DICTIONARY OF DRESSINGS AND SAUCES

The definitions below are provided for general reference. For those products with no standard of identity, there are many variations and formulations available. The descriptions of taste and consistency are general and may vary between brands.

I. DRESSINGS

**Blue Cheese/Roquefort** – Blue-veined, semisoft to hard cheese made from cow, goat or ewe milk. The cheese is inoculated with *Penicillium roqueforti*. This cheese is added in crumbles, chunks or granulated forms to a creamy dressing base. This cheese imparts a sharp, peppery, piquant flavor to the dressing. Commonly used ingredients in these dressings include vinegar, buttermilk, sour cream, lactic acid, spices including salt and pepper, oil, sweeteners, and eggs.

**Caesar** – An oil and water vinaigrette (emulsified) base to which Romano and/or Parmesan cheese is added. Worcestershire sauce, garlic, medium to coarse ground black pepper and lemon juice are commonly used ingredients. Anchovy is a characteristic flavor associated with this dressing.

**Cole Slaw** – A sweet, creamy based dressing associated with shredded cabbage and other vegetables. Cider vinegar and celery seed are commonly used to develop the characteristic flavor. It is formulated to be able to absorb moisture from the cabbage and not thin out.

**Creamy Cucumber** – Creamy based dressing which uses cucumber juice to impart a mild cucumber flavor. Sour cream or yogurt is used as the dairy base. Acid flavor and spices are on the mild side.

**Dry Mixes** – Packages of spices and other ingredients to be added to oil, vinegar, or other base materials to make a salad dressing at home.

**French (Separating)** – This product is covered by a Standard of Identity (21 CFR 169.115), which designates the ingredients that can and cannot be used in this product. Ketchup or tomato paste is used as a major component of this product. Paprika is another integral ingredient that imparts color and flavor to this product. Characteristic flavor is sweet, tart and spicy. The amount of separation is determined by the emulsion stability of this product. In this case, the emulsion is weaker and the product may separate into oil and water phases. Color may vary based on the amount of separation. The emulsion can temporarily be brought back by vigorously shaking the product. This product is sometimes called Red French Dressing.

**French (Non-Separating)** – Same as above, but the product has a better emulsion. Consistency will be thicker and color more orange than red.

**Green Goddess** – A thick, creamy pourable dressing flavored with anchovy and herbs such as tarragon, garlic and chives.

**Honey Mustard Dressing** – Sweet, creamy, medium thick, emulsified mustard-based dressing that may be prepared with yellow mustard, coarse ground mustard, brown mustard, dry mustard, oil (salad dressing or mayonnaise), liquid sweeteners, and often accompanied by cinnamon and other spices. It may have a slightly hot, pungent bite when fresh.
Italian (Separating) – Thin, oil and vinegar dressing with spices such as red pepper, garlic, Parmesan cheese, black pepper, oregano, herbs and other ingredients resulting in a zesty, tangy flavor. Product is usually translucent in color and may need to be vigorously shaken before use to break up the separated liquid phases. Other varieties of vinegar may be used to provide unique flavors.

Italian (Non-Separating) – Same as above, but product has a better emulsion. Consistency will be thicker and have a whiter color. Variants to this dressing would include:

- **Oil and Vinegar** – Simply the two main ingredients used in salad dressings. Product is a combination of oil and vinegar, herbs and spices. The consistency is thin with liquid phase separation.
- **Red Wine Vinegar and Oil** – Same definition as above, but red wine vinegar is used to impart a different flavor.
- **Vinaigrette Dressing** – Commonly uses a ratio of 3 parts oil to 1 part vinegar.

Ranch Dressing/Buttermilk – A creamy, mildly seasoned and mildly acidic dressing with a buttermilk/dairy base. Spices and ingredients most associated with this dressing include bacon, chives, onion and garlic. The dairy base includes milk or cream to which lactic acid cultures (Streptococcus lactic, Streptococcus cremoris) have been added which imparts a characteristic buttery, nutty and mild acid flavor to the product. The texture is thick and viscous. Ingredients such as buttermilk, sour cream or buttermilk powders are used to build a white, dairy base used in house and ranch dressing formulations.

Reduced Nutrient-Claim Dressings – These products are nutritionally reduced versions of the normal or standard dressing and can be adjusted to reduce calories, fat, salt/sodium, cholesterol, etc. Formulations can be considered reduced, low or free, but must meet established criteria to make these label claims. Please refer to the “Light and Sodium Claim Reference Values for Salad Dressings” on the Members Only section of the ADS website for additional details. The FDA’s “Guidance for Industry: A Food Labeling Guide,” Section 9. Appendix A: Definitions of Nutrient Content Claims is another source of information.

Russian – A product similar in nature to French dressing. Tomato paste or ketchup may be used to impart flavor and provide a darker red color. The dressing is sweet with strong spice flavors.

Thousand Island – A product with mayonnaise and ketchup/tomato as the base with sweet pickle relish. Consistency is thick and creamy. The flavor is sweet accompanied by a crunchy texture of the relish.

II. **CONDIMENT SAUCES**

Barbecue Sauce – Products are flavoring sauces used to accompany meats of which there are many versions. The ingredients used are many and varied and will determine the flavor desired. Sauce bases can include ketchup or tomato paste, vinegar, mustard, honey, sweeteners, spices, ingredients, starch and other stabilizers and thickeners. Regional locations may dictate preferred flavors. Variants include the following:

- **East Carolina Style** – Thin, vinegar-based, hot spices and pepper.
- **Kansas City Style** – Thick, sweet, ketchup/tomato-based sauce, smoky.
- **Memphis Style** – Thick, sweet, ketchup/tomato-based sauce. Usually contains more vinegar than the Kansas City Style. Sweeteners used are molasses and brown sugar.
South Carolina Style – Thin, sweet, tart/vinegar, mustard-based with spices, black pepper.

Western Carolina Style – Thick, ketchup/tomato-based sauce with spices, vinegar.

Buffalo Sauce – Hot, spicy sauce with the primary flavor derived from Louisiana Hot Pepper Sauce and butter.

Chili Sauce – Sauces made from the fruit of the capsicum plant. Different chile peppers are selected based on their flavor and heat levels. Combination of ground chile peppers and red tomato pulp. Commonly used with corn syrup, garlic and spices. Product is red, thick and coarse. Flavor profile can vary from hot to sweet. Other variants include:
- Gochujang Sauce – Savory and pungent fermented Korean condiment made from red chili peppers, glutinous rice, fermented soybeans and salt.
- Green Chile Sauce – Thick, green, tart, coarse sauce using ground green chili peppers.
- Sriracha Sauce – Thin, spicy hot sauce made from chili pepper paste, vinegar, garlic and salt.
- Sweet Chili/Chili Sauce – Thick, very sweet sauce followed by lingering hot, spicy pepper heat. Sauce base is usually opaque in color. Often referred to as Thai Chili Sauce.

Chimichurri Sauce – Spicy, vinegar_parsley sauce made of chopped fresh parsley and onion and seasoned with garlic, oregano, salt, cayenne and black pepper, oil and vinegar. Usually served with grilled meat.

Cocktail Sauce – Thick sauce that is composed primarily of ketchup and prepared horseradish. Sauce is commonly used with fish and seafood. Horseradish provides a pungent flavor and a numbing, nasal reaction caused by allyl isothiocyanate. Wasabi (Japanese horseradish) and some types of mustard seed provide a similar effect.

Honey Mustard Sauce – Sweet, mustard-based dressing that may be prepared with yellow mustard, coarse ground mustard, oil (salad dressing or mayonnaise) and often accompanied by cinnamon.

Horseradish, Prepared – Basic prepared horseradish is the grated prepared horseradish root mixed with distilled vinegar. Spices or other ingredients may be added (such as salt, sugar, cream or vegetable oil) to enhance and protect flavor. Horseradish provides a very pungent flavor and sensory experience.

Horseradish Sauce – Mayonnaise- or salad dressing-based sauce, with horseradish, horseradish powder or horseradish flavor, which imparts a pungent flavor.
- Wasabi Sauce – Similar to horseradish sauce but Wasabi is used alone or with horseradish to give the characteristic flavor.

Hot Sauce – Sauce that is a combination of fermented peppers, vinegar and salt which impart a very hot flavor. Heat levels are determined by the capsaicin content of the peppers and can be rated according to heat levels by Scoville Heat Units (SHU). Typically known as Louisiana Style, Cayenne Pepper Sauce or Cajun hot sauce. Variants include:
- Ancho Pepper Sauce – Mild heat level and fruity. Uses ancho peppers, 1,000-1,500 SHU.
- Chile de Arbol – Small and potent chili pepper. 15,000-30,000 SH.
**Chipotle Pepper Sauce** – Chipotle peppers are ripened and smoked jalapeno peppers. Uses chipotle peppers which impart a smoky flavor as well as heat, 5,000-10,000 SHU.

**Habanero Pepper Hot Sauce** – Uses Habanero peppers, 100,000-500,000 SHU.

**Jalapeno Pepper Sauce** – Uses jalapeno peppers, 2,500-15,000 SHU, dependent on maturity of peppers.

**Louisiana Style Hot Sauce, Cayenne Pepper Sauce or Cajun Hot Sauce** – Uses cayenne peppers, 30,000-50,000 SHU.

**Peri-Peri Sauce** – Sauce that has a medium to hot heat level from chili peppers combined with vinegar, oil, garlic, lemon juice, onion and herbs and may include tomato paste and paprika.

**Ketchup (Catsup)** – This product is covered by a Standard of Identity (21 CFR 155.194), which designates the ingredients that can and cannot be used. Primarily tomato paste combined with sweeteners, vinegar, water, salt and spices. The product may be homogenized to develop thickness and viscosity. No colors, thickeners or preservatives of any type may be used.

**Mayonnaise** - This product is covered by a Standard of Identity (21 CFR 169.140), which designates the ingredients that can and cannot be used. By definition, the product must contain not less than 65% vegetable oil. Product is thick and white due to the emulsion formation process. Flavor is mild with slight tartness or lemon flavor. Egg is used to stabilize the emulsion.

**Mexican-Styled Sauces (Taco, Picante and Salsa)** – A group of sauces formulated around tomatoes/tomato paste, hot peppers, onions, and cilantro with piquant spice flavor.

- **Taco Sauce** – Smooth, thin pourable, blended sauce made with tomatoes, chili peppers, vinegar, garlic and salt. Contains no particulate material.
- **Picante Sauce** – Literally defined as “hot and spicy” sauce. Usually a thinner and more pureed version of salsa sauce. May contain some particulate material.
- **Salsa Sauce** – Spanish for sauce. Salsa contains more and larger pieces of ingredients and particulate material. All products can be formulated as mild to hot dependent on the flavor to be achieved.

**Salad Dressing (Spoonable)** - This product is covered by a Standard of Identity (21 CFR 169.150), which designates the ingredients that can and cannot be used. This product is very similar to mayonnaise but uses much less oil, and the emulsion is stabilized by the use of starch and other stabilizers and thickeners.

**Sandwich Spread** – Mayonnaise-based product using sweet pickle relish.

**Soy Sauce** – A soybean protein extract from fermented soy and wheat paste (by *Aspergillus oryzae* and *Aspergillus sojae* molds) that is combined with water and salt to make soy sauce. Soy sauce is used in many Asian-styled products. Soy sauce is considered a flavor enhancer. Other variations may add caramel color or sweetener.

**Steak Sauce** – A thick, dark tomato-based condiment that is used to compliment the flavor of steak and other beef products. Product may not be as sweet as ketchup and other sauces. Characteristic flavors include raisin, tamarind, orange peel and strong spices including garlic, onion and pepper.
**Tartar Sauce** – A mayonnaise/salad dressing-based sauce which includes sour, acidic dill relish. This sauce is primarily used with fish and seafood.

**Worcestershire Sauce** – A sauce that is developed from fermented anchovies. It is a thin, spicy, dark brown liquid and contains cider or malt vinegar, anchovies, molasses, salt, tamarind, and spices such as garlic, onion and cloves. This strong flavored sauce is used in many products to impart its characteristic flavor.

### III. MUSTARD

**Coarse-ground Mustard, Stone Ground** (country style, brown, old fashioned) - A blend, including brown mustard seed, that is coarsely ground, vinegar, water, salt and a variety of spices and flavorings. Characteristic of coarse ground mustard is the presence of highly visible specks of mustard bran and a pungent flavor from the brown seed.

**Dijon-style Mustard** - A smooth blend including brown mustard seed, vinegar and other acidulants, water, white wine and seasonings, such as salt and tarragon. Characteristic of Dijon-style mustard is a smooth appearance resulting from the removal of the mustard bran by passing the product through a screening device, and a pungent flavor from the brown seed.

**Hot Mustard** - Sharp-flavored mustard seeds (brown or oriental) are added to vinegar, water and other seasonings, such as allspice, tarragon or shallots. Chinese, English and some German varieties fall into this category with tastes ranging from sharply pungent to very hot.

**Spicy Brown-style Mustard** (spicy brown, German-style, Dusseldorf-style) - A blend including brown mustard seed that is finely ground, vinegar, water, salt and a variety of spices and flavorings. Characteristic of spicy brown mustard is a uniform brown color, the absence of highly visible specks of mustard bran, and a pungent flavor from the brown seed.

**Whole Grain Mustard** - Prepared mustard with visible mustard seeds.

**Yellow Mustard** *(prepared mustard)* - A smooth paste of yellow mustard seed, vinegar, water, tumeric, seasonings (e.g., salt, clove and coriander) and sometimes sugar.

*Note:* FDA’s Compliance Policy Guide (CPG) for prepared mustard (CPG 525.575) states that prepared mustard is made from ground mustard seed and/or mustard flour and/or mustard cake. (See pages 6 - 7 of this document for a copy of the CPG.) Mustard bran is not listed as an ingredient used to make prepared mustard. However, it is a natural component of ground mustard seed or mustard meal. FDA has advised The Association for Dressings and Sauces that the Agency would not object to the addition of mustard bran to prepared mustard. However, any mustard bran or mustard seed added to the prepared mustard product must be listed in the ingredient statement. FDA also stated that they “...would not object to the use of ‘mustard with mustard bran’ as the statement of identity on the principal display panel.” (May 2003)
REGULATORY - CPG Sec. 525.575 Prepared Mustard – Composition

BACKGROUND:

No standard of identity for prepared mustard has been established under the Federal Food, Drug, and Cosmetic Act. Prepared mustard and the mustard seed ingredients used therein were defined in Food Inspection Decision 192, June 27, 1923. These definitions were adopted as a guide for purpose of enforcement of the Food and Drugs Act of 1906 and with few changes have continued in use as a guide for enforcement purposes under the Federal Food, Drug, and Cosmetic Act of 1938. The latest revision of the definitions appeared in Service and Regulatory Announcement F.D. No. 2, Revision, 5, November 1936.

POLICY:

In absence of a standard of identity for prepared mustard, we consider the following definitions to be satisfactory guides for the composition of prepared mustard for purposes of enforcement of the Federal Food, Drug, and Cosmetic Act.

PREPARED MUSTARD: A paste composed of a mixture of ground mustard seed and/or mustard flour and/or mustard cake, with salt, a vinegar, and with or without sugar and/or dextrose, spices or other condiments. In the fat-, salt-, and sugar-free solids it contains not more than 24 percent carbohydrates, not more than 12 percent crude fiber, not less than 5.6 percent nitrogen, the carbohydrate being calculated as starch.

MUSTARD SEED: The seeds of Brassica hirta Moench. *and Sinapis alba* (L.) (both known as white mustard), B. nigra (L.) Koch (black mustard), B. juncea (L.) Cosson, *(Chinese mustard)*, or varieties or closely related species of B. nigra and B. juncea. (In S.R.A. F&D No. 2, the name Sinapis alba (L.) was used. A B. hirta (white mustard) contains no appreciable amount of volatile oil. It contains not more than 5 percent of total ash nor more than 1.5 percent of ash insoluble in hydrochloric acid.

Brassica nigra (black mustard) and B. juncea yield 0.6 percent of volatile mustard oil (calculated as allylisothiocyanate). The varieties and species closely related to the types of B. nigra and B. juncea yield not less than 0.6 percent of volatile mustard oil, similar in character and composition to the volatile oils yielded by B. nigra and B. juncea. These mustard seeds contain not more than 5 percent of total ash, nor more than 1.5 percent of ash insoluble in hydrochloric acid.

GROUND MUSTARD SEED, MUSTARD MEAL: Unbolted, ground mustard seed conforming to the standards for mustard seed.

MUSTARD CAKE: Ground mustard seed, mustard meal, from which a portion of fixed oil has been removed.

MUSTARD FLOUR, GROUND MUSTARD, "MUSTARD": The powder made from mustard seed with the hulls largely removed and with or without the removal of a portion of the fixed oil. It contains not more than 1.5 percent starch, nor more than 6 percent of total ash.
CHARLOCK, Brassica kaber (DC.) L.C. Wheeler, according to available information, does not yield mustard oil. Therefore, charlock is not a suitable ingredient in prepared mustard. Its use in prepared mustard may serve to adulterate the article. Charlock is not generally recognized as safe and no regulation has been promulgated establishing safe conditions of use in accord with the Food Additives Amendment.

Prepared mustard must be labeled with a listing of its ingredients in accord with section 403(i)(2) of the Federal Food, Drug, and Cosmetic Act. The ingredients *shall be listed in by common or usual name in descending order of predominance by weight in accord with 21 CFR 101.4(a)(1)*.

