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Specialty Crops Program

Specialty Crops Inspection Division

AIM Inspection Series

Technical Procedures Manual

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Technical Procedures Manual
Table of Contents

INTRODUCTION

This document is designed to give guidance to Specialty Crops Inspection Division personnel of the United States Department of Agriculture (USDA) guidance for technical procedures or processes they use on a daily basis.

Compliance with the Agricultural Marketing Service (AMS) guidelines does not excuse failure to comply with the Food, Drug, and Cosmetic Act or any other applicable Federal or State laws or regulations. SCI Division of the Specialty Crops Programs (SC), AMS is responsible for grading/inspecting, audits and standardization programs of fresh and/or processed fruits and vegetables and related products. The legal authority for grading, auditing and standardization activities are the Agricultural Marketing Acts of 1936 and 1946, as amended.

Applicants may obtain inspections of any fresh and/or processed fruit and vegetable and related products for which they have a financial interest. The inspection service is voluntary and self-supporting and is offered on a fee-for-service basis.

GUIDE FOR ELECTRONIC USAGE

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ACID TITRATION

An acid is a substance that dissociates in a solution to give hydrogen ions. The higher the hydrogen-ion concentration, the stronger the acid; the lower the concentration, the weaker the acid.

Acids are sour to the taste and occur naturally in most fruits and vegetables. Acids are also added to processed products to inhibit the growth of mold and bacteria, and as flavor enhancers.

Total acidity is usually determined by titration with a weak base, such as 0.1N sodium hydroxide. The "N" following the number refers the normality of the solution which is another way to quantity the concentration of a solution. The normality of a solution is defined as the number of gram equivalents dissolved in 1 liter of solution. This is a neutralization reaction resulting in the formation of water and "salts" derived from the particular acid involved. As the acid and base react, the hydrogen-ion concentration (pH) decreases until an equivalent amount of base has been added. At this point the pH value of the solution is not neutral (pH 7) as inferred by the name "neutralization reaction" but is slightly basic due to the hydrolysis of the salts. Using the neutralization reaction, total acidity may be measured visually with the use of an indicator, or potentiometrically with a pH meter.

Composition of Some Common Acids

Acid	Molecular Weight	Valence	Equivalent Weight	Acid Factor	Common Associated Products
Acetic	60.05	1	60.1	.0601	Vinegar, Mustard, Sauces, Mayonnaise, Salad Dressing, and Dressings for Foods
Citric	192.12	3	64.0	.0640	Citrus Juices, Cranberry Apple Juice, and Cherry Apple Juice
Malic	134.09	2	67.0	.0670	Apple Juice
Tartaric	150.09	2	75.0	.0750	Grape Juice

Sample Preparation

Note: Use distilled or deionized water in the preparation of samples.

Fruit and Vegetable Juices

Review the appropriate U.S. grade standards and/or specifications to determine the following:

- Are the results to be determined as weight/weight (w/w) or weight/volume (w/v)?
- Are concentrated samples to be reconstituted before taking aliquot for analysis?

- Which acid will results be expressed, e.g. malic, tartaric, citric?

The acid titration sample size for single strength fruit/vegetable juices can be based on either weight or volume. However, for fruit/vegetable juice concentrates, the sample size must be based on weight of product. This is due to the more viscous nature of concentrate, reducing the accuracy when measuring by volume. The acid titration procedures will be the same, but the calculation at the end will be different. Depending on which variation applies to your product, follow the following instructions:

A. Measure out a specific sample size.

- **Weight:** Transfer a 10 – 20 gram (g) sample of well mixed concentrate or juice (either 10 g concentrate or 20 g single strength) into 250 milliliter (ml) beaker.

- **Volume:** Transfer 10 – 25 ml sample of well mixed juice in 250 ml beaker.

B. Add approximately 100 ml of distilled water to sample. If using a magnetic stirrer, insert magnetic stir bar now.

Proceed with determination using one of the methods in the Acid Titration Methods section.

Mustard and Sauces

Mix the sample thoroughly. Weigh 10.0 g of the sample into a 200 ml volumetric flask and dilute to volume with water. Shake well and filter through a dry fluted paper filter. Determine acidity on 100 ml of filtrate using 0.1N NaOH and express results as acetic acid.

Mayonnaise, Salad Dressing, and Dressings for Foods

Weigh 15.0 g of the sample into a 500 ml Erlenmeyer flask and dilute with 200 ml of water. Shake until all lumps are thoroughly broken up. Determine acidity using the visual indicator method, titrating with 0.1N NaOH. To recognize the endpoint, you may wish to have a duplicate sample nearby so that the first color change will be evident by comparison. Express results as acetic acid.

Vinegar

Pipette 10.0 ml of the sample into a 500 ml Erlenmeyer flask and dilute with water until the vinegar is only slightly colored. Determine acidity using the visual indicator method, titrating with 0.5N NaOH. Express the results as acetic acid.

Acid Titration Methods

Visual Indicator Method (Phenolphthalein)

This method is useful for light colored samples that will allow the inspector to detect the faint pink end point color change of phenolphthalein.

- Equipment
    - Gram scale
    - 250 ml glass beakers
    - 25 ml standard glass burette, graduated to ml, suitable for rapid and drop wise titration
    - Magnetic stirrer and magnetic stir bar
    - Distilled water
- Reagents
    - Sodium Hydroxide (NaOH) solution (0.3125N, 0.1N, or any other known normality)
    - Phenolphthalein Indicator

      This is prepared by dissolving 1 g of phenolphthalein powder in 50 ml of 95% ethyl alcohol and adding 50 ml of water (pre-mixed phenolphthalein is available commercially).
- Procedure

    1. Fill a clean burette with the appropriate standard NaOH solution.

       NOTE: During periods of limited use, the normality of the NaOH can be affected by its environment. Make sure to purge burette and lines during periods of limited use. There are devices on the market that can check the concentration of NaOH to ensure it is at proper normality before use.

    2. Drain the solution meniscus to the 0.0 ml mark. Take readings with your eyes at the level of the meniscus, measuring at the lowest point of the meniscus.

3. Add two or three drops of phenolphthalein indicator to the prepared sample and place under the burette. If possible, the burette tip should be approximately 1 inch from the surface of the sample.

4. Titrate the sample by running the NaOH from the burette slowly but steadily while utilizing a magnetic stirrer or swirling or stirring the sample gently. Near the end point, the indicator color in the sample will appear and disappear and do so more and more slowly towards the end point. At this point, run the solution from the burette one drop at a time until the sample stays a faint pink color for approximately 30 seconds, indicating that the end point has been reached.

    - If juice is pulpy, care should be taken to reach the proper end point by allowing for "leaching" of color into pulp.

5. Read the burette at the lowest point of the meniscus. Record this as the volume of NaOH used. Use this figure to calculate total acidity. See the Calculations section.

    - If the amount of NaOH used is less than 10 ml or more than 50 ml, adjust the sample size accordingly so that the titration will fall within that range.

    - At the discretion of the supervisor, the titration may be repeated, and the results averaged. Titrations should agree within 0.1 ml.

Potentiometric (pH) Method

- Equipment
    - Gram scale
    - 250 ml glass beakers
    - 25 ml standard glass burette, graduated to ml, suitable for rapid and drop wise titration
    - Magnetic stirrer and magnetic stir bar
    - pH meter (if phenolphthalein is used, refer to alternative phenolphthalein procedure)
    - Distilled water
- Reagents
    - Sodium Hydroxide (NaOH) solution (0.3125N, 0.1N, or any other known normality)

- Procedure

This method may be used for determining the acidity on any sample solution, regardless of color.

1. Standardize the pH meter according to the manufacturer's instructions using a commercial pH 7 buffer solution. See pH Meter Calibration.

2. After standardizing the instrument, rinse the electrode thoroughly with water and submerge in the sample.

3. Fill a clean burette with the appropriate standard NaOH solution.

   NOTE: During periods of limited use, the normality of the NaOH can be affected by its environment. Make sure to purge burette and lines during periods of limited use. There are devices on the market that can check the concentration of NaOH to ensure it is at proper normality before use.

4. Drain the solution meniscus to the 0.0 ml mark. Take readings with your eyes at the level of the meniscus, measuring at the lowest point of the meniscus.

5. Stir moderately by hand or with a magnetic stirrer.

6. Add NaOH rapidly until near pH 6, and then slowly add until reaching pH 7.

7. After pH 7 is reached, titrate by adding NaOH very slowly, a few drops at a time. Allow the sample to mix before adding more.

8. Continue titrating to the end point of pH 8.1 (± 0.2); add NaOH one drop at a time because the pH will change more rapidly with each addition.

9. Record the volume of NaOH used to reach pH 8.1 (± 0.2), reading the burette at the lowest point of the meniscus. Use this figure to calculate the total acidity. See the Calculations section.

   - Titrations should be between 10 ml and 50 ml. If not, adjust the sample size and re-titrate.

   - At the discretion of the supervisor, the titration may be repeated, and the results averaged. Titrations should agree within 0.1 ml.

Mettler Toledo T50 and T5 Titrators

- Equipment
    - Mettler Toledo T50 or T5 Titrators,
    - 100 ml plastic beakers,
    - Gram scale,
    - Sample changer,
    - Printer connected to titrator.
- Reagents
    - Sodium Hydroxide 0.3125N,
    - pH buffer 7 (used for calibration only),
    - pH buffer 10 (used for calibration only),
    - Distilled water.
- Calibration

1. Remove electrode from storage solution, rinse with water, and insert into titration head.
2. Using pH buffer 7 and 10, pour approximately 40 ml of each into two (2) 100 ml plastic titrator beakers.
3. Place buffer 7 into the number 1 position on the sample charger carousel; place buffer 10 into position 2.
4. Press the calibration icon on the titrator terminal. The calibration will begin automatically.
5. The calibration result will print automatically when calibration is complete.
6. Check the results of the calibration for acceptability:
    - The range of acceptability for Zero Point is 6.5 to 7.5.
    - The range of acceptability for the Slope is -55.0 to -65.0.

7. If the results are within the above ranges, document results in the calibration logbook. If the results of the calibration are outside the acceptable ranges, repeat steps 2 through 6.

- Procedure

1. Sample Preparation

a. Tare an empty 100 ml plastic beaker on the scale before sample addition.

b. Add juice as follows:

- Single strength juice: Add 18.0 to 22.0 grams of juice sample.

- Concentrate juice: Add 8.0 to 12.0 grams of concentrate.

c. Record the weight of the sample.

d. Fill beaker with distilled water to the 40 ml mark. If concentrate used, mix sample with a rubber policeman or similar utensil prior to placing in carousel.

2. Sample Testing

a. Press the “Reset” or “Home” button.

b. Press the “Single” icon on the titrator terminal for single strength juice. Press the “Concentrate” icon on the titrator terminal for concentrate juice.

c. Place samples in the carousel, starting with the number 1 position.

d. Enter the number of samples to be run. Press OK.

e. Press “Samples.”

f. Select sample number 1.

g. Press “ID.” Enter the sample identification using the touch screen. Press OK.

h. Press “Sample size.” Enter the sample weight. Press OK.

i. Press OK.

j. Select the next sample in numerical order.

k. Repeat step g. through j. until all samples have been entered.

l. Press "Start."

m. When all samples have been run, the results will print automatically or may be read from the terminal.

Calculations

Total acidity is calculated as the predominant acid in the sample. To determine the percent acid per weight or volume, use one of the corresponding formulas below. The type of acid being measured determines the acid factor, which can be found in the Composition of Some Common Acids section. If your sample was weighed in grams, use the weight equation. If your sample was measured by volume in milliliters, use the volume equation.

Equations for Determining Total Acidity

- Weight: Total Acidity (weight/weight or w/w)

$$\text{Total Acidity } \left({}^{\text{g}}/_{100\text{ g}}\right)\% = \frac{\text{(ml of NaOH Used) x (Normality of NaOH) x (Acid Factor) x 100}}{\text{weight of sample (g)}}$$

  - Conversions only necessary if U.S. grade standards for fruit juices are based on acid expressed as "grams per 100 ml of juice" (or percent by volume) rather than "grams per 100 grams of juice" (or percent by weight).

- Volume: Total Acidity (weight/volume or w/v)

$$\text{Total Acidity } \left({}^{\text{g}}/_{100\text{ ml}}\right) = \frac{\text{(ml of NaOH Used) x (Normality of NaOH) x (Acid Factor) x 100}}{\text{volume of sample (ml)}}$$

  - To convert the units from weight/volume (grams/100 ml) to weight/weight (grams/100 g), use one of the methods as described in the section Acid Unit Conversion weight/volume to weight/weight for Fruit Juices (if necessary).

  - If inspecting citrus fruit juices (0.064 acid factor) using 0.3125N NaOH, a 25 ml volume of juice sample, and a milliliter graduated burette, Appendix XIV – Citric Acid Determination Chart can be used as a quick and convenient method which is based on this equation. This chart also already covers the acid conversion to (w/w) discussed in the next section.

Example:

A 25-ml sample of 9.2 °Brix juice requires 9.4 ml of 0.3125N NaOH. Refer to Appendix XIV – Citric Acid Determination Chart. Locate the acid value corresponding to 9.4 ml titer. The acid at 7.0 to 9.3 °Brix is reported as 0.73 grams per 100 grams.

Simplifying Total Acidity Calculations – Examples

When grading in the field, you would know the normality of NaOH being used, acid factor, and the sample size used (weight or volume). As a result, the above equations can be simplified to speed up calculations using what is already known. An example for both weight and volume sample usage are:

NOTE: The following simplified equations can only be used if all the factors are the same for your situation. These examples are provided as guidance so you may simplify the above equations to fit your own needs.

- Using 0.3125N NaOH, a 10 g sample of concentrate, and a standard burette calibrated in milliliters to the equation can be simplified as follows:

$$\text{Total Acidity } \left({}^{\text{g}}/_{100\text{ g}}\right)\% = \frac{\text{(ml of NaOH Used) x (Normality of NaOH) x (Acid Factor) x 100}}{\text{weight of sample (g)}}$$

Weight of sample = 10 g

Normality of NaOH = 0.3125N

Acid Factor = 0.064 for citric acid (identified as citric acid factor using Composition of Some Common Acids).

  - $\text{Total Acidity } \left({}^{\text{g}}/_{100\text{ g}}\right)\% = \frac{\text{ml x .3125 x 0.064 x 100}}{10}$
  - $\text{Total Acidity } \left({}^{\text{g}}/_{100\text{ g}}\right)\% = \text{ml x 0.2}$

    Example: A 10-gram sample of concentrate requires 18.9 ml of 0.3125N NaOH. Following the steps as outlined, the titer is multiplied by 0.2 and the acidity (expressed as anhydrous citric) is reported as 3.78%.

    $\text{Total Acidity } \left({}^{\text{g}}/_{100\text{ g}}\right)\% = 18.9 \text{ x } 0.2 = 3.78\%$

- Using 0.100N NaOH, a 5 g sample of concentrate, and a standard burette calibrated in milliliters to the equation can be simplified as follows:

$$\text{Total Acidity } \left({}^{\text{g}}/_{100\text{ g}}\right)\% = \frac{\text{(ml of NaOH Used) x (Normality of NaOH) x (Acid Factor) x 100}}{\text{weight of sample (g)}}$$

Weight of sample	=	5 g
Normality of NaOH	=	0.100N
Acid Factor	=	0.064 for citric acid (identified as citric acid factor using Composition of Some Common Acids).

  - $\text{Total Acidity } \left({}^{\text{g}}/_{100\text{ g}}\right)\% = \frac{\text{ml x .100 x 0.064 x 100}}{5}$
  - $\text{Total Acidity } \left({}^{\text{g}}/_{100\text{ g}}\right)\% = \text{ml x } 0.128$

    Example: A 5-gram sample of concentrate requires 22.5 ml. of 0.100N NaOH. The titer is multiplied by 0.128 and acidity (expressed as anhydrous citric) is reported as 2.88 percent.

    $\text{Total Acidity } \left({}^{\text{g}}/_{100\text{ g}}\right)\% = 22.5 \text{ x } 0.128 = 2.88\%$

- Using 0.3125N NaOH, a 25 ml sample of juice, and a standard burette calibrated in milliliters, the equation can be simplified as follows:

$$\text{Total Acidity } \left({}^{\text{g}}/_{100\text{ ml}}\right) = \frac{\text{(ml of NaOH Used) x (Normality of NaOH) x (Acid Factor) x 100}}{\text{volume of sample (ml)}}$$

Volume of sample	=	25 ml
Normality of NaOH	=	0.3125N
Acid Factor	=	0.064 for citric acid (identified as citric acid factor using Composition of Some Common Acids).

  - $\text{Total Acidity } \left({}^{\text{g}}/_{100\text{ g}}\right) = \frac{\text{ml x .3125 x 0.064 x 100}}{25}$
  - $\text{Total Acidity } \left({}^{\text{g}}/_{100\text{ g}}\right) = \text{ml x } 0.08$

Example: A 25 ml sample of 11.0 °Brix juice requires 10.3 ml. of 0.3125N NaOH. The titer is multiplied by 0.08 which gives a result of 0.75 g/100 ml (w/v).

$$\text{Total Acidity } \left({}^{\text{g}}/_{100\text{ ml}}\right) = 10.3 \text{ x } 0.08 = 0.82 \text{ g}/100\text{ml}$$

- If the U.S. grade standard requires this result to be in units expressed as "percent by weight," following the instructions in the next section, the inspector would use the equation or the conversion chart show in Appendix XIII – Acid Conversion Chart.

- Using this conversion chart, locate the acid value (w/v) in the left column as found above (0.82 g/100ml). With a straight edge at this acid, move to the right and find the Brix range of the juice and the corresponding acid (w/w). For 0.82 g/100ml and 11.0° Brix, the chart says the acid in (w/w) is reported as 0.79 g/100g.

Acid Unit Conversion (Weight/Volume) to (Weight/Weight) for Fruit Juices

Acid content and Brix/acid ratio limits in most US. grade standards for fruit juices are based on acid expressed as "grams per 100 grams of juice" (or percent by weight) rather than "grams per 100 ml of juice" (or percent by volume). When expressed in this manner, acid content calculated as (w/v) must be converted to (w/w) before determining acid compliance or calculating Brix/acid ratio. This may be accomplished by using the formula shown below with the specific gravity of the juice or by using the acid conversion chart for fruit juices. If needed, these methods can work both ways.

Conversion Formula from (weight/volume) to (weight/weight)

$$\text{Acid (w/w)} = \frac{\text{Acid (w/v)}}{\text{Specific Gravity of Juice (at } {}^{20}/_{20}\text{°C)}}$$

The specific gravity of the juice may be obtained from the Brix reading by use of Appendix XV – Sucrose Conversion Table in this instructional manual.

Acid Conversion Chart (weight/volume) to (weight/weight) for Fruit Juices

The conversion chart in Appendix XIII – Acid Conversion Chart is based on this formula above and provides a quick and convenient means for converting the acid content of fruit juices from weight/volume (g/100ml) to weight/weight (g/100g). If the acid (w/v) or Brix of the juice is not covered by these charts, the acid (w/w) may be obtained by the above formula.

Brix/Acid Ratio Calculation Example

Brix/acid ratios are calculated after acid conversions.

- Acid after titration = 0.75 grams/100ml (w/v)
- Acid after conversion = 0.72 grams/100 grams (w/w)
- Brix of juice = 11.8 °Brix

The true Brix acid ratio would be as follows:

$\frac{11.8}{0.72} = 16.4{:}\,1$

Vitamin C (Ascorbic Acid) Titrations

Ascorbic acid is a white or yellow crystal powder with a molecular weight of 176.12 grams. It is odorless but has a pleasant, sharp, acidic taste. Ascorbic acid is relatively unstable and is easily oxidized upon exposure to air and light. When this occurs, products may turn more yellow or brown and potentially result in a change of smell or taste. It occurs naturally in many fruit and vegetables and is abundant in freshly harvested produce.

The Division does not routinely test for ascorbic acid, and the reagents for this test are different from reagents for other acid titrations. If you are asked to perform a Vitamin C test, contact your supervisor for guidance.

AFLATOXIN ANALYSIS OF PEANUT BUTTER AND OTHER PEANUT PRODUCTS

To ensure that peanut products are in compliance with the Food and Drug Administration (FDA) guidelines, aflatoxin testing must be done. **All peanut butter that is graded and all peanut products that are inspected for quality will be chemically tested for the presence of aflatoxin.** Peanut butter is the only processed peanut product for which a U.S. standard has been issued. However, neither the U.S. Standards for Grades of Peanut Butter, nor the Grading Manual for Peanut Butter makes a reference to aflatoxin. Other products such as roasted peanuts, peanut granules, peanut flour, etc. are inspected against the requirements contained in contracts, announcements, federal specifications, and other specifications or instructions. These documents may or may not include aflatoxin testing as a part of inspection.

FDA has an administrative guideline of a maximum of 20 parts per billion (ppb) in processed peanut products. Since good manufacturing practices will remove sufficient aflatoxin to result in a level of 20 ppb aflatoxin in processed peanut products, the Memorandum of Understanding between the Agricultural Marketing Service and FDA (MOU 225-19-031) permits a level of 15 ppb aflatoxin in raw peanuts.

Any product that fails to meet the FDA guidelines for aflatoxin must be placed on hold for reexamination and/or possible destruction regardless of the source of the original samples. This includes product represented by samples submitted by the applicant. Under these circumstances, the product to be placed on hold would be the lot as declared by the applicant at the request for inspection. All samples for re-examination must be officially drawn.

Sampling

Samples must be drawn for quality in accordance with 21 CFR § 52.38. Samples for analysis must be composited from the sample units drawn for quality, provided sufficient product is available after inspection. If these sample units will not provide a sufficient quantity of product, parallel sample units must be drawn. Composite samples will be made as indicated in the table below, based on the number of sample units drawn for quality.

Sampling Rate for Aflatoxin

Sample Size (from 7 CFR § 52.38)	**3**	**6**	**13**	**21**	**29**
No. of Composite Samples (minimum)	1	1	2	3	4

- The composite samples will be made from approximately equal portions of each sample unit.
- The composite samples will be of the following minimum size for each product:
  - Roasted peanuts – 48 pounds
  - Peanut granules – 48 pounds
  - Peanut Butter – 1 pound

Aflatoxin samples drawn should be sent to the AMS Science and Technology Programs (S&T)

Aflatoxin Laboratory:

Blakely Laboratory 6567 Chancey Mill Road Blakely, GA 39823	**Laboratory Supervisor** Phone (229) 723-4570 Fax (229) 723-7251

Most specifications that include aflatoxin testing as a requirement state that aflatoxin must be negative. In no case may the specification permit a higher level of aflatoxin than permitted by FDA.

Certification of peanut products will be withheld until aflatoxin results are obtained from the laboratory.

Other Products

Inspection requests may be received for processed peanut products other than peanut butter, roasted peanuts, and peanut granules. In addition to peanut products, other nut products often have aflatoxin requirements. Under these circumstances, the Eastern, Central, or Western regional office should contact the Regional Operations Support for proper sampling and analysis procedures.

Aflatoxin Failure Re-inspection Procedure

A. The S&T aflatoxin laboratory notifies their Technical Services Branch (TSB) and the SCI Division field office of failed product. The notification may be given by telephone, with a follow-up in writing by fax or by email.

B. The SCI Division field office that graded the product will immediately notify Regional Operations Support by email to report the following:

- Contractor's name;
- Plant location;
- Product;
- Date packed;
- Codes;
- Quantity; and
- Reason for failure.

Verbal notification should be followed up with an email containing the same information. Send the email to Regional Operations Support and the Eastern, Central, or Western regional office, based on location.

C. The SCI Division field office will complete form SC-16, Notice for Hold for Reexamination (intranet link), to notify the applicant that the product exceeds the FDA guidelines for aflatoxin.

D. If desired, the applicant will send a letter on company letterhead and signed by a company official to S&T, TSB to request retesting of the product. This letter must include:

- Appeal for retesting with the lot broken down into sub-lots (normally a sub-lot is a pallet);
- Product name;
- Primary container code;
- Case count, and number and size of containers per case (e.g. 480 cases 6/No 10 cans);
- Current location(s) of product and amount of product at each site; and
- Method desired for shipment of samples to laboratory.

E. The TSB will send an email message or fax to Regional Operations Support containing the following information:

- Applicant's name, location, telephone number, and fax number (if applicable);
- Request for sampling on a sub-lot by sub-lot basis, or other sampling plan that is acceptable to SCI Division in the event of a claim for indemnification;
- Product name;
- Primary container code;
- Case count, and number and size of containers per case (e.g. 480 cases 6/No 10 cans);
- Current location(s) of product and amount of product at each site; and
- Method of shipment to laboratory.

F. Regional Operations Support will send an email message requesting sampling to the Eastern, Central, or Western regional office and also notify the Division Director. The message will contain all the information shown in E. along with any additional instructions that may be necessary.

G. Each sub-lot must be marked by some means to be separately identifiable. This is the responsibility of the applicant. However, if the applicant is acting in good faith and each pallet is marked the same, one acceptable way to mark the sub-lots is to stamp the cases with the USDA "Officially Sampled" stamp with a different lot number for each sub-lot. Case stamping procedures may be found in the General Processed Procedures Manual. The SCI Division field office will sample the product by sub-lot and will mark each sub-lot in a manner that will identify it from all other sub-lots. The field office will complete

form SC-637, Laboratory Sample Submittal Sheet (intranet link), to accompany the samples to the S&T laboratory. The samples will be clearly marked to indicate the sub-lot identification. Samples are shipped at the applicant's expense. The field office should confirm with the plant how they prefer the samples to be shipped.

H. The SCI Division field office will bill the applicant for the sampling, stamping (if necessary), and travel.

I. The SCI Division field office will send an email message to Regional Operations Support notifying when the samples are to be shipped to the laboratory, with copies to the appropriate Regional office, TSB, and the laboratory.

J. When the samples arrive at the laboratory, the laboratory will notify TSB, the SCI Division field office, and Regional Operations Support by fax or email.

K. The laboratory will perform aflatoxin analysis in duplicate on each sample, and immediately report the analytical results to the SCI Division field office and to TSB by telephone, fax, or email.

L. The TSB will send a fax or email message to Regional Operations Support containing the applicant's name and the following information for each location:

- Product name;
- List of aflatoxin results (in ppb), and number of cases for each sub-lot;
- The statement “Sub-lot No(s). _____ exceed(s) FDA administrative guidelines of 20 ppb aflatoxin”;
- Number of cases (and pounds) that pass;
- Number of cases (and pounds) that fail; and
- Total number of cases (and pounds).

M. The S&T laboratory will notify the applicant by telephone or fax of average analytical results.

N. The laboratory will prepare the certificate of analyses in the usual manner with the following exceptions:

1. For each lot and each primary container code, all sub-lots meeting FDA guidelines will be reported on one certificate.

2. For each lot and each primary container code, all sub-lots failing FDA guidelines will be reported on one certificate.

3. In both cases (1 and 2), each sub-lot is listed separately with its corresponding analytical result.

O. The laboratory will send a copy of each certificate prepared to TSB and the SCI Division field office and distribute the remainder of the certificates in the usual manner. The laboratory will bill the applicant for the analyses.

P. The TSB will provide the Regional Operations Support with a photocopy of each certificate.

Q. Failing product must be destroyed to the satisfaction of SCI Division, or the lot reported to FDA, per our Memorandum of Understanding (MOU).

R. Regional Operations Support will notify the Eastern, Central, or Western Regional office and field office that the product must be destroyed, and issue instructions for witnessing the destruction of the product by a USDA inspector. The instructions should consist of the following:

1. Notify the applicant that the product is not to be destroyed unless a USDA inspector is present. If an inspector is not present at time of destruction, FDA will be notified of the sub-lots in violation.

2. The field office is to notify Regional Operations Support through the Eastern, Central, or Western Regional office, of how the applicant intends to destroy the product. If the method of destruction is acceptable to the Regional Operations Support, the field office will be advised.

3. During the destruction, the USDA inspector will record the following:

- Date;
- Applicant's name and address;
- Truck identification (truck number or license number) used to transport the product;
- Name and address of dump site;
- Method of destruction;
- Lot identification (primary container codes, sub-lot numbers);

- Number of cases, size and kind of containers, and number of pounds of product; and

- Certificate number(s) of aflatoxin analyses certificate(s) covering the product.

ATTRIBUTES

An attribute may be defined as a characteristic or quality of a thing, a food product in this case. As used in statistics, the term "attributes" refers to when a record shows only the number of articles conforming and the number of articles not conforming to any specified requirement.

Attribute standards are directed toward specific quality levels based on predetermined acceptable average numbers of defects per hundred units of product. Acceptable quality level (AQL) is defined as the average number of defects per hundred units of product in a lot that is acceptable for the grade. The emphasis in attribute standards is placed on the lot as a whole instead of the individual container or sample unit. The amounts of defects permitted for the various grades (specific quality levels) are expressed in terms of numbers of defects per hundred units, geared towards a specified sample unit's sizes and acceptable quality levels.

The current sampling plans for attribute standards can be found in the following sections of the CFR:

- 7 CFR § 52.38b Statistical sampling procedures for on-line inspection by attributes of processed fruits and vegetables

- 7 CFR § 52.38c Statistical sampling procedures for lot inspection of processed fruits and vegetables by attributes

BRIX MEASUREMENT

The term "Brix" technically means the percent by weight of sugar solids in a pure sucrose solution.

Fresh Products

In fresh fruits it is generally referred to as soluble solids. Use the equipment and procedures in the General Market Manual for any fresh commodity that does not have an established procedure in the U.S. standards or inspection instructions. Products such as cantaloupes, table grapes, and watermelons have specific guidelines and instructions in determining soluble solids in their respective commodity inspection instructions.

Processed Products

In canned fruits, fruit juice, and similar products Brix is commonly used as a convenient term to express the percent by weight of all soluble solids in solutions. The solutions are generally not pure sucrose but contain sweeteners or mixtures of two or more types of sweeteners, and small amounts of other substances.

The instruments generally used for Brix measurement are Brix hydrometers and refractometers. These instruments are affected not only by the sugars present in a product but also by such substances as fruit acids, pectin, and minerals. Regardless of the composition of the solution, the Brix reading expresses the soluble solids content of the solution in terms of a Brix value corresponding to a pure sucrose solution of the same specific gravity.

The final Brix measurement of liquid packing media in canned fruit and similar products depends largely on four factors:

- The soluble solids of the in-going fresh products.
- The Brix of the in-going liquid medium.
- The proportion of fresh product to packing medium, and
- The extent to which the finished product (fresh product and liquid medium) has equalized.

Canned fruits are usually packed in a liquid medium, which may range from a water pack (no added sweetener) to a packing medium of natural juice, to a syrup of relatively high sugar content. The statement shown on the inspection certificate to indicate syrup density may be "syrup designation" or "Brix measurement." The appropriate statement to use when certifying canned fruits in a liquid media is described in the Certification Manual.

Liquid Packing Medium

Most liquid packing media fall into one of the following categories or syrup designations:

- Artificially sweetened.
- In fruit juice(s).
- In fruit juice(s) and water.
- In water.
- Slightly sweetened water, or extra light syrup, or slightly sweetened fruit juice(s) and water, or slightly sweetened fruit juice(s).

- Light syrup, or lightly sweetened fruit juice(s) and water, or lightly sweetened fruit juice(s).

- Heavy syrup, or heavily sweetened fruit juice(s) and water, or heavily sweetened fruit juice(s).

- Extra heavy syrup, or extra heavily sweetened fruit juice(s) and water, or extra heavily sweetened fruit juice(s).

