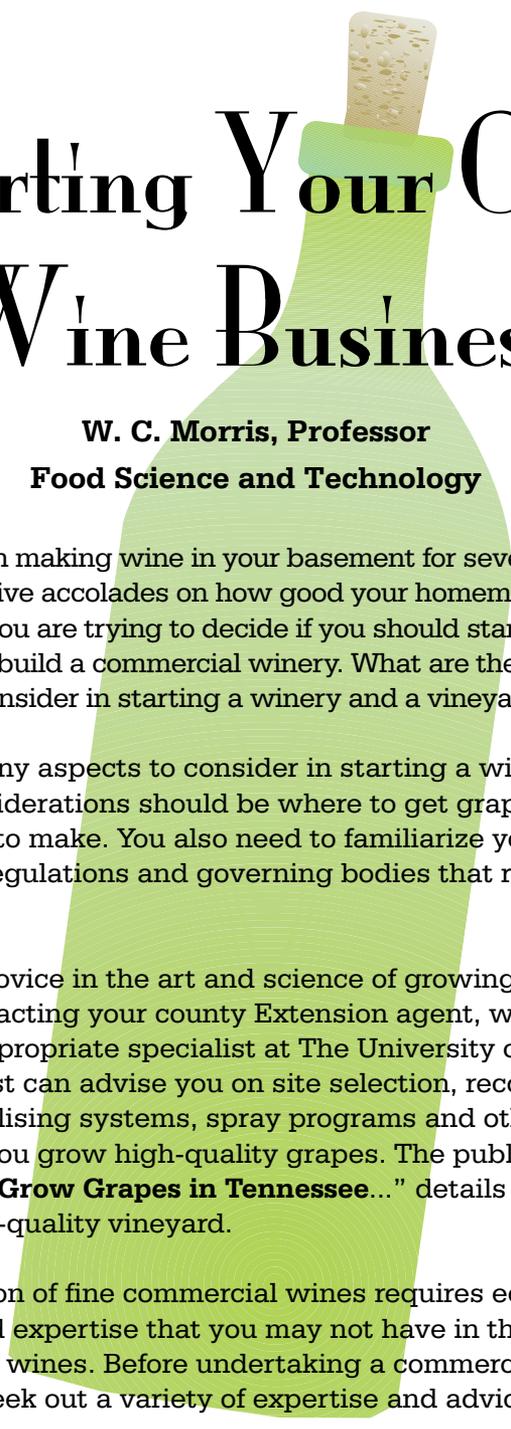


A large, stylized illustration of a wine bottle and a wine glass. The bottle is green and the glass is filled with red wine. The background is a light green gradient with decorative grapevines and clusters of grapes in various colors (red, purple, green) scattered around the bottle and glass.

Starting Your Own Wine Business

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Starting Your Own Wine Business

**W. C. Morris, Professor
Food Science and Technology**

You have been making wine in your basement for several years and routinely receive accolades on how good your homemade wine tastes. Now you are trying to decide if you should start your own vineyard and build a commercial winery. What are the factors that you should consider in starting a winery and a vineyard?

There are many aspects to consider in starting a winery. One of the first considerations should be where to get grapes and what kind of wine to make. You also need to familiarize yourself with the various regulations and governing bodies that regulate the industry.

If you are a novice in the art and science of growing grapes, we suggest contacting your county Extension agent, who can direct you to the appropriate specialist at The University of Tennessee. This specialist can advise you on site selection, recommended varieties, trellising systems, spray programs and other information to help you grow high-quality grapes. The publication “**So You Want to Grow Grapes in Tennessee...**” details the production of a high-quality vineyard.

The production of fine commercial wines requires equipment, materials and expertise that you may not have in the home production of wines. Before undertaking a commercial winery, you should seek out a variety of expertise and advice from such

people as reputable wine makers, wine consultants, equipment and ingredient suppliers and specialists at your university. The intent of this publication is not to instruct you on how to make wine. There are a multitude of other resources that detail the science and art of making wine. Several good references are listed in Appendix E. The objectives of this publication are to outline the process of obtaining approval from the various regulatory agencies and to define the minimum requirements of the facility and equipment needed for a commercial winery. The publication also defines basic equipment requirements and basic must and wine analytical techniques.