*Material between asterisks is new or revised.*

Updated: 11/29/2005

(Note: The above Compliance Policy Guide (CPG) is reprinted from the Food and Drug Administration’s (FDA’s) website.)

IV. **COOKING SAUCES**

**Asian Authentic** – Sauces used to accompany food products and provide Asian/Oriental flavors. These products use typical ingredients such as soy sauce, teriyaki sauce, mirin, rice vinegar, fish stock and oyster sauce and strong spice flavors such as salt, garlic, onion and ginger. Historically has been linked to the use of monosodium glutamate (MSG). Variants to this group include:

- **Black Bean Sauce** – Sauce consisting of fermented soybeans, garlic, sugar, soy and spices such as ginger and garlic.
- **Fish Sauce** – Sauce derived from fermented fish, salt and water. Anchovies are primarily used, but can be sourced from other fish or squid. Color is translucent and can range from amber to reddish-gold.
- **Hoisin Sauce** – Sauce consisting of miso, soy sauce, spices and other ingredients.
- **Katsu Sauce** – Sauce consisting of tomato paste, soy sauce and spices.
- **Miso** – Thick paste from fermented soybeans and other grains, salty.
- **Oyster Sauce** – Sauce consisting of cooked oysters, soy sauce, brown sugar, corn starch and vinegar.
- **Peanut Sauce** – Sauce consisting of peanuts, soy sauce, sugar/honey, wine, sesame seed oil, miso, spices and seasonings.
- **Ponzu Sauce** – Tart, thin, dark brown citrus-based sauce which may include soy sauce.
- **Stir Fry Sauce** – Sauce consisting of soy sauce, spices, garlic and oyster sauce.
- **Sukiyaki Sauce** – Sauce consisting of soy sauce, mirin, sugar and spices/seasonings.
- **Sweet and Sour Sauce** – Sauces that have an initially sweet flavor, followed by a tart sour/vinegar flavor in combination with spices and flavors. Base is usually a fruit concentrate or puree such as peach, pineapple, plum or apricot. Tomato paste can be used as well.
- **Plum Sauce** – Variant of the above using plum puree as the sauce base.

**Curry Sauce** – Sauce made from a complex combination of spices such as hot chili peppers, turmeric, coriander, cumin, garlic, ginger and pepper. The sauce is named for the curry leaf used in the product to impart the characteristic flavor. Bases can include coconut and yogurt. Flavor variations exist due to regional and desired flavor profile.
**Marinades** – Flavor infusing liquids used to soften tougher cuts of meat and impart flavor. Commonly used ingredients include herbs, spices, condiments, oils, vinegars and other acids and sweeteners.

**Marinara (Italian-Styled Sauces)** – Tomato-based sauces with garlic, herbs such as oregano and basil, very mildly acidic and used for a variety of purposes.

**Mexican Authentic Sauces** –
- **Adobo** – Cooking sauce composed of Guajillo, ancho chili peppers, jalapeno peppers, garlic, cinnamon and oregano, lemon and orange juice, vinegar, onion and tomato paste.
- **Mole** – Very dark brown, smooth, thick, rich, nutty and pungent sauce made from many ingredients, including a blend of ancho, pacilla, mulato and chipotle chili peppers, spices such as cumin, clove, garlic and chocolate/cocoa. Can include a tomato, tomatillo or raisin base, and sesame seeds. It usually has a spicy hot, smoky and chocolate flavor.
- **Salsa Ranchero** – Typical sauce made from tomatoes/tomato paste, chili and jalapeno peppers, onion and garlic.
- **Salsa Roja** – Red sauce made from a base consisting of tomato paste and includes chile peppers, onion, garlic and cilantro.
- **Salsa Verde (Green Tomatillo)** – Sauce made with chopped tomatillos, onion, cilantro, jalapeno peppers, salt and lime juice. Tomatillo is a tart, green fruit related to the gooseberry. Often referred to as a green tomato, but it is not.

**Teriyaki Sauce** – A sauce that is brown, translucent, and soy sauce-based. It may also be salty, tart, sweet, spicy, sherry wine-flavored with spices, primarily garlic, and sometimes sesame.

V. **MISCELLANEOUS**

**Hummus** – Base of mashed chickpeas to which sesame seed paste (tahini), olive oil, lemon, salt and garlic. Base can be flavored with other ingredients to create unique flavors.

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Methods & Procedures
SECTION II

SAMPLING PROCEDURES

The function of a sampling plan is to assure, with a given degree of certainty that a specific product falls within the pre-defined normal range of variation. It should be noted that one sampling plan should not be used for all applications. The criticality of the measurement must be taken into account, along with the amount of risk that a business can afford to take. Management must consider both safety and economic factors and decide how much exposure the business is willing to take. The information presented in this section is not intended to be inclusive and should only be used as a guide. Companies should evaluate their processes, and then develop and maintain appropriate sampling plans to enhance food safety and improve product quality.

Completion of a "risk assessment" with appropriate "classification" of raw materials and finished products should be completed prior to identifying initial and ongoing sampling/testing requirements. It is important to understand vendor manufacturing and sampling practices and to compare test methods in order to consistently manage potential "risks."

Included in this section is a portion of Military Standard (Mil. Std.) 105 Sampling Plan**. This plan is used as a model for many other sampling plans in existence. IT MUST BE EMPHASIZED THAT THIS PLAN WORKS ONLY WITH A CONTINUING PROGRAM. The tendency is to use this model for all sampling, but it is not designed as such.

For all sampling scenarios, the number of samples taken is determined by the size of the lot and an individual company’s past history with the supplier. Acceptance and rejection numbers are given for each sampling. The use of all charts included in this document are is explained in more detail in the body of this section.

Also, included in this section is an explanation of the three-class attribute sampling plan and how this type of plan can be applied to determine the microbiological quality of food.

**Mil. Std. 105E, “Sampling Procedures and Tables for Inspection by Attributes,” was cancelled by the U.S. Department of Defense in 1995. The American National Standards Institute (ANSI) and the American Society for Quality Control (ASQC) have established a non-government standard, ANSI/ASQC Z1.4, which is somewhat similar to Mil. Std 105E and is now being used by many companies.
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I. SAMPLING GUIDELINE OF RAW MATERIALS, IN-PROCESS AND FINISHED PRODUCT

A. Physical, Chemical, Organoleptic and Extraneous Matter

Military Standard 105 is an ideal and model system for attribute sampling. Attribute sampling is a process in which decisions to accept or reject a product is based on a count of the number of defects and defectives. The suggested program for a sampling guideline for raw materials, in-process and finished product is a modification adapted for the dressings and sauces industry. It is recommended that the individual company use the original Standard 105, the outlined modification or a similar sampling guideline developed by any other recognized source (FDA Inspections Operations Manual, etc.).

The individual company should recognize that specific raw materials, in-process and finished products require a varying degree of sampling based on the criticality of the raw materials, how they are handled, the levels of use in finished goods and the criticality of the finished products themselves as related to overall safety and quality.

It is recommended that sampling and testing of raw materials, in-process and finished product be segregated into several classes based on their individual levels of criticality. Further, the microbiological sampling program should be treated separately from other sampling programs (e.g., physical, chemical) due to its particular association with potential health hazard risks.

1. Physical, Chemical, Organoleptic and Extraneous Matter - Sampling

   a. Criticality Level

      1) Class A - A critical test, which must be performed for each lot in all shipments prior to plant usage.

      2) Class B - A major test concerning an ingredient characteristic, which has a significant effect on product image as perceived by the consumer. This is generally an analytical test whose frequency or performance is determined by the statistical sampling plan in effect.

      3) Class C - A test for ingredient characteristics useful for audit and informational purposes. This test should be performed on at least the first three shipments from a new supplier and periodically afterwards. A reduced level of testing may be justified following completion of the vendor qualification/certification activities. (For information on vendor/supplier documentation, refer to the "Vendor/Supplier Information Packet" contained in Section IX,
“Industry Guidelines” of ADS’ Quality Assurance Guidelines (QAG) Manual.) Class C Sampling may not be adequate to ensure receipt of high quality materials routinely received in high volume shipments.

B. Sampling Guideline - All Aspects

The regular sampling program is based on Mil. Std. 105, Special Inspection Level S-3. (No defects are allowed.) An example from the above section appears below:

<table>
<thead>
<tr>
<th>Lot Size</th>
<th>No. of Samples Normal Inspection</th>
<th>No. of Samples Reduced Inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 - 15</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>16 - 50</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>51 - 150</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>151 - 500</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>500 - 3,200</td>
<td>13</td>
<td>5</td>
</tr>
</tbody>
</table>

Each supplier should be evaluated on the basis of on-going performance.

1. Establishing Inspection Levels

If seasonality could impact results, an increased testing level may be necessary.

   a) Normal to Reduced

   The plant will go from normal to the reduced inspection level when five consecutive lots from a vendor have been considered acceptable on original inspection.

   b) Reduced to Reduced Composite

   The plant will go from reduced to reduced composite testing when three consecutive lots from a vendor have been considered acceptable on original inspection at the reduced testing level. Reduced composite testing is similar to reduced inspection except that the samples required for reduced inspection may be composited for a single analysis.

   c) Reduced and Reduced Composite to Normal

   The plant will go from the reduced and reduced composite to the normal inspection level when two out of five consecutive lots from a vendor have been rejected on original inspection. Quality Assurance, the applicable department and the vendor should be notified. The appropriate team should determine if a visit to the vendor is needed.

   d) Discontinuation of Inspection

   In the event that three consecutive lots from a vendor are rejected, inspection should be discontinued and Quality
Assurance should be notified. It is recommended that manufacturers identify root cause and repeat vendor certification.

e) **Intensified Inspection**
Each week (or at some other pre-defined schedule that will ensure continued receipt of high quality materials), one or more specific ingredients should be selected for intensified inspection. The inspection is on a supplier's lot basis and should follow Mil. Std. 105, General Inspection Level II, AQL (Acceptable Quality Level) 1.0 Normal Inspection. This activity should include the Class A & B criticality levels. (See pages 8-10 for pertinent excerpts from Mil Std. 105.)

The selection of the ingredient should be based on past performance (i.e., an ingredient that had two rejections within the last five lot inspections) or the critical nature of the ingredients.

Example of Intensified Inspection for 290 bags: The sample size code letter is obtained by using Table I. In the far left column, find the lot sizes which brackets the lot to be inspected. (In this case, refer to the row with lot or batch size of 281 to 500.) Follow this row to the right under General Inspection Level II. The letter “H” in this column refers to the sample size code letter. On Table II-A, Single Sampling Plan, find the appropriate sample size code letter (H). The column to the right indicates the sample size is 50. Follow this row to the Acceptable Quality Levels column labeled as “1.0.” Based on sampling 50 bags, the lot would be acceptable (Ac) if only one defective unit was found and rejectable (Re) if two or more defective units were found.

f) **Special Instructions**
All samples and inspection are on a supplier's lot basis.

1) Liquid Bulk Containers - only require one sample per shipment.
2) Dry Bulk Containers, i.e., flour - five samples per shipment for normal inspection; two samples on reduced inspection.

NOTE: Due to the potential enormity of the sampling involved, frequency of sampling in-process and finished products should be tempered accordingly (previous experiences, possibility for compositing, etc.).

NOTE: When sampling for unintended food allergens, the form of the allergen should be taken into consideration regarding sampling size. Instances where the unintended allergen is in chunk or particulate form (i.e., almond and/or walnut slices) may require larger samples due to the lack of homogeneity of the allergen in the product.
II. SAMPLING GUIDELINE OF PACKAGING MATERIALS - CAPS, INSERTS, GLASS OR PLASTIC CONTAINERS, LABELS AND SHIPPING CARTONS

Military Standard 105 is also applicable for sampling all packaging materials. The suggested program is a modification of this system and is similar in general outline to the guideline proposed for raw materials, in-process and finished product.

The individual company should recognize that specific packaging materials require varying degrees of sampling based on the criticality of the individual packaging component. It is also recommended that the sampling program cover raw material, in-process and finished product.

Sampling and testing of packaging materials should be segregated into several classes based on levels of criticality.

A. Criticality Level

**Class A** - A critical test that must be performed for each lot in all shipments prior to plant usage.

**Class B** - A major test concerning a characteristic, which has a significant effect on the product. This is generally a physical and/or visual test whose frequency or performance is determined by the statistical sampling plan in effect.

**Class C** - A test for a characteristic useful for audit or informational purposes. This test should be performed on at least the first three shipments from a new supplier and periodically afterwards. A reduced level of testing may be justified following completion of vendor qualification/certification activities.

For further details, refer to sampling guidelines for Raw Materials, In-Process and Finished Product, page 45 of this section.
### TABLE I — Sample size code letters

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<thead>
<tr>
<th>Lot or batch size</th>
<th>S-1</th>
<th>S-2</th>
<th>S-3</th>
<th>S-4</th>
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</table>

**CODE LETTERS**
TABLE II-A — Single sampling plans for normal inspection (Master table)

(See 9.4 and 9.5)

<table>
<thead>
<tr>
<th>Sample size letter</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<table>
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</tbody>
</table>

Legend:
- Ac = Acceptance number.
- Ab = Rejection number.
- Use first sampling plan below arrow. If sample size equals, or exceeds, lot or batch size, do 100 percent inspection.
- Use first sampling plan above arrow.

Methods & Procedures
### TABLE II-B — Single sampling plans for tightened inspection (Master table)

(See 9.4 and 9.5)

<table>
<thead>
<tr>
<th>Sample size code letter</th>
<th>Sample size</th>
<th>Acceptable Quality Levels (tightened inspection)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0.010 0.015 0.025 0.040 0.065 0.10 0.15 0.25 0.40 0.65 1.0 1.5 2.5 4.0 6.5 10 15 25 40 65 100 150 250 400 650 1000</td>
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<tr>
<td>B</td>
<td>3</td>
<td><img src="chart.png" alt="Diagram" /></td>
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<tr>
<td>C</td>
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</tr>
<tr>
<td>D</td>
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</tr>
</tbody>
</table>

- **Ac.**: Acceptance number.
- **Re.**: Rejection number.
- **TIGHTENED**: Use first sampling plan below arrow. If sample size equals or exceeds lot or batch size, do 100 percent inspection.
- **100%**: Use first sampling plan above arrow.
III. THREE-CLASS ATTRIBUTE SAMPLING PLAN/MICROBIOLOGICAL TESTING

Scope

Three-class attribute plans were devised for situations where the quality of the product can be divided into three attribute classes depending upon the concentration of microorganisms within the sample units. Counts of microorganisms above the concentration “m” (i.e., the level of the test organism that is acceptable) separate good quality from marginally acceptable quality.

The use of a three-class attribute plan has advantages over the Mil. Std. 105 D plan in that it uses an operational function acceptance curve along with applied risk case variations to fit the proper application for realistic acceptance criteria with respect to microbiological growth in food systems. The use of the Mil. Std. 105 D in food microbiology has been rather difficult, due not only to the complicated variety of plans and inspection levels, but also to the often unacceptable large sample size. In an attempt to develop a universally applicable sampling strategy, the International Commission on Microbiological Specifications for Foods (ICMSF) published three-class sampling plans in “Microorganisms in Foods 7: Microbiological Testing in Food Safety Management.” (See the References section for additional information on this publication.)

Three-Class Attribute Sampling Plan Elements

Definitions

SU = sample unit
n = number of samples
m = the level of the test organism that is acceptable
M = the maximum value that if exceeded, product must be rejected
c = the number of samples with values between m and M that would be considered acceptable
RU = reporting units

What is a three-class sampling plan?

The definition of a three-class sampling plan incorporates two limits: m and M. M is higher than m, which distinguishes three classes of sampling results (i.e., results would either be less than m, greater than M or results would fall in between m and M). Varying the value of c with relation to m and n changes the stringency of the plan. Many food companies have microbiological plans that are set with very stringent limits. Often non-pathogenic microbiological specification limits are set for example, as yeast and mold <10 colony forming units (cfu)/gm. What happens if the microbiology lab technician reports 20 cfu/gm? It may be realized that the quality of the lot containing 20 cfu/gm will not be much different than the one that contains <10 cfu/gm, yet we must now reject this lot because it is above the upper specification limit. Experience has shown that given the variability and the nature of the way in which microorganisms live and grow in food products, it might be expected that occasional tests may be well over 10 cfu/gm, but these samples would not be indicative of the count in the total production lot. To avoid conflicting test results and unnecessary rejections, the upper specification limit could be changed to 100 cfu/gm. However, this might result in a supplier providing production lots of food that average 90 cfu/gm, and the mean count of 90 cfu/gm may cause quality problems or reduced shelf life. The way to avoid this dilemma is to use a three-class
sample plan, which would still keep the acceptable quality level at <10 cfu/gm but allow one out of every five samples to have microbiological test results between 10 cfu/gm and 100 cfu/gm. An example of this three-class plan would be set up as indicated in Table III.

<table>
<thead>
<tr>
<th>Table III</th>
<th>SU</th>
<th>RU</th>
<th>n</th>
<th>c</th>
<th>m</th>
<th>M</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
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<td>11 gm</td>
<td>CFU/gm</td>
<td>5</td>
<td>1</td>
<td>10</td>
<td>100</td>
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</tr>
</tbody>
</table>

Given the sample unit (SU) is 11 grams and the reporting unit (RU) is cfu/gm, when taking five random samples from one lot of this food product, it could be expected that the test results would indicate:

1. all of the samples would have test results of <10 cfu/gm or
2. four samples would have a yeast/mold count of <10 cfu/gm and one sample would have a marginal yeast/mold count of >10 cfu/gm and <100 cfu/g.