The Brix measurement for each designation varies with the product. Inspectors must refer to the applicable U.S. Standards for Grades, buyer's specification, and Division instructions for special certification criteria to determine the actual requirements.

Inspection and Certification Criteria

When certifying the liquid medium, inspectors should consider certain Food and Drug Administration (FDA) mandatory requirements or U.S. Standards for Grades recommendations as to the following:

- The Brix of a liquid packing medium is not evaluated as a factor of quality when applying the U.S. grade standards. However, these standards do provide recommended or mandatory FDA syrup designations based on specified Brix measurements.

- Brix determination for syrup designation is a definite requirement in many specifications for canned fruits. The requirement may also be incorporated in a procurement document or buyer’s specification.

- Drained weights are sometimes predicated upon specified syrup designations. For example, the recommended drained weight for canned red tart pitted cherries packed in a sweetened medium differs from those packed in water.

- The Brix measurement(s) shown on the certificate of quality and condition is the soluble solids determination made at the time of final examination. This must be after the equalization of the natural sugars in the fruit and the in-going liquid medium. See Equalization – Terminology.

Acceptance Criteria

Use the following guide to allow for a reasonable variation in syrup densities and at the same time be within the limits of good commercial practice. A lot will be considered as meeting a required, recommended, or declared syrup designation under the following conditions:

- The average of the Brix measurements from all the sample units falls within the range for the designated syrup; and

- No individual reading is below the range of the next lower syrup designation, or above the range of the next higher syrup designation. If no lower syrup designation exists, none may fall more than 2 °Brix below the minimum of the specified designation.

Preparation of Samples

Equalization – Terminology

To properly evaluate Brix readings, it is important that the product has reached equalization with the packing medium. In the case of canned fruits and vegetables packed in syrup, complete equalization may require several weeks. However, unless otherwise stated in the particular standard or specification, assume that equalization is completed 15 days after packing. Even though the product and packing media may not have completely equalized during this period, the process is sufficiently complete for inspection and certification purposes.

Complete equalization may be accomplished at any time by comminuting the product and packing medium using the proper equipment and techniques. This procedure is referred to as simulated equalization. It will yield results comparable to natural equalization without requiring a 15-day delay in inspection.

The two basic categories of products on which Brix is measured:

- Naturally equalized products (either by prolonged storage or by the nature of the product)
- Non-equalized products

Samples are to be taken from individual containers only. Composite samples are not to be used.

Procedure for Equalized Products

Mix the sample. Completely liquid products should be stirred while still in the original container. Liquid packing media of products such as canned fruits is recovered during or after the drained weight step, while the fruit remains on the sieve. The container collecting the drained liquid must be free from water and reasonably free from syrup adhering from previous samples. Containers used for syrup samples that are borderline, or in dispute, must be cleaned and dried for each reading. Syrup collected in this manner is considered well mixed.

A. Transfer syrup to a standard laboratory glass cylinder and take the Brix hydrometer reading. Smaller containers with sufficient liquid content may be poured directly from the can into the cylinder.

B. Make temperature corrections (if needed).

- When using a Brix hydrometer calibrated to 20 °C, use Appendix XVII – Temperature Corrections – 20 °C Brix Hydrometers.

- When using a Brix hydrometer calibrated to 17.5 °C, use Appendix XVIII – Temperature Corrections – 17.5 °C Brix Hydrometers.

Note: If a refractometer is used, follow procedure as outlined in the Abbe Refractometer Procedure section.

Procedure for Non-Equalized Products

Simulated equalization replicates the natural equalization of soluble solids in the fruit or vegetable ingredient and the packing media. The entire contents of the canned product are blended into a homogeneous liquid state, and the degrees Brix of this slurry is determined by refractometer. The degrees Brix found is considered equivalent to the Brix obtained by hydrometer on the liquid packing media of equalized product.

The following equipment is required to perform this procedure:

- Blender or other similar machine with bowl size adequate to accommodate the contents of can sizes from a 2 ½ to a No. 10 can
- Refractometer, water cooled and equipped with thermometer and suitable light source
- Appendix XVI - Temperature Corrections – Refractometers without Automatic Temperature Correction
- Soft applicator such as plastic spatula
- Filtering equipment:
  - Funnel
  - Test tube
  - Filter paper

    Note: Nylon cloth or similar material may be used in lieu of filter paper provided comparable results can be obtained.

A. Perform the procedure as follows:

1. Pour entire contents of container into blender bowl. Whole, unpitted fruit should be carefully pitted, and pitted product should be checked for pits before comminuting. Transfer all the fruit and liquid to the bowl.

2. Blend the sample until homogeneous. This process could take up to two minutes. Check efficiency of blending by occasionally pouring a sample onto a clean, dry

pan and visually examining for lumps of fruit or vegetable flesh. Further blending is needed if lumps are present. (NOTE: It is usually not possible to completely liquefy maraschino cherries used in fruit cocktail and fruit mixes; however, final results are not adversely affected). Avoid excessive mixing since it overheats the sample.

An alternative method for overcoming any small container problem is the use of double dilution with an equal part by weight of distilled water, blending, and multiplying the result by 2.

3. Filter if necessary, discarding the first few drops. Avoid evaporation by covering the sample if not performing the reading immediately.

4. Apply two drops of sample to the refractometer prisms.

5. Take the reading, make temperature correction (if needed), and record results.

Selection of Brix Measuring Instrument

The following selections are recommended but not mandatory. A refractometer may be used in lieu of a hydrometer if equivalent results may be obtained.

Use hydrometer for:

- Naturally equalized canned fruit and canned vegetables (such as sweet potatoes in syrup) consisting of separate units in a liquid packing medium (including water and dietetic packs).

- Canned, chilled, and frozen single-strength fruit juices.

- Frozen fruits (in-going syrups only).

- Special products (such as pickles, pickle relish, molasses, and table syrups) as specified in standards or specifications and instructions.

Use refractometer for:

- Non-equalized canned fruits and canned vegetables (such as sweet potatoes in syrup) consisting of separate units in a liquid packing medium, including water and dietetic pack, after undergoing simulated equalization. See Procedures for Non-Equalized Products section for instructions.

- Canned fruit products such as purees, pulps, butters, jams, preserves, and jellies.

- Canned and frozen fruit juices other than single strength.

- Naturally equalized canned fruit and canned vegetables consisting of separate units in a liquid packing medium, where individual containers contain insufficient liquid medium to measure by hydrometer.
- Frozen fruits.
- Special products, such as honey, as specified in standards, specifications, or instructions.

Procedures

Hydrometer Procedure

The Brix hydrometer or spindle is a glass instrument consisting of a hollow bulb which causes the hydrometer to float. Below this bulb is a section filled with shot which causes the instrument to float in an upright position. Above the bulb is a graduated stem from which the readings are taken. The extent to which the stem extends above the surface of the liquid depends upon the specific gravity of the liquid being tested.

The instrument is similar to any specific gravity hydrometer indicating degrees of liquid density. However, the graduations on the stem of this instrument are expressed in degrees Brix and indicate the percentage of soluble solids in terms of sucrose equivalent. If the Brix hydrometer is immersed in a solution composed entirely of sucrose and water, the reading at proper temperature is exactly the percentage by weight of pure dry sugar (sucrose) in the solution. The degrees Brix is easy to determine, is a convenient measurement of the specific gravity in terms of the Brix scale, and reflects the total soluble solids in solution.

The hydrometer most often used in laboratories has a 10-degree range for each spindle with graduations in $^{1}/_{10}$ degrees. Most SCI Division laboratories are equipped with instruments to cover at least the range from 5 to 40 °Brix and are calibrated at 20 °C, but some may be calibrated at 17.5 °C.

The Brix hydrometer should be checked periodically for accuracy. Please see the section on Hydrometer Calibration for instructions.

- Equipment
  - Gram scale (for calibration only)
  - Brix hydrometer with proper range to cover the expected result, graduated in 1/10° Brix (calibrated to 17.5 °C or 20 °C)
  - 500 ml hydrometer cylinder

- Procedure

1. Pour the liquid to be examined into a standard glass laboratory cylinder (approximately 1 ¼ inches inside diameter, 10 to 12 inches tall). Completely fill the cylinder and allow to overflow slightly to float off any foam or bubbles.

2. Remove sufficient liquid from the cylinder to allow the hydrometer to float at a level of liquid slightly below the top of the cylinder.

3. Slowly lower the clean, dry hydrometer into the liquid until it is very near floating position. Release spindle with a slight spinning motion.

    - If it is dropped into the syrup, it will sink too far and when it rises some of the syrup will adhere to the stem. The weight of this adhering syrup will cause the hydrometer to float at a lower position than it should. Air bubbles in the syrup or liquid will also cause the hydrometer to float at an incorrect level.

    - It may be necessary to strain any samples of juice with excessive pulp.

    - If the syrup or liquid has air bubbles, deaeration will be necessary. This is accomplished one of the two methods listed below. The length of time depends upon the amount of air incorporated into the sample.

        - Let the juice stand for a period of time.

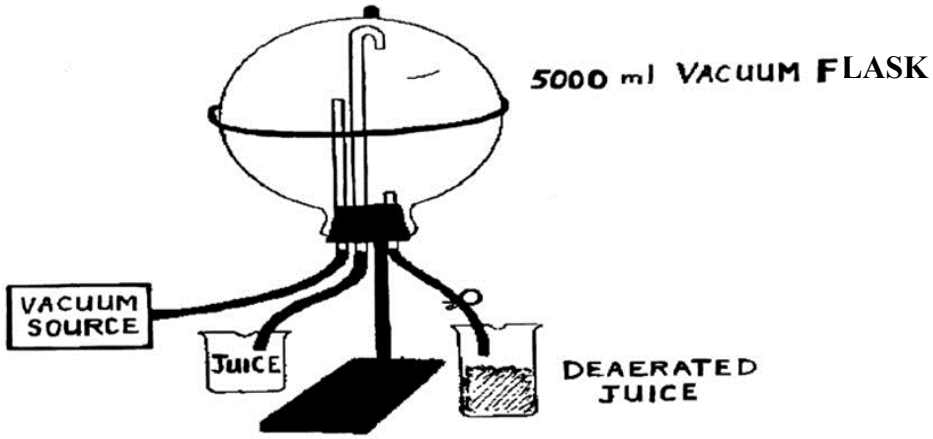
        - Deaeration by use of a vacuum.

            - Equipment

                - Vacuum source, such as a small electrical pump

                - 5000 ml vacuum flask (safety netting recommended)

                - Hoses, rubber stopper, and clamps



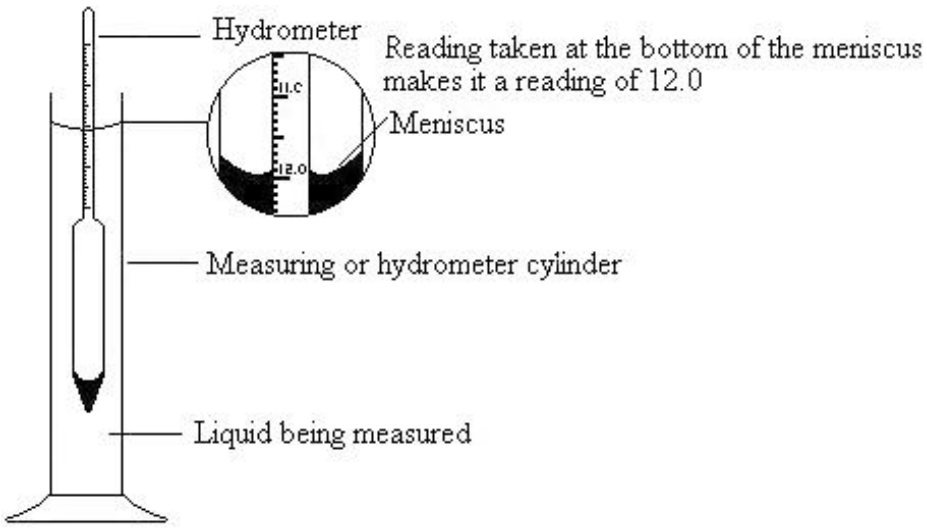
- Procedure

  (1) Draw vacuum on a large vacuum flask.

  (2) Place intake hose into juice sample and draw the juice into the flask to remove air bubbles.

  (3) Release the vacuum and allow the deaerated juice to flow in the container which will be used for obtaining Brix value.

4. Observe the reading on the stem after allowing the hydrometer to come completely to rest. The hydrometer should not touch the side of the glass cylinder. Where the liquid touches the stem, it rises a short distance to form a meniscus. Looking at the surface level of the liquid, take the reading from the bottom of the meniscus at the true liquid level, not at the top of the meniscus.



5. Record the temperature of the liquid, and refer to the appropriate temperature corrections chart for your Brix hydrometer to make any necessary temperature corrections:

   ºBrix Sample = ºBrix (Hydrometer reading) ± Hydrometer Temperature Correction

   - Appendix XVII – Temperature Corrections – 20 °C Brix Hydrometers
   - Appendix XVIII – Temperature Corrections – 17.5 °C Brix Hydrometers

6. The Brix hydrometer is a very delicate and fragile instrument. It must be handled with care to avoid breakage and should be thoroughly cleaned and dried immediately after each use. Store it in an adequately cushioned container to protect it from damage.

Handheld Refractometer Procedure

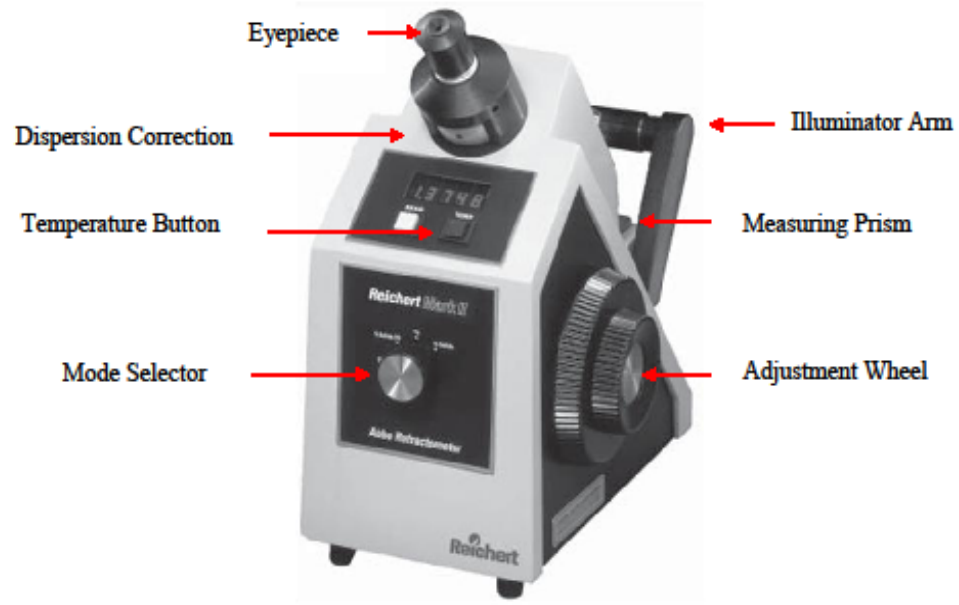
A refractometer is an instrument that optically measures the density of a liquid. Light passes through the sample and is deflected in relation to the density of the sample. The instrument is calibrated in terms of refractive index and usually contains a scale in terms of degrees Brix.

Handheld refractometers are used when estimating the soluble solids of fresh fruit and are not sufficiently accurate for laboratory purposes as required by certain processed products. See the General Market Manual under the "Soluble Solids (Brix)" header for guidelines regarding general use of a handheld refractometer when not specifically covered within an commodity grading manual for fresh product.

See the section on calibration of Handheld Refractometers (Fresh Products) for calibration and care instructions.

Abbe Refractometer Procedure

An Abbe type refractometer consists of two prisms between which a portion of the test sample is placed. A mirror will reflect light through the prisms and test sample. A telescopic tube with crosshairs is superimposed on the field of vision, correlating to a scale calibrated in terms of refractive index, degrees Brix, or both. There is also a compensator to correct for the chromatic dispersion of light, and a thermometer in the water circulating system. There may be some variation depending on the make and model of the individual instrument. Become familiar with the refractometer by reviewing its instruction manual.



The refractometer should be checked for accuracy before use. This should be on a daily basis when in constant use, such as during in-plant inspections. The method of determining the instrument's accuracy of calibration will be specified in the refractometer manual. See the section on the calibration of Abbe Refractometers (Processed Products) for calibration instructions.

- Equipment
  - Abbe refractometer
  - Soft tissue or nonabrasive material
- Reagents
  - Distilled water or a solution of known refractive index

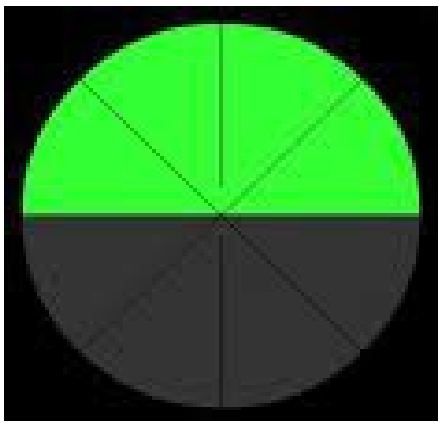
- Procedure

1. Apply one or two drops (amount may vary; follow the instruction manual) of the sample (filtered or well mixed when necessary) to the lower prism. Be careful not to scratch the soft refractometer prisms in the process. Avoid using product that is too hot or too cold, as this could also damage the prisms.

   Caution: Incorrect readings may be caused by too much sample on the prism (causing the liquid to flow around onto the backside of a prism), or by water on the prism from incomplete drying from the previous sample.

2. Close and lock the prism chamber.

3. Apply the light source and view the shadow through the telescope, keeping the eye in the center of the eyepiece. Align the shadow edge (which should be sharp) exactly with the intersection of the crosshairs.



An indistinct shadow edge may be caused by:

- Insufficient or excessive sample on prisms.
- Unfiltered sample of purees and slurries.
- Improper chromatic dispersion adjustment indicated by a blue or red tinge in the shadow edge.
- Insufficient or excessive light directed on the prisms.
- Improper closing of prisms (too rapid closure of prisms, or prisms not locked securely).

- Light stop that controls the amount of light transmitted to the prisms (present on some instruments) is not fully closed.

4. Read degrees Brix or Refractive Index on refractometer.

   - On Abbe refractometers not equipped with a direct reading Brix scale, convert to the appropriate tables of "Refractive Indices of Sucrose Solutions" using Appendix XV – Sucrose Conversion Tables and then apply any necessary Brix reading corrections as shown below.

   - On Abbe refractometers equipped with a direct reading Brix scale, record such Brix reading and adjust this Brix measurement by applying any necessary Brix reading corrections as shown below.

5. Note the temperature indicated by the thermometer and apply refractometer Brix reading corrections as necessary:

   - Temperature Correction:

     Note: If the specific refractometer being used is equipped with Automatic Temperature Control (ATC), a temperature correction is not necessary.

     Temperature greatly influences the Brix reading, and it is essential that the reading be corrected to the instrument's standard temperature (usually 20 °C or 68 °F) if the instrument does not automatically correct for temperature. Temperature of the prisms should remain as close to standard temperature as practical by adjusting the flow of water through the cooling system.

     Refractometers standardized at 20 °C are preferred by the Division. When sample temperatures are above or below the temperature at which the instrument is calibrated, corrections are based on the standard temperature of the instrument. Temperature correction charts for refractometers at 20 °C are included in Appendix XVI – Temperature Corrections – Refractometers without Automatic Temperature Correction and are only for instruments standardized at 20 °C and those without ATC.

   - Citrus Fruit Juices ONLY: Citric Acid Corrections to Brix:

     In addition to any temperature corrections required when using refractometers, citrus juices also require the Brix result from refractometers be corrected for citric acid, called an acid correction (see exceptions below). This is because citrus juices contain soluble constituents other than sucrose. The values obtained by the refractometric method differ significantly from results obtained by the Brix hydrometer, which is

unaffected by the optical characteristics of the different materials in solution.

The greatest single difference between refractometer and Brix hydrometer values in citrus juices appears to be caused by the citric acid, which lowers the refractive index. By applying a correction for citric acid, the results by refractometer will be closer to the "true" Brix if it were to have been determined by a Brix hydrometer. Acid corrections to Brix refractometers readings of citrus fruit juices can be found in Appendix XIX – Citrus Fruit Juices, Acid Corrections to Brix – Refractometers .

The acid corrections in Appendix XIX – Citrus Fruit Juices, Acid Corrections to Brix – Refractometers do not apply to the following products:

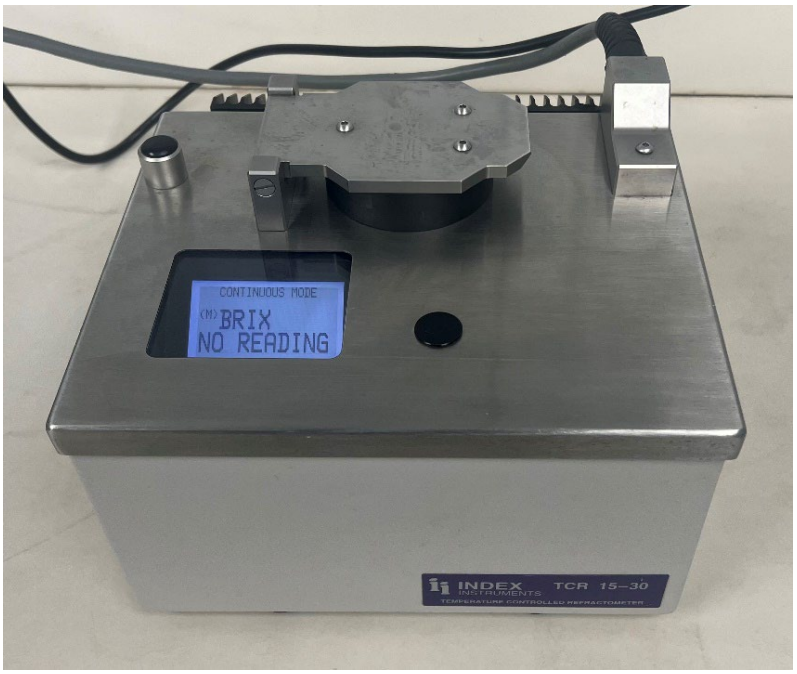
- **Lemon Juice** acidity correction to Brix is left uncorrected.
- **Concentrated Lemon Juice for Manufacturing** acidity correction to Brix is left uncorrected.
- **Pineapple Juice** acidity correction to Brix is left uncorrected.
- **Frozen Concentrated Lemonade** utilizes its own acid correction to Brix chart. See the Frozen Concentrate for Lemonade inspection instructions for the chart.

Note: These only apply to Brix readings using a refractometer. Do not apply these acid corrections when using a Brix hydrometer.

6. The refractometer must be always kept clean and in proper working order. Clean and dry the prisms with soft, lint free tissues immediately after each reading. The prisms are soft and scratch easily; never touch them with hard objects such as spoons or glass rods. Place a small piece of soft paper or tissue between them when the instrument is not in use and protect with a cover. Refer to the instruction manual for any specific storage or handling procedures.

Digital Index Refractometer Procedure

Digital index refractometers should be calibrated at least daily. See the section on the calibration of Digital Index Refractometers (Processed Products) of this manual for calibration instructions. Due to the wide variety of digital index refractometers used by the Division, refer to instruction manual for each device if the device is different than shown below (Texas Instrument TCR-15-30).



- Equipment
  - Digital Index Refractometer
  - Soft lint-free cloth or lens paper
- Reagents
  - Distilled water
- Procedure
  1. Assure the digital index refractometer prism and lid are clean. Use deionized water and a soft absorbent tissue.
  2. Dry carefully with a soft absorbent tissue.

3. Pour the sample onto the prism (sample size should be between a dime and a quarter). The sample should cover the entire prism.

   - Avoid putting juice that is too hot, or too cold on the refractometer prism, as extreme temperatures can damage the prism, as well as give inaccurate readings. Hot juice will give lower Brix reading and cold juice will give higher Brix readings.

4. Close the lid.

5. Press the digital index refractometer's "read" button and wait for the results.

7. Note the temperature indicated by the thermometer and apply refractometer Brix reading corrections as necessary:

   - Temperature Correction:

     Note: If the specific refractometer being used is equipped with ATC, a temperature correction is not necessary.

     Temperature greatly influences the Brix reading, and it is essential that the reading be corrected to the instrument's standard temperature (usually 20 °C or 68 °F) if the instrument does not automatically correct for temperature. Temperature of the prisms should remain as close to standard temperature as practical by adjusting of the flow of water through the cooling system.

     Refractometers standardized at 20 °C are preferred by the Division. When sample temperatures are above or below the temperature at which the instrument is calibrated, corrections are based on the standard temperature of the instrument. Temperature correction charts for refractometers at 20 °C are included in Appendix XVI – Temperature Corrections – Refractometers without Automatic Temperature Correction and are only for instruments standardized at 20 °C and those without ATC.

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The greatest single difference between refractometer and Brix hydrometer values in citrus juices appears to be caused by the citric acid, which lowers the refractive index. By applying a correction for citric acid, the results by refractometer will be closer to the "true" Brix if it were to have been determined by a Brix hydrometer. Acid corrections to Brix refractometers readings of citrus fruit juices can be found in Appendix XIX – Citrus Fruit Juices, Acid Corrections to Brix – Refractometers.

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- **Frozen Concentrated Lemonade** utilizes its own acid correction to Brix chart. See the Frozen Concentrate for Lemonade inspection instructions for the chart.

Note: These only apply to Brix readings using a refractometer. Do not apply these acid corrections when using a Brix hydrometer.

8. Record the corrected result onto the worksheet.

Reporting Results

After adjusting the reading for temperature variation, report results of Brix readings to the closest $^{1}/_{10}$ or 0.1 degree, or to the appropriate degree per the grading instructions. Corrections for the presence of fruit acids, minerals, and similar ingredients are not made unless specified in the standard or specification.

Percentage Juice Declaration

Through 21 CFR 101.30, FDA has declared that the use of the below standard Brix levels in the table will promote consistency in calculating the percentage of juice, which is included on the label of products. This is an FDA labeling regulation that includes minimum Brix levels to facilitate the calculation the percentage of juice and these brix levels serve as the formula to calculate or verify the percentage of actual juice. To declare a fruit or vegetable juice prepared from concentrate to be 100% juice, the reconstituted juice must meet the minimum Brix level indicated in the table.

If the Brix reading of a reconstituted juice is less than the Brix shown in the chart on the following page, the product is not considered to be 100% juice. In this case, the processor must calculate the exact percentage of juice and declare the proper percentage of juice on the retail label. As a reminder, this is only a labeling requirement so any product graded will still follow all FDA Standard of Identities, U.S. grade standards, or specifications when determining grades and whether deviants are allowed.

When the food is not in package form (bulk), the required nutrition labeling information (including percentage juice declaration) should be displayed clearly at the point of purchase (e.g., on a counter card, sign, tag affixed to the product, or some other appropriate device). Alternatively, the required information may be placed in a booklet, binder, or other appropriate format that is available at the point of purchase.

Juice	100 Percent Juice [1]
Acerola	6.0
Apple	11.5
Apricot	11.7
Banana	22.0
Blackberry	10.0
Blueberry	10.0
Boysenberry	10.0
Cantaloupe Melon	9.6
Carambola	7.8
Carrot	8.0
Casaba Melon	7.5
Cashew (Caju)	12.0
Celery	3.1
Cherry, dark, sweet	20.0
Cherry, red, sour	14.0
Crabapple	15.4
Cranberry	7.5
Currant (Black)	11.0
Currant (Red)	10.5
Date	18.5
Dewberry	10.0
Elderberry	11.0
Fig	18.2
Gooseberry	8.3
Grape	16.0
Grapefruit	10.0 [3]
Guanabana (soursop)	16.0
Guava	7.7
Honeydew melon	9.6
Kiwi	15.4
Lemon	4.5 [2]
Lime	4.5 [2]
Loganberry	10.5
Mango	13.0
Nectarine	11.8
Orange	11.8 [3]
Papaya	11.5
Passion Fruit	14.0
Peach	10.5
Pear	12.0
Pineapple	12.8
Plum	14.3
Pomegranate	16.0
Prune	18.5
Quince	13.3
Raspberry (Black)	11.1
Raspberry (Red)	9.2
Rhubarb	5.7
Strawberry	8.0
Tangerine	11.8 [3]
Tomato	5.0
Watermelon	7.8
Youngberry	10.0

[1] Indicates Brix value unless other value specified.
[2] Indicates anhydrous citrus acid percent by weight.
[3] Brix values determined by refractometers for citrus juices may be corrected for citric acid.

Note: The Brix levels shown in this table do not apply to juices that are directly extracted from a fruit or vegetable (i.e., not concentrated or reconstituted). Such products are considered to be 100% juice and will be declared as 100% juice.

Example: If a reconstituted juice has a blend of natural juice solids and sweetener solids, the minimum brix levels in the table above are provided to be used as a basis for the calculation for the natural juice (minus the Brix from sweetener). If the U.S. grade standard required 13.0 °Brix, but this chart says 100% juice for that product is at 16.0 °Brix of natural solids, then the processor must declare the actual percent of natural juice on the label. The product still will meet grade if it meets the requirements in the U.S. grade standard despite the need to declare a percentage juice other than 100%.

Example: Calculations of the percentage of juice in a juice blend or a diluted juice product made directly from expressed juice (i.e., not from concentrate) shall be based on the percentage of the expressed juice in the product computed on a volume/volume basis.

Percent Juice Declaration – Inspector Responsibilities

When it is suspected a lot does not meet the above requirements in 21 CFR 101.30, the in-plant inspector will calculate the percentage of juice in the batch using the above table as a basis for calculations to determine if there is a discrepancy from the amount declared on the label. When a juice or juice beverage product fails the required reconstituted Brix, fails to show the percent juice, or does not have the correct percent of juice on the label, document the score sheet accordingly, and flag the certificate under the grade statement. See the Certification Manual for examples.

When the product label bears an approved USDA identification mark and the product fails FDA's minimum Brix requirement, the lot will be placed on hold and may not be shipped. This would also apply to lots labeled incorrectly for percentage of juice. The processor has the option to rework the product to meet the Brix requirement; or use a label that states the proper percentage of juice.

Processors should contact the FDA (https://www.fda.gov/about-fda/contact-fda), if they have any questions regarding percentage juice labeling or nutritional facts that relate to the Nutritional Labeling Education Act (NLEA) regulations.

Information on beverages that contain fruit and vegetable juice are available at the websites listed below:

- Identity labeling of food in packaged form, FDA regulations 21 CFR 101.3, https://www.ecfr.gov/current/title-21/chapter-I/subchapter-B/part-101/subpart-A/section-101.3

- Percentage juice declaration for foods purporting to be beverages that contain fruit or vegetable juice, FDA regulations 21 CFR 101.30, https://www.ecfr.gov/current/title-21/chapter-I/subchapter-B/part-101/subpart-B/section-101.30

- Beverages that contain fruit or vegetable juice, FDA regulations 21 CFR 102.33, https://www.ecfr.gov/current/title-21/chapter-I/subchapter-B/part-102/subpart-B/section-102.33

APPROVAL OF INSPECTION INSTRUMENTS FOR USE BY THE DIVISION

Instruments for use in the inspection of fresh, processed, and specialty products must be approved for use. Instruments for the purposes of this guidance consist of inspection aids (e.g. area measuring guides, commodity sizers), measuring devices (e.g. refractometer, salometer) and other devices used in inspection duties. Various approved equipment may be found in the Equipment Catalog for Fresh and Products Inspections located on the AMS web site at the following link: https://www.ams.usda.gov/grades-standards/how-purchase-equipment-and-visual-aids. Additional approved equipment may be discussed within Specialty Crops Inspection (SCI) Division guidance documents, inspection instructions, and U.S. standards for grades.

