668	93521	44072	01785	27003	01851	40232	25842
55809	70237	10368	58664	39521	11137	20461	53081	07150	11832
50948	64026	03350	03153	75913	72651	28651	94299	67706	92507
27138	59012	27872	90522	69791	85482	80337	12252	83388	48909
03534	58643	75913	63557	25527	47131	72295	55801	44847	48019
48895	34733	58057	00195	79496	93453	07813	66038	55245	43168
57585	23710	77321	70662	82884	80132	42281	17032	96737	93284
95913	24669	42050	92757	68677	75567	99777	49246	93049	79863
12981	37145	95773	92475	43700	85253	33214	87656	13295	09721
62349	64163	57369	65773	86217	00135	33762	72398	16343	02263
68193	37564	56257	50030	53951	84887	34590	22038	40629	29562
56203	82226	83294	60361	29924	09353	87021	08149	11167	81744
31945	23224	08211	02562	20299	85836	94714	50278	99818	62489
68726	52274	59535	80873	35423	05166	06911	25916	90728	20431
79557	25747	55585	93461	44360	18359	20493	54287	43693	88568
05764	29803	01819	51972	91641	03524	18381	65427	11394	37447
30187	66931	01972	48438	90716	21847	35114	91839	26913	68893
30858	43646	96984	80412	91973	81339	05548	49812	40775	14263
85117	38268	18921	29519	33359	80642	95362	22133	40322	37826
59422	12752	56798	31954	19859	32451	04433	62116	14899	38825
73479	91833	91122	45524	73871	77931	67822	95602	23325	37718
83648	66882	15327	89748	76685	76282	98624	71547	49089	33105
19454	91265	09051	94410	06418	34484	37929	61070	62346	79970
49327	97807	61390	08005	71795	49290	52285	82119	59348	55986
54482	51025	12382	35719	66721	84890	38106	44136	95164	92935
30487	19459	25693	09427	10967	36164	33893	07087	16141	12734
42998	68627	66295	59360	44041	76909	56321	12978	31304	97444
03668	61096	26292	79688	05625	52198	74844	69815	76591	35398
45074	91457	28311	56499	60403	13658	81838	54729	12365	24082
58444	99255	14960	02275	37925	03852	81235	91628	72136	53070
82912	91185	89612	02362	93360	20158	24796	38284	55328	96041

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44553	29642	20317	69470	57789	27631	68040	73201	51302	66497
01914	36106	71351	69176	53353	57353	42430	68050	47862	61922
00768	37958	69915	17709	31629	49587	07136	42959	56207	03625
29742	67676	62608	54215	97167	07008	77130	15806	53081	14297
07721	20143	56131	56112	23451	48773	38121	74419	11696	42614
99158	07133	04325	43936	83619	77182	55459	28808	38034	01054
97168	13859	78155	55361	04871	78433	58538	78437	14058	79510
07508	63835	83056	74942	70117	91928	10383	93793	31015	60839
68400	66460	67212	28690	66913	90798	71714	07698	31581	31086
88512	62908	65455	64015	00821	23970	58118	93174	02201	16771
94549	31145	62897	91582	94064	14687	47570	83714	45928	32685
02307	86181	44897	60884	68072	77693	83413	61680	55872	12111
28922	89390	66771	39185	04266	55216	91537	36500	48154	04517
73898	85742	97914	74170	10383	16366	37404	73282	20524	85004
66220	81596	18533	84825	43509	16009	00830	13177	54961	31140
64452	91627	21897	31830	62051	00760	43702	22305	79009	15065
26748	19441	87908	06086	62879	99865	50739	98540	54002	98337
61328	52330	17850	53204	29955	48425	84694	11280	70661	27303
89134	85791	73207	93578	62563	37205	97667	61453	01067	31982
91365	23327	81658	56441	01480	09677	86053	11505	30898	82143
54576	02572	60501	98257	40475	81401	31624	27951	60172	21382
39870	60476	02934	39857	06430	59325	84345	62302	98616	13452
82288	29758	35692	21268	35101	77554	35201	22795	84532	29927
57404	93848	87288	30246	34990	50575	49485	60474	17377	46550
22043	17104	49653	79082	45099	24889	04829	49097	58065	23492
61981	00340	43594	22386	41782	94104	08867	68590	61716	36120
96056	16227	74598	28155	23304	66923	07918	15303	44988	79076
64013	74715	31525	62676	75435	93055	37086	52737	89455	83016
59515	37354	55422	79471	23150	79170	74043	49340	61320	50390
38534	33169	40448	21683	82153	23411	53057	26069	86906	49708
41422	50502	40570	59748	59499	70322	62416	71408	06429	70123
38633	80107	10241	30880	13914	09228	68929	06438	17749	81149
48214	75994	31689	25257	28641	14854	72571	78189	35508	26381
54799	37862	06714	55885	07481	16966	04797	57846	69080	49631
25848	27142	63477	33416	60961	19781	65457	23981	90348	24499
27576	47298	47163	69614	29372	24859	62090	81667	50635	08295
52970	93916	81350	81057	16962	56039	27739	59574	79617	45698
69516	87573	13313	69388	32020	66294	99126	50474	04258	03084
94504	41733	55936	77595	55959	90727	61367	83645	80997	62103
67935	14568	27992	09784	81917	79303	08616	83509	64932	34764
63345	09579	40232	51061	09455	36491	04810	06040	78959	41435
87119	21605	86917	97715	91250	79587	80967	39872	52512	78444
02612	97319	10487	68923	58607	38261	67119	36351	48521	69965
69860	16526	41420	01514	46902	03399	12286	52467	80387	10561
27669	67730	53932	38578	25746	00025	98917	18790	51091	24920
59705	91472	01302	33123	35274	88433	55491	27609	02824	05245
36508	74042	44014	36243	12724	06092	23742	90436	33419	12301
13612	24554	73326	61445	77198	43360	62006	31038	54756	88137
82893	11961	19656	71181	63201	44946	14169	72755	47883	24119
97914	61228	42903	71187	54964	14945	20809	33937	13257	66387