When written in this manner, the number of samples is specified as well as the acceptance criteria. As stated above, this type of sampling information can also be included in a food product specification to show the microbiological limits with a clear demonstration of marginal limits.

**How to establish n and c**

The n and c numbers are established by obtaining the degree of concern in which the food will be handled and matching that with the degree of concern as it relates to the testing of utility, indicator organisms, or those organisms which present a health hazard. (See Table IV below.)

Degrees of concern are defined as:

1. **Utility** - those organisms that indicate spoilage or reduced shelf life.
2. **Indicator** - those organisms shown to indicate contamination when present.

**These first two categories may be established by the use of industry and customer preferences.**

The three hazard categories listed below are reserved for pathogens and are defined directly by the ICMSF in “Appendix 8-A, Ranking of Foodborne Pathogens or Toxins into Hazard Groups” of the ICMSF publication. Table IV provides additional information regarding these hazard categories. Table VI, “Ranking of Foodborne Pathogens or Toxins into Hazard Groups,” shows examples of specific organisms associated with these categories. (Refer to page 15.)

**I. Severe hazards** – Life threatening for the general population or for a restricted sector of the population; substantial chronic conditions or long duration (e.g., *Listeria monocytogenes*, *Clostridium botulinum*, *Vibrio cholerae*).

**II. Serious hazard** – Incapacitating, but not life-threatening; moderate duration (e.g., *Hepatitis A*, *Salmonella enteritidis*, *Shigella boydii*).
III. **Moderate** – not usually life-threatening; normally short duration; symptoms are self-limiting; can cause severe discomfort (e.g., *Staphylococcus aureus*, *Bacillus cereus*).

<table>
<thead>
<tr>
<th>Degree of concern relative to utility and health hazard</th>
<th>Conditions reduce degree of concern</th>
<th>Conditions cause no change in concern</th>
<th>Conditions may increase concern</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1) Utility:</strong> general contamination, reduced shelf life, incipient spoilage</td>
<td>Increase shelf life Case 1 Three-class ( n=5, c=3 )</td>
<td>No change Case 2 Three-class ( n=5, c=2 )</td>
<td>Reduce shelf life Case 3 Three-class ( n=5, c=1 )</td>
</tr>
<tr>
<td><strong>2) Indicator:</strong> low, indirect hazard</td>
<td>Reduce hazard Case 4 Three-class ( n=5, c=3 )</td>
<td>No change Case 5 Three-class ( n=5, c=2 )</td>
<td>Increase hazard Case 6 Three-class ( n=5, c=1 )</td>
</tr>
<tr>
<td><strong>III) Moderate hazard:</strong> direct, limited spread</td>
<td>Case 7 Three-class ( n=5, c=2 )</td>
<td>Case 8 Three-class ( n=5, c=1 )</td>
<td>Case 9 Three-class ( n=10, c=1 )</td>
</tr>
<tr>
<td><strong>II) Serious hazard:</strong> incapacitating but not usually life threatening, sequelae are rare, moderate duration</td>
<td>Case 10 Two-class ( n=5, c=0 )</td>
<td>Case 11 Two-class ( n=10, c=0 )</td>
<td>Case 12 Two-class ( n=20, c=0 )</td>
</tr>
<tr>
<td><strong>I) Severe hazard:</strong> for (a) the general population or (b) restricted populations, causing life threatening or substantial chronic sequelae or illness of long duration</td>
<td>Case 13 Two-class ( n=15, c=0 )</td>
<td>Case 14 Two-class ( n=30, c=0 )</td>
<td>Case 15 Two-class ( n=60, c=0 )</td>
</tr>
</tbody>
</table>


NOTE: There is no marginal acceptable level (c) for serious and severe hazards, including pathogens and unintended food allergens. Therefore, for these situations, there are only “2 Class” plans.
How to establish m and M
The establishment of m and M may be directed by industry or customer standards in categories 1 and 2. However, minimal acceptable limits would most likely be established by governmental or medical authorities for hazard categories I, II and III because these categories contain pathogenic microorganisms. For selected organisms, refer to ICMSF categories of microorganisms on pages 15 – 23.

Applying the Sampling Plan and the ICMSF Criteria to Food Ingredients for Raw Material Specifications
Employing the criteria stated above, it is possible to develop an example of a sampling plan for a raw ingredient used in a dressing. Assume the raw ingredient is a cheese product, which is intended to be used in a refrigerated dressing. The cheese product has a pH of 5.45, water activity of 0.95, aged 10 months, has been converted into shreds and is to be shipped and stored at refrigeration temperatures until used. While creating a specification for this product, consider the conditions that would be realistic for the storage, shipping and use of the raw material. Using the information above regarding the cheese ingredient and the information in Table IV, a sampling plan is developed for each organism with respect to the ingredient.

Specifications for a cheese ingredient appear in Table V.

<table>
<thead>
<tr>
<th>Table V</th>
<th>SU</th>
<th>RU</th>
<th>n</th>
<th>c</th>
<th>m</th>
<th>M</th>
<th>Comments</th>
<th>Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coliforms</td>
<td>11g</td>
<td>CFU/gm</td>
<td>5</td>
<td>2</td>
<td>10</td>
<td>100</td>
<td></td>
<td>Case 2</td>
</tr>
<tr>
<td>E. coli</td>
<td>11g</td>
<td>CFU/gm</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>10</td>
<td></td>
<td>Case 6</td>
</tr>
<tr>
<td>Coagulase Positive Staphylococcus</td>
<td>11g</td>
<td>CFU/gm</td>
<td>5</td>
<td>1</td>
<td>10</td>
<td>100</td>
<td></td>
<td>Case 6</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>11g</td>
<td>CFU/gm</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>10</td>
<td></td>
<td>Case 9</td>
</tr>
<tr>
<td>Yeast and Mold</td>
<td>11g</td>
<td>CFU/gm</td>
<td>5</td>
<td>1</td>
<td>100</td>
<td>1000</td>
<td></td>
<td>Case 3</td>
</tr>
<tr>
<td>Listeria species</td>
<td>25g</td>
<td>/1x375 gm</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td>Case 13</td>
</tr>
<tr>
<td>Salmonella species</td>
<td>25g</td>
<td>/1x375 gm</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td>Case 13</td>
</tr>
</tbody>
</table>

Summary
Three-class sampling plans allow “flexibility” (i.e., changes in stringency that can be adjusted depending on the cause for concern and the case that is applied). They can also be used as specifications as well as a sampling plan. Three-class sampling plans allow for consideration of the use of “marginal” products presuming knowledge of the “susceptibility” of a specific product matrix (finished good) and knowledge of the growth characteristics of individual microorganisms.
## Ranking of Foodborne Pathogens, **Unintended Food Allergens**, or Toxins into Hazard Groups**

### Table VI

<table>
<thead>
<tr>
<th>Severity of threat to health</th>
<th>Frequency of involvement in foodborne disease</th>
<th>Example of vehicles</th>
<th>Other factors contributing to significance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I.A. Severe hazard for general population, life threatening or substantial chronic sequelae or long duration</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Brucella melitensis</em>, <em>B. abortus</em>, <em>B. suis</em> (brucellosis)</td>
<td>Common in endemic areas</td>
<td>Raw milk and cheese, especially from goats and sheep</td>
<td>Convalescence often prolonged</td>
</tr>
<tr>
<td>Botulinal neurotoxin (<em>Clostridium botulinum, C. butyricum, C. barati</em>) (botulism)</td>
<td>Rare</td>
<td>Improperly processed canned or preserved low-acid foods: home-cured meat products; smoked fish, other marine products; foil wrapped baked potato in salad, garlic in oil</td>
<td>Rapid recognition and treatment essential for patient survival; substantial mortality</td>
</tr>
<tr>
<td>Enterohemorrhagic <em>E. coli</em> (e.g., <em>E. coli</em> O157:H7, O111:NM) (hemorrhagic colitis and hemolytic uremic syndrome)</td>
<td>Sporadic; epidemic</td>
<td>Undercooked ground beef, unpasteurized apple juice, vegetable sprouts, lettuce, venison, yogurt, fermented sausage, untreated and recreational water, contact with farm animals</td>
<td>Very severe for children and elderly, severe complications including kidney failure and death, low infectious dose, acid tolerance</td>
</tr>
<tr>
<td><em>Salmonella typhi</em>, <em>S. paratyphi</em> A, B (S. schotmulleri) and C (typhoid and paratyphoid fevers)</td>
<td>Endemic in many parts of the world; occasionally epidemic</td>
<td>Untreated water, raw milk, meat products, raw shellfish</td>
<td>Prolonged medical care required, asymptomatic chronic carrier state commonly occurs</td>
</tr>
<tr>
<td><strong>Severity of threat to health</strong></td>
<td><strong>Frequency of involvement in foodborne disease</strong></td>
<td><strong>Example of vehicles</strong></td>
<td><strong>Other factors contributing to significance</strong></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------------------------------------------------</td>
<td>-------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td><em>Shigella dysenteriae</em> I (shigellosis)</td>
<td>Sporadic; endemic</td>
<td>Salads, untreated water</td>
<td>High mortality rate, especially among children, low infectious dose</td>
</tr>
<tr>
<td><em>Burkholderia cocovenenans</em></td>
<td>Rare</td>
<td>Coconut tempeh</td>
<td>Restricted geographic populations</td>
</tr>
<tr>
<td><em>Vibrio cholerae</em> O1 and O139 (cholera)</td>
<td>Sporadic; endemic; sometimes epidemic</td>
<td>Raw seafood from polluted water; untreated water</td>
<td>Substantial mortality among dehydrated, untreated persons; moderate symptoms with available rehydration treatment</td>
</tr>
<tr>
<td><em>Mycobacterium bovis</em> (tuberculosis)</td>
<td>Rare</td>
<td>Raw (unpasteurized) milk</td>
<td></td>
</tr>
<tr>
<td>Aflatoxins, produced by <em>Aspergillus flavus</em> and <em>A. parasiticus</em> (aflatoxicosis)</td>
<td>Common in tropical regions</td>
<td>Nuts and oilseeds, especially peanuts and maize, figs, milk</td>
<td>Most potent liver carcinogens known; acutely toxic in high doses; carcinogenic, teratogenic, and probably immuno-suppressive at low levels</td>
</tr>
<tr>
<td>v CJD/BSE; Protease Resistant protein (PrP); Bovine Spongiform encephalopathy (BSE); variant Creuzfeldt-Jakob disease</td>
<td>Sporadic</td>
<td>Specified bovine offal (brain, spinal cord, intestines, tonsils, thymus, spleen) from adult cattle</td>
<td>Severe central nervous system disorder resulting in death; no treatment or cure</td>
</tr>
<tr>
<td>Severity of threat to health</td>
<td>Frequency of involvement in foodborne disease</td>
<td>Example of vehicles</td>
<td>Other factors contributing to significance</td>
</tr>
<tr>
<td>-----------------------------</td>
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<td>---------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>I.B. Severe hazard for restricted populations, life threatening or substantial chronic sequelae or long duration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Campylobacter jejuni</em> serovar O:19 and other serotypes associated with GBS (Guillain-Barré Syndrome)</td>
<td>Sporadic</td>
<td>Poultry, water</td>
<td>Associated with Guillain-Barré Syndrome</td>
</tr>
<tr>
<td>Enteropathogenic <em>E. coli</em> (EPEC) Enterotoxigenic <em>E. coli</em> (ETEC)</td>
<td>Frequent in certain regions</td>
<td>Untreated water; food contaminated by nonpotable water or infected food handler</td>
<td>Symptoms are mild but can be severe in infants, major cause of infant mortality in certain regions</td>
</tr>
<tr>
<td><em>Clostridium perfringens</em> type C (enteritis necroticans)</td>
<td>Rare</td>
<td>Cooked pork</td>
<td>High mortality in protein-deficient persons, associated with malnutrition and a diet rich in trypsin inhibitors</td>
</tr>
<tr>
<td><em>Clostridium botulinum</em> (types A and B)</td>
<td>Sporadic</td>
<td>Honey</td>
<td>Infant botulism</td>
</tr>
<tr>
<td><em>Enterobacter sakazakii</em></td>
<td>Rare</td>
<td>Dried milk powder in infant formula (temperature abuse of dehydrated infant formula)</td>
<td>Causes death in infant populations (up to 70% mortality rate among neonates)</td>
</tr>
<tr>
<td><strong>Severity of threat to health</strong></td>
<td><strong>Frequency of involvement in foodborne disease</strong></td>
<td><strong>Example of vehicles</strong></td>
<td><strong>Other factors contributing to significance</strong></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------------------------------------------</td>
<td>------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td><em>Listeria monocytogenes</em></td>
<td>Sporadic; occasionally epidemic</td>
<td>Soft cheeses, pâté, smoked fish, ready-to-eat food</td>
<td>High risk groups include immunocompromised persons and pregnant women; high mortality (ca. 25%) in high risk populations; infrequent illness in immunocompetent persons; low numbers of <em>L. monocytogenes</em> are frequently consumed in foods</td>
</tr>
<tr>
<td><em>Vibrio vulnificus</em></td>
<td>Sporadic</td>
<td>Raw oysters</td>
<td>High mortality (ca. 50%) among persons that have elevated levels of serum iron; liver disorder associated with high alcohol consumption</td>
</tr>
<tr>
<td><em>Hepatitis A virus</em></td>
<td>Common</td>
<td>Raw and underprocessed bivalve mollusks, salads, untreated water</td>
<td>Very severe for patients with liver disease, convalescence prolonged</td>
</tr>
<tr>
<td><em>Cryptosporidium parvum</em></td>
<td>Sporadic; endemic; occasionally epidemic</td>
<td>Untreated water; unpasteurized apple juice, contaminated produce, unpasteurized milk</td>
<td>Severe prolonged diarrhea that is life threatening in immunocompromised; prognosis is poor for AIDS patients; usually short-term diarrhea that resolves spontaneously in immunocompetent persons</td>
</tr>
<tr>
<td><em>Unintended food allergens</em></td>
<td>Sporadic; more frequent in underdeveloped countries</td>
<td>Unintended milk in Italian dressings</td>
<td>Potentially life-threatening for up to 4% of the population</td>
</tr>
<tr>
<td>Severity of threat to health</td>
<td>Frequency of involvement in foodborne disease</td>
<td>Example of vehicles</td>
<td>Other factors contributing to significance</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-----------------------------------------------</td>
<td>---------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td><strong>II. Serious hazard; incapacitating but not life threatening; sequelae infrequent; moderate duration</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Salmonella enteritidis, Salmonella typhimurium</em> and other <em>Salmonella</em> serovars (salmonellosis)</td>
<td>Very common; epidemic</td>
<td>Eggs; poultry; dairy products; wide range of other foods</td>
<td>Serious for young and elderly persons; cross contamination from raw meat and poultry; eggs and poultry meat can be internally contaminated during production; some serovars of <em>Salmonella</em> are highly virulent, reactive arthritis occurs in 1-2% of cases (Reiter’s syndrome)</td>
</tr>
<tr>
<td><em>Yersinia enterocolitica</em> (pathogenic), <em>Yersinia pseudotuberculosis</em> (yersiniosis)</td>
<td>Sporadic</td>
<td>Milk; chitterlings; untreated water</td>
<td>Most infections occur in children less than 5 years of age, with symptoms of mild gastroenteritis; in older children symptoms are severe, presenting a pseudo appendicular syndrome; only certain serovars of <em>Y. enterocolitica</em> are noteworthy pathogens; sequelae; arthritis can occur in genetically predisposed persons that carry the human leucocyte antigen (HLA-B27)</td>
</tr>
<tr>
<td>Severity of threat to health</td>
<td>Frequency of involvement in foodborne disease</td>
<td>Example of vehicles</td>
<td>Other factors contributing to significance</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------------------------------------</td>
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<td>------------------------------------------</td>
</tr>
<tr>
<td><strong>Shigella flexneri, S. boydii, S. sonnei</strong> (shigellosis) (nondysentery)</td>
<td>Sporadic in industrialized countries; sometimes endemic in developing countries</td>
<td>Foods subjected to contamination by infected persons or sewage-contaminated water, such as salads; untreated water</td>
<td>Serious for young and elderly persons; secondary infections among contacts; sometimes low infectious dose, HUS occasionally</td>
</tr>
<tr>
<td><strong>Listeria monocytogenes</strong></td>
<td>Sporadic, rare</td>
<td>Foods where multiplication has occurred during storage</td>
<td>Low numbers of <em>L. monocytogenes</em> are often consumed on a wide variety of foods</td>
</tr>
<tr>
<td><strong>Hepatitis A</strong></td>
<td>Common</td>
<td>Raw or undercooked bivalve mollusks, salads, untreated water, strawberries</td>
<td>Less severe if no liver disease, but convalescence prolonged</td>
</tr>
<tr>
<td><strong>Arcobacter butzleri</strong> and <strong>A. cryaerophila</strong></td>
<td>Sporadic</td>
<td>Untreated water; poultry</td>
<td>Appendicitis infrequently occurs</td>
</tr>
<tr>
<td><strong>Cryptosporidium parvum</strong></td>
<td>Sporadic, endemic, occasionally epidemic</td>
<td>Untreated water, unpasteurized apple juice, contaminated produce, unpasteurized milk</td>
<td></td>
</tr>
<tr>
<td><strong>Cyclospora cayetanensis</strong></td>
<td>Sporadic; endemic; occasionally epidemic</td>
<td>Raspberries; lettuce; water</td>
<td>Severe, prolonged diarrhea</td>
</tr>
<tr>
<td>Trichothecene toxins, especially deoxynivalenol, nivalenol, and T-2 produced by <em>Fusarium graminearum</em> and related species</td>
<td>No clear</td>
<td>Cereals, especially wheat and maize in temperate climates</td>
<td>Immunosuppressive, probably contributing to increased disease incidence in endemic areas</td>
</tr>
<tr>
<td>Severity of threat to health</td>
<td>Frequency of involvement in foodborne disease</td>
<td>Example of vehicles</td>
<td>Other factors contributing to significance</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-----------------------------------------------</td>
<td>--------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Zearalenone, produced by <em>Fusarium graminearum</em> and related species</td>
<td>Probably not common</td>
<td>Cereals, especially wheat and maize in temperate climates</td>
<td>Estrogenic effects, not commonly observed in humans</td>
</tr>
<tr>
<td>Fumonisins, produced by <em>Fusarium moniliforme</em> and related species</td>
<td>Not clear</td>
<td>Fungus endemic in maize, toxins present in staple diets in regions of high maize consumption</td>
<td>Immunosuppressive, carcinogenic to rats and probably humans, implicated in esophageal cancer</td>
</tr>
<tr>
<td>Ochratoxin A, produced by <em>Penicillium verrucosum</em>, <em>Aspergillus ochraceus</em>, and related species, <em>A. carbonarius</em> and perhaps related species</td>
<td>Not clear</td>
<td>Cereals and pig meats in cool temperate climates, dried fruit, wines, and coffee beans</td>
<td>Nephrotoxic, probably contributing to reduced life spans in parts of Europe</td>
</tr>
</tbody>
</table>