Standardized Equipment

Lab equipment such as scales, calibrated glassware, calibrated pipettes, refractometers, thermometers, and other equipment may be purchased with National Institute of Standards and Technology (NIST) traceable certification of accuracy. This certification provides assurance that the product when purchased has undergone testing verifying accuracy of performance for the purpose the equipment is designed for. Each device purchased with NIST certification will be verified upon receipt and have specified intervals of calibration recommended. Mandatory annual preventative maintenance calibration by a third party will be performed as required by SCI Division.

Non-Standardized Equipment

Non-standardized equipment may be submitted for SCI Division approval. Depending on the technical complexity of the equipment, SCI Division will conduct a study to determine if the equipment meets established standards. For non-standardized equipment approval for use submit a request to the Standardization Branch Chief or Assistant Branch Chief. Include all pertinent information regarding the device as well as why current methods are not adequate.

Exception: SCI inspections performed under specific industry standards and applicable state rules and regulations are exempt from this approval process, as the industry standards are consistent with the expectations of the Division.

SCI Division will neither solicit nor discourage the participation of any specific manufacturer or its equipment.

CALIBRATION OF EQUIPMENT

Accurate results from equipment rely on standardized procedures and properly calibrated equipment. Equipment such as refractometers or thermometers should be calibrated before use instead of set intervals if usage is infrequent. Calibration logs have been established to record

these readings and to document the calibration process. The calibration logs noted below are guides and may be photocopied and maintained as documentation of inspectors' results.

Any equipment that cannot be calibrated within specified guidelines should be "tagged" and removed from usage. Equipment without serial numbers or some other means of identification should be labeled with a property decal.

Thermometer Calibration

Fresh Products

Refer to the Thermometer sections of the General Market Manual for guidelines regarding proper use and calibration of thermometers used in the inspection of fresh products.

Processed Products

Thermometers used should be tested every week, or as often as each inspection if any potential abuse has ensued (such as carton penetration). This is done by immersing the thermometer in an ice and water bath.

Fill an appropriate size beaker with ice and then water. Stir for 2 minutes and then immerse the thermometer for 2 minutes in the center of the mixture. Do not permit the thermometer bulb to rest against the side of the container. The thermometer may be held vertically by fitting it through a perforated piece of cardboard positioned across the top of the beaker. The thermometer should read within 1 ° ± of 32 °F (0 °C). Record results on the Thermometer Checks Log in Appendix I.

There may be a need to test the thermometer at other temperatures. For calibration at temperatures from 0 to -5 °F, use a brine mixture consisting of 1 part of salt and 3 parts chipped ice. Compare the thermometers being tested with a thermometer that is known to be accurate, i.e. traceable to the National Institute of Standards and Technologies (NIST). Insert both thermometers into the brine mixture with the stems next to each other. Do not permit either of the thermometer bulbs to rest against the side of the container. Wait 2 minutes and compare and record readings on the Thermometer Checks Log in Appendix I.

Scale Calibration

Fresh Products

Refer to the scales section of the General Market Manual for guidelines regarding proper use and calibration of scales used in the inspection of fresh products.

Processed Products

The scales used for checking net weights and drained weights should be calibrated weekly or more often as recommended by the instruction manual and the results recorded on the appropriate log (Appendix II – Weekly Gram Scale Checks Log and Appendix III –Weekly

Ounce Scale Checks Log). The scales used for analytical weighing are generally calibrated yearly by a service technician.

- Gram Scales

    1. Complete value readings with an NIST class weight, preferably 10 g and 100 g weights. Record results to the 0.0 g.

    2. Tare scale to zero reading.

    3. Add the 10 g weight.

    4. Record reading; adjust as necessary per the instruction manual. Record on the Weekly Gram Scale Checks log in Appendix II.

    5. Reweigh 10 g if necessary.

    6. Add 100 g weight.

    7. Record reading; adjust as necessary per the instruction manual. Record on the Weekly Gram Scale Checks log in Appendix II.

    8. Reweigh 100 g if necessary.

    9. Return to zero and recheck calibrations if adjustments were made.

- Ounce Scales

    Follow the above procedures using a NIST class weight, preferably 10-ounce and 80-ounce weights. Record results to the 0.0 ounce. Record on the Weekly Ounce Scale Checks log in Appendix III.

Refractometer Calibration

Handheld Refractometers (Fresh Products)

It is important that handheld refractometers be properly adjusted before use. Otherwise, it will be impossible to make an accurate determination of the sugar content. It will be found most convenient to adjust the instrument to read zero with distilled water at the temperature at which the test will be made. As the temperature changes during the day, it will be necessary to readjust the instrument. A small supply of distilled water should be kept on hand for this purpose, and precautions taken to keep it clean. Tap water should not be used because it frequently contains enough minerals in solution to materially affect the reading, instead use distilled water.

The refractometer must be clean, or the accuracy of the reading will be affected. It must be thoroughly cleaned after each use, as juice allowed to remain and dry on the instruments will materially affect the accuracy of the next test made. Care should be taken not to scratch the

surface of the prism or the hinged plate. Cheesecloth or a soft cotton towel may be used to dry the prism.

Abbe Refractometers (Processed Products)

The refractometer must be checked daily for compliance by using distilled water or a solution of known refractive index and the results recorded on the Refractometer Checks Log in Appendix IV. However, calibration of the refractometer should be done with the test prism (if applicable) provided with the instrument.

- Equipment
    - Test prism
    - Thin rod with well-rounded end
    - Soft lint-free cloth or lens paper
    - isopropyl alcohol
    - Monobromonaphthalene
    - Square-headed screwdriver supplied with refractometer
    - Distilled water
- Standardizing the Refractometer

    The refractometer should be checked for accuracy before use. It must be checked daily when in constant use, such as during in-plant inspection and the results recorded on the Refractometer Checks Log in Appendix IV.

    Frequent daily checks may be made with distilled water. The distilled water checks supplement less frequent checks with the test prism, and are performed as follows:

    1. Clean and dry prisms carefully.
    2. Apply one or two drops of distilled water to prisms.
    3. Compare observed refractive index and prism temperature with the appropriate refractive index for the same temperature (see Refractive Index of Distilled Water chart below). If the refractive index reading differs ± 0.0003, repeat steps 1 and 2 until a total of three readings are obtained. If the refractive index of the last reading still differs from the table ± 0.0003, check the refractometer with the standard test prism. If the reading still differs ±0.0003, recalibrate the refractometer.

Caution: Recalibration of the refractometer should be done by an experienced SCI Division inspector or plant official. If the plant's quality control representative performs the calibration, the USDA inspector should observe to assure accuracy.

REFRACTIVE INDEX OF DISTILLED WATER

Temperature (°F)	Temperature (°C)	Refractometer Reading
59.0	15	1.3334
60.8	16	1.3334
62.6	17	1.3333
64.4	18	1.3332
66.2	19	1.3331
68.0	20	1.3330
69.8	21	1.3329
71.6	22	1.3328
73.4	23	1.3327
75.2	24	1.3326
77.0	25	1.3325
78.8	26	1.3324
82.4	28	1.3322
86.0	30	1.3320

- Checking for Accuracy

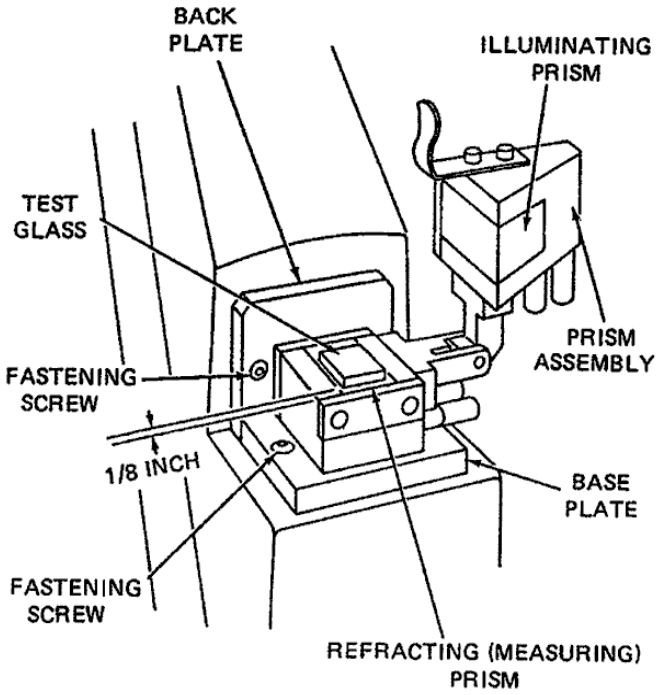
1. If feasible, adjust the refractometer prism temperature as close as possible to the standard temperature (20 °C).

2. Clean the lower refractometer prism face with a solvent, and dry with a soft lint-free cloth or lens paper, making sure no dust fibers adhere to the prism face.

3. Clean the test prism in the same manner as step 2.

4. Using a thin rod with a well-rounded end, carefully place a drop of monobromonaphthalene on the large, polished face of the test prism. The drop should not be larger than 1 mm in diameter.

5. Place the test prism longitudinally in the middle of the lower refractometer prism, with its large, polished face downward, and small polished face outward toward the light source.



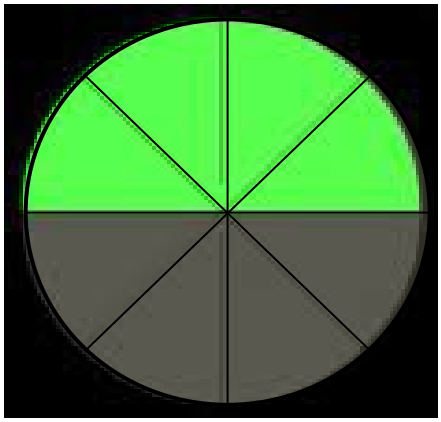
6. The correct quantity of monobromonaphthalene can be checked by pressing the test prism lightly against the refractometer prism face. If any of the solution leaks from under any of the test prism edges, the reading will be incorrect, and the procedure must be started again from step 1. Perform the procedure again if any bubbles are trapped under the test prism, as this will also cause an incorrect reading.

7. When the test prism is correctly placed, position the light source so that it is directly in line with the small, polished face of the test prism. A blue glass filter or tissue paper may be held in front of the light source so that the best contrast is obtained between the two halves of the field of vision.

8. Look through the refractometer eyepiece. Locate the shadow edge. Be sure that the line does not shift with motion of the light source. Any color fringe on the shadow edge can be eliminated by adjusting the chromatic compensator, also known as the dispersion correction wheel. This is a rotating drum located on the front of the refractometer housing beneath the eyepiece on the Abbe 3L type (see the illustration in the Abbe Refractometer Procedure section). Refer to the instruction manual if you are unsure how to adjust the chromatic compensator of the refractometer.

9. Reading the scale:

   On the Abbe type, the scale is read by depressing the switch on the side of the instrument. Release the switch and bring the shadow edge to line up at the intersection of the crosshairs as shown on following page.



10. Read the refractive index and compare to the one shown on the test prism. If the average of at least three (3) readings differs by more than two units on the fourth decimal place, the refractometer must be adjusted.

- Calibration or Adjustment

  Follow the steps in the refractometer's instruction manual.

Digital Index Refractometers (Processed Products)

The refractometer must be checked daily for compliance by using distilled water or a solution of known refractive index and the results recorded on the Refractometer Checks Log in Appendix IV.

- Equipment
  - Deionized water
  - Soft lint-free cloth or lens paper
- Calibrating the Digital Index Refractometer

  The digital index refractometer should be checked for accuracy before use. It must be checked daily when in constant use, such as during in-plant inspection and the results recorded on the Refractometer Checks Log in Appendix IV.

  Due to the wide variety of digital index refractometers used by the Division, please refer to the instruction manual for each device for instructions on calibrating your specific digital index refractometer.

  In the event the instruction manual cannot be located in print or online, use the following instructions for calibration of a **TCR-15-30 refractometer** as an example:

1. Clean off any residue left in the prism and lid utilizing deionized water and a soft absorbent tissue.

2. Dry carefully with a soft lint-free cloth or lens paper.

3. Place distilled water onto the prism.

4. Close the lid & press the "read" button.

5. If the refractometer reads more than ± 0.01 repeat steps 1 through 4. If the refractometer is within tolerance proceed to step 9.

6. If the readings continue to be out of range calibrate the refractometer using the Index TCR remote and press the "zero" button.

7. Follow the prompt screen instructions on the refractometer.

8. Once all the appropriate steps have been completed repeat steps 1 through 5.

9. Log reading and temperature in Appendix IV – Refractometer Checks Log.

10. In the event that calibration cannot meet the acceptable ranges, notify the appropriate personnel of the issue. Do not use the refractometer until calibration results are within acceptable ranges.

Caution: Recalibration of the refractometer should be done by an experienced SCI Division inspector or plant official. If the plant's quality control representative performs the calibration, the USDA inspector should observe to assure accuracy.

pH Meter Calibration

Most pH meters require daily calibration and standardization to two endpoints (usually pH 4 and pH 7, or pH 7 and pH 10) before use. Calibration checks should be documented each day of use on Appendix V.

Certified accurate endpoint pH buffer solutions can be purchased from a scientific supply source.

- Check the electrodes for freedom from crystals or damage.
- Follow the instruction manual provided with the meter.
- Check meter in two buffer solutions, and record values on Appendix V - Daily pH Meter Checks Log.

Sodium Hydroxide (NaOH) Calibration

Sodium hydroxide (NaOH) solutions must be created and maintained at proper concentrations to allow for proper calculation of results in the lab when performing titrations. All pre-mixed solutions of NaOH may change after time due to evaporation. Solutions mixed using a concentrated source may be mixed inaccurately. These instances will produce inaccurate titration readings if not caught. Verifications or calibration of the NaOH solutions must be conducted each day of use or anytime switching to new batches. NaOH solutions can be purchased pre-mixed at desired concentrations or purchased via concentrated solutions that require dilution prior to use, depending on the specific procedure being used. When performing calibrations using NaOH, calibrate the concentration using one of the following options below.

Notes:

- Normality (N) and molarity (M) are the same for NaOH. A 0.1 M solution of NaOH is also 0.1 N.

- 1 M NaOH = 1 N NaOH = 4% w/v solution

Titration with Potassium Hydrogen Phthalate (KHP) to Determine NaOH Concentration

A. Weigh out 0.8 grams of dried KHP and place into an Erlenmeyer flask. If using a small weighing dish, check the weight of the empty dish after transferring KHP to flask to account for any KHP which may still be adhering to it. Adjust total weight accordingly.

B. Dissolve the KHP in 50-75 ml of distilled water.

C. Add 4 to 5 drops of phenolphthalein indicator to the flask.

D. Mix well and ensure all KHP gets dissolved into solution (warming solution with hands with speed this up).

E. Ensure the burette containing NaOH reads 0.0.

F. Using a burette, slowly add NaOH while mixing or swirling the flask until the solution turns a permanent faint pink color and remains that way for 20 seconds.

G. Read and record the amount of NaOH used in ml as indicated on the burette. Divide this by 1000 to convert to liters (L)

H. Calculate the concentration of NaOH:

1. $\frac{grams\ of\ KHP\ used}{204.23\ g/mol} = moles\ of\ KHP$

2. $\frac{moles\ of\ KHP}{amount\ of\ NaOH\ used\ in\ titration\ (L)} =$
$Concentration\ of\ NaOH\ in\ Moles\ (M)\ or\ Normality(N)$

Using a Sodium Hydroxide Concentration Meter or Refractometer

There are various devices available designed for measuring the concentration of sodium hydroxide. If using these devices, refer to the user manual for calibration of these devices. A known supplier of these types of devices may be found at https://atagousa.corecommerce.com/. A National Institute of Standards and Technology (NIST) traceable certification of accuracy is required for these devices. Follow manufacturer's calibration instructions.

Analytical Glassware Calibration

Calibration should be performed prior to being placed into service. Glassware can be taped or tagged as to calibration. Enter a serial number and date calibrated on Appendix VI - Analytical Glassware Checks Log.

Example: 25 ml Pipette/25 ml Burette

A. Tare a 50 ml beaker on a gram scale.

B. Fill the pipette with distilled water to the marked fill line.

C. Place pipette over beaker and empty contents into the beaker.

D. Record weight (1 ml = 1 g).

E. Results should be within + 0.1 g. If accuracy is less than listed, contact your immediate supervisor. Procedures are the same for smaller and larger size pipettes and burettes.

Hydrometer Calibration

A certified accurate hydrometer can be purchased from a scientific supply company. If you have a hydrometer(s) with no certification, it can be checked against a certified hydrometer by inserting both spindles in the same cylinder of liquid and cross checking the references value. Cross checking can also be done with a calibrated refractometer.

Brix hydrometers should be checked for accuracy monthly or before use if usage is infrequent, and the results reported on the Hydrometer Checks Log in Appendix VII. Newly purchased hydrometers should always be checked for accuracy. Two methods are suggested:

Testing by Comparison Between Two Hydrometers

Compare the hydrometer reading of a sample of syrup with the reading of another hydrometer of known accuracy on the same syrup sample.

Testing Using Prepared Sucrose Solution with Known Percentage by Weight

Test the hydrometer in a sucrose solution which contains a known percentage by weight, of pure, dry sucrose. For all practical purposes dry commercial cane or beet sugar will be sufficiently pure for standardization of hydrometers.

Method:

A. Select a value approximately midway on the spindle to be tested. For example, a hydrometer in the range of 15 to 20 °Brix can be tested in a syrup of 18 °Brix.

B. Prepare a sugar solution of the required density by dissolving a weighed quantity of dry sugar in a weighed quantity of distilled water.

Example: To prepare 1000 grams of 18 °Brix syrup, tare a beaker on a gram scale and add exactly 180 grams of dry sugar. Then add sufficient water to bring the weight of the mixture (sugar and water) to exactly 1000 grams. This solution will give a reading of 18 °Brix with an accurate hydrometer at the proper temperature.

Note: 18 °Brix is 18% by weight of sugar solids, which is 18 grams per 100 grams of solution, not 18 grams made up to 100 ml. Do not prepare the solution by making up to volume in a volumetric flask.

C. Mix the sugar and water well by transferring the contents back and forth between two large beakers to assure proper mix.

D. Cool solution down to about 1 °Brix below the temperature at which the instrument is calibrated.

E. Transfer syrup to a cylinder and equalize to the temperature at which the instrument was calibrated. If necessary, immerse in a water bath of the proper temperature.

F. When the syrup has reached the proper temperature, immerse the hydrometer, and observe the reading in accordance with the Hydrometer Procedure section.

G. Take a series of readings by removing the hydrometer and cleaning and drying it before each immersion. If the hydrometer reads within $^{1}/_{10}$ of a degree of the proper reading, it can be considered sufficiently accurate for our purposes. If the error is $^{2}/_{10}$ to 3/10 degree, the correction should be recorded, and each reading with this instrument adjusted accordingly. If the error in the instrument exceeds $^{3}/_{10}$ degree, replace the instrument.

H. For more precise calibration, the instrument can be standardized at more than one check point.

Salometer Calibration

A salometer is a hydrometer used to measure the concentration of sodium chloride (NaCl) in water based on specific gravity. Two types of salometers are used in inspection procedures. A description of the two types of salometer follows; instructions for their calibration are provided in separate sections as follows.

- **Type I – Percent Weight**

  One type of salometer measures the "percent by weight" of NaCl in water at 60 °F. A saturated solution contains 26.5% salt, and the salometer scale ranges from 0 to 26.5%. This type of salometer is used for brine solutions when testing the maturity of peas.

- **Type II – Percent Saturation**

  A second type of salometer measures the "percent saturation" of NaCl in water at 60 °F. Readings are recorded as "degrees salometer." The full scale ranges from 0 to 100, but this type of salometer can be purchased in selected ranges. When using a salometer with a partial range, the expected readings should be midpoint on the scale, and scale divisions should be no greater than 0.2 increments. These salometers may be purchased with internal thermometers which are used to apply temperature corrections. This type of salometer is called a "combined form" salometer. The "percent saturation" salometer is used to measure the amount of NaCl in the brine of canned ripe olives.

Instructions for Checking the Calibration of Type I Salometers

A. Visually examine the salometer before each use and remove any damaged salometers from service. Inspect the salometer for:

   1. Cracks, chips, etching, or any other signs of damage;

   2. Loose pieces of ballast or other foreign material within the instrument;

   3. Proper alignment of paper scale within the stem, which should be straight without any twists; and

   4. Alignment of paper scale with scale slippage indicator.

   Remove any damaged salometers from service.

B. Clean and dry the salometer before starting verification procedures.

C. Prepare a standardized brine solution using the following procedures:

   1. Prepare a 13% brine solution by measuring 130 grams of pure, dry NaCl (such as kosher salt, not iodized salt) and 870 grams of distilled water.

2. Mix brine thoroughly.

3. A 13% salt solution is made up by weight, not volume. Do not use a volumetric cylinder to make up these solutions.

D. Verify the accuracy of the salometer using the following procedures:

1. Test the salometer in a specially prepared brine solution which contains a known percentage, by weight, of dry NaCl (see C. above).

2. Select a hydrometer cylinder appropriate for the size of the salometer:

   a. It must be deep enough that the salometer floats freely at least 25.4 mm (1 inch) above the inside bottom; and

   b. It must be wide enough that there will be at least 12.7 mm (½ inch) between the inner wall and all surfaces of the immersed salometer. The salometer should not touch the sides of the cylinder.

3. The cylinder and salometer must both be clean and dry.

4. The temperature of the test brine should match the calibration temperature of the salometer. Use a water bath if necessary.

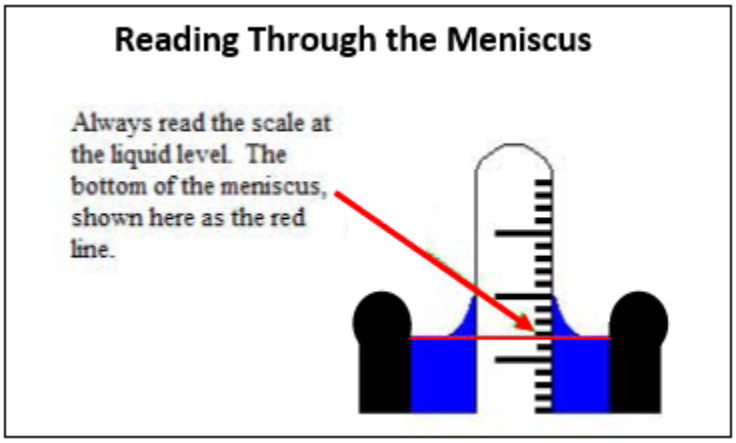
5. Completely fill the cylinder by pouring the brine inside and allowing it to overflow slightly to float off any foam or bubbles.

6. Remove sufficient liquid from the cylinder to allow the salometer to float at a level of liquid slightly below the top of the cylinder. Slowly lower the clean, dry salometer into the liquid until it is very near floating position.

7. Release the spindle with a slight spinning motion. If it is dropped into the solution, it will sink too far and some of the salt solution will adhere to the stem, which can affect the reading. Dropping the salometer may also damage it. Any bubbles present will also cause the salometer to read incorrectly.

8. Observe the reading on the stem after allowing the salometer to come completely to rest. The salometer should not touch the side of the glass cylinder.

9. Read the salometer by observing a point slightly below the plane of the liquid surface and raising the line of vision until level with the surface of the liquid. Where the liquid touches the stem, it rises a short distance to form a meniscus. The reading will be inaccurate if taken at the top of the meniscus rather than at the true liquid level (see the illustration on following page). The meniscus layer is usually thin, and the graduation marks can be seen through it.



10. Record calibration results on the Salometer Calibration Log in Appendix VIII. Include the brine temperature reading.

11. Remove inaccurate salometers from service.

Instructions for Checking the Calibration of Type II Salometers

A. To comply with these instructions, each grading lab will need both **grading salometers** and a **reference standard salometer** (for calibrating the grading salometers). Salometers for grading require a manufacturer's certificate of conformance. The accuracy of all grading salometers will be verified weekly against the reference standard salometer, which must have a NIST traceable certificate of calibration.

This NIST certificate of calibration references the serial number of the NIST Standard used for calibration, and the actual readings taken at three points. The NIST traceable reference standard salometer is only used for calibration (verifying accuracy) of the grading salometers; it is not to be used for grading. Store all salometers with copies of their corresponding certificates.

Contact the proper regional office (Eastern, Central, or Western) for Type II grading salometers used to measure the "percent saturation" of NaCl in water at 60 °F. Type II salometers require daily and weekly calibration checks when they are in use (see paragraphs E. and F.).

B. Visually examine salometer before each use. Inspect the salometer for:

1. Cracks, chips, etching, or any other signs of damage;

2. Loose pieces of ballast or other foreign material within the instrument;

3. Proper alignment of the paper scale within the stem, which should be straight without any twists; and

4. Alignment of paper scale with scale slippage indicator.

Remove any damaged salometers from service.

C. Clean and dry the salometer before calibrating (verifying accuracy) and before each reading. A buildup of salt, oil, or olive particles will affect the accuracy of readings.

D. Verify accuracy by testing the grading salometer:

1. Daily – using distilled water.

2. Weekly – by comparing the readings of the grading salometer(s) against the readings of the reference standard salometer in the same solution of canned ripe olive brine.

E. Daily Calibration.

Verify the accuracy of the grading salometers daily using distilled water, and record on the Salometer Checks Log in Appendix VIII.

1. Clean and dry both the cylinder and the grading salometer.

2. Select a (cylinder) appropriate for the size of the salometer.

   a. It must be deep enough that the salometer floats freely at least 25.4 mm (1 inch) above the bottom; and

   b. It must be wide enough that there will be at least 12.7 mm (½ inch) between the inner wall and all surfaces of the immersed salometer. The salometer should not touch the sides of the cylinder.

3. Completely fill the cylinder by pouring distilled water inside and allowing it to overflow slightly to float off any foam or bubbles.

4. Remove sufficient liquid from the cylinder to allow the salometer to float at a level of liquid slightly below the top of the cylinder. Slowly lower the clean, dry grading salometer into the water until it is very near the zero reading.

5. Release the grading salometer with a slight spinning motion. If it is dropped into the solution, it will sink too far and cause the stem to become wet, which can affect the reading. It may be damaged if it strikes the bottom of the cylinder. Any bubbles present will cause the salometer to read incorrectly.

6. Observe the reading on the stem after allowing the grading salometer to come completely to rest. The salometer should not touch the side of the glass cylinder.

7. Read the grading salometer through the meniscus as for the Type I salometer (refer to the Reading Through the Meniscus illustration). The reading should be zero.

8. Apply any corrections for temperature using Appendix H, Grading Manual for Canned Ripe Olives.

9. Record calibration results on Salometer Checks Log in Appendix VIII. Include temperature reading.

10. Remove inaccurate salometers from service.

11. Repeat steps 1 through 10 to check all grading salometers in use.

F. Weekly Calibration.

A weekly calibration is performed at the beginning of each week. It includes all steps for the daily calibration using distilled water, followed by a second phase. The second phase is to compare the readings of the grading salometer against the NIST certified reference standard salometer in the same sample of canned ripe olive brine:

1. The sample of brine should be well-mixed.

2. Clean and dry the **reference standard salometer**. The cylinder must be either clean and dry, or completely rinsed with a well-mixed sample of the brine to be read.

3. Completely fill the cylinder by pouring the canned ripe olive brine into the cylinder and allowing it to overflow slightly to float off any foam, bubbles, olive particles or olive oil in the sample.

4. Remove sufficient liquid from the cylinder to allow the grading salometer to float at a level of liquid slightly below the top of the cylinder. Slowly lower the clean, dry grading salometer into the brine until it is near the anticipated reading.

5. Release the reference salometer with a slight spinning motion. If it is dropped into the brine, it will sink too far and some of the brine will adhere to the stem and affect the reading. Any bubbles present will also cause the salometer to read incorrectly.

6. Observe the reading on the stem after allowing the grading salometer to come completely to rest. The salometer should not touch the side of the glass cylinder.

7. Read the reference salometer through the meniscus as for the Type I salometer (refer to the Reading Through the Meniscus illustration).

8. Record the calibration results, including the temperature reading on the Salometer Checks Log in Appendix VIII. Apply corrections for temperature using the Temperature Correction Tables in the Grading Manual for Canned Ripe Olives.

9. Remove the reference salometer from the hydrometer cylinder.

10. Repeat steps 1 through 9 for all grading salometers in use.

    Note: Use the same brine for the reference standard salometer and the grading salometer(s). Save some of the original brine to add to the cylinder if any is lost while taking readings. Reading will be inaccurate if brine, oils, or olive particles collect on salometers during grading.

11. The readings for the grading salometer(s) and reference salometer should agree.

12. Remove any inaccurate salometers from service.

Colorimeter Calibration

Calibration must be done at least once a shift, or per manufacturer instructions. Follow instructions in the unit's user manual for calibration and maintenance. The following calibration logs are available for use depending on your make and model:

- Hunter D45 – Use Colorimeter Calibration Log in Appendix IX
- Hunter D45D2 – Use Colorimeter Calibration Log in Appendix X
- Macbeth Color-Eye 3000, 3100, & i5 – Use Colorimeter Calibration Log in Appendix XI

CONTAINER INFORMATION

Sizes of Metal Containers

The following table may be used as a reference for the various can sizes and capacities. Any individual container may vary from the figures given in these tables as the result of normal variations in manufacture and variations in closure. Capacities will also vary with the profile of the ends. The dimensions and capacities given are generally recognized as standard measurements.

The practical method for the determination of a fill such as "not less than 90% of the capacity of the container" is by means of the headspace gauge. The headspace allowance of 10% (or for a 90% fill) shown in the Capacity - Sizes of Metal Containers table on the following pages, is calculated for the can size. To calculate headspace for containers other than those shown, or for headspace allowances other than 10%, calculate from the formula given below under Headspace.

The following terms are used in the Capacity-Sizes of Metal Containers table:

- Avoirdupois: Also referred to as avoir, is a system of weights (or mass) based on a pound (16 oz). It is the system of weight used in the United States, and will be referred to in these instructions in term of the appropriate English system weight, i.e. ounces, pounds, etc.

- Designation: The common name of container.

- Dimensions: The overall measurements, given in terms familiar to the industry. Refer to the Explanation of Dimensional Food Can Standards section for more information and examples.

- Water Capacity: The weight of distilled water at 68 °F that a sealed container will hold when filled to $^{3}/_{16}$ inch from the top. Capacity of containers is expressed in ounces. See the section titled Procedure to Determine the Water Capacity in for instructions.

- Headspace: Measured from top of double seam in sixteenths of an inch, calculated as follows:

  Overall height less both seams, times 10%, plus top seam = headspace of 10%

  Example: [(4 $^{11}/_{16}$ inches minus $^{6}/_{16}$ inch) x 10%] + $^{3}/_{16}$ inch = $^{9.9}/_{16}$ inch, or,
  [($^{75}/_{16}$ - $^{6}/_{16}$) x (0.10)] = $^{69}/_{16}$ x 0.1 = $^{6.9}/_{16}$ + $^{3}/_{16}$ = $^{9.9}/_{16}$ (rounded to $^{10}/_{16}$ inch).