Regulatory Approval

The basic steps required for approval are:

1. Local authority approval
2. State approval (Tennessee Department of Agriculture)
3. Alcohol Beverage Commission – ABC approval (state)
4. Bureau of Alcohol, Tobacco and Firearms - BATF approval (federal)
5. Individual label approval (federal)
6. Register label with Tennessee Department of Revenue

Once you have made the decision that this is something you are committed to, it is time to understand the process required to receive a license to operate. The first step is to receive permission from your local authorities. The form received from the Alcoholic and Beverage Commission (ABC) entitled “Winery Approval By Authorities of Jurisdiction” must be completed and signed by a local official such as the county commissioner/ executive, mayor, etc. The complete list of forms supplied by the ABC is shown in Appendix A. These must be completed and submitted to the ABC for approval.



State Approvals:

The Tennessee Department of Agriculture can be contacted at:

Tennessee Department of Agriculture
Regulatory Services
Food & Dairy Program
Ellington Agricultural Center
P.O. Box 40627 Melrose Station
Nashville, TN 37204
Phone: (615) 837-5177
e-mail: rheinrich@mail.state.tn.us

See Appendix B for the TDA Inspection form.

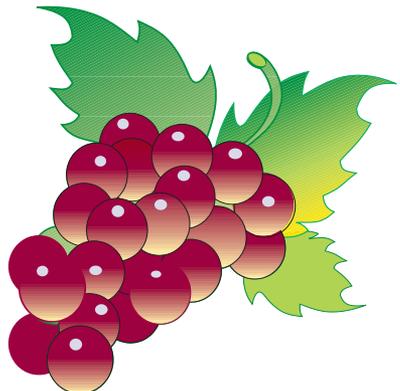
The ABC office can be contacted at:

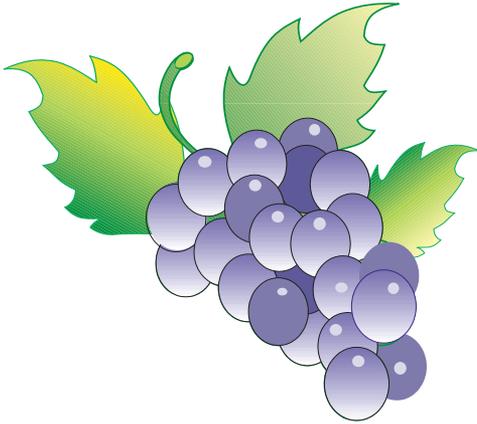
Alcohol Beverage Commission
226 Capitol Blvd.
Suite 300
Nashville, TN 37243-0755
Phone: (615) 741-1602, ext.111

See Appendix A for a list of forms obtained from ABC.

Your label must also be registered with the Tennessee Department of Revenue. Their address and telephone is:

Tennessee Department of Revenue
Taxpayer Services Division
Andrew Jackson State Office Bldg.
500 Deaderick St.
Nashville, TN 37242
Phone: (615) 253-3580





Federal Approvals

As these steps are being completed, you must also apply for a Bonded Wine Permit from the Bureau of Alcohol, Tobacco, and Firearms (BATF). This allows you to produce and bottle wine at your facility. A packet of forms may be obtained from:

BATF
550 Main Street
Cincinnati, OH 45202
Phone: (513) 684-3334

These forms can also be obtained from BATF's Web site:
www.atf.treas.gov

See Appendix C for a list of BATF forms.

In addition, the BATF must approve your bottle labels for each product you wish to produce and sell. To help you through this process, it is suggested that you contact the following address, telephone number, or fax:

Vic-Key Consultants
4021 Blue State Dr.
Alexandria, VA 22306
Phone: (703) 354-0566
Fax: (703) 660-9810



Facilities Approval

A first step is to ask your county health department where your septic system should be located (assuming you are not hooked

up to city sewer). If you wish to discharge into the city sewer system, written permission is required from the city.

The county health department must test your water supply if it is not coming from a municipal water treatment plant. This must be done on an annual basis and records maintained.

The next step is to obtain the approval of your winery facility from the Tennessee Department of Agriculture (TDA). This begins by submitting your floor plans or building design and layout to TDA for approval. These drawings should include the types of materials you plan to use in construction; floor, ceiling and wall coverings; and location of hand-washing sinks and the three-compartment sink. To receive approval from TDA, the facility must comply with the Good Manufacturing Practices in Manufacturing, Processing, Packing or Holding Human Food (GMPs) set forth in the United States Code of Federal Regulations (CFR), Title 21, Part 110. The ABC will not grant a license until your facility is approved by the Tennessee Department of Agriculture. The license granted by the ABC is your distillers or rectifiers license.