**III. Moderate, not usually life threatening; no sequelae; normally short duration; symptoms are self-limiting; can be severe discomfort**

- *Bacillus cereus* (B. cereus gastroenteritis), including emetic toxin
  - Common
  - Fried and boiled rice; reconstituted cereal products; puddings, custards
  - Usually diarrhea and/or vomiting of short duration; death is rare

- *Clostridium perfringens* type A (*C. perfringens*)
  - Common
  - Cooked, non-cured meats; poultry; gravy
  - Symptoms usually mild but are more serious in elderly or debilitated persons; death is uncommon
<table>
<thead>
<tr>
<th><strong>Severity of threat to health</strong></th>
<th><strong>Frequency of involvement in foodborne disease</strong></th>
<th><strong>Example of vehicles</strong></th>
<th><strong>Other factors contributing to significance</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Escherichia coli</em> (EPEC, ETEC)</td>
<td>Common in developing countries; infrequent in developed countries</td>
<td>Foods handled by persons carrying EPEC or ETEC; foods contaminated with nonpotable water</td>
<td>Usually diarrhea of short duration in general population</td>
</tr>
<tr>
<td><em>Staphylococcus</em> enterotoxins (<em>Staphylococcus aureus</em>) (enterotoxicosis or food poisoning)</td>
<td>Common</td>
<td>Cooked foods handled by persons carrying <em>S. aureus</em> then temperature-abused: ham; fermented sausages; cereal-filled pastries; cheese; milk; salads; peeled crustaceans, bivalve mollusks; mushrooms</td>
<td>Explosive vomiting and moderate diarrhea; symptoms usually resolve without treatment within 2 days of onset; death is rare</td>
</tr>
<tr>
<td><em>Vibrio cholerae</em> non O1 and non O139</td>
<td>Sporadic</td>
<td>Raw bivalve mollusks; cross-contaminated cooked crustaceans</td>
<td></td>
</tr>
<tr>
<td><em>Vibrio parahaemolyticus</em> (<em>Vibrio parahaemolyticus</em> gastroenteritis)</td>
<td>Common in Japan; epidemic</td>
<td>Cooked crustaceans; raw bivalve mollusks; raw marine fish</td>
<td>Common where seafood is consumed raw</td>
</tr>
<tr>
<td>Small Round Structured Virus (SRSV), including Norwalk virus</td>
<td>Common</td>
<td>Raw bivalve mollusks; food handled by infected persons; bakery products</td>
<td>Symptoms are usually mild</td>
</tr>
<tr>
<td>Severity of threat to health</td>
<td>Frequency of involvement in foodborne disease</td>
<td>Example of vehicles</td>
<td>Other factors contributing to significance</td>
</tr>
<tr>
<td>------------------------------</td>
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<td>---------------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>Biogenic amines (e.g., histamine)</td>
<td>Infrequent</td>
<td>Scombroid fish, some cheeses</td>
<td>Biogenic amines are probably necessary for disease, serious for persons taking MAO</td>
</tr>
</tbody>
</table>


IV. SAMPLING TECHNIQUES

These sampling techniques contain general rules and procedures, which are sufficiently detailed to allow them to be used for instructing a sampler on proper procedures and may be used thereafter as a checklist by the sampler.

Each ingredient will be assigned a specific sampling technique; the number will appear at the bottom of the ingredient specification. The sampling technique numbers are specific for types of ingredients and containers. It is the responsibility of the individual preparing the ingredient specification to select the sampling technique number which will result in obtaining the most representative sample.

The evaluation of each vendor will begin at the normal inspection level and proceed as described in the enclosed plan. The plan requires that material will be sampled and tested by supplier’s lot, as opposed to a shipment basis. Provisions should be made to include on the shipping documents, a breakout of the number of lots in a shipment and the number of containers per lot.

A. General Rules

Listed below are eight general rules that should apply to all sampling techniques unless otherwise stated.

1. To exhibit true conditions of a product, samples are to be obtained from original unopened containers.

2. In collecting material for bacterial examination, aseptic precautions - clean, dry, sterile equipment and wide mouth containers are critical. The 18 oz. sterile whirl-pack bags are recommended as they are convenient and save space. Refer to Section V, “Aseptic Technique” for guidance regarding aseptic sampling.
3. When individual samples are taken from units, avoid the practice of making composite samples. Composites can be mixed (when applicable) after the individual samples have been transferred to the processing location (e.g., the lab). This will avoid the potential for “cross mixing” the contents of individual containers.

4. The number and size of samples will vary depending on the material and intended use. Specific sampling numbers will be determined by the Quality Control/Assurance Department and instructions regarding the sampling plan and required technique should be provided to the sampler.

5. Samples should be representative of the product. Liquids should be agitated until contents are homogenous. Large containers should be sampled by means of tubes or triers whenever possible in order that all parts of the container are represented in the portion examined.

6. Identification and background information on the samples is essential. Inclusive should be:
   a) Number of samples (1 of 5, 2 of 5, etc.)
   b) Name of material
   c) Supplier’s lot number and date produced
   d) Supplier
   e) Date and time sampled
   f) Specification code number
   g) Condition of shipment on receiving

7. Retained samples should be maintained according to established company policy.

B. Materials

Listed below are the materials that should assist you in taking proper aseptic samples.

* Tool box - metal, 22”L x 8”W x 9”D
* Electric Drill - 3/8”, 1000 RPM (for partially thawed products use variable transformer to lower speed (Speed-Con motor, 15 amp., ACE SC #764-17)
* Extension Cord - 3-wire, 50 ft. with 2-prong adapter
* Wood Auger Bit - for electric drill, 1” x 16”, spiral entire length
* Dual Hammer - vinyl/tenite
* Lid Opener - large screwdriver, or 12” x 2” x 0.25” steel strip, or a special butter-cheese-egg friction can lid opener (available through egg supplier)
* Hatchet or Chisel
* Alcohol Dispensing Bottle - denatured ethyl alcohol in 8 oz. polyethylene bottle with plain cap for storage and dispensing cap for application (Dynalab, Rochester, NY #D-600) or prepackaged alcohol wipes. Account for all used wipes when finished.
* Paper Toweling
Sample Utensils – Stainless steel (SS) tablespoons, SS long handled dippers, SS long handled spoons, SS sampling tube, dry material sampler (trier, brass), SS 2 qt. funnel with seamless stem removed (8 3/8"D x 8 3/4"H), cork borers, sharp knife, spatula

Sampling devices are to be cleaned thoroughly with soap and water between uses, but between samples simply wipe with clean toweling to remove adhering food material.

Hold over non-flammable material or area and apply alcohol (soaked cotton or dispenser bottle), shake off excess, then with caution ignite. Sample containers must be clean (free of dust), sterile (metal, dry heat - 170ºC or 338ºF for 1 - 2 hr.; or glass, autoclave - 121ºC or 250ºF for 15 min.), and pre-cooled before collecting sample.

Sample Containers - sterile, cooled pint mason jars, friction lid cans, 18 oz. “Whirl-Pak” bags or pre-sterilized plastic containers.

Sample Carrier
* Burner - cigarette lighter, alcohol lamp, matches
* Absorbent Cotton
* Marking Pen, Labels, Notepad

C. General Procedures

Listed below are the general procedures that will assist in taking proper aseptic samples. Refer to Section V, “Aseptic Technique” for guidance regarding aseptic sampling.

1. Take separate samples, do not composite. Aseptically sample the required number of units in a lot.
2. Observe after sampling for off odors - normal, abnormal, musty, etc.
3. Record all the information listed in Section IV.A. 6. The samples and the opened ingredient container should be marked so that additional samples may be drawn, if required.
4. The sampling method for different food products is as follows:
   a) Liquid - Mix contents of bulk containers prior to sampling by shaking-inverting and/or use a sterile sampling tube or dipper. Samples of refrigerated material should be kept cold.
   b) Frozen - Remove top layer with sterilized hatchet or chisel. Drill cores from top to bottom of container. Refrigerate samples immediately.
      NOTE: Well-frozen product is easier to sample from the bulk container. Once thawing occurs, slower drill speed is needed.
   c) Dried - Remove or push aside top layer with spoon or other clean instrument. The grain trier should not to be sterilized, but wiped with a clean cloth after each sampling.
5. All sampled containers are to be resealed in a manner that will preserve the product from further contamination.
D. Examples of Sampling Techniques

1. ST #1.0
   Type Container: Metal can (Frozen)
   a. Apparatus
      * Electric high speed drill or hand drill with 1” x 16” auger
      * Hammer and lid opener and/or aseptic can opener
      * Tablespoon
      * Hatchet or chisel
      * Labels, sample containers, and alcohol
   b. Procedure
      Remove top layer of frozen material with sterilized hatchet or chisel. Using the auger, drill three cores from top to bottom of container; first core in center, second core midway between center and periphery, and third core near edge of container. Transfer drillings to the sample container with sterile spoon or scoop.

2. ST #2.0
   Type Container: Bulk Dry
   a. Apparatus
      * Long handled SS dipper
      * Labels, sample containers and alcohol
   b. Procedure
      Bulk dry (wheat, whole grain, etc.) in can, truck, wagon, etc. Take sample with dipper. Probe in several places in different parts of the carrier and deposit each probe into a separate container.

3. ST #3.0
   Type Container: Cardboard Box (Frozen)
   a. Apparatus
      * Electric drill and auger
      * Tablespoon or spatula
      * Labels, sample containers
   b. Procedure
      Drill in 2 separate areas of block. Transfer drillings to sample container with a spoon. Combine samples. Be sure to keep sample frozen until used.

1 Where square frozen egg cans (imported eggs) with small friction fit caps are encountered, do not attempt to enlarge the opening; any amount of metal filings is in violation of the Federal Food, Drug & Cosmetic Act (FD&C) and constitutes a hazard. The FDA employs a stemless 2 qt. funnel, which catches the drillings and also serves to transfer the drillings to a sample container.

4. ST #4.0
   Type Container: Cardboard Box
   a. Apparatus
      * Spatulas or tablespoons
      * Labels, sample containers and alcohol
   b. Procedure
Open box and polylining around product. Sample material using spoon or spatula and place in sample container.

5. St. #5.0  
Type Container: Multi-Wall Kraft bags  
   a. Apparatus  
      * Sterile spatulas, tablespoons or metal trier 1/2” diameter and slit 1/3 of circumference  
      * Labels, masking tape, knife, sample containers and alcohol  
   b. Procedure  
      * Stand bag upright and tear open. Remove sample with spatula or spoon and deposit in sample container.  
      * Lay bag flat and make inserted V-shaped incision into bag and fold back bag flap. Sample material using spoon or spatula and place in sample container.  
      * Tear open corner of bag and insert trier diagonally through product, slit side down, turn until slit is in upright position, remove trier and empty into sample container.

6. ST #6.0  
Type Container: Fiber Drums  
   a. Apparatus  
      * Spatulas or tablespoons  
      * Labels, sample containers  
   b. Procedure  
      Remove drum lid and open polyliner. Remove sample using spoon or spatula and place in sample container.

7. ST #7.0  
Type Container: Metal Drums  
   a. Apparatus  
      (1) For Liquids:  
         * Oil thief - aluminum preferable, 3/8” to 1/2” I.D. length equal to depth of metal drum (55 gal.)  
      (2) For Solids:  
         * Oil trier 1/2” I.D. and length equal to depth of metal drum  
         * Spatula  
         * Labels, and sample containers and alcohol  
   b. Procedure  
      (1) Liquids:  
         Remove bung and insert thief. Sample should be drawn from several locations. Remove thief and deposit sample in sample container.  
      (2) Solids:  
         * Use a metal trier (aluminum) with 1/2” I.D. instead of thief.  
         * Collect sample by turning trier one complete turn.  
         * Scoop solid sample into sterile can by means of a sterile spatula. Remove bung and insert trier. Sample should be drawn from several locations. Remove trier and scoop sample into sample container using a spatula.
8. ST #8.0
Type Container: Small Metal Container
a. Apparatus
   * Liquid thief (100 ml. cap.)
   * Grain thief (50 gr. cap.)
   * Labels, sample containers and alcohol
b. Procedure
   Remove cap from container. If liquid, remove sample with liquid thief and place in sample container. If dry, remove sample with grain thief and place in sample container.

9. ST #9.0
Type Container: Bins or Hoppers
a. Apparatus
   * Long handled SS dipper
   * Labels, sample containers and alcohol
b. Procedure
   Remove sample with long handled dipper and place in sample container.

10. ST #10.0
Type Container: Blocks
a. Apparatus
   * Cheese trier, spatula, or tablespoon
   * Labels, sample containers and alcohol
b. Procedure
   Remove outer covering and take sample with the trier, spatula or tablespoon. Deposit sample into sample container.

11. ST #11.0
Type Container: Bottles
a. Apparatus:
   * Aluminum thief (approximately 199 ml capacity)
   * Labels, sample containers and alcohol
b. Procedure
   Shake container so as to ensure homogeneity of contents. Sample with thief and transfer to sample container.

V. ASEPTIC TECHNIQUES

Definition
For the purposes of this document, aseptic technique refers to practices that are carried out under controlled conditions in order to help reduce/eliminate the likelihood that "unwanted" environmental microbial populations are introduced into raw materials, in-process or finished product samples during completion of sampling activities.

Contaminants may be introduced from:
1. The general environment
   a. carried on air currents
b. carried on aerosolized water particles

2. Equipment
3. Supplies
4. Personnel

A. General Environmental Considerations

1. Avoid sampling in the following areas:
   a. near open windows
   b. in areas of strong air currents
   c. spaces with heavy traffic usage
2. Avoid potential contact with aerosols
   a. generated during proximate activities or
   b. from condensate drips
3. Limit the number of people who enter the sampling area.
4. Eating and drinking is not allowed in areas close to those designated for microbial or food allergen sampling.

It is important to consider the potential to introduce contaminant populations (that are of concern to your specific product) directly from the environment. If airborne contamination is of critical concern (e.g., the presence of mold), it may be necessary to consider sampling in a location that exhibits positive air pressure to surrounding proximate areas or to sample only in a “clean (filtered) air” area.

B. Method

1. Thoroughly wash hands immediately prior to initiating sampling activities.
2. Control clutter in the workspace.
   a. Bring into the work area only those items required for the activities that are to be completed.
   b. Arrange workspace so that all necessary “tools” and samples are within easy reach.
3. Wipe down work area using clean lint free wipes and warm water (may require soap to remove gross “soil” loads).
4. Sanitize work area and hands immediately prior to initiating any sampling and as often as necessary to remove spills (spill control may also require the use of soap to facilitate removal of gross loads).
   a. Use approved sanitizer at the strength recommended by the manufacturer (i.e., “use dilution” strength).
   b. Use generous amounts of sanitizer.
   c. Use lint free wipes.
   d. Allow sanitizer to dry before initiating sampling.
5. In order to prevent contamination of the material, extreme care should be taken when opening containers.
   a. Bags, drum tops and bung holes should be cleaned and sanitized before opening.
   b. Hand held pumps should be pre-cleaned and sanitized following appropriate methods.
   c. Do not place cleaned/sanitized lids, etc. on dirty surfaces during sampling.
i. Place lid with “product contact side up” only if proximate area is protected from air and moisture contamination, or
ii. Place lid with “product contact side down” onto a pre-sanitized approved lint free wipe or approved equivalent.

6. When handling samples, make sure that:
   a. Hands and/or body fluids do not come into direct contact with sample(s) or apparatus.
   b. All apparatus used during sampling.
      i. is received “sterile” from an approved vendor and held in a manner that will maintain sterility.
      ii. is “treated” in the lab in some manner that will eliminate the presence of microbiological populations (e.g., autoclaving or boiling) and then held in a manner that will maintain that status (e.g., with aluminum foil pinched in place to cover openings).