- Cans per Case: Although other packs may be used, most of those listed are typical of the industry by representatives of box manufacturers, canners, other interested parties, and by the National Institute of Standards and Technology (NIST).

Capacity - Sizes of Metal Containers

Designation	**Dimensions**	**Water Capacity** (oz)	**Fluid Measure** (fluid oz)	**Headspace of 10%** (sixteenths of an inch)	**Cans Per Case**
5 oz	202 x 214	4.8	4.6	7	12, 24, 48
6 oz	202 x 308	6	5.8	8	24, 48
6 oz	202 x 314	6.75	6.5	8.6	24
6 oz	211 x 200	4.9	4.7	5.6	24
No. 211 baby food	211 x 210	6.75	6.5	6.6	48
4 oz mushroom	211 x 212	7.15	6.85	6.8	12, 24
8 oz short	211 x 300	7.9	7.6	7.2	24, 36, 48, 72, 96
8 oz tall	211 x 304	8.65	8.3	7.6	24, 36, 48, 72

Designation	**Dimensions**	**Water Capacity** (oz)	**Fluid Measure** (fluid oz)	**Headspace of 10%** (sixteenths of an inch)	**Cans Per Case**
No. 1 picnic	211 x 400	10.9	10.45	8.8	24, 48
No. 211 cylinder	211 x 414	13.55	13	10.2	24, 36, 48
Pint (Olive)	211 x 600	16.96	16.25	12	12, 24
4 oz pimiento	300 x 108	4.2	4.05	4.8	12, 24
7 oz pimiento	300 x 206	7.5	7.2	6.2	12, 24
12 oz (or 8 oz mushroom)	300 x 400	13.55	13	8.8	24
No. 300	300 x 407	15.2	14.6	9.5	24, 36, 48
No. 300	300 x 411	16.1	15.5	9.9	48
No. 300 cylinder	300 x 509	19.4	18.6	11.3	24
No. 1 flat	301 x 208	8.2	7.85	6.4	24
No. 1	301 x 400	13.98	13.4	8.8	24
No. 1 tall	301 x 411	16.6	15.95	9.9	24, 48
No. 1 square	300 x 308 x 308	17.27	16.6	8	24, 48
No. 303	303 x 406	16.85	16.2	9.4	12, 24, 36
No. 303	303 x 504	20.55	19.75	10.8	24
No. 303 cylinder	303 x 509	21.85	21	11.3	12, 24
No. 2 vacuum	307 x 306	14.7	14.1	7.8	24
No. 2 short	303 x 400	17.75	17.05	8.8	24
No. 2 western	307 x 408	20.2	19.4	9.6	24
No. 2 standard	307 x 409	20.5	19.7	9.7	12, 24
Jumbo	307 x 510	25.7	24.7	11.4	12, 24
No. 2 cylinder	307 x 512	26.35	25.3	11.6	24
No. 2 tall	307 x 604	28.8	27.65	12.4	12, 24
No. 1 1/4	401 x 207.5	14.44	13.87	6.4	24
No. 2 1/2	401 x 411	29.75	28.55	9.9	12, 24
No. 2 1/2 square	300 x 308 x 604	32.47	31.2	12.4	24
No. 3 vacuum (or squat)	404 x 307	23.85	22.9	7.9	24
No. 3	404 x 414	35.05	33.65	10.2	24
No. 3 cylinder	404 x 700	51.7	49.61	13.6	12
No. 5	502 x 510	59.1	56.75	11.4	12
No. 10	603 x 700	109.45	105.1	13.6	6
No. 12	603 x 812	138.35	132.85	16.4	4, 6
No. 12	610 x 800	145.7	139.85	15.2	6

Explanation of Dimensional Food Can Standards

Metal can sizes used in industry in the U.S. are derived from nominal outside dimensions. Measurements are made of the empty round can before seaming on the packers' end.

While such dimensions may be expressed in inches, the custom is to use a conventionalized method in which three-digit numbers are used to express each dimension. The first digit indicates the number of whole inches in a dimension, and the second and third digits indicate the fractional inches as sixteenths of an inch. Therefore:

- 303 x 406 means $3\ ^{3}/_{16}$ x $4\ ^{6}/_{16}$ inches
- 307 x 512 means $3\ ^{7}/_{16}$ x $5\ ^{12}/_{16}$ inches
- 603 x 700 means $6\ ^{3}/_{16}$ x 7 inches

The first three-digit number describing a round can indicates the diameter measured across the outside of the chime on the seamed end. The second three-digit number indicates the overall height of the can with one end on.

Outside dimensions are used to designate the dimensions of oval or round cans. The dimension of the opening is stated first, followed by the height. For oval cans, this results in three sets of figures, the first two being the long and short axis of the opening. Their interpretation in inches and sixteenths of an inch is the same as with round cans. An oval can might have the size given as 402 x 304 x 612, which would mean that the oval opening was $4\ ^{2}/_{16}$ x $3\ ^{4}/_{16}$ inches, and the height was $6\ ^{12}/_{16}$ inches.

In the table below the "No. 2 Equivalent" indicates the number of No. 2 cans equal to each of the cans designated in the first column.

Dimensional Food Can Standards

Name	**Dimensions**	**Total Capacity Avoir** (oz of water at 68 °F)	**No. 2 Can Equivalent**
6 oz	202 x 308	6.08	0.295
8 oz Short	211 x 300	7.93	0.386
8 oz Tall	211 x 304	8.68	0.422
No. 1 (Picnic)	211 x 400	10.94	0.532
No. 211 Cylinder	211 x 414	13.56	0.660
No. 300	300 x 407	15.22	0.741
No. 300 Cylinder	300 x 509	19.40	0.945
No. 1 Tall	301 x 411	16.70	0.813
No. 303	303 x 406	16.88	0.821

Name	Dimensions	Total Capacity Avoir (oz of water at 68 °F)	No. 2 Can Equivalent
No. 303 Cylinder	303 x 509	21.86	1.060
No. 2 Vacuum	307 x 306	14.71	0.716
No. 2	307 x 409	20.55	1.000
Jumbo	307 x 510	25.80	1.2537
No. 2 Cylinder	307 x 512	26.40	1.284
No. 1 ¼	401 x 206	13.81	0.672
No. 2 ½	401 x 411	29.79	1.450
No. 3 Vacuum	404 x 307	23.90	1.162
No. 3 Cylinder	404 x 700	51.70	2.515
No. 5	502 x 510	59.10	2.8744
No. 10	603 x 700	109.45	5.325

- The capacity of a 16 oz glass jar is approximately equivalent to a No. 303 can.
- The capacity of a No. 2 ½ glass jar is approximately equivalent to a No. 2 ½ can.

Net Contents and Fluid Measure

Labeling requirements under the Federal Food, Drug, and Cosmetic Act require certain foods to be labeled in terms of weight, and others in terms of liquid measure. In general, the statement is in terms of liquid measure if the food is liquid, and in terms of weight if the food is solid, semisolid, viscous, or a mixture of solid and liquid. Some exceptions include canned pickles (expressed in volume) and canned mushrooms (labeled according to the recommended minimum drained weight for the container capacity).

In reporting net contents in containers of products such as juices and other commodities customarily labeled and marketed in terms of volume, inspection certificates should record contents in fluid measure.

Weight to Fluid Ounces by Equation

In determining the net volume (or fluid measure), it is sometimes more rapid and accurate to determine the net weight as usual, and convert ounces or grams to fluid ounces by one of the following formulas:

- Ounces to Fluid Ounces:

$$\text{Fluid Ounces (at 20 °C)} = \frac{\text{ounces x 0.9614}}{\text{Specific Gravity of Product}}$$

- Grams to Fluid Ounces:

$$\text{Fluid ounces (at 20 °C)} = \frac{\text{grams x 0.9614}}{\text{28.35 x Specific Gravity of Product}}$$

Degrees Brix may be converted directly to specific gravity through use of Appendix XV – Sucrose Conversion Table. Products may be carefully measured into a suitable and accurately graduated receptacle if it is difficult or inconvenient to determine the specific gravity. If requested by the applicant, the net contents may be reported in terms of both weight and volume.

Weight to Fluid Ounces Conversion Charts

To provide more efficient calculations of ounces or grams to fluid ounces based on the above formulas, the following charts have been created for convenience and are based off the combination of the above equations and the Sucrose Conversion Table.

- Ounces to Fluid Ounces:

  See Appendix XX – Juice Weight Conversion Chart – Ounces to Fluid Ounces (at 20 °C)

- Grams to Fluid Ounces:

  See Appendix XXI – Juice Weight Conversion Chart – Grams to Fluid Ounces (at 20 °C)

Volumetric Flask – Measuring Fluid Ounces

Glass flasks are available that are accurately calibrated for measuring volume of liquids. The flask is calibrated for volume of a liquid at a standard temperature, usually 20 °C. The legend is etched on each flask. The fluid product being measured must be at this temperature for accuracy. It is also important to avoid incorporating air into the liquid when filling the flask. To do so, always pour the liquid slowly down the side of the flask. Heavier products such as tomato juice, nectars, etc., must stand after filling the flask to permit any trapped air to escape.

- Volume Correction Charts for Single Strength Citrus Juices at Various Temperatures

  See Appendix XXII – Volumetric Correction Charts for Single Strength Juices at Various Temperatures for an efficient means for correcting the volumes observed when using the volumetric method or adjusting the units in which volumes are reported to when using a volumetric flask or a milliliter graduated cylinder calibrated at 20 °C depending on the temperature.

Conversion Factors for Canned Foods

The following table designates common conversion factors that are applicable to most canned fruit and vegetable products. If an exact conversion does not exist, choose the closest can size.

- Columns "A" and "B" indicate the number of cans equal to each of the cans designated in the "Can Size" column.

- Columns "C," "D," and "E" apply to the case equivalents for the can sizes, and the common packing per case.

Factors For Converting

		A	B	C	D	E
Can Size	**# per Case**	**No. 2 Cans**	**No. 2 ½ Cans**	**Cases 24/2**	**Cases 24/2 ½**	**Cases 6/10**
5 oz	48	0.235	0.162	0.47	0.324	0.352
6 oz	48	0.295	0.203	0.590	0.406	0.440
8 oz short	48	0.385	0.266	0.770	0.532	0.576
8 oz tall	48	0.422	0.291	0.844	0.582	0.632
No. 1 picnic	48	0.532	0.367	1.064	0.734	0.800
No. 1 1/4	48	0.704	0.485	1.408	0.970	1.060
No. 300	48	0.740	0.500	1.480	1.200	1.112
No. 1 tall	48	0.810	0.559	1.620	1.118	1.224
No. 303	24	0.821	0.566	0.821	0.566	0.616
No. 1 square	24	0.843	0.581	0.843	0.581	0.632
No. 2	24	1.000	0.690	1.000	0.690	0.750
No. 2 ½	24	1.450	1.000	1.450	1.000	1.087
No. 2 ½ square	24	1.585	1.093	1.585	1.093	1.188
No. 3	24	1.710	1.179	1.710	1.179	1.284
No. 3 cylinder	12	2.516	1.735	1.258	0.868	0.943
No. 5	12	2.882	1.987	1.441	0.994	1.080
No. 10	6	5.336	3.680	1.334	0.920	1.000
No. 12	6	6.745	4.652	1.686	1.163	1.264

Examples: To find the equivalent number of No. 2 ½ cans:

- 100,000 cans No. 2 size = (100,000 x 0.690) = 69,000 No. 2 ½ size cans

To find the number of cases 24/2 ½:

- 7,000 cases 24/2 = (7,000 x 0.690) = 4,830 cases 24/2 ½
- 10,000 cases 6/10 = (10,000 x 0.920) = 9,200 cases 24/2 ½

Sizes of Glass Containers

Net weights for canned fruits and vegetables in glass are not mandatory. Federal and various State laws require that a statement of net contents be given on the label, but none of these laws specify what the weights must be. Label weights shown on these products generally state the contents for what is considered normal fill for the product. Variations in weights are to be expected. The following weights represent an approximate average weight of the product and packing medium inside the container.

Capacity of Glass Containers

Designation	**Glass Containers** (overflow) (fluid oz)	**Metal Containers** (oz)	**Designation and Size of Equivalent**	**Can Size**
Baby Jar	5.1	4.9	5 oz	211 x 200
Junior Jar	8.1	7.9	8 oz short	211 x 300
16 oz Jar	17	16.6	No. 1 tall	301 x 411
No. 303 Jar	17	16.85	No. 303	303 x 406
No. 2 ½ Jar	28.4	29.75	No. 2 ½	401 x 411
46 oz Jar	49	51.62	No. 3 cylinder	404 x 700

Packing of Glass Containers

Capacity of Glass Containers (fluid oz)	**Maximum Number of Units per Box**	**Number of Tiers per Box**
8 oz or less	48	2
over 8 oz to 17 oz	24	1
over 17 oz to 40 oz	12	1
over 40 oz to 70 oz	6	1
over 70 oz to 1 gallon	4	1

Calculating Drained Weight for Unpublished Container Sizes

Drained weights in the United States grade standards are generally published and applied by USDA for common container sizes. To determine the recommended minimum drained weight for unpublished container sizes on a proportional basis, use the following procedure as a guideline:

A. Refer to tables for Capacity-Sizes of Metal Containers for metal containers, or Capacity of Glass Containers for glass containers to find the water capacity of the unpublished container. For container sizes not listed in these tables, determine the water capacity of the target container by following the procedure in Procedure to Determine the Water Capacity.

B. After obtaining the water capacity of the target container, find the water capacity of the next closest container given in the standard.

C. Divide the recommended minimum drained weight of the closest container by its water capacity to get the proportional water capacity.

D. Multiply the water capacity of the target container by the proportional water capacity of the nearest container to establish the new recommended minimum drained weight for the target container. Round to the nearest tenth of an ounce, rounding up for digits ending in 5 or greater, rounding down for digits ending in numbers less than 5. Record both the range of results and the drained weight average on certificates. Refer to the Certification Manual for questions on certification.

Use this equation:

$X = \frac{A \times B}{C}$; where,

- X = Recommended minimum drained weight of unknown container,
- A = Recommended minimum drained weight of closest container size,
- B = Water capacity of the target container, and
- C = Water capacity of the closest container.

Example: Canned Tomatoes in No. 12 cans (603 x 812)

The water capacity of the No. 12 can is to be 138.35 ounces (see Capacity - Sizes of Metal Containers). The closest can size given in the standard is the No. 10 can, which has a water capacity of 109.45 ounces. The drained weight for canned tomatoes in the No. 10 can is 63.50 ounces for U.S. Grades A and B.

The corresponding drained weight of tomatoes in a No. 12 can is calculated as follows:

X = unknown drained weight, A = 63.50 oz, B = 138.35 oz, C = 109.45 oz,

so,

$$X = \frac{63.50\ oz\ x\ 138.35\ oz}{109.45\ oz} = 80.26\ or\ 80.30\ oz\ for\ A\ or\ B\ grade\ Canned\ Tomatoes\ in\ No.\ 12\ cans.$$

Procedure to Determine the Water Capacity

This procedure applies to several types of primary containers: cans, glass, and plastic (except polyethylene or other thin plastic film). Use three containers to determine the water capacity, unless the weight of the primary container is a very small percentage of the gross weight and is quite uniform. If this is the case, use a single container from the lot to determine water capacity.

The following is an excerpt from 21 CFR 130.12, "General Methods for Water Capacity and Fill of Containers."

To determine the water capacity of a container:

A. If the container has a lid attached by a double seam, cut out the lid without removing or altering the height of the double seam.

B. Wash, dry, and weigh the empty container.

C. Fill the container with distilled water at 68 °F to $^{3}/_{16}$ inch below the top level of the container. If the container has a lid attached other than by double seam, remove the lid and fill the container to the level of the top.

D. Weigh the filled container.

E. Subtract the container tare weight from the full container weight. The difference is the weight required to fill the container.

Containers for Frozen Fruits and Vegetables

Common consumer size containers for frozen fruits and vegetables are 10 ounce, 12 ounce, 14 ounce, and 16 ounce packages, depending upon the commodity. Some products are also packed in larger containers for institutional purchases. Vegetables packed in 2 ½ pound and 5 pound packages, and fruits in 2 ½ pound, 10 pound, 15 pound, and 30 pound containers are the most common.

The percentage figures for losses in preparation of raw product for freezing are approximate and are only given for estimates.

Containers for Frozen Vegetables

Vegetables	Common Packages and Usual Packing Per Case	Approximate Losses in Preparation of Raw Product for Freezing
Asparagus	12/2 ½ lb 12/8 oz 24/12 oz 24/10 oz	54%
Beans, Lima	12/2 ½ lb 24/12 oz	63%
Beans, Green	12/2 ½ lb 24/12 oz 24/10 oz	21%
Broccoli	8/4 lb 12/2 lb 24/10 oz	45%
Brussels Sprouts	8/4 lb 12/2 lb 24/10 oz	45%
Carrots	12/2 ½ lb	50%
Cauliflower	8/4 lb 12/2 lb 24/10 oz	70%
Corn	12/2 ½ lb 24/12 oz 24/10 oz	76%
Peas	6/5 lb 12/2 ½ lb 24/12 oz 24/10 oz	60%
Carrots and Peas	12/2 ½ lb 24/12 oz	60%
Spinach	12/3 lb 12/2 ½ lb 24/14 oz	45%
Squash, Pumpkin	24/1 lb	35%
Succotash	24/12 oz 24/11 oz 24/10 oz	35%
Mixed Vegetables	12/2 ½ lb 24/12 oz	35%

Containers for Frozen Fruits

Fruits	Common Packages and Usual Packing Per Case	Approximate Losses in Preparation of Raw Product for Freezing
Apples	30 lb	50%
Apricots	30 lb 10 lb 24/1 lb	22%
Blackberries	Barrels 30 lb	5%
Blueberries	Barrels 30 lb 10 lb 24/1 lb or less	5%
Cherries	Barrels 30 lb 24/1 lb	25%
Peaches	30 lb 10 lb 24/1 lb 24/12 oz	33%
Prunes and Plums	Barrels 30 lb	15%
Raspberries	Barrels 30 lb 24/1 lb 24/12 oz	15%
Rhubarb	30 lb 24/16 oz	15%
Strawberries	Barrels 30 lb 24/1 lb 24/12 oz	7%
Youngberries, Loganberries, Boysenberries	Barrels 30 lb 10 lb	5%

Approximate Shipping Weights

Shipping weights include the gross weight of the product, primary container, shipping container, and any incidental packaging material. Gross shipping weights may be used in determining the approximate number of cases that common carriers or transportation lines allow per freight car or truck. These weights are also required on bills of lading or manifests.

The approximate shipping weights shown are for guidance only and are common weights for most processed fruits and vegetables.

Approximate Gross Weights per Case

Type of Pack	**Fruits (Canned)** (Metal Containers, Fiber Cartons)	**Vegetables (Canned)** (Metal Containers, Fiber Cartons)
48 / 8 oz	35 lb	35 lb
48 / No. 1 tall	64 lb	---
48 / No. 1 picnic	---	43 lb
24 / No. 2	39 lb	39 lb
24 / No. 2 ½	56 lb	55 lb
6 / No. 10	49 lb	48 lb

Type of Pack	**Fruits (Dried)** (Packages and Fiber Cartons)	**Fruits (Dried)** (Wood Boxes)
48 / 16 oz	50 lb	---
36 / 16 oz	40 lb	---
36 / 11 oz	31 lb	---
25 lb	---	28 lb
30 lb	---	33 lb
50 lb	---	55 lb

Length-Inches and Millimeters-Equivalents of Decimal and Binary Fractions of an Inch in Millimeters

1/2s	1/4s	8ths	16ths	32nds	64ths	Milli-meters	Decimals of an inch	Inch	1/2s	1/4s	8ths	16ths	32nds	64ths	Milli-meters	Decimals of an inch
					1	0.397	0.015625							33	13.097	0.515625
				1	2	0.794	0.03125						17	34	13.494	0.53125
					3	1.191	046875							35	13.891	0.546875
			1	2	4	1.588	0.0625					9	18	36	14.288	0.5625
					5	1.984	0.078125							37	14.684	0.578125
				3	6	2.381	0.09375						19	38	15.081	0.59375
					7	2.778	0.109375							39	15.478	0.609375
		1	2	4	8	3.175	0.125				5	10	20	40	15.875	0.675
					9	3.572	0.140625							41	16.272	0.640625
				5	10	3.969	0.15625						21	42	16.669	0.65625
					11	4.366	0.171875							43	17.066	0.67875
			3	6	12	4.762	0.1875					11	22	44	17.462	0.6875
					13	5.159	0.203125							45	17.859	0.703125
				7	14	5.556	0.21875						23	46	18.256	0.71875
					15	5.93	0.234375							47	18.653	0.734375
	1	2	4	8	16	6.350	0.25			3	6	12	24	48	19.050	0.75
					17	6.747	0.265625							49	19.447	0.76525
				9	18	7.144	0.28125						25	50	19.844	0.78125
					19	7.541	0.296875							51	20.241	0.796875
			5	10	20	7.938	0.3125					13	26	52	20.638	0.8125
					21	8.334	0.328125							53	21.034	0.828125
				11	22	8.731	0.34375						27	54	21.431	0.84375
					23	9.128	0.359375							55	21.828	0.859375
		3	6	12	24	9.525	0.375				7	14	28	56	22.225	0.875
					25	9.922	0.390625							57	22.622	0.890625

1/2s	1/4s	8ths	16ths	32nds	64ths	Milli-meters	Decimals of an inch	Inch	1/2s	1/4s	8ths	16ths	32nds	64ths	Milli-meters	Decimals of an inch
				13	26	10.319	0.40625						29	58	23.019	0.90625
					27	10.716	0.421875							59	23.416	0.921875
			7	14	28	11.112	0.4375					15	30	60	23.812	0.9375
					29	11.509	0.453125							61	24.209	0.953125
				15	30	11.906	0.46875						31	62	24.606	0.96875
					31	12.30	0.48475							63	25.003	0.984375
1	2	4	8	16	32	12.700	0.5	1	2	4	8	16	32	64	25.400	1.000

ENZYME INACTIVATION

Inactivation of the peroxidase and catalase enzymes is achieved by the proper blanching of vegetables prior to freezing. These enzymes would otherwise cause development of off-flavors, loss of color, and loss of vitamin A and C during storage after freezing. Blanching also tends to fix the characteristic color of vegetables. Better color retention is attained by blanching at a higher temperature for a short time, rather than through lower temperatures for a longer time. Over-blanching may cause dull color, flavor loss, sloughing, and poor texture.
For most vegetables, inactivation of catalase alone does not indicate adequate blanch. Inactivation of the peroxidase enzyme is considered necessary to minimize future deterioration in quality. Consequently, the Peroxidase test is considered the official Division test for enzyme inactivation. For properly blanched products, test results are **negative**.

Lot Inspection Procedures

Products inspected under lot inspection will not routinely be tested for enzyme inactivation. The peroxidase test will be made on all condition inspections, or if required by Federal or buyers specifications, or if requested by the applicant. In addition, the peroxidase test will be run during inspections of frozen vegetables if there is organoleptic evidence of under-blanch such as off-colors, off-flavors, and toughening.

When specifications call for catalase or tests other than the peroxidase test or specify methods other than the USDA methods contained in this manual, such tests should be performed as required by the specification.

When required, use the following table to determine the minimum number of enzyme inactivation tests to perform:

Quality Sample Size	Number of Tests
3	1
6	1
13	3
21	3
29	4

Additional tests should be made if organoleptic inspection indicates the possibility of inadequate blanching.

In-Plant Inspection Procedures

All vegetables processed and frozen under in-plant inspection (except onion rings, sweet peppers, rhubarb, French fried potatoes, and cooked squash) are to be tested for peroxidase inactivation. Where required by Federal, buyer, or other specifications, testing for catalase inactivation must be in addition to the peroxidase test. Testing using methods outlined in specifications is permissible in lieu of the USDA method when inspection and certification are based on such specifications. Samples from each blancher are to be tested at the beginning of every processing period. Additional sample units should be tested whenever there is an indication that the blanch may have changed. Tests should also be made at least hourly throughout the shift.

Quality Control Testing – Unofficial

The official peroxidase test and other enzyme inactivation tests are useful quality control tools. For example, blanch temperature may be adjusted so that a peroxidase test will show no color development within three and a half minutes but will show color development within eight minutes. It is most useful to test the larger units of product for peroxidase activity. Depending upon the variation in product unit size, if there is color development in two and a half or three minutes, the product may be considered neither under nor over blanched, and official tests with units representative of all unit sizes may remain negative.

Indications of possible under blanching include low initial blanch temperature, drops in temperature, increased volume of product, or increase in unit size of product, which suggests the need for additional quality control checks. Quality control tests from isolated portions of production can and should be made for those plants relying on the inspector for help in quality control. This should be noted on the score sheet, but not be considered the official routine peroxidase test unless representative of the production. Similarly, quality control tests on larger units may be recorded on the score sheets, but this should be noted as being a restrictive test and not one of the routine representative tests for the hour.

Quality control tests may be made on the cut surface of an individual unit of product, but these are not considered official tests. Pieces of the product can be tested with 0-tolidine paper and hydrogen peroxide (H_2O_2) to show the extent of any unblanched area in a piece of product, and to show variations among pieces of the same size in judging the uniformity of the blanch.

Special Tests for Certain Products

Broccoli

For quality control purposes, test the top center portion of the heads of the large stalks where enzyme activity will be concentrated, if present. This may give quality control additional information but is not to be considered an official test.

Brussels Sprouts

Quality control checks can include the development of pink centers soon after freezing and storage, or the rapid development of pink color after about 15 seconds with the addition of ½ to 3% H_2O_2 to the cut surface immediately after blanching. Correlation of one of these tests with the official test should provide a rapid quality control check.

Corn-on-the-Cob

When testing corn-on-the-cob, use only the kernels removed from the cob. Scrapings taken from the cob at the base of the kernels may show residual peroxidase activity even though the product is adequately blanched.

Size, Collection, and Handling of Sample Units

Use a 200-gram sample that is representative of the variation in piece sizes. If some pieces are very large, all pieces should be cut in quarters, and a quarter from each piece used for the 200-gram sample.

Blanched, cooled, unfrozen samples should be taken just before entering the freezer. Test within ½ hour or quickly cool to 35 °F in ice water or in a freezer compartment and run the test within 2-3 hours.

Frozen samples should be water thawed in tap water at no more than 86 °F until units can be easily separated. Do not perform tests on completely frozen sample units. Enzyme tests must be completed within 30 minutes of thawing.

Peroxidase Testing Procedure

Reagents

- Distilled Water.

- 0.5% guaiacol in either 50% ethyl alcohol solution or a 50% 2-propanol (isopropyl alcohol) solution.

- 0.08% hydrogen peroxide (2.8 ml of 30% hydrogen peroxide made up to a liter with distilled water). Keep in the refrigerator in a dark bottle and replace each week or two.

Apparatus

- Test tubes – ¾ or $^{7}/_{8}$ inch diameter

- Funnels – 3 or 4 inch diameter

- Cotton milk filters – (6 or 7 inch diameter) or SS 604 filter paper or similar quality (18.5 cm in diameter)

- Mechanical blender

- Graduated cylinder – 50 ml

- Pipettes – 1 ml and 2 ml

- Timer or watch with second hand

- Test tube rack

- Balance with an accuracy of ± 0.1 gram

Procedure

A. The test must be completed within 30 minutes after the product is thawed.

B. Weigh out a representative 200-gram sample (see Size, Collection, and Handling of Sample Units).

C. Place in blender with 600 ml of water.

D. Blend for 1 minute at high speed.

E. Filter through cotton milk or SS 604 filter. Discard the first 5-10 ml of filtrate.

F. Prepare a blank by adding 21 ml of distilled water to 2 ml of filtrate in a test tube. Add 1 ml of 0.5% guaiacol solution without mixing. Do not add any hydrogen peroxide to this tube.

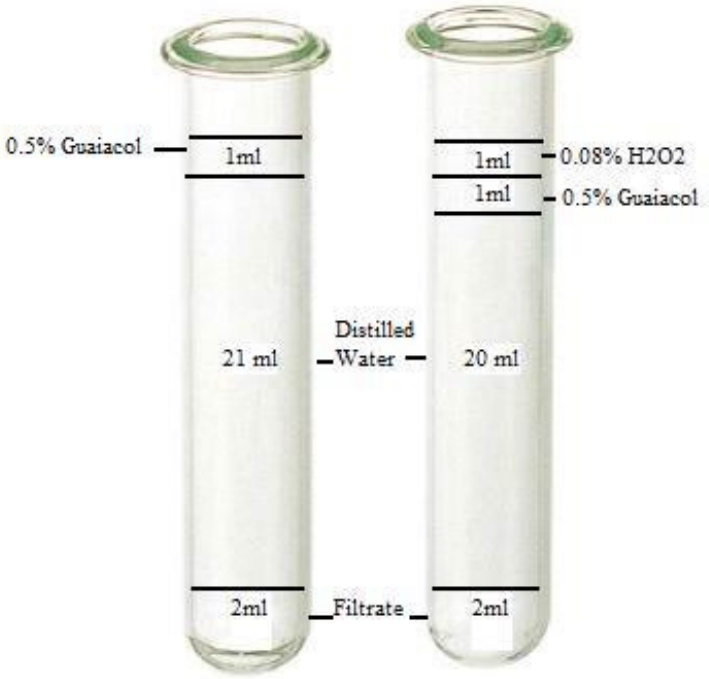
G. Prepare the sample by adding 20 ml of distilled water to 2 ml of filtrate in a second test tube. Add 1 ml of 0.5% guaiacol solution without mixing.

H. Add 1 ml of 0.08% hydrogen peroxide to the second test tube without mixing. See illustration below.

I. While wearing gloves, mix contents of both tubes thoroughly by inverting each 3 times and returning to test tube rack. Watch for development of any color in the sample tube to which hydrogen peroxide was added. Use the blank tube containing guaiacol, water and filtrate for comparison. Any color change in the sample tube that is in obvious contrast to the blank is considered a positive test. If no such color contrast develops in 3 ½ minutes (excluding zucchini squash and brussels sprouts whose time is bulleted on below), consider the test negative and the product adequately blanched. If color develops after 3 ½ minutes, it is to be disregarded, and the test still considered negative.

- Zucchini Squash: 1 minute.
- Brussels Sprouts: 2 ½ minutes; however, consider test results on the lot as meeting if no more than 1 of 3 sample units tested changes after 2 minutes. A lot fails if any sample units change color before 2 minutes.

PEROXIDASE TEST



Number 1 (Blank) **Number 2 (Test Sample)**

Note: Use only ¾ or $^{7}/_{8}$ inch diameter test tubes.

Catalase Testing Procedure

Reagents

- Distilled water
- Calcium carbonate ($CaCO_3$)
- 3% hydrogen peroxide (10 ml of 30% hydrogen peroxide per 100 ml of distilled water). Keep in refrigerator in a dark bottle

Apparatus

- Mechanical blender
- Footed fermentation tube with vertical tube graduated from 0 to 5 ml in $^1/_{10}$ ml graduations (Kimble 46162, or similar)
- Funnels – 3 or 4 inch diameter
- Cotton Milk filters – (6 or 7 inch diameter) or SS 604 filter paper or similar quality (18.5 cm. in diameter)
- Pipettes – 1 ml, 5 ml, and 10 ml
- Balance with accuracy of ± 0.1 gram
- Timer or watch with second hand

Procedure

A. Blend a 100-grams vegetable material with 100 ml of water and about 2 grams of calcium carbonate.

B. Filter slurry through cotton milk filter or SS 604 filter paper.

C. Add 2 ml of distilled water to the fermentation tube (see illustration on the following page).

D. Pipet 2 ml of filtrate into tube.

E. Add 8 ml of 3% hydrogen peroxide to tube.

F. Invert tube in such a manner as to completely fill the calibrated column. Tap gently to dissipate any bubbles that result from mixing the solution.