The GMPs are broken down into the following areas:

- a. Plant and grounds
- b. Equipment and utensils
- c. Sanitary facilities and controls
- d. Sanitary operations
- e. Processes and controls
- f. Personnel

Part of the good manufacturing practices for all food plants is reprinted in Appendix D; for additional information see the Code of Federal Regulations, (CFR), Title 21, parts 100-169.

Remember, as you develop plans for your food processing facility, the Tennessee Department of Agriculture, Regulatory Services, Food and Dairy Section requires a review of these plans. Listed below are the bases of their review and the key points to be addressed in your new or remodeled facility:

1. Walls, floors and ceilings must be light-colored, smooth, non-absorbent and easily cleanable in preparation, handling, stor-

age, warewashing areas and toilet rooms. (If concrete floors are used, they must be sealed.)

2. All fixed equipment must be sealed to the wall, unless sufficient space is provided for easy cleaning between, behind and above each unit.

3. All wiring and plumbing must be installed in a way that does not obstruct or prevent cleaning (behind wall).

4. Floor-mounted equipment, unless easily moveable, shall be sealed to the floor, or elevated to provide at least a 6- inch clearance between the floor and equipment

5. Lights located over wine/food preparation facilities and warewashing areas must be shielded, coated or otherwise shatter-resistant.

6. Restrooms must be properly ventilated.

7. Condensation drain lines cannot be directly connected into the sewer system. There must be an air-gap between two pipes (condensate drain and sewer system).

8. All threaded faucets must have a backflow preventer installed.

9. All outer doors and restroom doors must have self closures.

10. A conveniently located hand-wash sink must be provided in each wine/food preparation and warewashing area. Hand-washing facilities shall also be located in, or immediately adjacent to, toilet rooms or their vestibules.

11. Grease traps, if used, shall be located to be easily accessible for cleaning.

12. Except for properly trapped open sinks, there shall be no direct connection between the sewage system and any drains originating from equipment in which wine or juice, equipment or utensils are placed.

13. Dumpsters and outside storage areas must be located on smooth, non-absorbent surfaces.

14. Ice shall not be provided for self service unless served through a sanitary ice dispenser.

15. Potable water sufficient to meet all needs shall be provided from a source approved by the Tennessee Department of Environment.

16. All sewage, including liquid waste, shall be disposed of by a public sewage system or by a sewage disposal system approved by the Tennessee Department of Health.

17. Warewashing sinks with two or three compartments shall be provided and used. These compartments shall be large enough to accommodate the immersion of equipment and utensils, and each compartment shall be supplied with hot and cold potable running water. Hand-washing is prohibited in warewashing sinks.

18. Equipment, including ice makers and ice storage equipment, shall not be located under exposed or unprotected sewer lines, water lines that are leaking or on which condensed water has accumulated, open stairwells or other sources of contamination.

19. At least one service sink or curbed cleaning facility with a floor drain shall be provided for the cleaning of mops and for the disposal of mop water or similar liquid wastes.



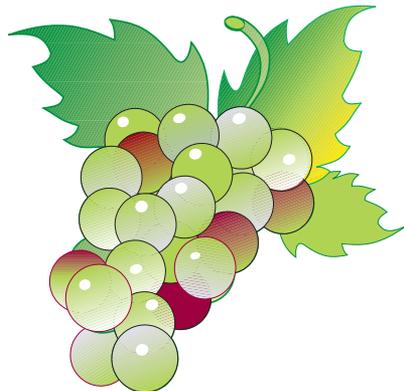
Equipping a Winery

(Credited to: Prospero Equipment Co, Muscatine, IA,
David Metz Feb, 2001)

When thinking of building your own winery, it is always good to know what is ideal, what your capital will allow and how will you proceed. There are certain basic pieces of information you should consider before making a large investment, but always think ahead and do not try to shortcut your needs. Listed below are some considerations you should evaluate before you start purchasing equipment. In addition, visit wineries the size you plan on starting or expanding to and work with suppliers and/or visit consultants. This will allow you to avoid some common mistakes. The list below may help guide your decision process and offers a starting point for decisions:

Planning:

1. Capital determines the size.
2. Start large enough – plan where you want to be in 2-3 years.
3. Have enough ceiling height – 15 feet is ideal.
4. Have a loading dock.
5. Have adequate electrical power – need three-phase power.
6. How much total capacity should you have? Ideally, one-third more total tank storage capacity than your total yearly production.