7. Sampling apparatus required considerations:
   a. Do not remove pre-sterilized and wrapped hand held tools until you are ready to use.
   b. Check that the wrapping on each package has not been damaged. (Discard if there is any indication that seal integrity has been compromised.)
   c. Open packages at the appropriate end only. This information should be on the package. If not, do not open in a manner that will expose the ends that will come into contact with the product (e.g., open pipettes at the “mouth” end and bags at the “closed” end).
   d. The opening should be only large enough to allow sufficient access to package contents – keep the opening as small as possible.
   e. Do not allow the product contact surfaces of tools to come into contact with potentially unsanitary surfaces. For example, do not allow pipette tips to touch the sampling surface, yourself and/or product containers. If there is any possibility that contamination has occurred, discard and start over with a fresh sample and “tool.”
   f. NEVER resample with a used pipette or other sampling tool – i.e., for each “draw,” use a fresh tool.
   g. When finished, close sample apparatus packaging and secure in a manner that will protect contents.

8. When finished with packages, re-close in a manner that will protect contents.

C. Precautions

1. Develop the habit of keeping hands away from your mouth, nose, eyes and face to prevent contamination of sample(s) and self.
2. Many solutions are “poisonous” and/or contain allergens to which the person sampling may be susceptible. These solutions should be handled with care. Always read labels carefully and wash hands thoroughly after contact.

3. “Mouth pipetting” should be discouraged and should only occur if cotton plugged pipettes are available and the solution to be pipetted is known NOT to be a health risk.

VI. REFERENCES


Hildebrant, G. Sampling Regimes & Statistical Evaluation of Microbiological Results, Encyclopedia of Food Microbiology, Volume 3, Academic Press, Boston, MA.

VII. OTHER RESOURCES


(rev 2005 2014)
SECTION IV

ESSENTIAL TESTS
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I. INGREDIENTS

A. Egg Products

1. Frozen Egg Handling

Critical control point lot tests should be salt content, assurance of frozen condition of incoming material and a visual check for denaturation upon thawing. Regular microbiological tests on a lot basis are neither required nor economically practical. Egg products are inspected and certified by USDA for microbiological quality, including statistical control over Salmonella. Periodic analysis should be employed to audit the supplier, when substandard lots are set aside due to a deficient salt content or where there is evidence of improper freezing and thawing technique.

2. Storage and Thawing Procedures

a. Unsalted Egg Products

Unsalted egg products should be stored at 0°F or below and defrosting shall be accomplished at a temperature of 40°F for a period of time not exceeding 24 hours provided that the temperature in any part of the defrosted liquid does not exceed 50°F. Defrosted material held below 40°F must be used within 12 hours or be disposed of; if held between 40° and 50°F, it must be used within four hours. Unused material should not be returned to frozen storage unless repasteurized or otherwise treated to destroy pathogenic organisms.

b. Salted Egg Products (10% salt)

Defrosted material should be held at 50°F or lower, if to be held 30 hours or less. If to be held in excess of 30 hours, the product shall be held at 45°F or lower. Current applicable state and local laws shall apply if more restrictive than the above.

3. Total Salt

a. From a well-mixed sample, weigh 1 to 2 gm of egg material into 150 ml beaker.

b. Add 20 ml of 10% Na$_2$CO$_3$ solution; mix and evaporate to dryness on electric hot plate.

c. Transfer beaker while hot to muffle furnace, heated to 500°C for one hour.

d. Cool and add few drops of distilled H$_2$O, cover beaker with watch glass. Then add 20 ml HNO$_3$, (75 ml HNO$_3$ and 25 ml H$_2$O) and break up charge with glass rod.

e. Add 50 ml distilled H$_2$O, cover beaker with watch glass. Then add 20 ml HNO$_3$ (75 ml HNO$_3$, and 25 ml H$_2$O boiled to colorless) slowly and wash watch glass.

f. Mix, filter and wash charred material with H$_2$O.

g. Add known volume of 0.1 N AgNO$_3$ solution in slight excess.

h. Stir, filter and wash AgCl precipitate thoroughly.
i. To combined filtrate and washing, add 5 ml of saturated solution FeNH$_4$(SO$_4$)$_2$ and a few ml of HNO$_3$.

j. Titrate excess AgNO$_3$ with 0.1 N potassium thiocyanate until permanent light brown color appears.


4. Salt Content - Alternate Methods

a. Weigh accurately about 1 gm of sample and wash into 400 ml beaker with about 100 ml warm distilled water.
b. Add 5 ml strong nitric acid and 5 ml ferric-ammonium-sulfate indicator.
c. Add known quantity of 0.1 N AgNO$_3$ (about 20 ml).
d. Back titrate excess AgNO$_3$ with 0.1 N KSCN.
e. Calculate NaCl content as follows:

\[
\% \text{ NaCl} = \frac{(\text{ml AgNO}_3 \text{ added} - \text{ml KSCN}) \times 0.5846}{\text{weight of sample}}
\]

f. Calculate NaCl content as follows:

\[
\% \text{ NaCl} = \frac{(N \text{ AgNO}_3) \times (\text{ml AgNO}_3) \times 0.05844 \times 100}{\text{weight of sample}}
\]


5. Salt Content - Potentiometric Method

a. From a well mixed sample, accurately weigh 0.3 - 0.5 gm egg yolk into the titration beaker.
b. Add distilled water to make about 100 ml.
c. Add 2 ml HNO$_3$.
d. Insert electrodes, start magnetic stirrer and stir at a constant rate. Titrate with 0.1 N AgNO$_3$ in intervals so that plot of MV against ml AgNO$_3$ can be prepared. Add 10 ml AgNO$_3$ to obtain a complete curve.
e. End point is the inflection point of the curve, where MV are changed at the greatest rate. This point should be determined with fresh electrodes and a standard MV point established. (Condition of the electrode may affect inflection point and results.) An autotitrator can be used to obtain the inflection point on the curve.
f. Calculation:

\[
\% \text{ NaCl} = \frac{(N \text{ AgNO}_3) \times (\text{ml AgNO}_3) \times 0.05844 \times 100}{\text{weight of sample}}
\]


6. Salt Content – Automatic Titrator
Salt analysis may be conducted using an automatic titrator. Consult with an equipment supplier for additional details.
Microbiological

a. Definition
These methods determine the total count, the yeast and mold count and the coliform group count in the sample. Applicable to frozen egg products.

b. Apparatus and Materials
* High speed (preferred) or hand drill fitted with a 1" x 16" auger.
* Alcohol lamp or other burner.
* Bunsen burner, adjustable to give a clean, hot flame.
* Tablespoons, individually wrapped in heavy Kraft paper and sterilized in hot air oven at 180°C-356°F for one hour.
* Sample jars, sterilized in hot air oven at 180°C-356°F for one hour.
* Pipettes, of convenient size and good grade. An 11 ml pipette is convenient for making the primary and serial dilutions and a 5 ml pipette is convenient for making multiple transfers to petri plates from the same dilution. The mouths of the pipettes are plugged with non-sterile, non-absorbent cotton, placed in suitable containers and sterilized in hot air oven at 180°C-356°F for one hour.
* Petri plates, placed in cans and sterilized at 180°C-356°F for one hour.
* Plate Count Agar (Difco) or Milk Protein Hydrolysate Agar (BBL). Potato Dextrose Agar, Violet Red Bile Agar or Desoxycholate Lactose Agar may be stored in test tubes, flasks or 4 oz. screw cap bottles. The test tubes should be without lips, 20 mm x 150 mm, contain about 15 ml of medium and cotton plugged. Prepare and sterilize media according to manufacturer’s directions.
* Saline dilution blanks. Add 8.5 gm sodium chloride to 1 liter distilled water. Dispense in 99 ml amounts in “milk dilution bottles” fitted with screw caps. Add a tablespoon of solid glass beads, 4 mm - 6 mm in diameter, to some of the bottles before sterilization. Sterilize at 15 psi and 124°C-250°F for 20 minutes in an autoclave or other pressurized steam chamber.
* Preferred method: Tartaric acid, reagent grade, 10% solution in distilled water. Cold-filter sterilize and keep solution refrigerated. Alternate method: Tartaric acid, reagent grade, 10% solution in distilled water. Sterilize in autoclave at 15 psi and 121°C-250°F for 20 minutes and then filter solution.
* Alcohol, isopropyl.
c. Procedure

(1) Take a representative sampling, the square root of the total number in the lot.* Open the cans in such a way as to prevent dirt or extraneous matter from entering the can.

(2) Remove the frozen material from three areas on the top, with a sterile tablespoon, one in the center, a second near the periphery and a third midway between.

(3) Sterilize the auger by wiping with alcohol and passing through the flame several times. Drill a core from top to bottom of container at each of the cleared areas and transfer shavings to chilled, sterile sample containers with sterile spoon. If analysis is delayed, keep frozen with dry ice.

(4) Examine the product organoleptically.

(5) Thaw the contents of the same container:

| | (a) In a hot water bath @ 45°C - 113°F for not more than 15 minutes, rotating sample container frequently,* or |
| | (b) In running tap water, with the bottle or jar two-thirds submerged, rotating sample container frequently until thawed, or |
| | (c) Thaw overnight in the refrigerator. |

(6) In a dust-free, draft-free area provided with a clean level surface, open the container aseptically, flame the opening and mix the contents thoroughly.

(7) Flame the opening of a tared 99 ml saline dilution blank with glass beads and add 11 gm of sample. Shake 25 times by hand through a 1 ft. arc. Prepare serial dilutions as needed using saline dilution blanks without beads.

(8) Pipette 1 ml from appropriate dilutions, in duplicate, into petri plates and pour with the appropriate agar, mixing the contents thoroughly to insure even distribution:

| | (a) Total count - use either plate count agar or milk protein hydrolysate agar incubate at 32°C - 89.6°F for three days. |
| | (b) Yeast and mold count - use potato dextrose agar brought to pH 3.5 with sterile 10% tartaric acid just before pouring. Incubate at 32°C-89.6°F for five days, observing at one, two and three days so that counts may be made in case of mold overgrowth. |
| | (c) Coliform group count - use either Violet Red Bile Agar or Desoxycholate Lactose Agar. After the medium has solidified, add an additional 4 - 5 ml medium. Incubate at 35°C-95°F for 18 - 24 hours and count the dark red colonies at least 0.5 mm in diameter. |
d. Calculations
Report the average count multiplied by the dilution as the number of organisms per gm of product.

e. References
Recommended Compendium of Methods for the Microbiological Examination of Foods, American Public Health Association, 3rd Edition.


B. Vegetable Oil

Peroxide Value Oil Analysis

1. Apparatus
   a. Pipet, Mohr, 0.5 ml capacity
   b. Erlenmeyer flask, 250 ml

2. Reagents
   b. Potassium iodide solution, saturated solution of KI, A.C.S. grade, in recently boiled water. Add 1.3 parts KI to 1 part water. Undissolved crystals should remain on the bottom. Store in a dark place.
   c. Sodium thiosulfate solution, 0.01 N.
   d. Starch indicator solution, 1% of soluble starch in distilled water.

3. Procedures

Test Potassium Iodide Solution:
   a. Add 30 ml acetic acid – chloroform solution to Erlenmeyer flask. Swirl flask and add 0.5 ml of saturated potassium iodide solution using a Mohr Pipet. Allow solution to stand exactly one minute. Then add 30 ml distilled water. Swirl flask and add 0.5 ml starch indicator solution. If a blue/black color is present, then titrate with 0.01 N sodium thiosulfate. Add sodium thiosulfate gradually until the blue/black color has disappeared. If no blue/black color is present, then the peroxide value is zero and there is no need to titrate. If blue/black color appears, then a new saturated potassium iodide solution is needed. If no blue/black color appears, then the solution is still good.

Test Peroxide Value:
   b. Weigh 5 gm of oil into an Erlenmeyer flask and add 30 ml acetic acid – chloroform solution. Swirl flask until the sample is dissolved in the solution. Add 0.5 ml of saturated potassium iodide solution using a Mohr Pipet.
c. Allow solution to stand with occasional shaking for exactly one minute. Then add 30 ml distilled water. If any peroxide is present, a dark mustard yellow color will be present.

d. Add 0.5 ml starch indicator solution. If a blue/black color is present, then titrate with 0.01 N sodium thiosulfate. Add sodium thiosulfate gradually until the blue/black color has disappeared. If no blue/black color is present, then the peroxide value is zero and there is no need to titrate.

4. Calculations

a. Peroxide value as milliequivalents of peroxide per 1000 gm of sample.

\[
\frac{(S-B) \times N \times 1000}{\text{weight of sample}}
\]

or

\[
\frac{(S) \times 0.01 \times 1000}{\text{weight of sample}}
\]

B = Titration blank (ml of sodium thiosulfate solution)
S = Titration of sample (ml of sodium thiosulfate solution)
N = Normality of sodium thiosulfate solution


C. Sweet Pickle Relish

1. pH

a. Select about 100 ml representative sample of liquor.

b. Calibrate pH meter to pH 4.0 in accordance with manufacturer’s instructions.

c. Rinse electrodes generously with a spray of distilled water.

d. Immerse at least ¼ of the length of the electrodes into liquor and determine pH reading.

2. Titratable Acidity

a. Weigh 2 gm of sample collected from above into 100 ml Erlenmeyer flask. Add 15 ml distilled water and stir to thoroughly mix.

b. Add 5 drops of 0.5% phenolphthalein solution.

c. Titrate slowly with 0.1 N sodium hydroxide stirring vigorously until a faint pink color persists for 30 seconds.
Caution: If deep red color develops, sample has been over-titrated.

d. If a standard 0.1 N sodium hydroxide reagent is used, calculate acetic acid by the formula below:

\[
\% \text{ acetic acid} = \frac{ml \ (NaOH) \times 0.1 \ N \times 0.06 \times 100}{\text{weight of sample}} = \frac{ml \ NaOH \times 0.6}{\text{weight of sample}}
\]

2. Titratable Acidity – Automatic Titrator

Acidity may be measured using an automatic titrator. Consult with an equipment supplier for additional details.

34. Salt

a. To flask of solution remaining from acid titration above add 1 drop of vinegar or nitric acid (do not use HCl) or just enough to change pink color to colorless.
b. Add 5 drops of 5% potassium chromate solution and stir.
c. Titrate slowly with 0.1 N silver nitrate, stirring vigorously until solution changes to a light yellow or straw color. Proceed drop by drop until a slight orange color is just visible.

Caution: If brick red color develops, solution has been over-titrated.

d. If a standard 0.1 N silver nitrate reagent is used, calculate % salt by the formula:

\[
\% \text{ salt} = \frac{ml \ AgNO_3 \times 0.1 \ N \times 0.05844 \times 100}{\text{weight of sample}} = \frac{ml \ AgNO_3 \times 0.585}{\text{weight of sample}}
\]

5. Salt – Automatic Titrator

Salt analysis may be conducted using an automatic titrator. Consult with an equipment supplier for additional details.

D. Vinegar Products

1. Acidity

a. Pipette 5 ml sample into 250 ml Erlenmeyer flask and dilute with about 50 ml distilled water and mix.
b. Add a few drops 1% phenolphthalein in 95% ethyl alcohol solution.
c. Titrate with 0.5 N sodium hydroxide solution accurately standardized, proceeding slowly toward end-point. Titrate until a faint pink color persists for 30 seconds.

Caution: If deep red color develops, sample has been over-titrated.

d. Calculate acetic acid by the formula:
% acetic acid = \( \frac{\text{ml NaOH} \times 0.5 \times 0.06 \times 100}{\text{ml sample}} \)

If exactly, 5 ml of sample was used:

% acetic acid = \( \frac{\text{ml NaOH} \times 0.5 \times 0.012 \times 100}{5} \)

2. **Titratable Acidity – Automatic Titrator**
   Acidity may be measured using an automatic titrator. Consult with an equipment supplier for additional details.

E. **Dairy Products**

1. Microbiological


2. **Food Allergens**

   Occasionally, a dairy product’s supplier may produce non-dairy products, which may include major food allergens. Examples include egg nog, almond milk or soy-based products. For dairy suppliers who do process allergenic foods in their facility, routine allergen testing with a validated test method should be done to ensure against unintended cross-contact with the dairy ingredient. See the International Dairy Foods HACCP certification program for details.

F. **Water**
1. Microbiological


G. Tomato Products

1. Microbiological

   NFPA Bulletin 27L Revised – Available from National Food Processors Association
   1401 New York Avenue, NW, Suite 400
   Washington, DC – 20005

   Grocery Manufacturers Association
   www.gmaonline.org

H. Spices and Seasoning Products

1. Microbiological

   Total Plate Count, Yeast, Salmonella, Staphylococcus, Coliform
   See Official Analytical Methods
   The American Spice Trade Association
   http://www.astaspice.org/
   P.O. Box 1267
   Englewood Cliffs, NJ – 07632

   Requirements to conform and comply with the Federal Food, Drug and Cosmetic Act.


2. Food Allergens

   Many seasonings contain allergenic ingredients, such as wheat and soy. Additionally, some spices and seasonings may unintentionally come into contact with major food allergens. For this reason, a screening program for incoming spices and seasonings for major food allergens is advised. See The American Spice Trade Association for additional details.
II. EQUIPMENT

A. Sanitation

1. Examination of Effectiveness of Sanitizing Treatment

The effectiveness of cleaning and sanitizing treatment of food contact surfaces should be periodically audited by microbiological testing of either the primary rinse water from clean-in-place systems or by swab sampling representative equipment surfaces. The frequency or to what degree the “equipment audit” should involve “invasive” evaluations/inspections (implies the requirement for a more complete “teardown” to facilitate access to the most interior equipment surfaces) is dependent on finished product susceptibility to contamination from microorganisms of public health and/or economic spoilage significance. Proximate non-product contact surfaces should be included at some defined regularity to assure the efficacy of “environmental cleaning.”