APPENDIX F. CALCULATION OF THE AVERAGE RANGE

To calculate the average range of package errors for groups of 5 packages:

1. Mark off the package errors in successive groups of five packages in the order of weighing.

   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:

   - 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: +2
     +4
     +5
     +10
     +3
     R = +10 - (+2) = 8

   - 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: -2
     -4
     -5
     -10
     -3
     R = -2 - (-10) = 8

   - 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: +2
     -4
     +5
     +10
     -3
     R = +10 + 4 = 14

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:

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

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

APPENDIX G.

Table G-1. Tolerances for field standard weights (avoirdupois and metric).[a]

CLASS F TOLERANCES FOR FIELD STANDARD WEIGHTS (Avoirdupois)

Tolerances for weights 2 lb or larger are 1 part in 10,000; weights between 0.5 lb and 0.02 lb are 1 part in 5,000; weights smaller than 0.02 lb have tolerances determined by the equation in footnote c. For all denominations not shown, but which are intermediate between those listed, the tolerance for the smaller denomination shall apply.

Denomination	Tolerances	
Pounds (lb)	Pounds (lb)	Grams (g)
10,000	1.00	454
5,000	0.50	227
3,000	0.30	136
2,500	0.25	113
2,000	0.20	90.5
1,000	0.10	45.5
500	0.05	22.5
100	0.010	4.5
50	0.005	2.3
30	0.003	1.4
20	0.002	0.91
10	0.001	0.45
	Micropounds (μlb)	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	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 (μlb)[b]	Milligrams (mg)
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

CLASS F TOLERANCES FOR FIELD STANDARD WEIGHTS (Metric)

Tolerances for weights 1 kg or larger are 1 part in 10,000; weights between 300 g and 10 g are 1 part in 5,000; weights smaller than 10 g have tolerances determined by the equation in footnote c. For all denominations not shown, but which are intermediate between those listed, the tolerance for the smaller denomination shall apply.

Denomination	Tolerances
Kilograms (kg)	Grams (g)
500	50.0
300	30.0
200	20.0
100	10.0
50	5.00
30	3.00
20	2.00
10	1.00
	Milligrams (mg)
5	500
3	300
2	200
1	100
Grams (g)	
500	70
300	60
200	40
100	20
50	10
30	6
20	4
10[c]	2
5	1.50
3	1.28
2	1.12
1	0.90
Milligrams (mg)	
500	0.72
300	0.61
200	0.54
100	0.43
50	0.35
30	0.29
20	0.26
10	0.21
5	0.17
3	0.14
2	0.12
1	0.10

Table G-1. Tolerances for field standard weights (avoirdupois and metric) (Continued).

Denomination	Tolerances	
Ounces (oz)	Micropounds	Milligrams (mg)
	(μlb)[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

[a]NBS 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.

[b]1 μlb = 0.000001 lb

[c]The 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 G-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 1 920 Minims (118.3 mL)	3 Minims (0.18 mL)	1.0 Minims (0.06 mL)
1/2 Pint 3 840 Minims (236.6 mL)	4 Minims (0.25 mL)	1.5 Minims (0.09 mL)
1 Pint 7 680 Minims (473.2 mL)	7 Minims (0.43 mL)	3.0 Minims (0.18 mL)
1 Quart 15 360 Minims (946.3 mL)	12 Minims (0.74 mL)	5.0 Minims (0.31 mL)
1/2 Gallon 30 720 Minims (1 892.7 mL)	16 Minims (0.99 mL)	5.0 Minims (0.31 mL)
1 Gallon 61 440 Minims (3 785.4 mL)	20 Minims (1.23 mL)	5.0 Minims (0.31 mL)
2 Fluid Ounce Cylinder 960 Minims (59.1 mL)	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

[a] NBS 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.

[b] Tolerance of 10 mL graduate is 0.08 mL calibrated "to contain" and 0.10 mL calibrated "to deliver".

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This handbook provides procedures for testing individual lots of packaged goods for conformance with legal requirements for the net quantity of contents using statistical sampling techniques. In its advisory capacity, NBS provides these methods as guidelines.

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commodity inspection; compliance testing; net weight; package checking; packaged product inspection; prepackaged consumer goods; statistical sampling

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