Typical Variable Capacity Tank Dimensions

1,000 lt.	264 gal.	41" dia. X 65" high
2,000 lt.	528 gal.	52" dia. X 75" high
3,000 lt.	792 gal.	55" dia. X 95" high
4,000 lt.	1,056 gal.	63" dia. X 95" high
5,000 lt.	1,320 gal.	63" dia. X 119" high
6,000 lt.	1,585 gal.	75" dia. X 119" high
8,000 lt.	2,113 gal.	75" dia X 139" high

Ref. "Equipping The Start Up Winery" Powerpoint, Dave Metz, Prospero Equipment Corp. , 725 Climers St. Muscatine, IA 52671

Note: Tanks: Sold by the gallon; larger tanks cost less per gallon, but do not buy larger tanks than you need.

7. Need fermentation temperature control on tanks greater than 500 gallons.

8. How many tons per hour do you need to process? This determines size of press/speed of destemmer.

NOTE: All aspects of a grape-processing operation affect its production. Equipment should be matched in capacity. "Rule of Thumb": Your production per hour is less than half of your destemmer production.

9. Use an external must pump to go from destemmer to press.

10. Presses: vertical basket press, membrane press (presses are sold by "hectoliter").

11. Pumps: No one pump can meet all your needs.

- flexible impeller pumps: wide range of uses; but not desirable for filtration because delivery falls off with increased back pressure.

- a 2-inch flexible impeller “must” pump can move 20 tons of “must” per hour, and a 3-foot hose should be used.
- use 3-phase pump motors.
- phase converter.

Filtration:

12. Plate and frame filter, 40 cm pads

- 20 plate and frame filter is correct for 2,000–20,000 gallon per year winery

13. Consider Lees Filters – they can pay for themselves the first year.

Bottling:

14. Determine your package design

- labels, capsules and bottle type
- how much will you want to bottle per day?

15. Semi-automatic filter, corker, spinner and pressure-sensitive labeling machine costs about \$10,000

- Flush with inert gas
- Six-spout table, top-gravity filters will do 600 bottles per hour; cost about \$1450
- Corking – hand corker costs about \$75; semi-automatic corker costs about \$3800
- Table-top, heat-shrink over
- Table-top foil spinner
- Labeling – semi-automatic, pressure-sensitive machine



Mistakes and Misconceptions of Start-up Wineries *

It is vital that the beginning winery owner understand that he/she will be working with large quantities of materials; that is, grapes, wine and packaging materials by the ton.

Important Figures to Consider:

- One ton of grapes equals approximately 220 gallons of crushed fruit (tank space).
- One ton of pressed grapes is approximately 130-180 gallons of liquid, depending on type of grape and type of press.
- One pallet of bottles equals 133 gallons of wine.
- There are 50-56 cases of wine bottles per pallet.
- A full case of wine weighs 48 pounds.
- A full pallet of wine weighs 2,500 pounds.
- With a forklift, you can stack empty bottles three pallets high.
- Filled bottles can be stacked two pallets high.
- To put this into perspective, let's use the example of a small start-up winery with five acres of vines in full production.
- Five acres of vines can produce 20 tons of grapes at four tons per acre.
- 20 tons equals 4,400 gallons of red must.
- 20 tons equals 2,600-3,600 gallons of pressed whites.

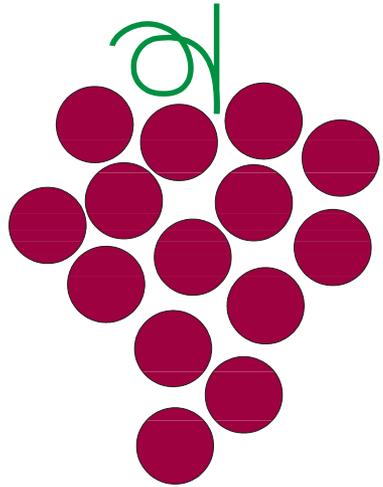
- Add 25 percent to the volume of your tanks for headspace during the fermentation of the red wines.
- You can lose up to 10 percent of your total production as settling, fermentation and fining lees loss. Owning a lees filter reduces this loss to 2-3 percent.
- You need to have a way to handle TONS of materials. Therefore, a forklift is a necessity – one with at least a 3,000 to 4,000 pounds of lift.
- You cannot buy bottles one pallet load at a time. Keep in mind that one pallet is only 133 gallons and that you will most likely bottle all of the same wine at one time. For our example above with a five-acre vineyard:
- 3,600 gallons of must minus 10 percent losses = 3,240 gallons of finished wine.
- 3,240 gallons of wine equals 16,350 750 ml bottles, or 1,362 cases of wine, or 26 pallet loads (at 52 cases per pallet).