To assure the most realistic assessment of the presence (or absence) of post cleaning/sanitizing microbial populations, a “lag time” of not less than 24 hours (following completion of all sanitizing activities and prior to the completion of all inspection/evaluation activities) should be designed into the “auditing” program.

Selection of the identification/enumeration tests should be specific to the finished product to be manufactured and its inherent risk (as defined by completion of finished product risk assessment activities) unless some work has been completed to qualify the use of an “indicator” organism.


2. Examination of the Effectiveness of Cleaning to Remove Unintentional Food Allergens

Unlike microorganisms, sanitizing solutions will have minimal effect on the removal of unintentional food allergen proteins from equipment surfaces, thus putting a premium on cleaning techniques and detergents. To guard against unintentional food allergens, routine swab testing with allergen-specific (ELISA) tests should be done at changeover from allergen-containing product to non-allergen containing product. The allergen test swabs must be validated by the supplier and be capable of measuring the proper quantity for adequate control (e.g., 5 parts per million).
B. Swab Test


III. FINISHED PRODUCT

Commercial acidified salad dressings pose no health hazard if processed to a pH of not more than 4.1 and the acidity of the aqueous phase expressed as acetic acid is not less than 1.4% to control pathogens. To control food spoilage organisms (non-pathogens) substantially higher acid levels are required. For example, a level of at least 2.0% acidity of the aqueous phase is essential for mayonnaise. In every instance, good sanitary conditions and good manufacturing practices must be observed.

A. pH

1. Periodically calibrate pH meter at 4.0 pH, 25°C-77°F in accordance with manufacturer's instructions.
2. Measure about 30 ml of representative sample of product, well stirred, into 100 ml beaker.
3. Add about 30 ml of distilled or deionized water and mix thoroughly with product to eliminate lumps.* Add water in 5 - 10 ml increments when mixing to minimize lumping. (Thick dressings must be diluted to achieve reliable pH reading with glass electrodes.)
4. Insert electrodes into solution with meter on standby.
5. Read pH following directions of instrument manufacturer and record.
6. Wash electrodes thoroughly with distilled or deionized water.

*Note: If using a Ross Sure-Flow junction electrode, it is not necessary to dilute the product sample with water.

B. Moisture

1. Procedure A
   a. Fill an aluminum weighing dish about one-half full of dried absorbent cotton. Dry in 100°C-212°F oven to constant weight, cool in dessicator, weigh and record tare and return to dessicator.
   b. For products with grated cheese and pickle relish, comminute in blender until homogeneous. Weigh 10 gm homogeneous product onto cotton in tared weighing dish.
   c. Place dish in oven and come up slowly on temperature to 100°C-212°F. Dry to constant weight (about four hours is required with dressings).
   d. Cool in dessicator and weigh.
e. Calculate percent total solids and subtract from 100% for percent moisture.
RUN TEST IN DUPLICATE TO VERIFY ACCURACY.

2. Procedure B

Moisture analysis by microwave shows variability due to differences in operator, equipment and procedure. However, fairly consistent results can be obtained within an individual laboratory where much of this variability can be eliminated. To begin using microwave moisture analysis, the following guidelines are suggested:

**Note:** This procedure (microwave moisture) can be difficult to reproduce if the sample contains high levels of cheese products. Be careful to avoid scorching of sample when testing products with high levels of sweeteners.

a. Run a series of moisture analyses on dressings or sauces of varying moisture content (preferably in triplicate), using the standard MAPMAN oven method.

b. Run the same samples on your own microwave recommended by the manufacturer of your particular equipment (or an adaptation of the manufacturer's procedure suited to your own products and needs).

c. Plot a curve of the % moisture from Procedure A vs. the % moisture obtained via microwave as in Procedure B. This curve can then be used to apply a suitable “correction factor” to the microwave moisture results to bring them in line with the generally accepted method (which is theoretically a measure of the “true” moisture content).

**Note:** As is true with the standard moisture procedure, samples containing relish, grated cheese or other particulates should first be comminuted in a blender or food processor to assure uniformity.

C. **Total Acidity**

1. Procedure A

a. Comminute products containing coarse ingredients - relish, cheese, etc.

b. Weigh 10 gm well-mixed sample into tared 250 ml beaker.

c. Add 20 ml distilled water slowly while mixing to achieve uniform suspension.

d. Add 100 - 120 ml water (hot water for starch base) and mix.

e. Add 5 drops 1% phenolphthalein solution and titrate with 0.1 N NaOH to light pink color, which persists for 15 - 30 seconds. For highly colored dressings titrate to pH 8.4 using pH meter.

f. Calculate total acidity as % acetic acid.
(meg wt.)
% acetic acid = ml NaOH x 0.1 (n) x 0.6 (acetic) x 100 = 
ml of NaOH x .06

10 (sample wt.)

g. Express total acidity as % acetic in aqueous phase.
% acetic in aqueous phase = % acetic (f. above) divided by
decimal equivalent of moisture content (e.g., 0.19 for 19%).

2. Procedure B (for combination salt test)
   a. Weigh 6 gm into 500 cc side mouth Erienmeyer flask.
   b. Dilute with distilled water to 200 cc.
   c. Insert rubber stopper and shake well to thoroughly suspend and
      break lumps.
   d. Rinse stopper and sides with distilled water from wash bottle.
   e. Titrate with 0.1N NaOH using phenolphthalein indicator as in e. of
      Procedure A.
   f. Calculate % acetic acid as follows:
      % acetic acid = ml of 0.1 N NaOH x 0.1
   g. Express total acidity as % in aqueous phase as in gm of
      Procedure A.

3. Titratable Acidity – Automatic Titrator
   Acidity may be measured using an automatic titrator. Consult with an
   equipment supplier for additional details.

D. Fat Analysis

Analysis for fat content of many dressings and sauces is often complicated by
the use of emulsifiers to produce high-stability products. Experience has
indicated that much attention to breaking the emulsion is required. The following
two test methods are suggested.

1. Standard ADS Test for Total Fat in Dressings

   The standard ADS fat test, in which the emulsion is broken by refluxing
   the sample with acid and then the fat is extracted with a solvent. It is a
time-consuming test, but the results are very accurate if the test is
carefully done.

   a. Weigh (to the nearest mg) 5 - 6 gm of well mixed sample into a
      125 ml Erienmeyer flask. (Freezing samples after weighing could
      help to break the emulsion.)
   b. Add 50 ml of 1 N HCl, stopper the flask and shake it vigorously
      until the sample is thoroughly dispersed. Rinse the stopper and
      sides with a small amount of water from a wash bottle.
Immerse flask in boiling water for one hour (lead rings with a diameter slightly smaller than that of the flask should be used to keep the flask from floating in a water bath) with occasional stirring. Then cool to room temperature. (This is a good stopping point if it is desired to allow the sample to stand overnight before proceeding.)

Add approximately 20 ml chloroform to the cooled flask mix and transfer to a 125 ml separation funnel. Rinse the flask into the funnel with chloroform in a wash bottle. Add chloroform to a total volume of about 100 ml.

Shake gently, just enough to mix the two phases and allow the phases to separate. (The emulsion that forms may be broken by gentle rocking of a separatory funnel. It is not necessary to completely break the emulsion. A small amount of emulsion (5 - 10 ml) will remain at the top of chloroform layer. Do not draw off the emulsion as it will contain water soluble material. It should not be necessary to let the solutions stand longer than 5 - 10 minutes to get good separation.)

Place a boiling chip in a 150 ml beaker, dry for one hour at 105°C 221°F. Cool and obtain a tare weight.

Drain the clear chloroform (lower) layer into the tared beaker, retaining any emulsion in the separatory funnel. Repeat the extraction in the separatory funnel 3 times with 25 ml of chloroform each. Drain each washing into the tared flask. The three extractions will remove the oil phase.

Carefully evaporate the chloroform on a hot water bath. (Keep the temperature low enough to prevent the chloroform from bumping and spattering out of the beaker. A good fume hood, with the face shield pulled most of the way down, will provide enough draft to complete evaporation in about ½ hour.) Finish the drying for one hour in a forced draft oven at 105°C 221°F.

Measure the net weight of the oil residual in the beaker and calculate the percent oil in the sample.

2. **Modified Babcock Test for Total Fat in Dressings**

(Applicable to mayonnaise salad dressings)

A modification of the Babcock test for fat in milk involves breaking the emulsion with acid, then separating the oil by centrifuge. Although not as accurate as the standard ADS method, its results are fast and reasonably accurate for most in-house work.

a. **Reagents**
   * Conc. H$_2$SO$_4$ (Mix 35 ml of distilled H$_2$O with 200 ml of conc. H$_2$SO$_4$)
   * Butanol
   * Cleaning solution - (Chromic acid type)

b. **Equipment**
   * Centrifuge capable of handling 18 gm Babcock bottles
c. Procedure
(1) Heat distilled water, approximately 200 ml, to 135°F and fill wash bottle.
(2) Place 20 gm of dressing sample into Waring blender and add 180 ml of regular distilled water.
(3) Mix for about 45 seconds and immediately pipette 18 ml of the mixture into Babcock bottle.
(4) Add 2 ml of butanol to sample in Babcock bottle.
(5) Shake sample vigorously for five seconds and then add 15 ml of H₂SO₄ solution. Swirl.
Caution: Keep sample swirling or the H₂SO₄ will burn the sample and results will be affected.
(6) Place sample in the centrifuge; centrifuge for one minute at the standard speed for your specific centrifuge. See table on page IV-17 for guidance.
(7) Remove Babcock bottle from centrifuge and add enough hot distilled water from wash bottle to raise level of liquid to ½” below neck of bottle.
(8) Place bottle back into centrifuge; centrifuge additional two minutes at the standard speed for your specific centrifuge. See table on page IV-17 for guidance.
(9) Remove Babcock bottle from centrifuge and add enough hot distilled water from wash bottle to raise level of liquid to No. 6 on the neck of bottle. On mayonnaise samples, always add water to raise level to No. 8 on the neck of bottle.
(10) Place bottle back into centrifuge; centrifuge additional two minutes at the standard speed for your specific centrifuge. See table on page IV-17 for guidance.
(11) Remove and read immediately. Percent Oil = Reading x 10.
(12) Empty Babcock bottles, rinse with distilled water and add cleaning solution. Allow to stand for four hours. Pour out cleaning solution, rinse with distilled water and drain.

3. Babcock Oil Determination

a. Reagents
   * 95% ethyl alcohol
   * 50% ethyl alcohol, (90 cc distilled water mixed with 100 cc 95% ethyl alcohol)
b. Equipment
* 50 ml beakers
* Glass mixing rods
* 4 cc Pipette
* Babcock bottles
* Centrifuge

c. Procedure
(1) Weigh 9 gm of salad dressing or 4½ gm of mayonnaise into 50 cc beaker.
(2) Pipette 4 cc of 95% alcohol drop wise into beaker. Stir after the addition of each drop. It is very important to keep the mixture homogenous and lump free during this addition.
(3) Wash the stirring rod into the beaker using a minimum amount of 50% alcohol.
(4) Transfer the contents of the beaker into the Babcock bottle again using a minimum of the 50% alcohol to aid in the transfer.
(5) Add 50% alcohol until the bottle is about ½ full. If several determinations are being run at the same time, it is important that they be balanced in the centrifuge.
(6) Centrifuge for ten minutes at the standard speed for your specific centrifuge. See table below for guidance.
(7) Add 50% alcohol to the bottom of the neck of the Babcock bottle.
(8) Centrifuge for ten minutes at the standard speed for your specific centrifuge. See table below for guidance.
(9) Add more 50% alcohol to bring the column to the 45% mark.
(10) Centrifuge for 20 minutes at the standard speed for your specific centrifuge. See table below for guidance.
(11) Add a few drops of the Glymol Red reader down the side of the bottle so that it floats on top. This flattens the meniscus making the reading easier. Read at the bottom of the red level.

d. Calculation
(1) 9 gm sample reading is direct %.
(2) 4½ gm sample multiply reading by 2.0.

Rotational Speed Required in a Babcock Centrifuge

<table>
<thead>
<tr>
<th>Diameter of Wheel</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>inch</td>
<td>cm</td>
</tr>
<tr>
<td>10</td>
<td>25.4</td>
</tr>
<tr>
<td>12</td>
<td>30.5</td>
</tr>
<tr>
<td>14</td>
<td>35.6</td>
</tr>
</tbody>
</table>
16 40.6 848
18 45.7 800
20 50.8 759
22 55.9 724
24 61.0 693


4. Adapted Banco Fat Test

a. Mayonnaise
(1) Weigh out 4.5 gm of mayonnaise in Paley Cheese Bottle.
(2) Add boiling chip and/or one or two glass beads dipped in anti-foam.
(3) Add 13.5 ml hot water from the water bath.
(4) Shake until well mixed or liquefied.
(5) Add 2 ml 5N NaOH.
(6) Shake.
(7) Add 17 ml Banco Fat Test Reagent Solution.
(8) Shake well.
(9) Put in water bath and shake often until the color has changed to brown.
(10) Oil will float to top.
(11) Cool.
(12) Float oil up with 40% alcohol solution.
(13) Shake and hold in water bath on low until all oil is in the column.

b. Salad Dressing
(1) Weigh out 9 gm of salad dressing in Paley Cheese Bottle.
(2) Add boiling chip/one or two glass beads dipped in anti-foam.
(3) Add 9 ml hot water from water bath.
(4) Shake until well mixed or liquefied.
(5) Add 2 ml 5N NaOH.
(6) Shake.
(7) Add 17 ml Banco Fat Test Reagent Solution.
(8) Continue as with the mayonnaise.

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5. Total Fat for Mojonnier Flask Method

a. Procedure
(1) Weigh approximately 1 gm of sample into Mojonnier tube.
(2) Add 10 ml concentrated HCl, shake gently, set in water bath at 70°C-158°F and bring to a boil. Boil 30 minutes, shaking tube thoroughly every 5 minutes.

(3) Remove from the water bath and add water to fill the lower bulb of the tube (but not the neck). Cool to room temperature.

(4) To the mixture in the Mojonnier tube, add 25 ml ether and shake at least 1 minute. Then, add 25 ml petroleum (pet) ether and shake at least 1 minute. Pour extract into tared beaker.

(5) Repeat extractions twice, using 15 ml ether and 15 ml pet ether (or until all fat is extracted).

(6) Evaporate ether off in water bath on low heat under a hood.

(7) Dry beaker with extracted fat for approximately 90 minutes at 100°C-212°F. Cool and weigh beaker. Determine fat by difference from tared beaker weight.


6. Nuclear Magnetic Resonance – This technology may be used for fat analysis. Consult with an equipment supplier for additional details.

E. Food Allergens

In situations where unintended food allergens are designated as a risk, pH and acidification will not reduce the risk. To control the risk of unintended food allergens, a combination of allergen-specific (ELISA) swab tests and finished product testing is recommended. This is especially true where allergen-free labeling is instituted (i.e., gluten-free). Allergen test methods should be validated methods or conducted by a certified laboratory.

F. Brix/Total Solids

The degree Brix, designated as °Bx, is a unit of measurement for determining the amount of dissolved solids in many sauces and syrups. One degree Brix is 1 gram of sucrose in 100 grams of solution and represents the strength of the solution as percentage by mass. If the solution contains dissolved solids other than pure sucrose, then the °Bx only approximates the dissolved solids content. This is very useful for rapid testing food samples to determine formula control during mixing.

The Brix measurement is commonly performed with a device called a refractometer. There are four main types of refractometers: traditional handheld refractometer, digital handheld refractometer, laboratory of Abbe refractometer, and in-line process refractometer. The Abbe and handheld devices are the most commonly used in the food industry.

**E.G. Water Activity**

Water in food which is not bound to food molecules can support the growth of bacteria, yeasts and molds (fungi). The term water activity, designated as a$_w$, refers to the vapor pressure of this unbound water. This can be critical to food safety and determining the spoilage potential of a food.

The FDA has established a limit of less than or equal to (≤) 0.85 to inhibit the growth of pathogens. The water activity is partially used to determine the safety and classification of acidified and low-acid canned foods. If the water activity of a food is controlled at 0.85 or less in the finished product, it is not subject to the regulations in 21 Code of Federal Regulations (CFR) Parts 108 (Emergency Permit Control), 113 (Thermally Processed Low-Acid Foods Packaged in Hermetically Sealed Containers) and 114 (Acidified Foods).

Measurement of the water activity is most commonly performed using a meter designed for the application. There are a number of suppliers of digital water activity meters.


**E.H. Viscosity Measurement**

Rheology can be simply defined as the science of the deformation and flow of matter. Rheology is important in the stabilization of foods and beverages. Familiar examples of rheological behavior are the texture and mouthfeel of food stuffs and the extrusion of toothpaste.

In the science of rheology, possibly the most commonly used term is “viscosity.” Viscosity can be defined as the ratio of shear stress to the rate of shear. In more practical terms, the control of viscosity is used in a great number of commercial applications to provide a desirable use of characteristics. In food products such as salad dressings, rheology-modifying additives are used to stabilize the oil-in-water emulsion, to impart good cling characteristics and to make a dressing without a gummy mouthfeel.

When “viscosity” is defined as the ratio of shear stress to rate of shear, one or the other must be specified when a viscosity measurement is stated. Shear rate is the usual variable, defined either as an actual shear rate or as the speed and spindle number of a viscometer such as the Brookfield. A statement of solution viscosity which does not define shear conditions is virtually meaningless.