G. Return to upright position and allow contents to generate for 3 ½ minutes.

H. At the end of 3 ½ minutes, record the volume of gas formed.

I. A reading of 0.1 ml or less is considered negative for the catalase enzyme; any reading of more than 0.1 ml is considered positive.

Catalase Fermentation Tube

Certification

Official peroxidase or catalase tests that are representative of a production period or lot are shown on the score sheets for the item, but are not reported on a certificate unless:

- Requested by the Applicant.
- Required by Federal, Buyer, or other Specification.
- Inspection is for condition of the product, and some of the samples are positive.

Refer to the Certification Manual for appropriate statements to be shown in the "Body" and/or "Grade" section of a certificate.

FROZEN AND REFRIGERATED PRODUCT

SCI Division offices periodically get requests for inspecting and reporting the temperature and condition of refrigerated and frozen foods. Normally requests for this type of restricted inspection are from packers, buyers, or carriers; they may be either the result of dispute or rejection of deliveries because of alleged high temperatures upon arrival at terminal warehouses;

or the interested party is using the data as a part of a quality control program. Many times, condition inspection will involve small lots of commodities not assigned to the SCI Division. Do not examine or report conditions of commodities other than those assigned to our Division. Temperatures on such commodities may be taken and reported when they are part of a mixed load. Contact your immediate supervisor if you question the assignment of a commodity.

Inspection Request

It is very important to obtain sufficient information when taking applications for condition inspections on refrigerated and frozen products.

- If frozen, has the lot been thawed? If so, is it now refrozen?
- Does the applicant want the certificate restricted to condition and/or product temperature?
- Does the applicant want certification of quality, condition, and/or product temperature?

When taking the application, be sure the applicant understands the various options available.

- Inspection and certification may be restricted to temperature only. Inspection and certification may be restricted to:
    - Condition of containers and packaging
    - Condition of product (no grade determination)
    - Temperature of product
- Inspection and certification may include a quality determination in addition to all of the condition criteria previously stated, except that no quality evaluations will be made on frozen product unless the product is frozen. See the Certification Manual for conditions under which certification may be applicable.

Sampling

For condition of containers, follow sampling procedures outlined in the Condition of Food Container Manual. For product quality, condition, and temperature, as a minimum use the single sampling plan in the regulations. Increase sample size as needed.

Fill out the certificate of sampling as directed in the Sampling Manual with the following special notes:

- Record the time the product is sampled and temperature noted;
- Record pertinent information obtained from the rail car or truck temperature recording devices, thermometers, and any other useful information from the shipping documents;

- If the product is in a cold storage room and has recently been transferred from a "hot" carrier, attempt to locate documentation that may corroborate when the transfer took place; and

- Record the condition of the primary and secondary containers, especially noting stains, wetting, collapsed cases, etc.

Equipment Used for Checking Temperatures

The quality of frozen foods changes with time and the temperature of storage. Packers, shippers, carriers, distributors, retailers, and regulatory agencies are interested in the maintenance of proper temperatures for the protection of frozen products. One measure of control is to check the product at various points in the distribution channel to assure proper temperatures are maintained.

A. Temperature quality control starts with the use of an accurate, reliable thermometer. There are various thermometers and instruments available to take temperatures of frozen foods. The most common types are:

1. Metal dial thermometer, with the following characteristics:

   - A pointed stainless-steel stem, approximately 5 inches in length.

   - A temperature range of at least -20 °F. to +120 °F. The high end of the range is suggested, so that, if desired, a record may be made of the ambient (outside) temperature at the time the commodity temperature is taken. Markings on the scale should be in 1° or 2° divisions.

   - A hermetically sealed dial.

   - A pocket carrying case to protect the thermometer.

2. Electronic instrument, capable of registering temperatures very quickly. Most of these instruments have instantaneous adjustments that recalibrate in a matter of seconds.

B. Thermometers used for checking the temperatures of food products should be tested every week, or as often as is necessary to ensure their accuracy. See the "calibration of equipment" section of this manual for instructions on calibrating thermometers. Thermometer s must be handled carefully and should not be bent, dropped, handled roughly, or exposed to temperatures beyond those shown on it. Do not use a thermometer as a tool or probe. See the Sanitation Manual for sanitizing procedures for probes and thermometers.

Selecting Representative Samples

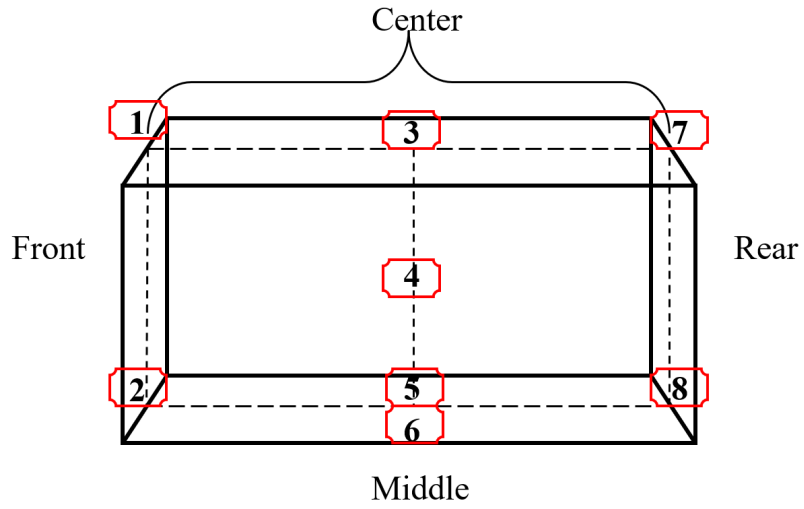
Warehouse Lots

Draw the number of samples specified in the single sampling plans as shown in the regulations. Select the samples in accordance with the sampling procedures in the Sampling Manual.

Railroad Car or Truck Lots

At time of loading, test the product in several packages in the warehouse before the packages are loaded into the railroad car or truck. Select test packages so that their temperatures will be representative of the entire load.

When product is being unloaded, test the product in packages taken from the locations shown in the illustration below. These packages should give product temperatures representative of the load. Additional packages may be tested if warranted, depending upon the type of product, appreciable cold or hot weather enroute, or other circumstances.



Suggested locations to select test packages in the car or truck:

- Top, front, center (1)
- Bottom, front, center (2)
- Top, middle center (3)
- Halfway up, middle, center (4)
- Bottom, middle, center (5)
- Bottom, middle, side (next to door if there is a side door) (6)
- Top, rear, center (7)
- Bottom, rear, center (8)

Methods for Measuring Temperatures of Samples

Measuring Temperatures by Opening Samples (Method I)

This method is recommended for precise product temperature measurement. It is sometimes referred to as "destructive" testing since some of the product is sacrificed during the process. However, in critical cases, the loss of product is small compared to the potential loss of the entire lot. Method I is always recommended for products in cans because it is difficult to obtain a firm contact between the thermometer probe and sidewall surfaces of the containers.

A. Make a hole in the sample

Make a hole in frozen products with a probe (ice pick, hand drill, or other pointed tool) into which a thermometer can be inserted. The tool should be slightly larger (approximately $^{1}/_{64}$ inch larger) in diameter than the diameter of the thermometer stem.

B. Equalize the thermometer

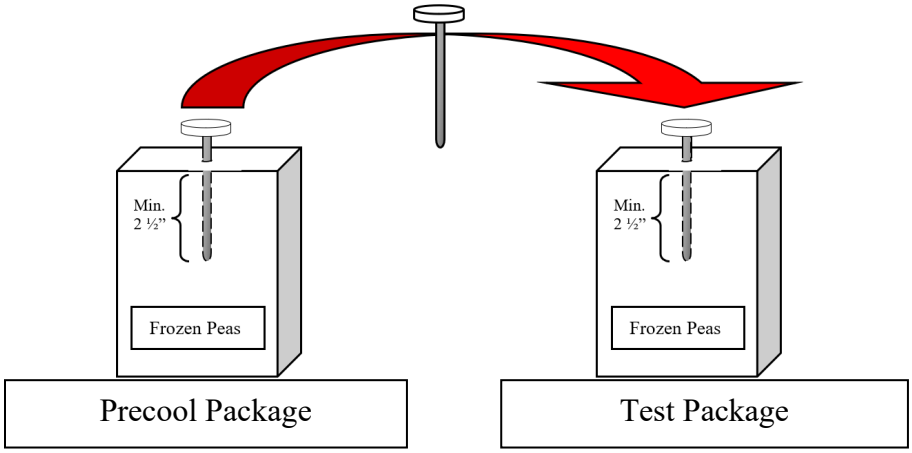
At least 5 minutes before using, place the thermometer and probe inside the car, truck, or warehouse where the product is stored to equalize their temperatures with the air surrounding the product. Because it may give a misleading temperature reading, avoid inserting a warm thermometer into a test package. Select a package at random from the load to precool the thermometer (referred to as the precool package). The product in this package is used to chill the thermometer stem before each insertion into a test package.

C. Take the product temperature

Gently insert the point of the thermometer into the center of the precool package. If the thermometer cannot be inserted into the product by gentle pressure, use the probe to make a hole to the center of the product.

Leave the thermometer in the center of the product for at least 30 seconds. Do not remove it until you are ready to insert it into the test package.

Then remove the thermometer from the precool package and immediately insert it to the center of the product in the test package (see illustration on following page). Wait at least 2 minutes and read the temperature. If several packages are being tested, the thermometer can be left in each test package until the next package is ready for testing.



Measuring Temperatures without Opening Samples (Method II)

This method is sufficiently accurate for routine temperature checks. Whenever exact product temperatures are necessary, or in the case of any doubt or controversy, Method I should be used in lieu of Method II.

A. Equalizing the thermometer

Follow the same procedure as specified for Method I, Step B.

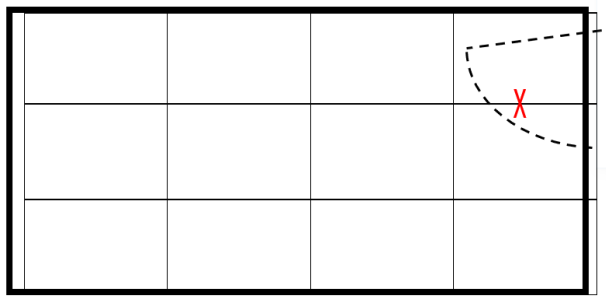
B. Selecting cases

Select 7 cases of frozen foods from the lot in question. Stack any 3 of the 7 on the floor area of the cold environment in which the lot is held.

C. Taking the temperature

Cut sidewall of the top case at one end with a sharp knife. Bend the cut tab outward. Insert probe of the temperature measurement device at about the center of the first stack of packages, and between the first and second layers of packages so that the entire sensing element is in firm contact with package walls (see illustration on following page). For poly bags, insert probe in the same direction as the length of the bag, deep enough for firm contact between bags. Stack the other 4 cases on top of the case containing the thermometer.

Read and record the temperature observed when the needle gives a steady reading. This is generally 5 minutes or less for a dial thermometer. Close and tape the cut sidewall area of the case.



Side View of Case Showing 12 Primary Cartons Within

Thawing Procedures

Frozen fruits and vegetables must be thawed to properly evaluate the characteristics of the product. Take care that during the thawing process the product is not damaged or exposed to abuse that will alter its true characteristics.

Frozen fruits are more susceptible to damage during thawing than frozen vegetables. Red cherries and light-colored fruits such as peaches and apricots will oxidize quite readily and should be examined for color while some ice crystals remain in the product. Some fruits show breakdown in texture or "bleed" when thawed. When preparing the product for examination, rapid thawing under controlled conditions is ideal.

There are three general methods for thawing frozen fruits and vegetables:

- Air Thawing
- Water Thawing
- Microwave Thawing

Water and microwave thawing are faster but may not be suitable for all products. Products thaw at different rates. Frozen peas or broccoli thaw much faster than frozen leafy greens. Consequently, no specific time can be designated to accomplish adequate thawing. Through experience, the inspector will learn to judge the best procedure and time requirement for each commodity.

When air thawing is used, it may be desirable to speed the process by placing the cartons on a table, so they are well separated by air space, and directing a stream of air from a fan on to the packages.

Air Thawing

- Frozen Fruit

  Fruit in closed containers may be air thawed until the product is sufficiently free from so ice that individual units may be readily separated and handled. Rapid thawing is most desirable; a fan should be used to speed the process. Do not air thaw in open containers. Do not over-thaw to avoid oxidation, breakdown of texture, bleeding, etc.

- Frozen Vegetables

  The air thawing method is suggested if there is suspicion of off flavors or odors. It should also be considered for products susceptible to insect infestation or sand and silt. Do not over-thaw.

Water Thawing

- Frozen Fruit

  Fruit may be thawed in a water bath if they are in tightly sealed containers. Temperature of the water should not exceed 86 °F. Thaw only until the product is sufficiently free from ice that individual units may be readily separated and handled. A water bath should be used to thaw large bulk containers.

- Frozen Vegetables

  Most frozen vegetables can be thawed directly in water without degrading the product. Remove the product from the package and place it directly in the water at a temperature not to exceed 86 °F. As soon as the product is sufficiently thawed to permit easy separation of the units, drain on an 8 mesh screen to remove excess water, and place the product on a tray for examination. Do not soak the product past the point of sufficient thawing. This is particularly important for products such as cut corn.

  Some preliminary checking of frozen vegetables may be necessary if there is any indication or suspicion of an off flavor or odor. If a sample is questionable, do not use direct water thawing since any suspect flavor might be diluted by the water. Such product may be water thawed in tightly sealed containers or air thawed. Place any suspect sample in a covered cooking pan and cook for analysis of flavor and odor.

  Some vegetables are susceptible to insect infestation, such as aphids and thrips, or sand and silt. In such cases, thaw the product in a suitable container, saving the water. Filter the water through a milk filter disk or white towel and examine the filter/towel for any extraneous matter present. Combine any material found in the thawing water with any additional material found by other means.

  Note: Some vegetables have Defect Action Levels based on standard sample unit sizes and procedures. If so, use the standard procedure.

Microwave Thawing

Microwave thawing is not recommended as a standard procedure for either fruits or vegetables because all or part of the sample unit may be changed in color or character by "hot spots." However, certain products, such as shredded hash browns and preformed potatoes can be quickly thawed to facilitate examination for defects and foreign material. After other factors have been evaluated, cherries may be completely thawed and warmed in this manner to facilitate pit determination.

If microwave thawing is used as a standard thawing procedure, it should only be done after careful experimentation with time and power settings to assure that no undesirable changes will take place.

Thawing Frozen Strawberries

These instructions are for thawing and sampling an entire institutional size container (weighing more than 10 pounds) of frozen strawberries. The product may be whole or sliced frozen strawberries, with or without packing medium. These instructions are not for individually quick frozen (IQF) strawberries.

A. In accordance with regulations, select containers to be used for samples. Allow all containers to thaw unopened following the procedures outlined in section Thawing Procedures.

B. Leave the containers unopened until the strawberries are thawed. When the strawberries are sufficiently free from ice crystals and readily separable, stir the contents of the containers using a large spoon or ladle, being careful not to damage the strawberries.

C. After the contents of the containers are thoroughly mixed, draw a sample unit weighing approximately three pounds from each container.

D. Follow the instructions in the current Grading Manual for Frozen Strawberries for the amount of strawberries to be used for quality and analytical testing.

Note: Determining the grade as soon as possible after thawing minimizes the risk of oxidation.

Verification of Frozen Sample Units

Under certain conditions, SCI Division inspectors may be called upon to inspect, grade, and certify frozen fruits or vegetables using unfrozen sample units drawn from the production line. This is applicable to products packed in silos, drums, or bulk institutional size containers (over 10 pounds), and situations where frozen samples are examined at a later date, or where no frozen samples are examined.

Note: Frozen verification sample units must be examined for all retail and small institutional size packages (less than 10 pounds).

See the General Processed Procedures Manual and Certification Manual for procedures to follow.

As a prerequisite to assigning the grade to frozen fruits and vegetables, the U.S. standards state: "frozen in accordance with good commercial practice and maintained at temperatures necessary for the preservation of the product." Specific temperature limits are not prescribed, although it is generally recognized that proper storage temperatures for frozen foods should be 0 °F or lower. A tolerance of 5 or 10 degrees must be made for conditions encountered during distribution in which the product may be temporarily held or handled in a manner that allows the product temperature to rise above 0 °F. Private buyers and government agencies may have either more stringent or less stringent requirements.

While having no authority to prescribe freezing and storage temperatures, the Division supports the concept of "0 °F or lower". We recognize that we are often called upon to certify products in which the freezing process is not entirely completed, and the product has not been reduced to a temperature of 0 °F. In the absence of specific instructions otherwise, we will not certify the grade of a frozen product if the temperature is more than 15 °F. This does not mean that we condone temperatures above 0 °F. It is merely an administrative allowance to facilitate inspection and certification prior to the completion of the freezing cycle.

A final U.S. grade should not be assigned to a production lot until frozen product sample units have been officially drawn and evaluated, regardless of how many line check sample units have been taken. The total number of sample units examined must equal or exceed the minimum number required for the single sampling plan or time sampling plan for each lot size of one grade, style, container size, etc. To meet this requirement, it may be necessary to grade additional frozen sample units from the cold storage.

If an insufficient number of line check samples were drawn during production, a number of frozen sample units must be completely graded to meet the minimum number of samples required. However, if sufficient line check sample units were drawn to meet the minimum number of samples for the lot size, then the frozen sample units need only to be evaluated for those factors which may change during freezing, such as, color, character, and flavor. Frozen verification samples should be properly thawed following the procedures in section Thawing Procedures. The units should be separated to determine whether product deterioration was due to oxidation, crystallization, or other causes.

Sampling

The verification sample units should be drawn as duplicates of the line check sample units. The duplicate sample units should be marked for identification with the line check and to assist in retrieval from the cold storage. The verification subsamples should be handled, transported, and stored in the same manner as the bulk containers in the lot that it represents.

Note: The above procedure is not applicable to drums and other large containers where verification subsamples are taken from the processing line.

When verification results indicate product condition is abnormal or product quality has been

impaired, the line check results cannot be considered reliable. Samples must be drawn from the cold storage for complete grading at the sampling rate indicated in the regulations, and the Sampling Manual.

If specific instructions indicate that the examination of more frozen sample units is necessary, follow those instructions.

Sample Size

- When the cold storage is located where the product is produced, and the freezing results in product that retains its initial quality characteristics, then the minimum sample size for verification of frozen product is one frozen sample unit per shift from each lot of a single grade, style, and container size, regardless of the size of the lot.

- When the cold storage is located at a different location from the processing plant, and conditions under which the product is transported and stored are not known, then the sample size for verification of frozen product must be in accordance with the table below.

Sample Size for Verification of Frozen Products

Sample Size Drawn for Quality	3	6	13	21	29
Sample Units Drawn for Verification	1	2	3	4	5

Recording Verification Results

When there is a U.S. grade standard, product verification results will be recorded as score point values, or quantity and type of defects found, or by letter grades. If there is no U.S. grade standard, use the appropriate descriptive terms to describe a quality level (see General Processed Procedures Manual under Score/Tally Sheet Completion and Quality Level Descriptions and Abbreviations header).

Re-inspection of Affected Lots

When temperatures of affected lots are reduced to acceptable levels in storage, they may be sampled, re-inspected and certified as to grade. The normal sampling rate for such re-inspections will be determined from the appropriate table in the regulations.

After three consecutive lots have been re-inspected using the normal sampling rate, a reduced rate may be considered. This rate will be based on the inspector's knowledge of the product, and the ability of the processor to reduce high temperature production to certifiable levels quickly without detrimental effects on product quality. In any event, the inspector must sample and completely inspect enough sample units to assure the correct certification of the lots as "frozen."

Approved Identification

It is necessary to protect the integrity of production that has been packaged under "Approved Identification," marks. In this case, a lot with temperatures 16 °F or higher must be placed on "hold" until a final grade can be determined. Should this lot be found to be substandard or a lower grade than indicated, the marks must be removed before the product leaves the plant (see the General Processed Procedures Manual section under Labeling and SCI Policy on Use of Approved Identification, as well as the regulations).

Cautions and Exceptions

These instructions do not apply when inspection and certification are based on a specification or exceptions which conflict with the temperature limits set forth.

Examples of such conflicts are:

- The temperature limit of + 5 °F that is required for frozen concentrated citrus products,
- The temperature requirement of 0 °F that is established in the standards of identity for frozen peas,
- The requirements that are established by either USDA or Department of Defense (DoD) for purchases of frozen foods, or
- The following on-line temperature exception for frozen french fried potatoes. This exception does not apply to frozen hash brown potatoes. When temperatures of frozen french fried potatoes checked off the line are between 16 and 19 °F, the product may be given a final grade and certified only if:
    - It has been placed in 0 °F (or less) storage temperatures for a minimum of 24 hours.
    - The inspector verifies storage temperatures on a daily basis.

Cooking Procedures

Final examination of many frozen products requires preparation by cooking, particularly frozen vegetables. In some cases, cooking is required for product examination of texture, tenderness or maturity. In other cases, there may be a question regarding the flavor of the prepared product.

Most frozen vegetables are blanched or partially precooked during preparation for freezing. The freezing process softens the tissues, and frozen vegetables require only from one-third to one-half as much cooking time as does the fresh product. Take care to neither overcook (mushy vegetables) nor undercook (tough vegetables) the product.

When checking flavor, take care to prevent dilution of any off or objectionable flavors by

exposure to excessive water. Suspect containers can ordinarily be identified by odor as the package is opened and prepared for inspection. If an off odor is noted, the container(s) should be evaluated for flavor.

Sample Selection

Generally, we do not take a separate set of samples strictly for cooking purposes. The exception might be in the case of bulk or institutional type containers, when enough product is available that a portion of each container can be allocated for visual examination, chemical or physical tests, and (in the frozen state) for cooking. Usually, the inspector will only have the same samples used to evaluate other product characteristics available for cooking. With this in mind, complete testing can be performed by careful segregation and planning during the process of product examination.

In the case of retail size packages (16 ounces or less), all the container packages may be partially or completely air thawed and checked for suspect off-odors and flavors. Portions of suspect samples should be cooked for further odor and flavor evaluation. If the odor of the thawed product is normal, proceed with product examination and cook representative portions of the samples for whatever checks may be required. If the packages are very small, it may be desirable to draw additional containers for cooking purposes only.

Note: Inspectors should note on the applicable tally sheet or score sheet which sample units were cooked.

Seasonings

For the purpose of laboratory testing, it is recommended that seasonings such as salt, sugar, butter, vinegar, or spices be avoided; such additives may cover up undesirable or off-flavors that may be present.

Cooking Method

Most vegetables are cooked without thawing. However, for inspection purposes, it may be necessary to cook a product that is partially or completely thawed since portions of the sample may have been used for other examinations or tests. Be guided by the standard for the product.

The following steps will assure uniformity in the cooking of frozen vegetables for test purposes:

A. Using a two-quart saucepan, bring about 180 ml of water to a boil and add approximately 8 ounces (225 grams) of product to the pan.

B. Bring contents to a rapid boil and continue to heat sufficiently to maintain a rolling boil.

C. Start timing the cook from the moment the water returns to a boil after the vegetables are added.

D. During the cooking process, keep a reasonably tight-fitting cover on the pan to avoid excessive loss of water.

E. Continue the cooking for the period of time specified for the product (see the following recommended cook times).

Note: Cooking time may vary within range specified depending upon variety, maturity, size of pieces, and degree of blanching. See label cook time.

F. At the end of the cooking period, drain any excess water and place the cooked product on a tray.

G. Allow to cool sufficiently to be comfortably warm and make the required organoleptic tests.

Recommended Cook Times

The following table is the recommended cook time for various products:

Product	**Time (Minutes)**
Asparagus, small and medium sizes	5 to 7
Asparagus, large and very large sizes	7 to 9
Green Beans	8 to 10
French Cut Green Beans	4 to 6
Italian Green Beans	4 to 6
Lima Beans (thin seeded)	15 to 18
Lima Beans (thick seeded)	12 to 15
Broccoli	5 to 7
Brussels Sprouts	8 to 10
Carrots	6 to 8
Cauliflower	3 to 5
Corn (whole kernel)	2 to 4
Corn-on-the-Cob	3 to 5
Leafy Greens: Collards, Kale, Mustard, Turnip	20 to 25
Leafy Greens: Spinach (leaf)	3 to 4
Leafy Greens: Spinach (chopped)	2 to 4
Mixed Vegetables	9 to 12
Okra	8 to 10
Peas	3 to 5
Black Eye or Field Peas	40 to 45
Peas and Carrots	6 to 8
Squash (summer)	5 to 7
Succotash	8 to 10

FRUIT-SUGAR RATIO

Determination and certification of the proportion of fruit to packing medium is an important element in the inspection and certification of frozen fruits. This is valuable data for both the seller and buyer, especially if the product is intended for further processing into jam or preserves. For these products, it is essential that the user know the fruit content (or proportion of fruit to packing media) in order to adjust the formula to meet mandatory Food and Drug Administration Standards of Identity. These require a minimum of 45 parts of fruit ingredient (exclusive of added sweeteners) to each 55 parts of sugar solids.

The fruit and sugar content of frozen fruits and berries is not a requirement of the United States standards, and an official form for calculating fruit-sugar ratios, or noting observations that confirm the ratio being packed has not developed. However, the product needs to be packed in accordance with good commercial practice, and must also conform to provisions of the Federal Food, Drug, and Cosmetic Act with respect to labeling. Even for products not covered by mandatory standards, it is important for the user to have reasonable assurance of the fruit content of the frozen fruit ingredient as well as the quality of the finished product.

Many buyers specify a proportion of fruit to sugar as a part of their requirements. Berries and fruits are packed with varying amount of added sugar, ranging from a "straight pack" with no added sugar, to what is known as 7 + l, 6 + l, 5 + l, 4 + l , 3 + l, etc. Unless otherwise specified, these ratios are understood to mean a dry sweetener rather than a liquid packing medium, and sucrose rather than other sweeteners. The first number indicates the proportion of fruit and the second number the proportion of sugar. For example, a 3 + 1 pack means 3 parts by weight of fruit and 1 part by weight of dry sugar.

Some fruits are packed with a liquid sweetened packing medium and may be labeled to indicate the proportion of fruit to liquid media as "5 parts fruit to l part 60 °Brix syrup." These ratios such as 5 + 1 could be expressed as "5 to 1," "5 x 1," or "5:1," all meaning the same thing.

Assuming the merchandise is accurately labeled or represented, the buyer or receiver can readily ascertain the weight of fruit ingredient and the weight of sugar in a given container or lot.

For example, the proportion of ingredients in a 400-pound barrel of frozen berries packed with different declared proportions of fruit and sugar is calculated as follows:

Example: If declared as 5 + 1 (5 parts fruit, 1 part sugar), then $^5/_6$ of the contents is fruit and $^1/_6$ is sugar.

Fruit = ($^5/_6$) (400) or 333 $^1/_3$ pounds
Sugar = ($^1/_6$) (400) or 66 $^2/_3$ pounds

Example: If declared as 3 + 1 (3 parts fruit l part sugar), then $^3/_4$ of the contents is fruit and $^1/_4$ is sugar.

Fruit = ($^3/_4$) (400) or 300 pounds
Sugar = ($^1/_4$) (400) or 100 pounds

Example: If declared as 4 parts fruit and 1 part 60 °Brix syrup, then $^4/_5$ of the contents is fruit and $^1/_5$ is packing medium.

Fruit = ($^4/_5$) (400) or 320 pounds
Syrup = ($^1/_5$) (400) or 80 pounds

Calculate the amount of added sugar in the packing media as follows:
60 °Brix syrup means 60% sugar solids.

(80) (0.60) = 48 pounds of sugar solids, and the remaining 32 pounds is water from the liquid packing medium.

However, the precision of these figures depends on the accuracy of the packer in maintaining the correct fruit and sugar proportions during processing. Direct observation of the processing operation is the most reliable method for determining fruit-sugar ratio.

Verification of Fruit-Sugar Ratio: In-Plant Inspection

Processors may need to ascertain the fruit-sugar ratio of products in order to formulate for various receivers, or to meet mandatory FDA requirements. The proportion of fruit to sugar or liquid packing medium may be determined and certified under the following conditions:

- When packed under USDA In-Plant Inspection, with the inspector present to make suitable checks verifying the declared fruit-sugar ratio during the entire packing operation of the specific lot;

- When the plant facilities are such that suitable checks can be made during packing operations; and

- When a sufficient number of checks are made to certify the ratio with a reasonable degree of reliability.

Inspectors must determine and verify the proportion of fruit to sugar or liquid sweetener under the following circumstances:

- Whenever the containers are labeled to indicate a specified ratio, and in addition bear approved identification marks. The USDA has put its stamp of approval on the product, not only for quality but also for fruit-sugar ratio.

- When an inspector is assigned to plants packing jams (preserves). Frequent checks should be made on the raw material to determine the fruit-sugar ratio or proportion of fruit to liquid packing media.

- Whenever a lot is offered on a government contract requiring that the fruit-sugar ratio be determined.

It is optional for the packer to determine fruit-sugar ratio on containers of less than or equal to 10 pounds that are not labeled to indicate a specific ratio.

USDA inspection certificates including the label declaration for fruit-sugar ratio may be misinterpreted by the trade to mean that the USDA inspector has verified that declaration, particularly if they are in-plant during the packing operation. When such verifications are not made, the inspection certificate should state that the fruit-sugar ratio was not determined.

Even if an applicant does not require a certification of fruit-sugar ratio, inspectors assigned to plants should ascertain that the fruit is properly drained, and that there is no unreasonable deviation in compliance with the declared or indicated fruit-sugar ratio.

Checks for Fruit-Sugar Ratio Under In-Plant Inspection

Inspection and certification of fruit-sugar ratio should be based upon numerous determinations made during processing to allow for reasonable variation between individual containers. These are to be expected, even under carefully controlled packing conditions. The in-plant inspector should use the method or combination of methods that will best work with that particular plant's processing system. Whenever possible, checks should be made by more than one method.

Checks should start with observing that the fruit or berries are well drained after washing.

Checks may include:

- Physical checks of the amount of fruit, sugar or packing media (or both) being packed into individual containers. Procedures will depend upon the plant's operations.
    - If dry sugar is being used and the fruit and sugar are being weighed separately, check the accuracy of the scales or metering devices by periodic observations of the weighing operation, and by physically weighing the amount of each product being dispensed by such devices.
    - If a liquid packing medium is being added, check the actual weight of fruit in numerous containers prior to the addition of syrup. Determine the proportion of fruit to syrup based on weight of fruit in relation to the weight of the entire container.
- Check of the amount of sugar used and number of containers packed over a given interval of time. If the fruit is being mixed with dry sugar in a continuous mixer, check the number of containers packed out from a given number of bags or other measured quantity of sugar over a reasonable time interval. Determine the fruit-sugar ratio based on number of containers packed, and quantity of sugar used during that period. Even though there will be variation between individual containers, this will represent an average value for the entire quantity packed.

- Checks of the soluble solids. If direct measurements of fruit and sugar cannot be made, the ratio can be determined with the soluble solids of both the in-going fruit prior to adding sugar, and that of the finished product.