Bottles will be delivered by tractor trailer. Do not expect them to be delivered by a little lift gate truck. You are expected to be able to unload (and load) pallets at a bed-level dock using pallet jacks or a forklift. If you buy grapes, they will come in picking bins that will have to be handled by a forklift. You need to be able to weigh each bin (to confirm weights for payment) and lift and dump the bin into the destemmer.



Elementary Wine Analysis

Certain chemical analyses need to be conducted to determine the various chemical adjustments in the must and wine. Following are the basic chemical analyses that you should be able to conduct and use routinely in making adjustments and helping to assess the quality of your must and wine. However, remember the final assessment is always based on your sensory determination.



Sugar

The sugar content of the juice used to make a wine directly impacts the final alcohol content of the finished wine, so determination of the initial total soluble solids content is important. Determination of the solids level in fermenting musts or juices is also important to help monitor the progress of the fermentation. The sugar content of finished table wines is generally reduced to between 0.5 percent (dry wine) to 3.0 percent (sweet wine). It is important to know the level of sugar, because it can affect the long-term stability of wine.

To measure sugar in juices and fermenting musts/juices, you can use either of two types of instruments: a hydrometer or a refractometer. Hydrometers are cylindrical glass tubes of varying lengths and diameters that are loaded with specific amounts of lead in the bottom and graduated at the top to allow measurement of the density of the liquid. The density measurement is related to a specific percent of sugar if a Brix^o hydrometer is used. The density of pure water is measured as 1.0; measurements above or below 1.0 indicate a solution with a higher or lower density than water. In raw juice or must, the measurement is read as “degrees Brix,” and in fermenting juices/musts the measurement is read as “degrees Balling.” The two terms

are used to indicate percentage of sugar (Brix) or the relative viscosity of the fermenting liquid (Balling).

A rough calculation of the final alcohol content of the wine can be made using the °Brix measurement of the unfermented juice/must. For each initial °Brix of sugar in the must, approximately 0.535 percent alcohol will result. For a juice with 16 °Brix initially, the final alcohol content will be about 8.5 percent if all the sugars are fermented. The density of the juice/must will change as the sugars are converted into alcohol, allowing the monitoring of the progress of the fermentation. Sugars make the solution more dense, causing the hydrometer to float higher, while alcohol reduces the density of the solution, which depresses the float level. The two forces tend to offset each other, allowing relatively accurate measurements with the instrument. Hydrometers are available from most wine-supply outlets at very reasonable prices, generally around \$15. These “spindles” are available in many different Brix° ranges, but a set of four with the following ranges would serve the small winemaker very well:

- -5.0 - 5.0 degrees Brix°
- 0.0 - 8.0 degrees Brix°
- 8.0 - 16.0 degrees Brix°
- 16.0 - 24.0 degrees Brix°

Refractometers use the optical density of the solution to determine the sugar content. The optical density of the solution affects the angle of light refracted off its surface, and allows very accurate measurements of its density. The most accurate measurements are made at a specified temperature or are temperature-corrected. Once fermentation begins, refractometers should not be used. Refractometers are much more expensive than hydrometers and the increase in accuracy of the determinations of sugar content is generally not considered to be adequate justification for the expense, especially for home winemaking.

Finished wine-sugar levels are so low that we cannot make accurate measurements with hydrometers and refractometers. For these tests, we borrow from medical science and use

Clinitest kits, which are designated to detect sugars in urine. This test is relatively inexpensive and very accurate at low sugar levels. However, the test only measures reducing sugars. This means if you add sucrose (table sugar) it will not be measurable until it is inverted to glucose and fructose. You should wait for about 24 hours after sugar addition before making a residual sugar test. If you add corn sugar (glucose), you can test immediately. Typically, this test would be used when the hydrometer reading is 0 or below.