The “viscosity” of water and similar fluids that exhibit a constant ratio between shear stress and shear rate are said to be Newtonian. For non-Newtonian fluids,
the ratio of shear stress to shear rate at any point is known as apparent viscosity. Since the shear-stress/shear-rate changes, a value for apparent viscosity has no meaning unless accompanied by the corresponding shear rate or shear stress.

The most common type of non-Newtonian behavior is pseudoplastic flow in which the fluid exhibits shear thinning over a wide range of shear rates. A comparatively small group of fluids exhibit shear thickening with increasing shear rates, and this type of non-Newtonian behavior is called dilatant flow.

Rheological behavior of some fluids is time dependent, that is, shear stress or apparent viscosity either decreases or increases with time during flow at a constant shear rate. Fluids which exhibit this time dependent behavior are said to be thixotropic. Mayonnaise is a non-Newtonian system that exhibits thixotropy.

Finally, flow behavior of liquid solutions is influenced considerably by temperature. Viscosity decreases with an increase in temperature and, as a rule, a greater decrease per degree temperature change is noted for high-viscosity liquids than for low-viscosity liquids.

Sampling location is important. Since pumps, filling machines, pipes and valves all influence product viscosity, it is important to be consistent in sampling location. For “in-house” QC tests, any sampling location, such as at the mill, is acceptable, as along as there is consistency. For reporting to other agencies and customers, it is most likely the finished, filled product that should be considered. In all cases, it is important to indicate the sampling procedure and location.

Age of Samples. Viscosity of dressings usually increases from the moment of manufacture for perhaps 24 hours or so, then begins a slow decline, this viscosity degradation lasting usually for several months. For this reason, the greatest change takes place in the first few hours and therefore, in recording viscosities this time-effect must be considered. Dressings and sauces change viscosity as they change in temperature. Therefore, the following tests require uniform sample temperatures as indicated.

1. Bostwick Method for Measuring Viscosity

   (Recommended for pourable dressings and sauces)
   The Bostwick consistometer measures consistency by suddenly releasing a chamber of sample into a graduated chute. Distance of product flow within the chute during a standard time period is an indication of consistency or viscosity.

   a. Equipment Needed
      * Bostwick consistometer
      * Thermometer
      * Stopwatch or clock with sweep second hand
b. The Test Method

(1) Bring sample to 80 - 82°F.
(2) Make certain the consistometer is level.
(3) Lower the gate and lock in place with trigger.
(4) Fill the cubical compartment level-full with the sample.
(5) Note time and trip the trigger releasing the gate. It is advisable to hold down the consistometer at the moment when the gate is released in order to minimize any possible increase in the flow due to jumping of the consistometer.
(6) Take a reading after 15 seconds and again after 30 seconds. Readings are recorded in centimeters.

2. Brookfield Method for Measuring Viscosity

(Recommended for spoonable and pourable dressings and sauces)
The Brookfield viscometer measures apparent viscosity by measuring the force (resistance) required to rotate a spindle within a sample. The force is indicated by the position of a pointer on the viscometer dial or a digital readout on a digital viscometer and is proportional to the apparent viscosity of the sample for any given speed. As dressing and sauce viscosities become higher, viscosity measurements become more difficult as dressings tend to thin out if disturbed. Therefore, it is recommended that for spoonable dressings the viscometer be equipped with a Helipath attachment. This attachment lowers the spindle continuously into the test material and eliminates the “channeling” effect by constantly moving through undisturbed material. However, since the products resistance to the rotation of the shaft can also be significant, measurements should be taken when the spindle is at specified depth within the sample. A guard leg is not used when the Helipath Stand is used. Large particulates, such as relish, other vegetable material or cheese pieces, may also interfere with the rotation of the spindle giving a false viscosity measurement.

Viscosity measurements will be affected by the model viscometer used, the spindle and attachments used, the speed of rotation of the spindle, the sample and container size, the temperature of the product and the preparation of the sample prior to testing (including time between measurements). All of these factors should be specified if correlation of laboratory results is desired.

Equipment Needed
* Brookfield Viscometer
* Helipath Stand
* Spindles for spoonable products
* 600 ml or larger beaker

a. Test Method for Pourable Products – Dial Viscometer

(1) Place 600 ml of sample in the beaker or test product directly in its own container if the container is an appropriate size to avoid interference of the spindle
rotation or effects on apparent viscosity measurement from closeness of container walls. Since the sample container size will affect the viscosity reading, the container size used should be specified, or agreed upon between vendor and user, to obtain better correlation of results.

(2) Attach appropriate spindle to lower shaft of viscometer and lower spindle into the sample, taking care not to trap air bubbles under the spindle, until the test material's level is at the groove cut in the spindle shaft and the spindle is located in approximately the center of the container. Again, to obtain better uniformity of results between labs, the spindle size should be agreed upon in advance.

(3) Level the viscometer.
(4) Depress the clutch and turn on the viscometer. Release the clutch and allow the dial to rotate until the pointer stabilizes at a fixed position in the dial. Each facility should establish a time when the viscosity reading should be recorded based on spindle, revolutions per minute (rpm) and product type.

(5) Depress the clutch and stop the viscometer with the pointer in view. Note the reading on the dial.
(6) The viscosity of the sample can be obtained by multiplying the dial reading by the appropriate factor. Factor finder charts are available from Brookfield, applicable to testing performed with a particular viscometer model, spindle, sample size, guard leg and speed. When these specified conditions are not met, new factors can be developed by the operator through recalibration.

(7) The apparent viscosity of the sample is reported in centipoise (cps) along with the following: temperature of the product, spindle used, speed, viscometer model, guard leg, sample volume, sample container size and time between measurements.

b. Test Method for Pourable Products – Digital Viscometer
(1) Place 600 ml of sample in the beaker or test product directly in its own container if the container is an appropriate size to avoid interference of the spindle rotation or effects on apparent viscosity measurement from closeness of container walls. Since the sample container size will affect the viscosity reading, the container size used should be specified, or agreed upon between vendor and user, to obtain better correlation of results.

(2) Level the viscometer.
(3) Zero the viscometer.
(4) Attach appropriate spindle to lower shaft of viscometer and lower spindle into the sample, taking care not to trap air bubbles under the spindle, until the test material's level is
at the groove cut in the spindle shaft and the spindle is located in approximately the center of the container. Again, to obtain better uniformity of results between labs, the spindle size should be agreed upon in advance.

(5) Input spindle number and rotational speed to the viscometer.

(6) Turn the motor on and allow to run for a predetermined number of rotations or a specific time period before recording viscosity and percent (%) torque.

(7) Measurements between 10 – 100% torque are within the valid measurement range of the instrument. A spindle and speed combination should be selected that will produce satisfactory readings within this range.

(8) The apparent viscosity of the sample is reported in centipoise (cps) along with the following: temperature of the product, spindle used, speed, viscometer model, guard leg, sample volume, sample container size and time between measurements.

b. Test Method for Spoonable Products – Dial Viscometer

(1) Place sample in beaker or test product directly in its own container if of appropriate size to avoid interference of spindle rotation or effect on apparent viscosity measurement from closeness of container walls. Since the sample container size will affect the viscosity reading, the container size used should be specified, or agreed upon between vendor and user, to obtain better correlation of results.

(2) Attach appropriate spindle to lower shaft of viscometer and carefully lower the leveled viscometer until the spindle is in the center of the sample and is covered by about ¼ of the sample. Again, to obtain better uniformity of results between labs, the spindle size should be agreed upon in advance.

(3) Set the adjustable stops for the spindle penetration required and push the reversing rod down for the initial drive direction.

(4) Start the viscometer and let the dial make one or two revolutions before turning on the Helipath. Note the dial reading after a predetermined number of revolutions or a specific time period.

(5) Calculate the apparent viscosity of the sample by multiplying the dial reading by the appropriate factor. Factor tables are supplied by Brookfield for specific spindles used with the Helipath Stand by viscometer model and speed. When specified conditions of the tables are not met, new factors can be developed by the operator through recalibration.
The apparent viscosity of the sample is reported in centipoise (cps) along with the following: temperature of the product, spindle used, speed, viscometer model, volume of test sample, sample container size and time between measurements.


1. Place sample in beaker or test product directly in its own container if of appropriate size to avoid interference of spindle rotation or effect on apparent viscosity measurement from closeness of container walls. Since the sample container size will affect the viscosity reading, the container size used should be specified, or agreed upon between vendor and user, to obtain better correlation of results.

2. Level the viscometer.

3. Zero the viscometer.

4. Attach appropriate spindle to lower shaft of viscometer and carefully lower the leveled viscometer until the spindle is in the center of the sample and is covered by about ¼ of the sample. Again, to obtain better uniformity of results between labs, the spindle size should be agreed upon in advance.

5. Set the adjustable stops for the spindle penetration required and push the reversing rod down for the initial drive direction.

6. Input spindle number and rotational speed.

7. Start the viscometer and let the dial make one or two revolutions before turning on the Helipath. Allow the viscometer to run for a predetermined number of rotations or a specific time period before recording viscosity and percent (%) torque.

8. Measurements between 10 – 100% torque are within the valid measurement range of the instrument. A spindle and speed combination should be selected that will produce satisfactory readings within this range.

9. The apparent viscosity of the sample is reported in centipoise (cps) along with the following: temperature of the product, spindle used, speed, viscometer model, volume of test sample, sample container size and time between measurements.

Viscometer Calibration
The Brookfield viscometer should be regularly checked using standard viscosity oils and appropriate correction made to viscosity readings, if necessary. Any deviation should be reported and noted in a log book. If deviations are about 1% of full scale range, the viscometer should be
repaired. Repairs can be accomplished through Brookfield Engineering Laboratories, Inc., 240 Cushing Street, Stoughton, MA 02072.

3. Simple Viscosity Method

(Can be used for both pourable and spoonable dressings and sauces)
This method is similar to the Bostwick Method in that the measurement is taken by sudden release of the sample and measurement of product flow during a standard time period as an indication of “viscosity.” It is an inexpensive test method to take relative “viscosity” measurements.

a. Equipment Needed
   * Thermometer
   * Stop-watch or clock with sweep second hand
   * Glass plate
   * Ruler (graduated in inches or centimeter)
   * A large spoon
   * A board, book, etc. to prop up the glass plate

b. Temperature: The samples should be 75°F ± 2°F.

c. The Test Method
   (1) Prop the cleaned glass plate on a book, board, etc. and measure the vertical distance between the bottom of the prop and the top of the glass plate. Keep this distance constant during all measurements.
   (2) Place the ruler on the glass plate.
   (3) Fill the spoon level-full with sample.
   (4) Note time and pour the sample on to the glass plate along side the rule (care should be taken not to pour the sample on the ruler).
   (5) Take a reading after 15 seconds and again after 30 seconds. Readings are recorded in inches or centimeters. (See diagram on page 24 in Appendix A on page 29.)

Appendix B, Measuring Viscosity/Flow Practical Guidelines, provides insight regarding analytical equipment and methods to measure the viscosity/flow of products.
The following references contain complete details regarding test methods for the evaluation of ingredients and finished products.

- Compendium of Methods for the Microbiological Examination of Foods
- Official Methods of Analysis of AOAC International
- Official Methods and Recommended Practices of the AOCS
**APPENDIX A - SIMPLE VISCOSITY TEST METHOD**

Side View

Board, Books, etc.

Glass Plate

Ruler

Front View

Pour sample here.
Sample will flow down glass plate.

Measure time it takes for sample to flow a certain distance.
<table>
<thead>
<tr>
<th>Measurement Type</th>
<th>Correlates with?</th>
<th>Limitations &amp; Concerns</th>
<th>Applications</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bostwick Consistometer</strong></td>
<td>Limited correlation with cling of product to a surface.</td>
<td>Newer instruments exist. Leveling and waiting the proper time to open the gate are problematic as is temperature control.</td>
<td>Useful mainly for “pass / fail” Quality Control (QC) measurements. Other instruments more suitable for product development or R&amp;D. Some correlation with cling.</td>
<td>Updated instrumentation is now available. A more appropriate replacement is the Brookfield YR-1 yield rheometer (see explanation below).</td>
</tr>
<tr>
<td><strong>Brookfield Spindle</strong></td>
<td>Depends upon the speed chosen. The normal 20 or 60 rpm (revolutions per minute) speeds do not measure the shear rate of two important attributes of mouthfeel or stabilization.</td>
<td>For most materials, the factors only give approximate viscosity. Change a spindle and there is a jump in viscosity. The shear rate applied (about 10 s⁻¹) does not correlate with important properties.</td>
<td>Widely used to check the quality of incoming raw materials and final product. Most industry standards have been set with this instrument in the past. Most useful to correlate with pouring.</td>
<td>Today, there are better devices available. A better choice would be the use of the small sample adapter on the same Brookfield (see explanation below).</td>
</tr>
<tr>
<td><strong>Brookfield Small Sample Adapter</strong></td>
<td>Higher speeds can correlate with mouth thickness (about 75 s⁻¹ shear rate). Low speeds can correlate with cling.</td>
<td>Need to keep the bob size large so that the gap between the cup and bob is about 10-20% of the bob diameter.</td>
<td>Used in some labs in place of the spindles on the Brookfield. Could be adopted with minimal cost. Can obtain data on clinging, pouring and mouthfeel.</td>
<td>A better instrument than the spindle because it uses less sample, is easy to control the temperature and, known measurement conditions allow exact determination of shear rate. Essentially the same price and ease of use as the standard spindle but yields more information.</td>
</tr>
<tr>
<td><strong>Brookfield YR-1 Yield Rheometer</strong></td>
<td>Yield stress measures how much force is required to start flow. Also correlates to clinging and how hard it is to get something out of a bottle.</td>
<td>Samples need to be well conditioned (sheared and allowed to stand and recover) for a consistent amount of time.</td>
<td>This is the modern replacement for the Bostwick. The best instrument for clinging and “pourability.”</td>
<td>This new instrument offers the ability to measure attributes of importance to consumers, which other instruments may not be capable of measuring.</td>
</tr>
<tr>
<td>Measurement Type</td>
<td>Correlates with?</td>
<td>Limitations &amp; Concerns</td>
<td>Applications</td>
<td>Comments</td>
</tr>
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<td>----------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------</td>
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<tr>
<td><strong>Brookfield Helipath Attachment</strong></td>
<td>The standard Brookfield can be fitted with “T” shaped spindles and a special motorized stand that lowers the rotating “T” spindle into the sample.</td>
<td>Though the viscosity is expressed in units of viscosity (cP) this is not a viscosity measurement but a useful flow index. Careful attention by the operator is needed to get good data. Pieces of large solids such as onions or pickles pose problems.</td>
<td>The “T” spindles are most suitable for materials like the viscous salad dressings. Materials that pour are better measured with other techniques. Very solid materials, like table spreads cannot be tested.</td>
<td>Not always so widely used in the dressing and sauce industry but often a better choice than the standard spindle. A good rule of thumb is that spindles that leave a hole in the sample when they are removed do not give accurate readings. In these viscous samples, the “T” spindle gives a better index of the thickness of the sample. However, this cannot correctly be referred to as “viscosity.”</td>
</tr>
<tr>
<td><strong>Flow Curve Test at steady shear</strong></td>
<td>Many rheometers are capable of this basic test that measures viscosity as a function of shear rate.</td>
<td>More expensive initially, requires operators with more training. Needs rheological expertise for initial setup but not daily use.</td>
<td>Could be the basis measurement of the future. Knowing viscosity at various shear rates allows a single measurement to predict many aspects of quality.</td>
<td>This instrument is highly recommended. Modern instruments are reliable, robust and suitable for daily Quality Control. The initial capital investment is minimal compared to the business impact.</td>
</tr>
<tr>
<td><strong>Step Shear Rate</strong></td>
<td>Most instruments capable of running the flow curve test mentioned above can also run this test that steps quickly from high shear rates to low or back again.</td>
<td>More expensive initially, requires operators with more training. Needs rheological expertise for initial setup but not daily use.</td>
<td>Other tests measure how viscosity changes with different shear rates, this test reveals how it will change with shearing at the same rate but different times. For example, after shaking a dressing, how quickly will it regain a high viscosity and cling to the salad?</td>
<td>The flow curve test measures how shear rate dependent a sample is. The step shear rate test measures how sensitive a sample is to shear “history” or time. Some samples regain viscosity quickly and some take more time. This is a property called “thixotropy.”</td>
</tr>
</tbody>
</table>
A comment on quality:
Quality is not a single dimension. That is, one number can never express if a product meets all the customer’s expectations. In the future, quality measurements will need techniques capable of predicting consumer responses in a variety of dimensions. One dimension may be stability, another may be mouthfeel. Often, what is good for stability has a negative effect on mouthfeel. A single number could not encompass all of what the customer expects. Meeting all of the customer’s expectations for the product is necessary if the product is to be considered “high quality.” New techniques and approaches are needed for that.

Vendor Information
It is advisable to consult with the equipment vendor regarding questions related to the instruments or tests presented in these guidelines. Below is a list of vendors that manufacture and/or sell rheometers and viscometers.