  See Appendix XII - Optional Worksheet for Fruit/Sugar Ratio for an example.

IN ALL CASES, IT IS IMPORTANT THAT THE INSPECTOR IS ASSURED THAT THE FRUIT OR BERRIES ARE PROPERLY DRAINED AFTER WASHING PRIOR TO MIXING WITH SUGAR.

Estimation Based On Direct Measurement of Fruit or Packing Media in Individual Containers

Some plants weigh out a specified quantity of fruit in each container and then add a measured amount of sugar or syrup to make up the required net weight. In such instances, observe the operation at unannounced intervals and do periodic checks on the weighers.

Some plants may layer the fruit into the container together with sugar added by means of a measured scoop rather than by weight. In such instances, the sugar is generally received in 100 pound bags and dumped into a tub or vat located adjacent to the filler. The fruit-sugar ratio may be assessed by counting the number of bags of sugar and the number of containers packed over a specified interval. For example:

Over a 5-minute period, 400 pounds of sugar were used in packing 50 containers of fruit in 50 pound cans of a specified 5 + 1 ratio.

- 50 cans at 50 pounds each = 2500 pounds finished product.
- 5 + 1 ratio means $^{5}/_{6}$ fruit and $^{1}/_{6}$ sugar.
- ($^{1}/_{6}$) (2500) = 416 $^{2}/_{3}$ pounds of sugar.

Therefore, the packer is complying reasonably close to the declared ratio since the theoretical quantity of sugar needed is 416 $^{2}/_{3}$ pounds, and the packer actually used slightly less, or 400 pounds. To look at it from another perspective, 2083 ⅓ pounds of fruit was needed, but 2100 pounds of fruit was used.

In the case of fruit packed with a liquid packing media, the fruit content can best be determined by periodically checking containers prior to the addition of the syrup. Generally the fruit is added to the container and then passed beneath a syruper which adds a measured quantity of syrup. For example, frozen raspberries packed in 10 pound cans with a declared ratio of 4 parts fruit and 1 part syrup would be expected to contain a fruit weight of 8 pounds ($^{4}/_{5}$ x 10) per container.

Estimation Based on Soluble Solids

The use of soluble solids as a means of estimating the fruit-sugar ratio is not as reliable as direct checks on the amount of fruit used in relation to the amount of sugar used. However, when these

direct checks cannot be made, the soluble solids method is probably the best alternative procedure. This method does have potential disadvantages:

- It may be difficult to obtain a sample of the finished product that can be positively identified as originating from fruit of a specific soluble solids reading. However, if the fresh fruit does not vary substantially during the packing period, this error is not significant.

- Numerous samples to determine fruit content must be checked because of the variation in the proportion of the fruit and sugar that can be expected from container to container.

- As is true of any method of estimation, excess water adhering to the berries after washing will lower the Brix value of the finished product, and tend to distort the true fruit-sugar ratio. When water is calculated as part of the fruit component, the results indicate more fruit content than was actually provided.

Despite the potential for error, the ratio of fruit to sugar may be estimated with a reasonable degree of accuracy. The more samples taken throughout the day, the more the average ratio obtained will compensate for errors in individual samples. Follow this procedure:

A. Obtain a representative one-pound sample of the in-going fruit before processing. If the fruit is washed, select the sample immediately before mixing with the sugar. Do not drain the sample any more than is normally accomplished during processing.

B. At approximately the same time, obtain a sample of the finished product prior to freezing. This sample should be selected and prepared as follows:

    - If retail size containers, select a sufficient number simultaneously from the line to make an approximate 2-pound composite (e.g., three 10-ounce cartons or two 16-ounce cartons).

    - If institutional size (e.g., No. 10 cans), thoroughly mix the entire container and select a representative 3-pound subsample.

    - If bulk containers, such as 30-pound cans or barrels, catch approximately 15 pounds from the filler, mix thoroughly, and select a representative 3-pound subsample. This method can only be used with continuous or pre-mixing filling operations, not independent or layered fill.

C. Place the finished product sample in a blender or other mechanical mixer, and blend until it is thoroughly mixed and homogeneous.

D. Place a drop of the filtrate from this blended mixture (filtered through a rapid filter paper if needed) on the refractometer prism, and determine the Brix reading. Make any necessary temperature correction.

E. Follow steps C and D above to determine the soluble solids of the in-going fruit obtained before mixing with sugar.

F. Knowing the soluble solids of both the in-going fruit and the finished product, calculate the proportion of fruit to sugar as follows:

$R = \frac{100-Ps}{Ps-Fs}$ in which

- R = Ratio of fruit to sugar.
- Ps = Soluble solids of finished product (fruit plus sugar).
- Fs = Soluble solids of in-going fruit.

Example: The soluble solids of fresh peaches is 12.2. The soluble solids of the finished product (peaches plus dry sugar) is 31.8.

The fruit-sugar ratio is calculated as follows:

$R = \frac{100-31.8}{31.8-12.2}$

$R = \frac{68.2}{19.6}$

R = 3.48

If the product were labeled or specified as a 3.5 to 1 ratio, the actual proportion of fruit to sugar (3.48 to 1) would meet requirements.

Ratio Determination Frequency Guidelines (In-Plant)

- If the fruit and sugar (or liquid sweetener) are being weighed or metered into individual containers, the inspector should check samples for accuracy at approximate hourly intervals for each line. If the results remain satisfactory, this frequency should be adequate.
- If the fruit and sugar are being mixed in a continuous type mixer and the determination is based on soluble solids, samples of the fresh fruit should be checked at approximate hourly intervals.

Samples of finished product should be checked according to the following schedule:

Amount of Finished Product	Number of Samples
First 8,000 pounds	3
Each additional 8,000 pounds	1

For example, if a line can produce 10,000 pounds per hour for an 8-hour shift (80,000 pounds), check 3 samples for the first 8,000 pounds, and check 9 samples during production of the next 72,000 pounds, for a total of 12 samples for the shift.

These are minimum sampling rates and should be increased if warranted. Keep in mind that the more frequent the checks, the more reliable the lot estimate.

Verification of Fruit-Sugar Ratio: Lot Inspection

Generally, fruit-sugar ratio will not be determined or certified under lot inspection. Fruit-sugar ratio results based solely on the finished product are not fully reliable. However, if specifically requested by the applicant, the ratio may be estimated as follows:

- If the lot can be identified as having been packed under in-plant inspection, the fruit-sugar ratio may be certified, if the records compiled at time of packing substantiate the declared ratio. See section Verification of Fruit-Sugar Ratio: In-Plant Inspection for key measurements for ratio determination. Information may be obtained from the SCI Division field office involved.

- If there is no history on the lot, the fruit-sugar ratio can be estimated using the average natural solids for the specific fruit. The reliability of this testing depends upon the degree to which the in-going fruit conforms to average values established for that fruit, as well as the integrity of the packer in observing good commercial practice during processing. Certification will be restricted to finished product examination only.

Some buyers base their specifications on finished soluble solids and not on a specified ratio particularly for retail packs. For example, the buyer's specification may indicate that the finished product solids must be in the range 25 to 28 °Brix. In these instances, determine the solids and report the findings in terms of soluble solids with no conversion to fruit-sugar ratio.

If the applicant requests a fruit-sugar ratio on the finished product, the most reliable means of checking the fruit content is by measuring the soluble solids. See In-Plant Inspection, Estimation Based on Soluble Solids for the procedure and formula used for calculating the theoretical fruit-sugar ratio. Under these circumstances, a figure representing the average solids of the fresh fruit is substituted for the soluble solids of in-going fruit, since the actual solids of the in-going fruit is unknown.

This procedure involves comminuting the entire container for the solids test and checking a representative number of containers to estimate the ratio with reasonable accuracy. The applicant should be informed ahead of time that full containers must be taken for the test, and the inspection will be lengthy due to the time it takes to prepare the samples.

Average Authentic Values for the Most Common Fruits and Berries

The "authentic values" referred to in this section are based on FDA data prepared by examining numerous samples of the respective fruits or berries, and is summarized in the Journal of the AOAC, Vol. XXI, No. 3, August 1938.

Fruit or Berry	Average Authentic Values
Apples	13.7
Apricots	14.4
Blackberries	10.0
Cherries	13.9
Crabapples	15.4
Currants	10.6
Figs	19.0
Gooseberries	8.2
Guavas	7.6
Loganberries	10.6
Grapes	14.1
Peaches	11.8
Pineapples	14.6
Plums	14.8
Raspberries (red)	10.5
Raspberries (black)	11.2
Strawberries	8.0

Example of calculation for frozen strawberries using the equation $R = \frac{100-Ps}{Ps-Fs}$ to find ratio of fruit-sugar:

Ps (soluble solids of product) = 28.4

Fs (soluble solids of authentic fruit) = 8.0

$R = \frac{100-28.4}{28.4-8.0}$

$R = \frac{71.6}{20.4}$ or 3.50

- There are limitations and potential errors in using soluble solids as an estimation of fruit content:
    - The entire contents of container must be blended, leading to destruction of the product. In addition, this can be time consuming especially in the case of bulk containers.
    - If the fresh fruit varies materially from the established authentic values, results will be questionable.
    - Improper draining of washed fruit, or the addition of water materially affects the ratio. This is a very significant factor, as shown by the following example.

Assume a processor is packing strawberries to a declared ratio of 4 + 1, that the strawberries have a soluble solids of 8.0%, and that for each 100 pounds of finished product, 8 pounds of water is unintentionally added through improper draining.

a. For each 100 pounds there should be 80 pounds of berries and 20 pounds of dry sugar.

80 lbs fruit at 8 percent solids = 6.4 lbs
20 lbs sugar at 100 percent solids = 20.0 lbs
Theoretical solids of finished product = **26.4 lbs**

Applying the formula in Estimation Based on Soluble Solids, this ratio is:
$\frac{100-26.4}{26.4-8}$ or $\frac{73.6}{18.4}$ or $\mathbf{4.0:1}$

b. However, there would actually be 72 pounds of berries, 8 pounds of water, and 20 pounds of dry sugar.

72 lbs fruit at 8 percent solids = 5.76 lbs
8 lbs water at 0 solids = 0 lbs
20 lbs sugar at 100 percent solids = 20 lbs
Finished product solids = **25.76** lbs

Rounding up and applying the formula as above, this ratio is:
$\frac{100-25.8}{25.8-8}$ or $\frac{74.2}{17.8}$ or $\mathbf{4.2:1}$

From the soluble solids values, this makes it appear that the packer is being generous with the fruit, while he has actually substituted 8 pounds of water for 8 pounds of fruit. This illustrates the importance of checking that the fruits used in processing are properly drained.

Ratio Determination Frequency Guidelines (Lot Inspection)

If an estimate is required on lot inspection and there is no previous history of the lot, entire containers must be checked. For lots of 20,000 pounds or less, make a minimum of 6 determinations. For lots more than 20,000 pounds, make a minimum of 13 determinations. If the lot is very large, increase the number of determinations at the rate of 6 for each approximate 50,000 pounds more than 100,000 pounds.

In the case of large containers, this sampling rate may appear rather high. However, it is necessary to assure a reliable estimate.

Determining Lot Acceptance

Depending upon the product and packing practices, a reasonable deviation in fruit-sugar ratio between individual containers is to be expected. Lot acceptance is based on the average value of numerous ratio determinations. However, there is also a limit on individual sample deviation. To be in compliance with the declared or specified ratio, the following criteria must be met.

- For the average of all samples, allow a tolerance of 0.2 below or above declared or specified ratio.
- All individual determinations must be within the range of ± 4 ° of the soluble solids value corresponding to the declared or specified ratio, except:
    - Individual checks that exceed the 4 ° limitation is allowed at a tolerance equal to the deviant rate (1 in 6, 2 in 13, etc.), provided:
        - No individual determination is more than ± 8 ° of the soluble solids value corresponding to the specified ratio.

Example:

Frozen Strawberries packed to a 4 plus 1 ratio, fresh fruit solids of 8%. The theoretical solids of the finished product of a 4 + 1 ratio should be 26.4.

- The average of all the determinations must be not less than 3.8 nor more than 4.2 (4 ± .2 for the ratio);
- No more than 1 in 6, 2 in 13, etc. may be less than 22.4 ° nor more than 30.4 ° soluble solids (26.4 ± 4 °); and
- No individual may be less than 18.4 ° nor more than 34.4 ° soluble solids (26.4 ± 8 °).

These guides are intended to allow for reasonable variations under normal packing procedures. For products that are closely controlled by direct measurement, this allowance for individual samples may seem rather liberal. However, in the case of products like frozen strawberries, experience has shown that a reasonable tolerance must be permitted. This doesn't mean that packers should be permitted to continually fall below requirements or take advantage of the administrative guides outlined. If the inspector finds that the plant tends to be slightly low on the amount of fruit used relative to sugar or packing medium, this deviation should immediately be called to the attention of plant management for correction.

GOOD COMMERCIAL PRACTICES

Counts

Unless otherwise specified, when either a count range or a specific count (even if qualified by the word "approximately") is declared on a label or specified by a purchaser, criteria for "good commercial practice" will apply.

A lot will be considered as complying with requirements of good commercial practice under the following conditions:

- Average of all sample units meet the declared or required count; and
- 50% or more of the sample units meet or exceed the declared or required count.

Range of Counts Guide for Good Commercial Practice

When a range of counts is specified or declared, counts in all sample units must fall within this range. Sample units with counts not falling in this range are allowed as deviants as specified in the regulations (in addition to quality deviants), provided these counts do not exceed the limits outlined below.

- Sliced Pineapple
    - Counts up to 20 slices or 40 half slices:

      Allow 1 slice or 2 half slices less than the lower end of the range, or more than the upper end of the range.
    - Counts over 20 slices or 40 half slices:

      Allow 5% by count less than the lower end of the range, or more than the upper end of the range.
- Other Processed Products
    - Counts up to 20 units:

      Allow 2 units less than the lower end of the range, or more than the upper end of the range.
    - Counts over 20 units:

      Allow 10% by count less than the lower end of the range, or more than the upper end of the range.

Specific Count Guide for Good Commercial Practice

When a specific count is declared or specified, count in sample units may vary above and below this number within the limits shown below. Sample units with counts that deviate from these limits are considered deviants (in addition to quality deviants) as specified in the regulations. If the deviation is considered excessive for current packaging practices, then a 1 in 48 allowance should be applied.

- Sliced Pineapple
    - Counts up to 20 slices or 40 half slices:

      Allow 1 slice or 2 half slices less than the specific count.
      Allow 2 slices or 4 half slices more than the specific count.
    - Counts over 20 slices or 40 half slices:

      Allow 5% by count less than the specific count.
      Allow 10% by count more than the specific count.
- Other Processed Products
    - Counts up to 20 units:

      Allow 1 whole or half unit less than the specific count.
      Allow 2 whole or half units more than the specific count.
    - Counts over 20 units:

      Allow 5% by count less than the specific count.
      Allow 10% by count more than the specific count.

Drained Weight

Although generally not a factor of quality, drained weight of processed fruit and vegetable products is an important marketing consideration. It indicates the amount of fruit or vegetable ingredient in relation to packing media, and sometimes the degree to which a product may have disintegrated during processing and handling.

Drained weight considerations:

- Most U.S. standards for canned fruits and vegetables contain a recommended drained weight consistent with good commercial practice
- Drained weight can be a requirement in purchase specifications (i.e., USDA Commodity Specifications)

- Drained weight may be a requirement in a buyer-seller contract
- Drained weight is a limiting quality factor in Canned Tomatoes
- Drained weight is a FDA mandatory requirement in the standard of fill for Canned Fruit Cocktail, Mushrooms, Canned Tomatoes, and Canned Crushed Pineapple
- Drained weight is the common labeled statement of contents for a few products, such as Canned Olives and Canned Mushrooms
- Drained weight requirements or recommendations may vary for the same product in the following cases
    - Maturity - as in Canned Whole Kernel Corn
    - Count - as in Canned Pears and Canned Plums
    - Size of units - as in Canned Green and Wax Beans

Limits of Good Commercial Practice

Unless specified in the U.S. standards other inspection documents, compliance with the minimum drained weight recommendations will be determined by the following criteria.

- The average of all sample units in the lot must meet the minimum; and
- There should be no unreasonable shortage in any individual container.

Determination of "Unreasonable Shortage"

Unless specifically covered by an inspector's instruction or a U.S. standard, the following administrative guide applies to all canned fruit and vegetable products. The drained weight of no container may be as follows, whichever is the lesser drained weight.

- Less than 45% of the container's water capacity, or
- More than the weight of one average size unit of product below the recommended or required minimum.

Averaging Drained Weights of Codes within a Lot

Drained weight averages for individual codes, shifts, or portions of shifts in a lot may be less than the required minimum average but may not be unreasonably low. Averages failing the criteria below are considered unreasonably low.

Limits for low average drained weights:

- No. 2 ½ can size and smaller:

  95% of the minimum requirement or 0.5 ounces low, whichever is the lesser weight.

- Containers larger than No. 2 ½ can size:

  97% of minimum requirement or 1.0 ounce low, whichever is the lesser weight.

Procedures for Frozen Products In-Plant or Lot Inspection

Drained weight is not taken routinely on frozen food. However, it may be determined upon request of the applicant, and it should be taken where there is evidence that the product may contain excessive ice.

- Retail Packages

  After obtaining gross weights, allow containers to thaw at room temperature (approximately 70 °F), or immerse the packages in water circulated and maintained at 68 °F ± 1 °. If packages are not watertight, place in a suitable plastic bag, remove as much excess air as possible and tie off. Avoid agitation of packages during thawing by using clamps or weights if necessary. When the center of package reaches approximately 30 °F, remove from bath, blot off adhering water, and open with minimum agitation.

  Tare a No. 8 mesh sieve. Use an 8-inch diameter sieve if the container holds 16 ounces or less, and a 12-inch sieve if more than 16 ounces. With the screen tilted about 2 ½ inches and supported for drainage, distribute the contents of the package evenly over the screen in one sweeping motion. Drain for exactly two minutes, reversing the tilt of the screen after one minute.

- Bulk Containers (Principally Fruit)

  After obtaining gross weights, allow the unopened containers to thaw at room temperature (approximately 70 °F) until the product temperature in the center of the container is approximately 30 °F, but not over 40 °F.

  Divide the thawed samples into four or more portions with each increment not to exceed 8 pounds and drain two minutes on a tilted 12-inch No. 8 mesh sieve, reversing the tilt of the screen after one minute. The combined weight of the four or more portions is the drained weight of the product.

- In-line Control

1. Sampling

   Subgroups of 3 may be taken every 30 minutes to provide a good in-line control on fill. The subgroups are drawn prior to freezing at a point where no further change in the net weight is likely to occur.

2. Tare

   Tare weights should be determined as outlined in the General Processed Procedures Manual.

3. Net Weights

   Net weights should be determined as outlined in the General Processed Procedures Manual. Immediately after the subgroup has been drawn, determine the net weight of each of the 3 sample units. They may be recorded on a $\bar{X}$ Data Sheet similar to the example of a statistical weight log.

4. Drained Weights

   Drained weights should be determined as outlined in the General Processed Procedures Manual. The subgroup average of the net weights minus the subgroup average of the drained weights is the subgroup average of the weight of water.

5. Calculations

   All calculations are to be made to the nearest 0.1 ounce. Calculate $\bar{X}$ (subgroup average) separately for the net weights and drained weights. These values may be recorded on the $\bar{X}$ Data Sheet opposite $\bar{X}$.

   Determine $\bar{X}$ for the weight of water for each subgroup by subtracting the drained weight subgroup average from the net weight subgroup average. This value may also be recorded on the $\bar{X}$ Data Sheet opposite $\bar{X}$ (weight of water).

   At the end of each shift or production day run, calculate $\bar{X}$ for drained weights and $\bar{X}$ for weight of water by adding the approximate $\bar{X}$ values and dividing by the number of $\bar{X}$ values. If using the $\bar{X}$ Data Sheet, record these $\bar{X}$ values in the upper right-hand corner of the sheet.

6. Plotting

   The $\bar{X}$ values (individual drained weight values) and the $\bar{X}$ values for drained weights representing each subgroup are plotted on the upper portion of a control

chart. The $\bar{X}$ values for the weight of water are plotted on the lower portion of the control chart.

7. Limits

Warning limits and reject limits will vary with the product.

8. Limitations

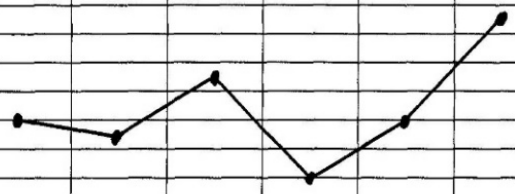
These instructions will not apply to products for which special procedures have been developed.

Example of a Statistical Weight Log:

MATTHEW'S CANNING COMPANY
STATISTICAL WEIGHT LOG

DATE: April 17, 2010 **PRODUCT:** FCOJ **CAN SIZE:** 24/12 oz **INSPECTORS:** A. Simmons A. Simmons

CODE			ABC 12A	→	→	→	ABC 12B	→				
BRAND			Jared's Juice	→	→	→	→	→				
TIME			0630	0712	0739	0801	0847	0910				
1			12.04	12.00	12.05	12.00	12.01	12.09				
2			12.00	12.00	12.04	11.98	12.00	12.07				
3			11.96	11.98	12.00	11.90	11.98	12.06				
			36.00	35.98	36.09	35.88	35.99	36.18				
$\overline{X}$			12.00	11.99	12.03	11.96	12.00	12.07				
			.00/1	-.01/2	.02/3	-.02/4	-.02/5	.05/5	Avg.=	12.01		
R			.08	.02	.05	.10	.03	.03				
SIZE												
32 oz	(12 oz)	6 oz										
.21	.14	.07										
.18	.12	.06										
.15	.10	.05										
.12	.08	.04										
.09	.06	.03										
.05	.04	.02										
.03	.02	.01										
.00	.00	.00										
.97	.98	.99										
.94	.96	.98										
.91	.94	.97										
.88	.92	.96										
.85	.90	.95										
.82	.88	.94										
.79	.86	.93										
.76	.84	.92										
.73	.82	.91										



1. Fill in heading, code, brand and time.
2. Record fills putting highest on line #1 and lowest on line #3
3. "T" = Total of all three fill weights
4. "X" = Average fill weight
5. Box with diagonal line (/)
   Top = running accumulative of avg. fill
   Bottom = Consecutive number of subgroup sample sets
6. "R" = Range between highest and lowest fill
7. Plot average fill on graph using appropriate can size column
8. Start new graph only when can size is changed and at start of new production date.
9. Average fill is determined by dividing the running accumulation by the number of subgroup samples

Fill of Container

Despite label statements concerning the weight or volume of a product in a container, purchasers may be misled as to the amount of the commodity they are buying. The Food and Drug Administration (FDA) requires that food containers be filled as full as is practical without impairment of quality. 21 U.S.C. 343 states that "A food shall be deemed to be misbranded if its container is so made, formed, or filled as to be misleading."

There is no single criterion that can be generally applied to all processed food products in determining proper fill. Factors which either singly or in combination may indicate improperly filled containers include:

- Low net weight or contents.
- Excessive headspace.
- Low drained weight.
- Insufficient packing medium.
- Insufficient fruit or vegetable ingredient in relation to packing medium.
- Container size considerably larger than actual contents of product therein.

Criteria for Determining "Fill of Container"

Consideration must be given to certain mandatory requirements by FDA, or fill recommendations included in U.S. standards in certifying the "fill of container" for products as outlined below:

- FDA Mandatory Requirements

  Legal standards for "Fill of Container" have been published by the FDA for the following specific processed food products:

Products with FDA Legal Standards for "Fill of Container" *				
Canned Applesauce	Canned Cream-Style Corn	Canned Grapefruit	Canned Pears	Canned Tomatoes
Canned Apricots	Canned Crushed Pineapple	Canned Mushrooms	Canned Peas	Canned Ripe Olives
Canned Cherries	Canned Fruit Cocktail	Canned Peaches	Canned Pineapple Juice	

* Note that this list is not to be considered all inclusive, and other products may be added from time to time.

  The criteria and method of determining compliance with these "fill of container" requirements vary for each product. Please review the following examples:

- Containers filled as full as practicable without impairment of quality.

  Examples: Canned Apricots, Canned Cherries, Canned Peaches, Canned Pears

- Total weight of drained fruit (or vegetables) not less than a required percentage of the water capacity of the container.

  Examples: Canned Fruit Cocktail, Canned Grapefruit, Canned Mushrooms, Canned Ripe Olives

- When removed from the container and returned in a specified manner, the vegetable ingredient completely fills the container.

  Example: Canned Peas

- A fill of not less than 90% of the total capacity of the container.

  Examples: Applesauce, Cream-Style Corn, Crushed Pineapple, Pineapple Juice, and Canned Tomatoes. 1/

  1/ In glass with a capacity of 6 ½ fluid ounces or less, the fill is not less than 85%.

- Deceptive Fill

All products not specifically covered by a "standard of fill" must comply with the requirements of 21 CFR § 100.100 Misleading containers with respect to deceptive fill. In other words, the containers must be filled to the extent that the consumer is not deceived by the size of the primary container in relation to the actual amount of product.

The following examples illustrate deceptive fill:

- Actual contents considerably less than the capacity of the container.

  Examples: Potato Flakes in which substantially less than 90% of the capacity of the container consists of product, or

  Frozen Spinach in which the capacity of the carton is substantially greater than the volume of spinach in the carton.

- Noticeable deficiency of fruit and vegetable ingredient in relation to total contents of container (including packing medium).

  Example: Canned Blackberries in which the drained weight of berries is extremely low (less than 50% of the water capacity of the can) even though the can is well filled with berries and packing medium.

- Recommendations or Requirements of U.S. Standards for Grades
  - Canned Fruit and Vegetables
    - FDA Standards of Fill for specific commodities becomes a requirement of the U.S. standards.

      Example: Those commodities listed in the table for which the FDA has published "Standards of Fill."

    - In some cases, the U.S. standards recommend:
      - "Fill of not less than 90 percent of the capacity of container."

      Example: Canned Applesauce, Canned Beets.

      - "As full as practical without impairment of quality."
    - If not specifically mentioned in the U.S. standards, fill of container must meet 21 CFR § 100.100 Misleading containers.
  - Frozen Fruit and Vegetables and Miscellaneous Products (Other Than Canned).
    - Currently there are no FDA "Standards of Fill" for specific frozen fruit, vegetables, or for certain canned fruit and vegetables.
    - The U.S. Standards for Grades do not include recommended fill of container for all commodities. However, Division policy requires that all products comply with the FD&C Act with respect to deceptive fill.
      - Recommendation in U.S. grade standard.

        Example: Frozen Concentrated Sweetened Grape Juice - "as full as practical without impairment of quality."

      - No recommendation in U.S. grade standard.

        Examples: Frozen Spinach, Frozen Cauliflower, Frozen Berries, and most frozen products - proper fill implied by the mandatory requirements of the FD&C Act with respect to deceptive fill.

- Guide for Good Commercial Practice

  Because "fill of container" is so closely associated with other factors such as net weight, drained weight, and headspace, any administrative guides applicable to these factors must

also be considered in dealing with fill of container. Inspectors should observe the following procedure to determine reasonable deviation within the limits of good commercial practice:

- If the product is fluid or homogenous in nature (juice, puree, jams, and jellies) and headspace measurements are an index of properly filled containers, allow the same number of containers to exceed headspace requirements as are allowed for deviations in quality per sampling plans contained in the regulations. No limit is being suggested as to what extent individual samples may exceed maximum headspace measurements, since extreme deviations will be reflected in net weight or content determinations.

- Frozen Fruit and Vegetables. Sufficient data has not been accumulated to finalize a guide for good commercial practice. However, if the product does not occupy at least 50% of the capacity of the container, the certificate should reflect this.

  The percent fill of a container is determined by the following calculation:

  $$\left(\frac{\text{Volume of product in container}}{\text{Total capacity of container}}\right) \text{ x } 100 = \% \text{ Fill}$$

  Example: Frozen Spinach - capacity of carton 125 cubic inches
  Volume of Spinach, by displacement, 60 cubic inches.

  $$\left(\frac{60}{125}\right) \text{ x } 100 = 48\% \text{ Fill}$$

  In this instance, the container is not well filled, and the grade statement should be properly flagged to direct attention to the "Fill of Container" in the body of the certificate (see the Certification Manual).

  If the product occupies more than 50% but less than 75% of the container capacity, the fill would be questionable and should be reported in the body of the certificate, but the grade statement would not be flagged.

Net Weight

Fresh Products

Refer to the Net Weight section of the General Market Manual for guidelines and procedures for determining net weight of fresh products.

Processed Products

Processed foods are commonly packed to meet a prescribed net weight or content and labeled accordingly. This net weight or content may be specified in a purchase specification or contract.

In the case of canned foods, if the containers are unlabeled and the required net weight or content is not stipulated in the purchase specification or contract, be guided by statements on labels customarily used for the commodity and container size.

Various guidelines have been developed for net weight and other measures of content. However, no specific reference is usually made to samples that contain an excessive quantity of product. Overfill may be undesirable for its effect upon vacuum, adequate sterilization of product under normal processing times and temperatures, or possible strain on container during retorting or processing. The Division is not in position to recommend maximum filling guides, but inspectors should review specifications with an eye for any specifications concerning overfill and underfill.

Net weights are not a factor of grade. However, compliance with the required net weight or volume is very important from an economic and regulatory viewpoint. The packer or other person responsible for shipping a product in interstate commerce is responsible for the accuracy and completeness of labels. Some buyers refuse to accept deliveries of processed products which contain more than a small percentage of short weight or short volume containers.

To avoid being considered mislabeled in accordance with the provisions of 21 U.S.C. 343, a packaged food is subject to the following statements.

"A food shall be deemed to be misbranded if it bears a label containing (1) the name and place of business of the manufacturer, packer, or distributor; and (2) an accurate statement of the quantity of the contents in terms of weight, measure, or numerical count, except that under clause (2) of this paragraph reasonable variations shall be permitted, and exemptions as to small packages shall be established, by regulations prescribed by the Secretary."

Guide for Good Commercial Practice

A lot will be considered to comply with requirements of "good commercial practices" with respect to average net weight or other measure of contents under the following conditions:

- The average of all containers meets the declared required or recommended minimum; and
- No container may be less than the tolerance specified in the following applicable groups:
    - Canned and Frozen Fruit and Vegetables
        - Containers of 10 ounces or less: 10% or 0.5 ounce, whichever is less.
        - Containers over 10 ounces up to 50 ounces: 5% or 1 ounce, whichever is less.
        - Containers over 50 ounces: 2% or 2 ounces, whichever is less.

        Example: 10 ounce frozen vegetable carton

The sample average must be at least 10.0 ounces.

No container in the sample may weigh less than 9.5 ounces. The 0.5 ounce allowance is less than 10% of 10 ounces (1.0 ounce).

- Canned and Frozen Concentrated Fruit or Vegetable Products

  - Containers of 8 ounces or less: 5% or 0.2 ounce, whichever is less.
  - Containers over 8 ounces up to 50 ounces: 2% or 0.5 ounces, whichever is less.
  - Containers over 50 ounces: 2% or 1.5 ounces, whichever is less.

  Example: Tomato paste in No. 10 cans, declared net weight 112 ounces

  The sample average must be at least 112 ounces.

  No container may weigh less than 110.5 ounces. The 1.5 ounces allowance is less than 2% of 112 ounces (2.24 ounces).