Acids – Total Titratable Acidity

The major acids in grapes are tartaric and malic acid, with small amounts of citric and other less widely recognized acids. As the grapes ferment, some additional acids are produced, including, in some cases, acetic, malic, lactic, propionic and butyric acids. Not all of these acids are beneficial or considered to enhance the wine, so steps are taken to prevent the formation of some and in certain cases, to enhance the formation of others. In all cases, the presence of acid and the pH of the wine directly affects the flavor, aroma, color and stability of the wine.

The total titratable acidity (TTA) of the wine is measured to determine the total amount of acid present in the wine, regardless of its identity. This measurement is used to help determine the level of preservative needed to render the wine safe for long-term storage, and to a great extent, the quality of the finished wine. Measurement of TTA is accomplished by titrating a sample of the wine with 0.1 N sodium hydroxide (NaOH) using a pH meter or phenolphthalein as an indicator of the titration endpoint. Phenolphthalein is a unique chemical compound that changes from colorless to a pinkish-red color at pH 8.2.

With white wines and very lightly colored pink wines, titration can be accomplished with phenolphthalein; with red wines it is best to use a pH meter due to the color interference with phenolphthalein's color change. In both cases, it is best to dilute your wine sample with distilled water before titrating to improve the accuracy of the measurement. Wine samples of 1.0-10.0 ml can be used, but keep in mind that the more wine in the sample, the more NaOH will be needed to titrate. Dilute the wine sample with at least five times the volume of distilled or

deionized water before titrating. If you use phenolphthalein, add two to three drops prior to titration. Standard 0.1 normal NaOH solution can be purchased from wine supply houses or from chemical suppliers.

Once you titrate your wine, the TTA of the wine is calculated by the following equation:

$$\frac{(\text{ml of NaOH solution used}) \times (\text{NaOH Normality}) \times (0.075) \times (100)}{(\text{ml of sample used})} = \text{TTA g/100 ml as Tartaric Acid}$$

NOTE: 0.075 is the factor to do the calculation in terms of tartaric acid for grape wines and 100 is a factor to obtain the calculation in terms of g/100 ml. If you want to calculate the TTA in other terms, you must modify the equation at these points.

Volatile Acidity

Several organic acids in wine are volatile and contribute to this constituent, but acetic acid is the predominant volatile acid. The measured volatile acidity level is expressed as grams of acetic acid per 100 ml. Wine normally contains a small amount of acetic acid as a result of fermentation. Spoilage organisms and malolactic bacteria produce more than the normal amount of acetic acid in wine, along with ethyl acetate and other volatile compounds that will be detected in the assay. The volatile acidity assay is therefore useful for the detection of spoilage and in commercial applications, to maintain compliance with federal regulations regarding the allowable volatile acidity level.

A true volatile acidity analysis must be conducted with an apparatus known as a Cash Still, but for the small wine maker, a close approximation can be done with the equipment normally present in your wine lab. Place 10 ml of your wine in a 100 ml or larger flask and add 50 to 100 ml deionized water. Bring the solution to a boil and allow to cool to room temperature. Measure the TTA of the boiled solution and compare it to the TTA of the wine. The difference in the TTAs can be attributed to the volatile acidity in the wine.



Cash still

Legal Limits for Volatile Acidity in Wines

Wine Type	BATF (g/L)	California (g/L)	OIV (g/L) ^a
Red	1.40	1.20	0.98
White	1.20	1.10	0.98
Dessert	1.20	1.10	
Export (all types)		.90	-----
Late Harvest ^b			

^a The whole acidity of various specially fortified old wines (wines subject to special legislation and controlled by the governments) may exceed this limit.

^b In the United States, white wines produced from unameliolated juice of 25 °Brix (or more); volatile acidity can be 1.5 g/L. Red wines produced from unameliolated must of 28 °Brix (or more); volatile acidity can be up to 1.7 g/L. Ref: *Wine Analysis and Production*, Zoecklein, B. W.; Fugelsong, K. C.; Gump, B. H. and Nury, F. S. Published. Chapman & Hall, 1995

Preservatives

Chemical preservatives are used to prevent oxidative damage and microbial spoilage and to promote the desired microbial growth for fermentation. Sulfur dioxide is used as both an antimicrobial and antioxidant agent in both “musts” and finished wines. Sorbic acid is used as an antimicrobial and antifungal agent. Both of these compounds have their uses in commercial and home winemaking enterprises.