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Web site Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bohlin Instruments</td>
<td><a href="http://www.bohlin.com">http://www.bohlin.com</a></td>
</tr>
<tr>
<td>Brookfield</td>
<td><a href="http://www.brookfieldengineering.com">http://www.brookfieldengineering.com</a></td>
</tr>
<tr>
<td>Anton Paar/Physica</td>
<td><a href="http://www.anton-paar.com">http://www.anton-paar.com</a></td>
</tr>
<tr>
<td>Reologica Instruments AB (Sweden)</td>
<td><a href="http://www.reologica.se/">http://www.reologica.se/</a></td>
</tr>
<tr>
<td>Thermo Scientific</td>
<td><a href="http://www.thermoscientific.com">www.thermoscientific.com</a> (HAAKE Rheometers &amp; Viscometers)</td>
</tr>
<tr>
<td>Malvern Instruments</td>
<td><a href="http://www.malvern.com">www.malvern.com</a></td>
</tr>
<tr>
<td>ATS Rheo Systems</td>
<td><a href="http://www.atrsystems.com">www.atrsystems.com</a></td>
</tr>
<tr>
<td>Formulaction</td>
<td><a href="http://www.formulaction.com">www.formulaction.com</a> (Turbiscan)</td>
</tr>
</tbody>
</table>

Revised 2009-2015
Overfill Capacity Testing (Density) Procedure – Mayonnaise & Spoonable Dressings

1. PURPOSE
   1.1. To ensure that fill level in mayonnaise and spoonable dressing products meet net volume label claim.

2. SCOPE
   2.1. A standardized methodology for testing the fill volume of mayonnaise and spoonable dressings requiring volume fill verification.

3. FREQUENCY
   3.1. At start up and at pre-determined frequency based on operational run time

4. RECORD
   4.1. Overfill Capacity – Online Test Report Form or Other Data Reporting Form
   4.2. NIST Handbook 133 - Table 2.6, MAV for Packages Labeled by Liquid and Dry Volume
   4.3. Vendor Jar Overfill Capacity Specification Sheet

5. EQUIPMENT
   5.1. Scale (Appropriate gram range for product tested)
   5.2. Distilled water with dispensing burette
   5.3. Certified test weight for scale calibration
   5.4. Appropriate sized jar opening cover disk
   5.5. Filled jar of product from each production line
   5.6. Calculator

6. PROCEDURE
   6.1. Daily Operations
      6.1.1. Acquire a blank On-Line Test Report Form (or other data reporting form) for each production line scheduled to run.
      6.1.2. Fill out the appropriate information at the top of the form:
      6.1.2.1. Date:
      6.1.2.2. Production line designation number
      6.1.2.3. Item Number: 10 digit UPC number
      6.1.2.4. Description: (Name of Product)
      6.1.2.5. Tester: (Person performing the tests)
      6.1.2.6. Volume Size of jar: (In ounces and milliliters)
      6.1.2.7. Minimum individual MAV:
         6.1.2.7.1. Using Table 2.6 of the NIST Handbook, find the volume range you are testing and obtain the MAV number in milliliters (mL).
         6.1.2.7.2. Subtract that number from the label claim number to get the individual minimum MAV volume for the jar/product.
6.1.2.7.3. Example: If testing for a 16 oz jar; the table range for labeled quantity would be (More than 11.75 fl. oz. to 17.00 fl. oz.). The MAV would be 0.5 fl. oz or 14.7 mL. Subtract this number from the product’s label quantity of 473 mL to get the minimum individual MAV of 458.3 mL. Record this number on the On-Line Test Report.

6.1.2.8. Density Blend Range

6.1.2.8.1. Acquire blend range from Density Blend Table Chart. Record range on form. This is an internal company specification.

6.1.3. At start-up of each production line, pull one jar from line past the filler and prior to the cap sealer. Do not pull jar until product is being packed as an acceptable finished product.

6.1.4. Take jars to the quality lab. Allow the samples to sit for 20 minutes before testing.

6.1.5. Calibrate the scale being used with the appropriate certified weight. Record on the form.

6.1.6. Record the test start time on the form.

6.1.7. Place the jar without the cap, but with the cover disk on the scale. Record the gross weight of the jar (in grams) on the form in Column (A).

6.1.8. Leaving the jar on the scale, use the burette to begin filling the jar with water through the center hole in the cover disk.

6.1.9. Continue adding water until all of the air in the container has been displaced and the water begins to rise in the center hole of the disk.

6.1.10. Stop the filling procedure when the water fills the disk hole and domes up slightly due to the surface tension. (Note: If the water dome beaks on the surface of the disk, the container has been overfilled and the test is void.)

6.1.11. Record the weight of the jar filled with water in Column (B) on the form. This is the total weight.

6.1.12. Calculate and record the headspace weight in Column (C) by subtracting Column (B) (total weight) from Column (A) (gross weight).

6.1.13. Empty, clean, and dry the jar. Weigh empty jar and the cover disk on the scale. Record the weight in Column (D). This is the tare weight of the jar and cover disk.

6.1.14. Calculate and record the net weight of the product in Column (E) by subtracting Column (A) (gross weight) from Column (D) (tare weight). This is the net weight of the product in the jar.

6.1.15. Center the disk and refill the jar with water until water domes up slightly through the disk hole.

6.1.16. Record the weight in Column (F). This is the total weight of jar and water.

6.1.17. Calculate and record net weight of the water in Column (G) by subtracting Column (F) (total weight) from Column (D) (tare weight). This is the net water weight in the jar.

6.1.18. Calculate and record fill volume of the product in milliliters (mL) in Column (H) by subtracting Column (G) (water weight) from Column (C) (headspace). This is the fill volume of the product in the jar.

6.1.19. Calculate the density in Column (I) by dividing Column (E) (weight of product) by Column (H) (fill volume). The resulting number should be in a 0.00 format.

6.1.20. Record the nitrogen level setting of the line where the sample was collected.
6.2. Test Result Evaluation

6.2.1. **Fill Volume**

6.2.1.1. Compare the fill volume in Column (H) to the individual MAV number. If the value is below the MAV, follow company procedure for disposition of the product and next steps.

6.2.1.2. If the fill volume is above the MAV number, but below label volume net weight, have operations adjust the fill volume and perform recheck to verify the product (jar) volume exceeds label claim.

6.2.1.3. Calculate the average from individual data in Column (H) (fill volume) and Column (I) (density) at the end of the production run. The average from Column (H) **MUST** meet or exceed the label claim. If not, follow company procedure for disposition of the product and next steps.

6.2.2. **Density:**

6.2.2.1. Compare the density results to the Density Blend Range at the top of the form.

6.2.2.2. If the density is out of the Density Blend Range on the high end, notify batch operator to adjust the nitrogen level upward (this decreases the density). Record adjusted level and retest the density. Keep adjusting the nitrogen upwards until test is within range.

6.2.2.3. If the density is out of range on the low end, notify batch operator to adjust the nitrogen level downward (this increases the density). Record adjusted level and retest for density. Keep adjusting downward until the test is within range.
1. **PURPOSE**
   To ensure that the fill level for mayonnaise and spoonable dressings meets net volume label claim.

2. **SCOPE**
   To standardize the methodology for testing the fill volume of mayonnaise and spoonable dressings requiring volume fill verification.

3. **FREQUENCY**
   3.1. Every hour during production runs.

4. **RECORD**
   4.1. On-Line Test Report Form or other data sheet to record the overfill volume capacity (density)

5. **EQUIPMENT REQUIRED**
   5.1. Electronic bench top weigh scale
   5.2. Center holed jar cap or Cover disk

6. **PROCEDURE**
   6.1. Work Instructions
6.1.1
Acquire On-Line Test Report form (or other data sheet) for recording information and performing calculations. Fill out the header of the form for the product being tested before starting the test.

6.1.2
Pull jar off line past filler and prior to capper and let set for 10 minutes. Temperature of product for testing should be around 68°F. (Reference NIST 133 Handbook Table 3.1 Reference Temperature for Liquids.)

6.1.3
Begin measurement process. Record start time of test on record. Be sure to calibrate scale prior to start, following the appropriate calibration guidelines for scale measurement range.
6.1.4
Weigh jar with product and the appropriate sized cover disc lid. Record the weight in column (A). This is the gross jar weight.

6.1.5
Leaving the jar on the scale, add water slowly to the jar until close to the rim.
### 6.1.6
Place cap disk with center hole on jar screwing down cap completely or place a cover disk on the jar. (Do not initially overfill jar with water. The water should not spill over the rim.)

---

### 6.1.7
Continue filling jar with water using a syringe or burette inserting water into the center hole until a meniscus bubble of water forms at the top of the hole.
(Do not overfill with water. If the water dome breaks/spills on the surface of the cap or disk, the container has been overfilled and the test is void.)
Record weight of the jar with water in Column (B). This is the total weight.

Also, calculate the headspace water weight by subtracting Column (A) from Column (B) – (total weight – gross weight).

Record the results in Column (C) on the form.
6.1.8
Take jar over to sink and empty jar of water and product.

6.1.9
Rinse jar out thoroughly with hot water and dry completely.
<table>
<thead>
<tr>
<th>Section</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1.10</td>
<td>Weigh empty jar and disk on scale and record the weight in Column (D). This is the tare weight. Calculate and record the net weight of the product that was in the jar by subtracting Column (A) from Column (D) – (tare weight – gross weight). Record the results in Column (E) as a gram weight (g).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section</th>
<th>Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1.11</td>
<td>Fill jar with water filling close to the top. Replace the cover disk (or cap with center hole) and finish filling with syringe or burette until meniscus forms in center hole. Record weight in Column (F). This is the total weight of water in the jar.</td>
</tr>
</tbody>
</table>
6.1.12
Calculate the net weight of the water by subtracting Column (F) from Column (D) – total weight of empty jar and disk – total weight of water and jar.

Record the total volume of the water in Column (G).

<table>
<thead>
<tr>
<th>Weight of H2O (g)</th>
<th>(Total Volume)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calc.(F-D)</td>
</tr>
<tr>
<td></td>
<td>(G)</td>
</tr>
</tbody>
</table>

6.1.13
Calculate and record the fill volume of the jar in (mL) by subtracting Column (G) from Column (C) – total volume of water – headspace weight.

This is the fill volume of the product in the jar.

Record this value in Column (H).

<table>
<thead>
<tr>
<th>Fill Volume (ml)</th>
<th>Calc.(G-C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(H)</td>
</tr>
</tbody>
</table>
6.1.14
Calculate the density by dividing Column (E) by Column (H) – weight of product ÷ fill volume.

Record the density in Column (I) (g/mL)

Compare the density of the product to the company established range.

7 CORRECTIVE ACTIONS:
7.1 Follow company procedure for any non-conformances.
### OVERFILL CAPACITY TESTING - DENSITY OF MAYONNAISE & SPOONABLE DRESSINGS ON-LINE TEST REPORT

**Date:** ____________  **Line:** ____________  **Tester:** ________________________________  **Density Blend Range**

**Item Number:** ____________________________  **Volume Size of Jar:** _______ (oz.) _______ (ml)

**Description:** ________________________________  

*Minimum Individual MAV: ___________

**Scale Calibrated (Check box)** □

<table>
<thead>
<tr>
<th>Time Checked</th>
<th>Gross jar Weight (g)</th>
<th>Fill jar with H20. Total Weight (g)</th>
<th>Headspace (g) Calc. (B-A)</th>
<th>Empty jar, Wash &amp; Dry. Tare Weight</th>
<th>Weight of Product (g) Calc.(A-D)</th>
<th>Fill jar with H20. Total Weight (g)</th>
<th>Weight of H20 (g) (Total Volume Calc.(F-D))</th>
<th>Fill Volume (mL) Calc.(G-C)</th>
<th>Density Calc.(E/H)</th>
<th>Nitrogen Setting</th>
<th>*Adjusted Nitrogen Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td>(B)</td>
<td>(C)</td>
<td>(D)</td>
<td>(E)</td>
<td>(F)</td>
<td>(G)</td>
<td>(H)</td>
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</table>

Perform test at start-up and during product operational running time.

Average:

Acquire Maximum Allowable Variance (MAV) number for individual jars for volume size range from NIST Handbook 133 - Table 2.6, Packages Labeled by Liquid and Dry Volume.

If individual jar below label claim - Column H, adjust fill volume and retest. (*If below MAV, notify QC and Production Supervisor, stop line and hold product to last check)

**Average Fill Volume from product run MUST meet or exceed label claim in mls (*Contact Quality and Production Supervisor if below)**

* Record Nitrogen setting at start up. Adjust Nitrogen setting if Density is outside operational range. Note adjusted setting in record. Increase Nitrogen to lower Density / Decrease to raise Density

Quality Management Verification Signature: ________________________________  **Date:** ____________

---

*Record on Line = Label claim - MAV number for jar size

Refer to Density Chart for Blend range. This is based on internal company
Overfill Capacity Flow- Density Calculation of Mayonnaise and Spoonable Dressings with No Smooth and Level Surface

Start

- Beginning of Shift, Pull one finished product jar prior to capper
- Take jar to quality lab. Allow jar to sit for 20 minutes before testing
- Acquire the Overfill Capacity Online Test Report Form
- Fill out top portion of form

Header Inputs:
- Date / Line
- Item # / Description
- Tester / Vol. of Jar
- Min MAV Value
- Density Target Range

- Acquire Individual Minimum MAV number based on jar label claim in the NIST Handbook 133 Table 2.6

Add water until a slight dome bubble of water appears in hole. Do not overflow water onto disk top.

- Leaving the jar on the scale, add water to jar using a burette. Place burette tip over center hole in cover disk.
- Weigh Jar with product with cover disk on top of jar. Record Gross weight in Column A

Begin Measurement Process. Start- Record time of test

Calibrate weight scale and check box on form

Subtract MAV number in table from volume of jar. This is your Minimum Maximum Allowable Variance. Record on form

End

- Center disk over empty jar and fill with water until slight dome bubble of water appears in hole. Record weight in Column F
- Calculate and record the net weight of the water by subtracting Column F from Column D. Record in Column G
- Calculate and record fill volume of jar in millimeters (ml) by subtracting column G from Column C. This is the fill volume of mayonnaise in the jar. Record in Column H
- Calculate the density by dividing Column E by Column H. Record the density in Column I

Record weight of jar with water in Column B

Calculate and record the headspace water weight by subtracting Column A from Column B. Record in Column C

Empty the jar completely. Clean and dry the jar. Weigh jar and cover disk. This is your tare weight. Record in Column D

Record weight of jar with water in Column B

Calculate and record the net weight of the product by subtracting Column A weight from Column D. Record in Column E

Center disk over empty jar and fill with water until slight dome bubble of water appears in hole. Record weight in Column F

Calculate and record fill volume of jar in millimeters (ml) by subtracting column G from Column C. This is the fill volume of mayonnaise in the jar. Record in Column H

If density is out of range on the high side increase nitrogen in blend to decrease density. Decrease Nitrogen to increase density if low.

Compare Density results to established range for product

Link To NIST 133 Handbook Tables - Ref Table 2.6
http://www.docs-archive.com/view/8683ea8ce7cdf825ae6f1ace26e52b6e/AppendixA-Tables.pdf

Link to NIST 133 Handbook 2013 Volumetric Test Procedure Mayonnaise, Salad Dressings with No Smooth and Level Surface
Section VIII
ADS’ Methods and Procedures Manual

Specific Gravity Determination for Pourable Dressings, Sauces and Marinades

PURPOSE: Determine the Specific Gravity (Density) of pourable dressings, sauces and marinades to ensure proper fill volume is achieved during manufacture. National Institute of Standards and Technology (NIST) Handbook 133 requires “on-shelf” net contents to be equal to or greater than declared net contents for each lot of product produced.

TOOLS AND EQUIPMENT: Scale, Density Cup (of known volume), Calculator

100 ml Density cup elcometer® 1800/5 SKU: K0018000M005
Note: The product discharge hole can be enlarged slightly to allow particulates to pass through.

PROCEDURE:

1. Obtain product (that has gone through the entire production process) that is at least three months old for testing. If possible, test three lots. The procedure should be conducted using product that has been maintained at its storage temperature. For example, the specific gravity of a refrigerated dressing should be conducted using the refrigerated product.
2. Tare the clean, dry density cup. This is weight “T.”
3. Gently shake or mix the product being careful not to incorporate air.
4. Completely fill the cup making sure no voids (air pockets) occur. Note: A small spatula can help break up air pockets in thicker products.
5. Carefully put the top on the cup, keeping it as square as possible. If a piece of particulate plugs the discharge hole, a small probe can be used to dislodge it. Several milliliters (mL) of product should exit the hole if the cup is filled properly.
6. Clean off excess product and reweigh the filled cup. This is weight “S.”
7. Repeat steps 2-6 (same sample) for verification.
8. Calculate Specific Gravity using the following method:

**CALCULATION**

1. Sample Weight (g) = Weight “S” (grams (g)) - Weight “T” (g)
2. Specific Gravity (SG) = Sample Weight (g)/Cup Volume (mL)**
3. Fill target (in grams) = Specific Gravity x declared net contents (mL)
4. Difference (D1-D2)/Density Average X 100%

Duplicate results (#4 above) should be within 1% or the test should be repeated with a third sample.

Example: D1=0.985; D2=0.991

\[0.985-0.991=0.006\]

\[0.006/0.988 \times 100 = 0.61\% \text{ (A third test is not required)}\]

** - It is important to verify the volume of the cup used for this test.

** Fill Weight Calculation for Two Stage Fills**

1. Declared label net contents (in mL) X SG = Fill Target (FT) in grams
2. Aqueous Phase Fill Weight = (([100 - Oil Phase % weight in formula]/100) X FT
3. Oil Phase Fill Weight = (Oil Phase Weight % in formula/100) X FT

Results of #2 and #3 above should add up to the fill target weight.