- Miscellaneous Processed Products

  Such as Jams and Jellies, Peanut Butter, Spices, Flavoring Extracts, and Similar Products

  - Containers of 8 ounces or less: 10% or 0.3 ounces, whichever is less.
  - Containers over 8 ounces up to 50 ounces: 5% or 0.8 ounces, whichever is less.
  - Containers over 50 ounces: 2% or 1.5 ounces, whichever is less.

  Example: Fruit jelly in 12 ounce jars

  The sample average must be at least 12.0 ounces.

  No container in the sample may weigh less than 11.4 ounces. 5% of 12 ounces (0.6 ounces) is less than the 0.8 ounce allowance.

In applying the guides, consider the allowance relative to sample size. Obviously, the tolerance of a "defective" or low net weight sample unit in a sample size of 6 is not the same as a "defective" in a sample size of 29. Consideration should be given to permitting an infrequent container to deviate beyond the range of good commercial practice. At the applicant's request, you may check additional samples from the lot and allow low net weights at a rate of 1 in 48.

Vacuum Readings

The term "vacuum," as used in the canning industry represents the difference between atmospheric pressure and lower pressure existing in a closed container. Atmospheric pressure decreases with an increase in altitude at the rate of approximately 1 inch of mercury for each 1,000 feet. Consequently, a container having a reading of 7 inches of mercury at sea level would have only 2 inches of mercury in Denver (elevation 5,000 feet). Although pressure may be recorded using different units of measure, one of the most common units of measure for vacuum gauges is inches of mercury. This refers to the height of a column of mercury in a U-Shaped tube (manometer) that may be supported by that pressure.

Temperature also affects vacuum readings. There is a relationship between the temperature at which the container is closed and sealed, and the vacuum of the container after processing and cooling. There is also a relationship between the vacuum readings of sealed containers at various temperatures. Studies have shown that the vacuum decrease is approximately 1 inch of mercury for each 5 °C increase in temperature. Thus, a container having a vacuum of 5 inches of mercury at 20 °C would have zero (0) at 45 °C. Prolonged storage at higher temperatures of such merchandise could result in "flippers" or "swells."

Although there are several methods by which "vacuum" may be measured in canned food products, the conventional method of using a mechanical gauge calibrated against a mercury volume has been adopted by the Division. As discussed here, vacuum readings refer to those readings as determined by a conventional vacuum gauge and are expressed in inches.

Cans should be at approximately room temperature before vacuums are taken. The correct technique for taking a vacuum reading is to force the tip of the vacuum gauge into the can at a high spot near the closing machine seam. This high spot is selected to minimize the chance of the gauge tip entering the product, plugging the gauge, and obstructing a vacuum reading. Take care not to bang the gauge, which may dull the tip and damage the gauge. There may be some slight variation to the technique for specific products or can sizes; in these cases, follow the direction of your supervisor.

Vacuum is not a factor of grade but may be a requirement of a purchase specification or contract. Inspectors must be aware of specific vacuum requirements in such orders.

The general requirement "packed in accordance with good commercial practice" which appears in most government specifications is interpreted as requiring vacuum on those products that are customarily packed to have a vacuum. The amount of vacuum in a can depends on many factors – product, container size, the particular process, temperature, and altitude. No attempt should be made to evaluate the readings except as directed in this instruction, or inspector's instructions for a specific commodity.

<u>Guide for Good Commercial Practice</u>

Consideration must be given to the type of product, type of container, special contractual requirements, and existing commercial practices.

- Containers with screw cap closures or friction type lids may not be designed to maintain vacuums. Consequently, zero vacuum reading in such containers may be considered acceptable under good commercial practices.

- Zero vacuum readings are considered less serious in products of the acid group (pH of 4.5 or less) than for those in the non-acid group (pH more than 4.5).

Acid Group	Non-Acid Group
Apples	Asparagus
Apricots	Beets
Berries	Black-eyed and Field Peas
Cherries	Canned Dried Beans
Citrus Products	Carrots
Peaches	Corn
Pears	Green and Wax Beans
Pickles	Hominy
Plums	Lima Beans
Prunes	Okra
Sauerkraut	Peas
Tomatoes	Pimientos

  - Zero vacuum readings in containers which normally have a vacuum are recorded and certified according to the Certification Manual. If a contract or specification includes specific minimum acceptance levels for vacuum readings, these requirements must be taken into consideration when certifying the lot.

  - In the absence of a contractual or program requirement for zero vacuums, inspectors will be guided by the following for both commercial and government contracts.

    - Acid group

      Allow 10% of the sample units to have zero vacuum readings before flagging the inspection certificate.

    - Non-acid group

      Allow only those samples units to have zero vacuum readings as can be considered infrequent (1 in 48).

Vacuum Requirements

If a specification or contractual document does not specify or designate a vacuum in terms of a measurable determination but simply states that the cans must have a vacuum, any vacuum reading above zero is considered to meet these requirements. Unless the needle is influenced by a disturbance such as jarring, any movement of the vacuum gauge needle above zero is

considered evidence of a vacuum and therefore complies with the requirements.

Where the specification or contractual document specifies a minimum vacuum, the permitted number of sample units that fail the requirement will be as indicated in Operational Rations Section instructions in the Inspections for Operational Rations Purchased by the Department of Defense Manual for DoD deliveries, and in the Sampling Manual for all other inspections.

When the vacuum indicates a vacuum of between 0 and 1 inch, record the vacuum as 1 inch on the score or tally sheet. Any other fractional vacuum reading above 1 inch will be rounded down and the vacuum recorded as a whole number. For example, a reading of 4 ½ inches on the vacuum gauge will be recorded as 4 inches.

MACROANALYTICAL PROCEDURES

"Macroscopic" analysis of a product refers to an evaluation of the substance using a person's unaided senses, primarily sight, smell, or taste. Probably every consumer in our society conducts some form of macroscopic examination to check for defects when purchasing or using foods and other consumer goods. The examination may range from a cursory or even unconscious visual check of the product to confirm that everything "looks right" to a much more detailed scrutiny to check for specific defects. A typical example of consumer macroscopic examination would be the shopper seen squeezing and sniffing the produce prior to purchasing.

In fulfilling responsibilities for protecting the public health and safety, regulatory authorities conduct more systematic examinations to detect both apparent and hidden defects. Over the years, standardized methods of macroscopic examination have evolved for determining filth, decomposition, and foreign matter in foods, drugs, and cosmetics and other products subject to the laws enforced by the U.S. Food and Drug Administration (FDA). These methods of analysis have evolved with the input of producers and consumers as well as regulatory authorities.

The FDA Macroanalytical Procedures Manual is available at the following website:
https://www.fda.gov/food/laboratory-methods-food/macroanalytical-procedures-manual-mpm

For inspectors without internet access, please contact your supervisor for a copy of this manual.

SALT DETERMINATION

This section is intended for use by inspectors and focuses on procedures for determining salt content in food products. Slight deviations in preparatory procedures are sometimes necessary for a particular commodity; be guided by the grading manuals for the product as needed.

SAFETY WARNING: Silver Nitrate ($AgNO_3$) solutions are used in titrations for salt determination. Dilute (0.1 N) $AgNO_3$ is not corrosive (although it will discolor the skin on contact), however, it may be necessary to work with concentrated or crystalline $AgNO_3$ to prepare the reagent. Both forms are extremely caustic and must be handled with great care. Wear protective clothing, eye wear, and gloves so that it cannot contact your skin or eyes. Work only in an adequately ventilated room, or under a ventilation hood to avoid vapor inhalation. If you accidentally come in direct contact with either form of $AgNO_3$, immediately wash the area

with running water for several minutes.

Be equally cautious when handling concentrated Nitric Acid. If it should contact your skin, quickly cover the area with large amounts of sodium bicarbonate or wash with running water.

See the Sanitation Manual and Safety Manual for more information concerning the safe handling of corrosive chemicals. See also the Safety Data Sheets (SDS) for these chemicals.

Glassware and Equipment

$AgNO_3$ solution will cause staining with a dark residue that is extremely difficult to remove from glassware. Wash flasks and beakers immediately after each titration or use. It is not practical to wash a burette after each test or between a series of titrations; however, a thorough washing at the end of each day will help to keep staining to a minimum.

Terminology

"Salt" as used in this instruction and in most food standards means "common salt" or sodium chloride (NaCl). It is also customarily referred to as "table salt" although table salt generally contains a few additives and is not chemically pure.

In this instruction, the total chloride content (i.e., that which occurs naturally, plus any added by the processor) is determined and results are expressed in terms of sodium chloride. These results frequently include several other chloride salts such as potassium chloride and calcium chloride. However, these other salts are usually present in extremely small quantities and are considered insignificant.

Methodology and Reagents

The most common methods for determining the salt content of food products involve titration, either with a visual indicator or by potentiometer. These methods include:

- Visual Indicator Method
    - Mohr method
    - Volhard method
- Potentiometer (pH Meter) Method
- Conductivity (Salt Meter Method)

For visual indicator and potentiometer (pH Meter) methods, the reaction depends upon precipitation of all the chloride as AgCl and detecting the end point either by a color change or observation of electromotive force (meter reading).

Whichever method is used, the preparation and standardization of reagents is very important.

Most reagents can be purchased premixed and standardized in the concentrations needed for these reactions. It is preferred that standardized solutions be purchased and used for these tests, when possible. Note and adhere to "use by" or expiration dates for these solutions.

Mohr Method Reagents

- **Calcium Carbonate ($CaCO_3$):** Should be finely ground, reagent grade.

- **Potassium Chromate Indicator (K_2CrO_4):** Dissolve 5 grams of K_2CrO_4 in a volumetric flask with distilled water and make up to 100 m1.

- **Silver Nitrate ($AgNO_3$):** Because $AgNO_3$ is unstable in the presence of light, it should be kept in a dark brown glass container and stored in a cool, dark place. As with all reagents, once a portion of the $AgNO_3$ has been transferred to another container, unused quantities must not be returned to the master container because of the possibility of adulteration. $AgNO_3$ tends to weaken with time, so its normality should be checked against a known saline solution before use.

  The $AgNO_3$ will need to be prepared and standardized.

  - Preparation of $AgNO_3$

    Wear protective clothing and eye wear. Dissolve 16.99 grams of reagent grade $AgNO_3$ in distilled water and to make exactly 1 liter of solution. This should result in a solution that is very slightly stronger than 0.1N. Any opalescence in the final solution is due to traces of a chloride or to unclean glassware.

  - Standardization of $AgNO_3$

    Measure out exactly 5.845 grams of reagent grade NaC1. Add enough distilled water to make exactly 1000 ml of solution in a volumetric flask. This will produce a salt solution of exactly 0.1N. Take a measured amount of the salt solution (25 to 40 ml), add potassium chromate indicator, and titrate to the end point.

    The addition of calcium carbonate is not strictly necessary but may make the end point easier to see. For those not familiar with the proper end point, a representative example can be helpful. Prepare by placing 40-50 ml of distilled water in a flask. Add 2 ml of potassium chromate indicator and 0.5 grams calcium carbonate. To this solution, add 1 drop of 0.1N $AgNO_3$ solution. A slight yellow-orange color should develop, representing the proper silver-chromate end point.

Calculate normality of the $AgNO_3$ solution by the formula $V_1N_1 = V_2N_2$

- V_1 = Volume of NaCl solution
- N_1 = Normality of NaCl solution
- V_2 = Volume of $AgNO_3$ solution used
- N_2 = Normality of $AgNO_3$ solution

Example: 35.0 ml standard (exactly 0.1N) NaC1 solution requires 34.2 ml $AgNO_3$ solution to reach the end point. Using the formula above:

$(35.0)\ (0.10) = 34.2\ x$
$3.50 = 34.2\ x$
$0.1023 = x$

The normality of the $AgNO_3$ reagent is 0.1023.

To convert to equivalent 0.1 strength $AgNO_3$, (exactly 0.1N), multiply the actual titer by this factor; in the above example, the factor is 1.023.

Example: 40.21 ml 0.1023N $AgNO_3$ is used in the titration

(40.21) (1.023) = 41.13 ml equivalent 0.1 $AgNO_3$.

Volhard Method Reagents

- **Silver Nitrate ($AgNO_3$):** (see previous pages for preparation and standardization).
- **Ammonium Thiocyanate (NH_4CNS):** 0.1N – Adjust and standardize by titrating against 0.1 $AgNO_3$.

  This reagent forms a pale reddish-brown color in the presence of ferric alum indicator when a slight excess is added to a standard $AgNO_3$ solution acidified with nitric acid.

  The NH_4CNS solution will need to be prepared and standardized prior to use.

  - Preparation

    Dissolve 7.6 grams of reagent grade Ammonium Thiocyanate in about 500 ml distilled water. Transfer to 1000 ml flask and make up to 1000 ml.

  - Standardization

    To a 250 ml flask, add 40 ml 0.1 $AgNO_3$, 5 ml HNO_3 (1 + 1), and 2 ml ferric

alum indicator. Titrate with the NH_4CNS solution (about 40 ml) to pale rose or tinge of brown end point. Calculate the normality of the thiocyanate solution by the formula $V_1N_1 = V_2N_2$ as in the example under $AgNO_3$. The exact normality of the $AgNO_3$ solution must be known.

- **Nitric Acid (HNO_3)** (1 + 1): Prepare by combining equal volumes of concentrated HNO_3 and distilled water. ***As with all acids, add the acid to the water, not the water to the acid***. For safety, add the acid slowly.

- **Nitric Acid (HNO_3)** (2%): Prepare by combining concentrated HNO_3 and distilled water in the ratio of 3 ml HNO_3 per 197 ml water.

- **Ferric Ammonium Sulfate (Ferric Alum Indicator):** Saturated solution of $FeNH_4(SO_4)_2 \cdot 12\ H_2O$ (held in solution, ratio 1 $FeNH_4(SO_4)_2$ to 12 H_2O)

- **Filter Aid:** Celite or diatomaceous earth.

Visual Indicator Methods

Two visual indicator methods are available for determination of salt in foods.

Mohr Method

This determination is generally simpler and faster than the Volhard method. It's the official method for determining the salt content of most foods. It is particularly suited for products that are not highly colored which will not interfere with the visual end point.

A. Equipment and Reagents:

- Standard titration burette with stand
- Erlenmeyer flask
- Pipette, if results re to be expressed as grams per 100 ml
- Analytical Balance if results are to be expressed as percent by weight
- Distilled Water
- Silver Nitrate ($AgNO_3$), reagent grade of appropriate normality (generally, 0.1N)
- Calcium Carbonate ($CaCO_3$) for acid products
- Potassium Chromate (K_2CrO_4) indicator

B. Procedure

1. Fill a clean burette with 0.1N $AgNO_3$.

2. Put the prescribed amount of sample into the Erlenmeyer flask.

3. Dilute with about 25 ml distilled water to increase the volume of solution in the flask and allow for better agitation and easier end point detection.

4. Neutralize any naturally occurring acidity (such as in pickles and sauerkraut) by adding about 0.5 gram of powdered calcium carbonate ($CaCO_3$). This does not need to be weighed but can be estimated by using the tip of a spatula.

5. Add approximately 2 ml (4 to 5 drops) of Potassium Chromate indicator (K_2CrO_4).

6. Titrate with $AgNO_3$ to the characteristic yellow-orange end point of the chromate indicator.

C. Calculations

Determine, to the nearest one-tenth milliliter, the amount of $AgNO_3$ necessary to reach the end point. Calculate the salt content according to this formula:

$$S = \frac{T \times N \times 0.05845 \times 100}{V}$$

- S = Salt Content (in percent)
- T = ml $AgNO_3$ required to reach the end point
- N = Normality of the $AgNO_3$
- V = Sample size - either in ml or grams, depending upon the terms in which the results are expressed.
- 0.05845 = the factor necessary to convert the titration to NaC1 and represents the number of grams of NaC1 which will completely react with one ml of Normal $AgNO_3$.
- 100 = the factor necessary to convert the results into percent by weight or volume.

Example: 10 ml of pickle juice requires 41.7 ml of exactly 0.1N $AgNO_3$ to reach the proper end point. The percent salt is calculated as follows:

$$S = \frac{41.7 \times 0.10 \times 0.05845 \times 100}{10} = 2.44\%$$

Therefore, the salt content is 2.44 ml per 100 ml pickle juice.

If the size of sample and the normality of $AgNO_3$ remain constant, a handy mathematical shortcut may be used when many samples are to be tested. Pre-calculate the following portion of the formula:

$$\frac{N \times 0.05845 \times 100}{V}$$

Example: You have several samples of pickle juice to titrate for salt. You know from experience that 0.1N $AgNO_3$ used in conjunction with a sample size of 10 ml pickle juice provides a convenient working range with a 100 ml burette. You establish a constant as follows:

N = 0.1

V = 10 ml

$$\frac{0.1 \times 0.05845 \times 100}{10} = 0.05845 = \text{constant}$$

The constant factor is then multiplied by the amount of $AgNO_3$ used during each titration to obtain the amount of salt in each sample. Say the first sample required 28.1 ml 0.1N $AgNO_3$. The calculation is (28.1) (0.05845), or 1.65 grams per 100 ml of product. All subsequent samples would be calculated in the same manner, substituting the actual amount of $AgNO_3$ used to titrate each sample.

Volhard Method

This method is more complicated and time consuming than the Mohr method. However, the end point is easier to discern, especially in intensely colored products.

A. Equipment and Reagents

- Filter paper, Buchner funnel, and vacuum source
- Erlenmeyer flask
- 250 ml beaker
- Silver Nitrate ($AgNO_3$)
- Nitric Acid HNO_3 (1 + 1)
- Dilute Nitric Acid (HNO_3) (2%)
- Filtering aid, such as Celite or diatomaceous earth

- Ferric Ammonium Sulfate indicator ($FeNH_4(SO_4)_2 \cdot 12\ H_2O$)
- Ammonium Thiocyanate (NH_4CNS) of same normality as $AgNO_3$ used, preferably 0.1N

B. Procedure

1. Measure sample and place in Erlenmeyer flask.
2. Add 5 ml HNO_3 (1 + 1).
3. Add 50 ml distilled water and about ½ gram of filtering aid.
4. Add an excess of 0.1N $AgNO_3$ (usually 30-40 ml).
5. Stopper flask and shake vigorously.
6. Allow to stand for a few minutes.
7. Filter through rapid filter paper in Buchner funnel. Wash with dilute HNO_3 (2 %) and place filtrate in beaker.
8. Add 5 ml Ferric Alum indicator.
9. Titrate filtrate to a permanent, faint brownish tinge using standard 0.1N NH_4CNS.

C. Calculations

Subtract the amount of 0.1N NH_4CNS used in step 9 of the procedure from the amount of 0.1N $AgNO_3$ used in step 4 of the procedure. The remainder represents "T" in the mathematical formula described in the Mohr method. Use the same formula to calculate salt for the Volhard method of titration.

$$S = \frac{T\ x\ N\ x\ 0.05845\ x\ 100}{V}$$

Example: To a 10.0 gram sample of product, 40.0 ml 0.1N $AgNO_3$ is added. The filtrate requires 10.2 ml 0.1N NH_4CNS to reach the end point.

0.1N $AgNO_3$ in reaction = 40.0 - 10.2 = 29.8 = T

$$S = \frac{29.8 \text{ x } 0.10 \text{ x } 0.05845 \text{ x } 100}{10}$$

S = 1.74%

Potentiometer (pH Meter) Method

This method is superior to visual titration methods for products with characteristics that interfere with visually detecting the correct end point. For example, the intense red color of tomato products is likely to mask the yellow-orange end point of the potassium chromate.

A pH meter is primarily designed for measuring acidity or alkalinity, but it can be easily modified to determine salt content by using different types of electrodes. There are many makes and models in use. They may vary in the location of electrodes and controls, but the operating principle is the same. Consult the instrument's manual for specific operating instructions.

Equipment

- Magnetic Stirrer.
- pH meter with scale divisions of 10 millivolts or less. Range not less than – 700 to + 700 MV. A direct-reading model is preferable.
- Electrodes: Beckman Silver Billet Combination Electrode (Beckman Instruments Part No. 39187 or equivalent). Separate electrodes (Silver indicator electrode and Calomel reference electrode) for above meter are also satisfactory. The Combination Electrode is used without a silver chloride coating. Before using, clean electrode tip with scouring powder and rinse thoroughly with water to assure absence of a halide coating.
    - Electrode Attachment

      If using two electrodes, connect the calomel electrode to the proper terminal on the meter using a jack adapter. Only one terminal will accept the jack adapter. Connect the silver electrode to the other terminal on the meter.

Reagents

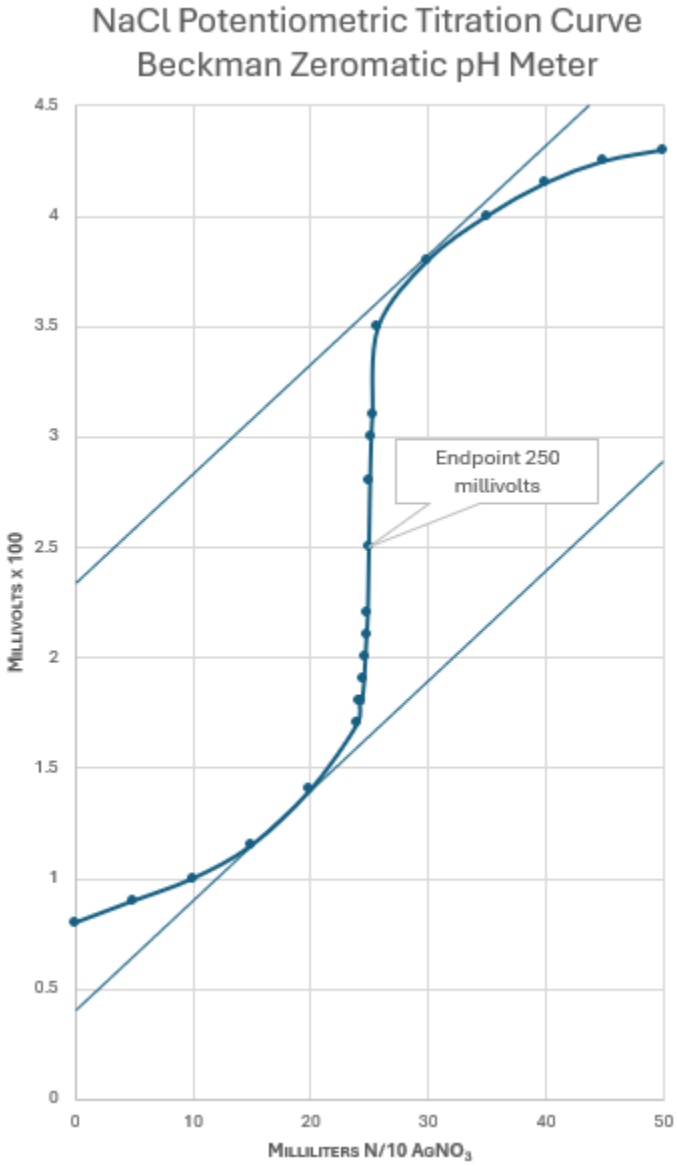
- Sodium chloride standard solution, 0.0856N
- Silver nitrate standard solution, approximately 0.0856N

Standardization

Pipette 25 ml of NaCl solution into a 250 ml beaker and dilute to approximately 100 ml with distilled water. Add 5.0 ml HNO_3 (1 + 4). Insert electrodes, start magnetic stirrer, and continue stirring vigorously throughout the titration. Titrate with $AgNO_3$ standard, adding increments small enough that the voltage end point and corresponding ml $AgNO_3$ added can be determined accurately from a plot of MV readings versus ml $AgNO_3$. Use a total of 50.0 ml $AgNO_3$ to obtain complete titration curve.

The end point is the inflection point of curve. Determine by drawing two straight lines with a

45° slope to the axes, and tangent to titration curve at the two points of greatest curvature. The inflection point is at the intersection with titration curve with a line drawn parallel to and midway between the other two lines (see below). From the volume of $AgNO_3$ used, calculate normality and adjust to 0.0856 N. Re-standardize occasionally.



Preparation of Sample

Either the solid portion or both the solid and liquid portions should be blended using a high-speed blender. If necessary, for the proper operation of the blender, add an equal weight of distilled water. Add 1 ml approximately 0.1N $AgNO_3$ and 5 ml HNO_3 (1 + 4) to 100 ml water. This should produce not more than a slight turbidity.

Determination

The voltage end point obtained on pure NaCl solution may be used as specified in this method. When extreme accuracy is required, the titration curve must be determined for each sample. Using NaCl standard as before, recheck endpoint potential occasionally, and redetermine when either the individual electrode, combination electrode, or pH meter is replaced.

The surfaces of the electrode must be thoroughly rinsed with distilled water and wiped dry after each determination (each test).

Samples containing <5.0% sodium chloride:

Weigh 5.00 ± 0.01 grams of prepared sample (10.00 ± 0.01 grams if equal weight of water is added in Preparation of Sample) in a 250 ml beaker. Dilute to approximately 100 ml with distilled water and add 5.00 ml HNO_3 (1 + 4). Stir to suspend all insoluble material and allow to stand at least 10 minutes for complete solution of chlorides. While stirring, titrate to endpoint established in "Standardization." If salt content is ≤1%, use a 10 ml burette to titrate.

$$\% \text{ NaCl} = \frac{\text{ml } 0.0856 \text{ N } AgNO_3}{10}$$

Samples containing > 5.0% sodium chloride:

Weigh 5.00 ± 0.01 grams of prepared sample (10.00 ± 0.01 grams if equal weight of water is added in Preparation of Sample). Transfer to a 100 ml volumetric flask and dilute to volume with distilled water. Mix and let stand at least 10 minutes. Mix the sample, allow settling, and transfer the aliquot containing 50-250 mg. NaCl to a 250 ml beaker. Dilute to approximately 100 ml with distilled water and add 5.00 ml HNO_3 (1 + 4). Stir to suspend all insoluble material and allow the sample to stand at least 10 minutes for complete solution of chlorides. While stirring, titrate to endpoint established in "Standardization."

- F = dilution factor = 100/ml aliquot titrated

$$\% \text{ NaCl} = \frac{\text{F x ml } 0.0856 \text{ N } AgNO_3}{10}$$

Conductivity (Salt Meter) Method

Another method of determining salt content is by use of a salt meter. A salt meter is an analytical device that can make a direct reading of the salt content of a product. Only instruments which have been approved by the Division can be used.

The current instruments approved are the DiCromat II or DiCromat IIA manufactured by:

Noramar Co.
P.O. Box 771
Chagrin Falls, OH 44022
Phone: 440-338-5740
Fax: 440-247-3879
Website: http://www.noramar.com

When using a salt meter, follow the manufacturer's instructions for instrument care, calibration, use, and sample preparation. Some products may require that the sample be diluted. Follow manufacturer's instructions for dilution of product prior to placing the sample into the salt meter. The salt meter should be calibrated for each product that will be routinely tested for salt content. A titration method suitable for the product that will be tested should be used to calibrate the salt meter. This should be done on one sample per lot being graded, or daily if more than one lot is graded.

The first sample for analysis will have the salt content determined by one of the titration methods. Once the salt content of the first sample has been determined, this product sample will be used to calibrate the salt meter in order to use the salt meter for the remaining samples from the lot, or lots graded daily.

REFERENCE LINKS **Version Date (Printed for distribution)**

☐ **7 CFR 43.101, 102, 103, 104, 105, and 106:** _____
https://www.ecfr.gov/cgi-bin/ECFR?page=browse

☐ **21 CFR 101.30, 102.33, 130.12:** _____
https://www.ecfr.gov/cgi-bin/ECFR?page=browse

☐ **Certification Manual:** _____
https://www.ams.usda.gov/publications/content/aim-certification-manual

☐ **FDA AMS MOU 225-19-031:** _____
https://www.fda.gov/about-fda/domestic-mous/mou-225-19-031

☐ **FDA Macroanalytical Procedures Manual:** _____
https://www.fda.gov/food/laboratory-methods-food/macroanalytical-procedures-manual-mpm

☐ **Form SC-637, Laboratory Sample Submittal Sheet:** _____
https://usdagcc.sharepoint.com/sites/ams/AMSFormsCatalog/Forms/AllItems.aspx

☐ **General Market Manual:** _____
https://www.ams.usda.gov/publications/content/general-market-manual

☐ **General Processed Procedures Manual:** _____
https://www.ams.usda.gov/publications/content/general-processed-procedures-manual

☐ **Sampling Manual:** _____
https://www.ams.usda.gov/publications/content/processed-products-sampling-manual

☐ **Sanitation Manual:** _____
https://www.ams.usda.gov/publications/content/aim-inspection-series-sanitation-manual

☐ **Section 403 of the Federal Food, Drug and Cosmetic Act (21 U.S.C. 343):** _____
https://www.govinfo.gov/content/pkg/USCODE-2023-title21/pdf/USCODE-2023-title21-chap9-subchapIV-sec343.pdf

Checked Materials have been printed from the links in this Manual and included for reference.

APPENDIX I – THERMOMETER CHECKS LOG

Electronic version of Appendix I – Thermometer Checks Log

THERMOMETER CHECKS LOG

ID # _____ DATE LAST SERVICE_____

DATE	THERMOMETER NUMBER	READINGS °C/°F	USDA INITIALS	COMMENTS AND ADJUSTMENTS

APPENDIX II – WEEKLY GRAM SCALE CHECKS LOG

Electronic version of Appendix II – Weekly Gram Scale Checks Log

WEEKLY GRAM SCALE CHECKS

Record to nearest 0.1 gram

ID # _____ DATE LAST SERVICE_____

DATE	VALUE READING WITH WEIGHT			USDA INITIALS	COMMENTS AND ADJUSTMENTS
	0 GRAMS	10 GRAMS	100 GRAMS		

APPENDIX III – WEEKLY OUNCE SCALE CHECKS LOG

Electronic version of Appendix III – Weekly Ounce Scale Checks Log

WEEKLY OUNCE SCALE CHECKS

Record to nearest 0.1 ounce

ID # _____ DATE LAST SERVICE_____

DATE	VALUE READING WITH WEIGHT			USDA	COMMENTS A[illegible] ADJU[illegible]MENTS
	0 OUNCES	10 OUNCES	80 OUNCES	INITIALS	

APPENDIX IV – REFRACTOMETER CHECKS LOG

Electronic version of Appendix IV – Refractometer Checks Log

WEEKLY *
DAILY **
RECORD BRIX OR REF INDEX OF FLUID ***

REFRACTOMETER CHECKS

ID # _____

DATE LAST SERVICE_____

____degree PRISM USED

DATE	TEMP ** OF WATER	DEGREES/REF INDEX FOUND			USDA INITIAL	COMMENTS AND ADJUSTMENTS
		WATER **	PRISM nD *	CALIBRATION FLUID ***		

APPENDIX V – DAILY PH METER CHECKS LOG

Electronic version of Appendix V – Daily pH Meter Checks Log

DAILY pH METER CHECKS

ID # _____ DATE LAST SERVICE_____

DATE	TIME	ELECTRODES FREE OF CRYSTALS?	pH 7 pH 4	pH 10 pH 7	USDA INITIALS	COMMENTS AND ADJUSTMENTS SLOPE

APPENDIX VI – ANALYTICAL GLASSWARE CHECKS LOG

Electronic version of Appendix VI – Analytical Glassware Checks Log

ANALYTICAL GLASSWARE CHECKS

ID # _____ DATE LAST SERVICED_____

DATE	GLASSWARE ID # *	mL	WEIGHT	N VALUE OR OTHER	USDA INITIALS	COMMENTS AND ADJUSTMENTS

* 1. BURETTE 4. CENTRIFUGE TUBE
2. PIPETTE 5. BEAKERS
3. COLOR TUBE 6. GRADUATED CYLINDER

APPENDIX VII – HYDROMETER CHECKS LOG

Electronic version of Appendix VII – Hydrometer Checks Log

HYDROMETER CHECKS

ID # _____ DATE LAST SERVICED _____

DATE	SERIAL NUMBER	READINGS ° BRIX		USDA INITIAL	COMMENTS AND ADJUSTMENTS
		Certified	Non-Certified		

APPENDIX VIII – SALOMETER CHECKS LOG

Electronic version of Appendix VIII – Salometer Checks Log

SALOMETER CHECKS

Type I Brine for Pea Maturity (percent NaCl by weight)
Type II Canned Ripe Olives (percent saturation, degrees salometer)

Serial Number or ID_____ **Date Placed in Service**_____

Date	Visual inspection for damage Meets/Fails	Verification method indicate a, b, c, d, or e a. Distilled water c. 13 % brine solution d. Olive brine e. Other (State type)	b. Reference standard Salometer serial # Final reading reference standard salometer	Temp °F	Temp corrected	Uncorr salometer reading	Final reading (grading salometer)	USDA Initials

APPENDIX IX – COLORIMETER CALIBRATION CHECKS LOG - HUNTER D45

Electronic version of Appendix IX – Colorimeter Calibration Checks Log - Hunter D45

COLORIMETER CALIBRATION CHECKS
HUNTER D45

ID # _____ DATE LAST SERVICE_____

DATE	SCALES	(+) OR (-) READINGS	USDA INITIALS	COMMENTS AND ADJUSTMENTS
	X			
	Y			
	Z			
	X			
	Y			
	Z			
	X			
	Y			
	Z			
	X			
	Y			
	Z			
	X			
	Y			
	Z			
	X			
	Y			
	Z			
	X			
	Y			
	Z			
	X			
	Y			
	Z			
	X			
	Y			
	Z			
	X			
	Y			
	Z			

APPENDIX X – COLORIMETER CALIBRATION CHECKS LOG - HUNTER D45D2

Electronic version of Appendix X – Colorimeter Calibration Checks Log - Hunter D45D2

COLORIMETER CALIBRATION CHECKS
HUNTER D45D2

ID # _____ DATE LAST SERVICE_____

DATE	SCALES	(+) OR (-) READINGS	USDA INITIALS	COMMENTS AND ADJUSTMENTS
	X			
	Y			
	Z			
	X			
	Y			
	Z			
	X			
	Y			
	Z			
	X			
	Y			
	Z			
	X			
	Y			
	Z			
	X			
	Y			
	Z			
	X			
	Y			
	Z			
	X			
	Y			
	Z			
	X			
	Y			
	Z			

APPENDIX XI – COLORIMETER CALIBRATION CHECKS LOG - MACBETH COLOR-EYE 3000, 3100, AND I5

Electronic version of Appendix XI – Colorimeter Calibration Checks Log - Macbeth Color-Eye 3000, 3100, and i5

COLORIMETER CALIBRATION CHECKS

MACBETH COLOR-EYE 3000, 3100 AND i5

ID # _____ DATE LAST SERVICED_____

DATE	TIME	CALIBRATED WITH WHITE TILE? Y, N	USDA INITIALS	COMMENTS AND ADJUSTMENTS

APPENDIX XII – OPTIONAL WORKSHEET FOR FRUIT-SUGAR RATIO.

Electronic version of Appendix XII – Optional Worksheet for Fruit-Sugar Ratio

Fruit – Sugar (F/S) Ratio Worksheet

Plant:_____ **Code:**_____

Instructions: Check Fruit – Sugar Ratio each time a sample unit is drawn as follows:

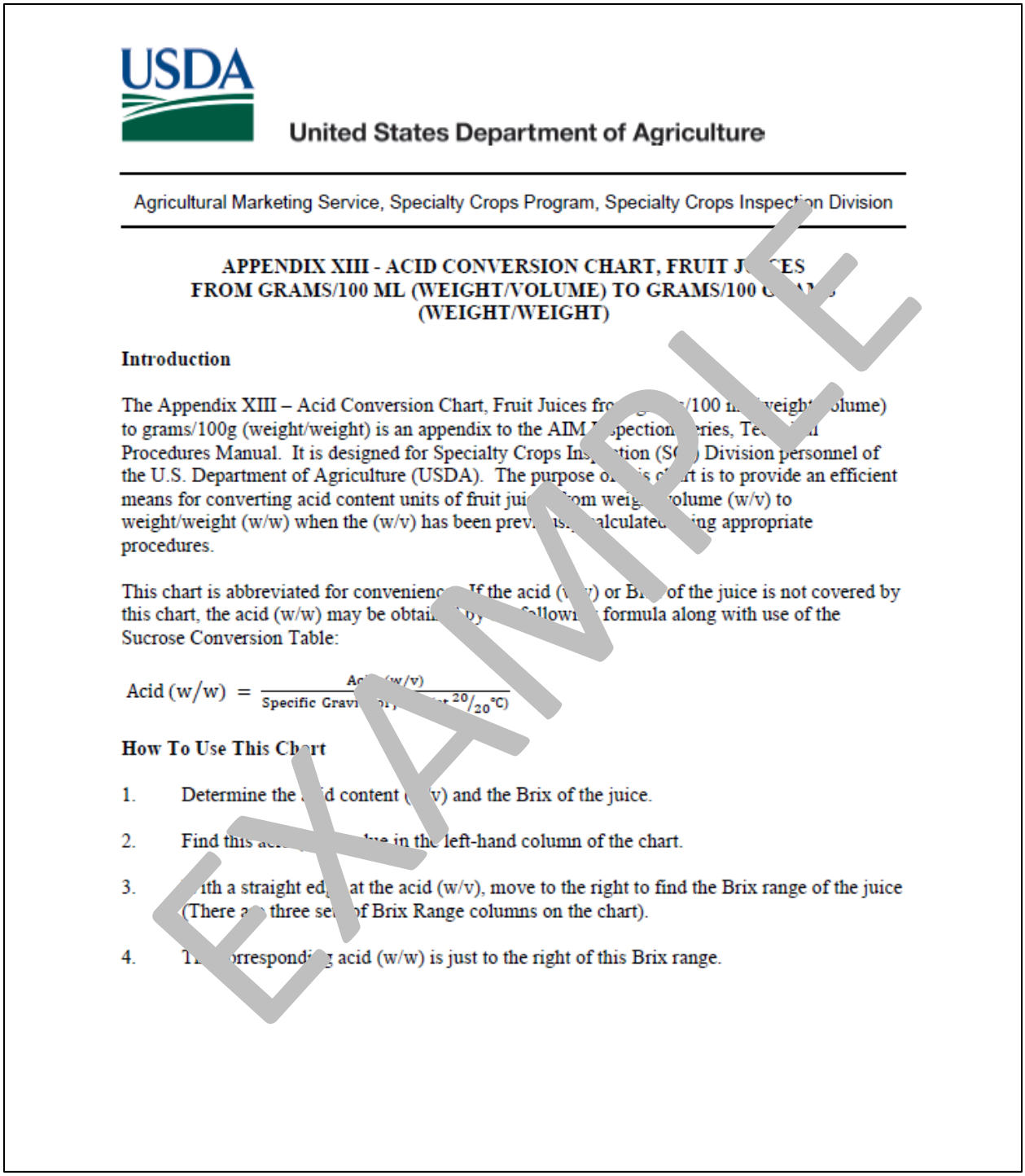
1. Tare scale for pail and lid.
2. Weigh **one** finished pail (net weight) and enter in **column 2.**
3. Weigh **one** pail with fruit only (with lid) and enter in **column 3**
4. Subtract the fruit (**column 3**) from the fruit and sugar (**column 2**) and enter in **column 4.**
5. Divide the fruit (**column 3**) by the sugar (**column 4**) and enter in **Column 5.**
6. Total all the ratios in **column 5** and divide by the number of ratios and enter the average in **column 6.**

To meet the requirements of a 5 + 1 ratio, the lot average must be between **4.** and **5.2.**
Target weights are in parentheses.

1 Time	2 Net Weight (30 LBS)	3 Fruit (25 LBS)	4 #2 minus #3 Sugar (5 LBS)	5 Fruit Sug Ratio	6 Running Average (4.8-5.2)	7 Remarks

APPENDIX XIII – ACID CONVERSION CHART – FRUIT JUICES, FROM GRAMS/100 ML (WEIGHT/VOLUME) TO GRAMS/100 GRAMS (WEIGHT/WEIGHT)

Electronic version of Appendix XIII – Acid Conversion Chart – Fruit Juices, from grams/100 ml (weight/volume) to grams/100 grams (weight/weight)



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Agricultural Marketing Service, Specialty Crops Program, Specialty Crops Inspection Division

APPENDIX XIII - ACID CONVERSION CHART, FRUIT JUICES FROM GRAMS/100 ML (WEIGHT/VOLUME) TO GRAMS/100 GRAMS (WEIGHT/WEIGHT)

Introduction

The Appendix XIII – Acid Conversion Chart, Fruit Juices from grams/100 ml (weight/volume) to grams/100g (weight/weight) is an appendix to the AIM Inspection Series, Technical Procedures Manual. It is designed for Specialty Crops Inspection (SCI) Division personnel of the U.S. Department of Agriculture (USDA). The purpose of this chart is to provide an efficient means for converting acid content units of fruit juices from weight/volume (w/v) to weight/weight (w/w) when the (w/v) has been previously calculated using appropriate procedures.

This chart is abbreviated for convenience. If the acid (w/v) or Brix of the juice is not covered by this chart, the acid (w/w) may be obtained by the following formula along with use of the Sucrose Conversion Table:

$$\text{Acid (w/w)} = \frac{\text{Acid (w/v)}}{\text{Specific Gravity at } {}^{20}/_{20}\text{°C}}$$

How To Use This Chart

1. Determine the acid content (w/v) and the Brix of the juice.
2. Find this acid value in the left-hand column of the chart.
3. With a straight edge at the acid (w/v), move to the right to find the Brix range of the juice (There are three sets of Brix Range columns on the chart).
4. The corresponding acid (w/w) is just to the right of this Brix range.

APPENDIX XIV – CITRIC ACID DETERMINATION CHART – CITRUS FRUIT JUICES FROM ML 0.3125 N NAOH USED IN TITRATING TO ACID GRAMS/100 GRAMS (WEIGHT/WEIGHT)

Electronic version of Appendix XIV – Citric Acid Determination Chart – Citrus Fruit Juices from ml 0.3125 N NaOH used in titrating to grams/100 grams (weight/weight)

United States Department of Agriculture

Agricultural Marketing Service, Specialty Crops Program, Specialty Crops Inspection Division

APPENDIX XIV – CITRIC ACID DETERMINATION CHART, CITRUS JUICES FROM ML 0.3125 N NAOH USED IN TITRATING TO ACID GRAMS/100 GRAMS (WEIGHT/WEIGHT)

Usage Requirements: 0.3125 N NaOH + 25 ml volume of juice + ml burette

Introduction

The Appendix XIV – Citric Acid Determination Chart, Citrus Juices from ml 0.3125 N NaOH used in titrating to grams/100 grams (weight/weight) is an appendix to the AIM Inspection Series, Technical Procedures Manual. It is designed for Specialty Crops Inspection (SCI) Division personnel of the U.S. Department of Agriculture (USDA). The purpose of this chart is to provide an efficient means for determining citric acid content grams/100 grams (weight/weight or w/w) from the amount of 0.3125 sodium hydroxide (NaOH) used during the titration process when 25 ml volume of citrus juice are used for sample size.

The charts are abbreviated for convenience. If ml and/or Brix of the juice is not covered by these charts, the acid (w/w) may be obtained by the following formula:

$$\text{Anhydrous citirc acid g/100 g} = \frac{\text{ml NaOH used x Normality (0.3125) x .064 x 100}}{\text{Specific gravity of juice (at } {}^{20}/_{20}\text{°C) x volume of sample (25ml)}}$$

How to Use This Chart

1. Determine ml of 0.3125 NaOH used in titration of the 25 ml sample.
2. Find this ml in left hand column of the chart.
3. With a straight edge at the ml NaOH, move right until you can find the Brix range of juice.
4. The corresponding citric acid w/w is just to the right of this Brix range.

ml of 0.3125 N NaOH	Brix	Acid w/w	Brix	Acid w/w	Brix	Acid w/w
6.0	7.0 - 8.1	0.47	8.2 - 13.5	0.46	13.6 - 18.0	0.45
6.2	7.0 - 11.0	0.48	11.1 - 16.2	0.47	16.3 - 18.0	0.46
6.4	7.0 - 8.6	0.50	8.7 - 13.7	0.49	13.8 - 18.0	0.48
6.6	7.0 - 11.3	0.51	11.4 - 16.2	0.50	16.3 - 18.0	0.49

APPENDIX XV – SUCROSE CONVERSION TABLE

Electronic version of Appendix XV – Sucrose Conversion Table

United States Department of Agriculture

Agricultural Marketing Service, Specialty Crops Program, Specialty Crops Inspection Division

APPENDIX XV – SUCROSE CONVERSION TABLE

Introduction

The Appendix XV – Sucrose Conversion Table is an appendix to the AM Inspection Se Technical Procedures Manual. It is designed for Specialty Crops Inspe n (SCI) Division personnel of the U.S. Department of Agriculture (USDA). The purpose o s chart is to provide the necessary data for personnel in an organized metho

Refractive Index at 20 Degrees C	Percent Sucrose or Degrees Brix	Apparent Specific Gravity @ 20/20 Deg	unds/ al. in 20 De es C	Pounds Solids per Gallon
1.3330	0.0	1.00000	8.3	0.000
1.3331	0.1	1.00039	8.325	0.008
1.3333	0.2	1.00078	328	0.017
1.3334	0.3	00117	8.331	0.025
1.3336	0.4	001	8.335	0.033
1.3337	0.5	0194	8.338	0.042
1.3339	0.6	1.00	8.341	0.050
1.3340	0.7	1.0027	8.344	0.059
1.3341	0.8	00312	8.348	0.067
1.3343	0.9	1.00	8.351	0.075
1.3344	1.0	1.00390	8.354	0.084
1.3346	.1	1.00429	8.357	0.092
1.3347	2	1.00468	8.361	0.100
1.3349		1.00507	8.364	0.109
1.335		1.00546	8.367	0.117
1.3 52	1	1.00585	8.370	0.126
353	1.(	1.00624	8.374	0.134
1.3	1.7	1.00663	8.377	0.142
1.335(	.8	1.00702	8.380	0.151
1.3357	1.9	1.00741	8.383	0.159
1.3359	2.0	1.00780	8.387	0.168
1.3360	2.1	1.00819	8.390	0.176
1.3362	2.2	1.00859	8.393	0.185
1.3363	2.3	1.00898	8.396	0.193
1.3365	2.4	1.00937	8.400	0.202

APPENDIX XVI – TEMPERATURE CORRECTIONS – REFRACTOMETERS WITHOUT AUTOMATIC TEMPERATURE CORRECTION

Electronic version of Appendix XVI – Temperature Corrections – Refractometers without Automatic Temperature Correction

United States Department of Agriculture

Agricultural Marketing Service, Specialty Crops Program, Specialty Crops Inspection Division

APPENDIX XVI – TEMPERATURE CORRECTIONS – REFRACTOMETERS WITHOUT AUTOMATIC TEMPERATURE CORRECTIONS

Introduction:

The Appendix XVI – Temperature Corrections for Refractometers Without Automatic Temperature Corrections is an appendix to the AIM Inspection Series, Technical Procedures Manual. It is designed for Specialty Crops Inspection (SCI) Division personnel of the U.S. Department of Agriculture (USDA). The purpose of this chart is to provide an efficient means for applying the temperature corrections required when using a refractometer without Automatic Temperature Corrections.

Temp. Degrees C.	Refractometer Degrees Brix										
	0	5	10	15	20	25	30	40	50	60	70
	Subtract from Refractometer Brix Reading										
10	.50	.54	.58	.61	.64	.66	.68	.72	.74	.76	.79
11	.46	.49	.53	.55	.58	.60	.62	.65	.67	.69	.71
12	.42	.45	.48	.50	.52	.54	.56	.58	.60	.61	.63
13	.37	.40	.42	.44	.46	.48	.49	.51	.53	.54	.55
14	.33	.35	.37	.39	.40	.41	.42	.44	.45	.46	.48
15	.27	.29	.31	.33	.34	.34	.35	.37	.38	.39	.40
16	.22	.24	.25	.26	.27	.28	.28	.30	.30	.31	.32
17	.17	.18	.19	.20	.21	.21	.21	.22	.23	.23	.24
18	.12	.13	.13	.14	.14	.14	.14	.15	.15	.16	.16
19	.06	.07	.07	.07	.07	.07	.07	.08	.08	.08	.08
	Add to Refractometer Brix Reading										
21	.06	.07	.07	.07	.07	.08	.08	.08	.08	.08	.08
22	.13	.13	.14	.14	.15	.15	.15	.15	.16	.16	.16
23	.19	.20	.21	.22	.22	.23	.23	.23	.24	.24	.24
24	.26	.27	.28	.29	.30	.30	.31	.31	.31	.32	.32
25	.33	.35	.36	.37	.38	.38	.39	.40	.40	.40	.40
26	.40	.42	.43	.44	.45	.46	.47	.48	.48	.48	.48
27	.48	.50	.52	.53	.54	.55	.55	.56	.56	.56	.56
28	.56	.57	.60	.61	.62	.63	.63	.64	.64	.64	.64
29	.64	.66	.68	.69	.71	.72	.72	.73	.73	.73	.73
30	.72	.74	.77	.78	.79	.80	.80	.81	.81	.81	.81

Note: Above chart is only for instruments standardized at 20 degrees C.

APPENDIX XVII – TEMPERATURE CORRECTIONS – 20 °C BRIX HYDROMETERS

Electronic version of Appendix XVII – Temperature Corrections – 20 °C Brix Hydrometers

United States Department of Agriculture

Agricultural Marketing Service, Specialty Crops Program, Specialty Crops Inspection Division

APPENDIX XVII – TEMPERATURE CORRECTIONS – 20 °C BRIX HYDROMETERS

Introduction:

The Appendix XVII – Temperature Corrections for 20 °C Brix Hydrometers is an appendix to the AIM Inspection Series, Technical Procedures Manual. It is designed for Specialty Crops Inspection (SCI) Division personnel of the U.S. Department of Agriculture (USDA). The purpose of this chart is to provide an efficient means for applying the temperature corrections required when using a Brix hydrometer calibrated to 20 °C.

Temp. Degrees C.	Hydrometer Degrees Brix														
	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70
	Subtract From Brix Hydrometer Reading														
0	.3	.5	.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.4	1.4	1.4	1.5	1.5
5	.4	.5	.6	.7	.8	.9	.9	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1
10	.3	.4	.4	.5	.5	.6	.6	.7	.7	.7	.7	.8	.8	.8	
11	.3	.4	.4	.4	.5	.5	.6	.6	.6	.6	.7	.7	.7	.7	.7
12	.3	.3	.4	.4	.4	.5	.5	.5	.5	.6	.6	.6	.6	.6	.6
13	.3	.3	.3	.4	.4	.4	.4	.5	.5	.5	.5	.5	.5	.5	.6
14	.2	.3	.3	.3	.3	.4	.4	.4	.4	.4	.4	.5	.5	.5	.5
15	.2	.2	.2	.3	.3	.3	.3	.3	.3	.4	.4	.4	.4	.4	.4
16	.2	.2	.2	.2	.2	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3
17	.1	.1	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2
18	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.2	.2	.2	.2	.2
19	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
	Add to Brix Hydrometer Reading														
	.0	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
	.1	.1	.1	.1	.1	.1	.1	.1	.2	.2	.2	.2	.2	.2	.2
23	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2
24	.2	.2	.2	.2	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3
25	.2	.2	.3	.3	.3	.3	.4	.4	.4	.4	.4	.4	.4	.4	.4
26	.3	.3	.4	.4	.4	.4	.4	.4	.5	.5	.5	.5	.5	.5	.5
27	.4	.4	.4	.4	.5	.5	.5	.5	.5	.5	.6	.6	.6	.6	.6
28	.5	.5	.5	.5	.5	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6
29	.5	.6	.6	.6	.6	.6	.7	.7	.7	.7	.7	.7	.7	.7	.7
30	.6	.6	.6	.7	.7	.7	.7	.8	.8	.8	.8	.8	.8	.8	.8
35	1.0	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
40	1.4	1.5	1.5	1.5	1.5	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7	1.7

APPENDIX XVIII – TEMPERATURE CORRECTIONS – 17.5 °C BRIX HYDROMETERS

Electronic version of Appendix XVIII – Temperature Corrections – 17.5 °C Brix Hydrometers

United States Department of Agriculture

Agricultural Marketing Service, Specialty Crops Program, Specialty Crops Inspection Division

APPENDIX XVIII – TEMPERATURE CORRECTIONS – 17.5 °C BRIX HYDROMETERS

Introduction:

The Appendix XVIII – Temperature Corrections for 17.5 °C Brix Hydrometers is an appendix to the AIM Inspection Series, Technical Procedures Manual and is designed for Specialty Crops Inspection (SCI) Division personnel of the U.S. Department of Agriculture (USDA). The purpose of this chart is to provide an efficient means for applying the temperature corrections required when using a Brix hydrometer calibrated at 17.5 °C.

How To Use This Chart:

1. Make the reading as close to 17.5 °C as possible and record the temperature.
2. Take reading from 17.5 °C Brix Hydrometer.
3. Look at chart for the temperature of product and its applicable correction and if you need to subtract or add the amount from the observed reading using the heading titles.

Temperature °C	Subtract from Brix
10.0	0.45
10.5	0.425
11.0	0.40
11.5	0.375
12.0	0.35
12.5	0.325
13.0	0.30
13.5	0.275
14.0	0.25
14.5	0.225
15.0	0.20
15.5	0.175
16.0	0.15
16.5	0.125
17.0	0.10
17.5	0.075
18.0	0.05
18.5	0.00

APPENDIX XIX – CITRUS FRUIT JUICES, ACID CORRECTIONS TO BRIX – REFRACTOMETERS

Electronic version of Appendix XIX – Citrus Fruit Juices, Acid Corrections to Brix – Refractometers

United States Department of Agriculture

Agricultural Marketing Service, Specialty Crops Program, Specialty Crop Inspection Division

APPENDIX XIX – CITRUS FRUIT JUICES, ACID CORRECTIONS TO BRIX REFRACTOMETERS

Introduction

The Appendix XIX – Citrus Fruit Juices, Acid Corrections to Brix Refractometers is an appendix to the AIM Inspection Series, Technical Procedures Manual. It is designed for Specialty Crops Inspection (SCI) Division personnel of the U.S. Department of Agriculture (USDA). The purpose of this chart is to provide sufficient instructions for correcting Brix readings obtained from refractometer readings when inspecting citrus fruit juices. These corrections are in addition to temperature corrections and the acid corrections shown below are added to the refractometer readings.

NOTE: These tables DO NOT apply to Frozen Concentrated Lemonde, Lemon Juice, Concentrated Lemon Juice for Manufacturing, or Pineapple Juice.

Single Strength Juices

Citric Acid, %	Add to Brix	Citric Acid, %	Add to Brix	Citric Acid, %	Add to Brix
0.50	0.11	0.68	0.14	0.86	0.18
0.51	0.11	0.69	0.14	0.87	0.18
0.52	0.11	0.70	0.15	0.88	0.18
0.53	0.11	0.71	0.15	0.89	0.18
0.54	0.12	0.72	0.15	0.90	0.19
0.55	0.12	0.73	0.15	0.91	0.19
0.56	0.12	0.74	0.15	0.92	0.19
0.57	0.12	0.75	0.16	0.93	0.19
0.58	0.12	0.76	0.16	0.94	0.19
0.59	0.13	0.77	0.16	0.95	0.19
0.60	0.13	0.78	0.16	0.96	0.20
0.61	0.13	0.79	0.16	0.97	0.20
0.62	0.13	0.80	0.17	0.98	0.20
0.63	0.13	0.81	0.17	0.99	0.20
0.64	0.14	0.82	0.17	1.00	0.20
0.65	0.14	0.83	0.17	1.01	0.21
0.66	0.14	0.84	0.17	1.02	0.21
0.67	0.14	0.85	0.18	1.03	0.21

APPENDIX XX – JUICE WEIGHT CONVERSION CHART – OUNCES TO FLUID OUNCES (AT 20 °C)

Electronic version of Appendix XX – Juice Weight Conversion Chart – Ounces to Fluid Ounces (at 20 °C)

United States Department of Agriculture

Agricultural Marketing Service, Specialty Crops Program, Specialty Crops Inspection Division

APPENDIX XX – JUICE WEIGHT CONVERSION CHART – OUNCES TO FLUID OUNCES (AT 20 °C)

Introduction

The Appendix XX – Juice Weight Conversion Chart – Ounces to Fluid Ounces (at 20 °C) is an appendix to the AIM Inspection Series, Technical Procedures Manual. It is designed for Specialty Crops Inspection (SCI) Division personnel of the U.S. Department of Agriculture (USDA). The purpose of this chart is to provide efficient means for converting net avoirdupois weight in ounces to fluid ounces (at 20 °C).

This chart is abbreviated for convenience and is based on the following formula:

$$\text{Fluid ounces (at 20 °C)} = \frac{\text{avoirdupois ounces} \times 1.04}{\text{Specific Gravity (at 20/20 °C)}}$$

How To Use This Chart

1. Determine the Brix value of the product.
2. Determine the net weight in ounces.
3. Locate the factor for the Brix value of the sample in the following charts.
4. Determine the fluid ounces as follows:

   Fluid ounces (at 20 °C) = Net Weight (in ounces) x Factor

Example

A 64 fluid ounce sized container of Bottled Orange Juice from Concentrate at 11.8° Brix weighs 70.1 ounces. Using the factor .091778 for 11.8° Brix in these charts we have:

70.1 ounces x .091778 = 64.3 fluid ounces (at 20 °C)

Brix	Factor	Brix	Factor	Brix	Factor	Brix	Factor
0.10	0.96103	0.30	0.96028	0.50	0.95954	0.70	0.95879
0.20	0.96065	0.40	0.95990	0.60	0.95917	0.80	0.95841

APPENDIX XXI – JUICE WEIGHT CONVERSION CHART – GRAMS TO FLUID OUNCES (AT 20 °C)

Electronic version of Appendix XXI – Juice Weight Conversion Chart – Grams to Fluid Ounces (at 20 °C)

United States Department of Agriculture

Agricultural Marketing Service, Specialty Crops Program, Specialty Crops Inspection Division

APPENDIX XXI – JUICE WEIGHT CONVERSION CHART GRAMS TO FLUID OUNCES (AT 20 °C)

Introduction

The Appendix XXI – Juice Weight Conversion Chart – Grams to Fluid Ounces (at 20 °C) is an appendix to the AIM Inspection Series, Technical Procedures Manual. It is designed for Specialty Crops Inspection (SCI) Division personnel of the U.S. Department of Agriculture (USDA). The purpose of this chart is to provide efficient means for converting net avoirdupois weight in grams to fluid ounces (at 20 °C).

This chart is abbreviated for convenience and is based off the following formula:

$$\text{Fluid ounces (at 20 °C)} = \frac{\text{Gram...}}{28.35 \times \text{Specific Gravity (...°C)}}$$

How To Use This Chart

1. Determine the Brix value of the product.
2. Determine the net weight in grams.
3. Locate the factor for the Brix value of the sample in the following charts.
4. Determine fluid ounces as follows:

   Fluid ounces (at 20 °C) = Net Weight (in grams) x Factor

Example:

A 4-ounce container of Frozen Concentrated Orange Juice at 41.9° Brix weighs 142.7 grams. Using the factor .02853 for 41.9° Brix in these charts we have:

142.7 grams x .02853 = 4.07 fluid ounces (at 20 °C)

Brix	Factor	Brix	Factor	Brix	Factor	Brix	Factor
0.10	.03390	0.30	.03387	0.50	.03385	0.70	.03382
0.20	.03389	0.40	.03386	0.60	.03383	0.80	.03381

APPENDIX XXII – VOLUMETRIC CORRECTION CHARTS FOR SINGLE STRENGTH CITRUS JUICES AT VARIOUS TEMPERATURES

Electronic version of Appendix XXII – Volumetric Correction Charts for Single Strength Citrus Juices at Various Temperatures

United States Department of Agriculture

Agricultural Marketing Service, Specialty Crops Program, Specialty Crops Inspection Division

APPENDIX XXII – VOLUME CORRECTION CHARTS FOR SINGLE STRENGTH CITRUS JUICES AT VARIOUS TEMPATURES

Introduction:

The Appendix XXII – Volume Correction Charts for Single Strength Citrus Juices at Various Temperatures is an appendix to the AIM Inspection Series, Technical Procedures Manual. It is designed for Specialty Crops Inspection (SCI) Division personnel of the U.S. Department of Agriculture (USDA). The purpose of this chart is to provide an efficient means for correcting the volumes observed when using the volumetric method for adjusting the units in which volumes are reported to when using a volumetric flask or a milliliter graduated cylinder calibrated at 20 °C depending on the temperature.

How To Use These Charts:

1. Add or subtract the amount in the chart to the observed volume reading for the appropriate temperature accordingly to the specific volumetric flask size.

Corrected to 68 °F (20 °C) Using A Volumetric Flask Calibrated at 20 °C

Temperature Degrees		Flask Size – Mostly for Canned Juices			
°C		fl oz	18 fl oz	32 fl oz	46 fl oz
0	[illegible]	0	+ 0.1	+ 0.1	+ 0.1
5	41	0	0	+ 0.1	+ 0.1
[illegible]	50	0	0	+ 0.1	+ 0.1
15	59	0	0	0	0
[illegible]	68	0	0	0	0
25	77	0	0	0	- 0.1
30	86	0	- 0.1	- 0.1	- 0.1
35	95	0	- 0.1	- 0.1	- 0.2
40	104	0	- 0.1	- 0.2	- 0.3
45	113	- 0.1	- 0.2	- 0.3	- 0.4
50	122	- 0.1	- 0.2	- 0.3	- 0.5
55	131	- 0.1	- 0.2	- 0.4	- 0.6

Corrections are all to the nearest 0.1 fluid ounce.

APPENDIX XXIII – CALIBRATION AND VERIFICATION OF EQUIPMENT OR SYSTEMS

Equipment/System	Action	Frequency
Refractometers	Calibrate	Each day of use
Thermometers	Calibrate	Weekly or as often as each inspection if potential abuse occurs.
Scales	Calibrate (Regular)	Weekly *(or more often if recommended by the owner's manual)*
	Calibrate (Third-party calibration)	Once annually
Analytical Glassware	Calibrate	Before being placed into service.
Hydrometers	Calibrate	Monthly *(if used frequently)* Each day of use *(if infrequently used)*
Salometers	Calibrate	Weekly
Salt Meters	Calibrate	Either one sample per lot being graded, daily if more than one lot is graded, or each change in product.
Sodium Hydroxide (NaOH) Solutions *(used for titration)*	Verification of concentration	Daily or any changes in batches
Colorimeters or Spectrophotometers	Calibrate and maintain	Calibration must be done at least once a shift, or per manufacturer instructions. Follow instructions in the unit's user manual for calibration and maintenance.
pH Meters	Calibrate	Each day of use