To achieve the best long-term storage, a balance between pH and the sulfur dioxide level must be maintained. Sulfur dioxide will chemically bind to many different compounds in the wine (including the anthocyanin pigments in red wines) and reduce its effectiveness against microorganisms. You must determine the amount of sulfur dioxide to add based on assumptions about how much will be left after these chemical reactions take place. The optimal level is 0.8 ppm molecular sulfur dioxide; the proper amount of sulfur dioxide to be added is based on the wine pH can be determined using the following tables:

**Free Sulfur Dioxide Needed to Achieve
0.8 ppm Molecular Potassium Metabisulfite**

pH	ppm
2.9	11.0
3.0	13.0
3.1	16.0
3.2	21.0
3.3	26.0
3.4	32.0
3.5	40.0
3.6	50.0
3.7	63.0
3.8	72.0
3.9	79.0
4.0	99.0

**Formula and Chart for adding Potassium
Metabisulfite (KMBS)**

ppm	grams of
100	0.6570
90	0.6075
80	0.5400
70	0.4725
60	0.4050
50	0.3285
40	0.2700
30	0.2025
20	0.1350
10	0.0675

Note: (ppm) x (0.00657) = grams/gallon

“Campden” tablets, a commercially available pre-packaged source of potassium metabisulfite, will deliver 75 ppm sulfur dioxide per gallon of wine per tablet. If you use these tablets to treat your wines, refer to the charts above to determine the proper number of tablets to add.

Sorbic acid has a long history of use in the wine industry, and although the trend in general is to limit the amount of chemical preservatives in wines, it continues to be used today. In combination with ethanol and sulfur dioxide, sorbic acid is a powerful agent against yeast and mold growth. The minimum effective dosage in wine is 200 mg/l. Most countries specify a maximum level allowed to be used, but for home winemaking use, this level will be sufficient. High levels will effect the flavor and pH of the wine.

Preservative Analysis

For commercial purposes, analysis of preservative levels in wine is critical. For instance, some people are severely allergic to sulfur dioxide, and suffer shortness of breath, headaches, dizziness and in severe cases, coma. Most people, however, suffer no such side effects, and cannot detect its presence at levels below 70 ppm.

Analysis of sulfur dioxide in wine involves looking at both the free and total levels. Free sulfur dioxide analysis is relatively simple, utilizing iodine as a titrant. Bound sulfur dioxide must be liberated before it can be directly analyzed; the problem lies in capturing all that is liberated. Generally, unless the procedure is conducted very carefully with the proper equipment, losses during analysis and the resultant variation in the results make this analysis impractical for the home winemaker. There are commercial kits available that do an acceptable job of measuring sulfur dioxide levels. Most of these kits consist of ampules preloaded with appropriate chemicals under vacuum that will draw up samples of wine. The solution in the ampule, before wine addition, is clear. Upon drawing the wine into the ampule, the solution will turn blue. In the case of red wine, continue to add wine to the ampule until the solution reaches the approximate color of the original sample of red wine. With an original

sample of a white wine, continue to add wine to the ampule until the solution has cleared. These kits tend to be accurate to about $\pm 7\text{mg/l}$.

When adding sulfur dioxide in preparation for bottling, be sure to allow 20 to 30 minutes for all chemical reactions to occur before measuring the level present. Allow more time if the wine is cold.

Sorbic acid (from potassium sorbate) analysis is generally done by steam distillation of the wine and measurement by absorption of light in the UV range. Although the procedure is relatively simple, the average home winemaker does not have the equipment to do the analysis. Therefore, the best advice in the case of this preservative is to measure it carefully before you add it to the wine. The rule of thumb level is 200 ppm or mg/l. This level approximately equates to 1gm potassium sorbate/gallon of wine. Generally speaking, the flavor of the wine will not be affected, so do not depend on your tastebuds to determine the level you have added. Sorbate has little activity against bacteria and lactic acid bacteria can metabolize it to give a strong geranium-like odor. Therefore, it is generally recommended that you add the SO_2 before the sorbate to kill bacteria present.

Detecting Malolactic Fermentation

Malolactic fermentation (MLF) is a biochemical process that converts malic acid to lactic acid and carbon dioxide. This reaction results in an increase in the pH and a decrease in the total acidity of the wine, and is often used to change the character of a wine. Malolactic fermentation can be induced by adding malolactic culture to the fermenting must. In many cases, the intent is not to allow this reaction to occur; however, if it starts the normal fermentation will take an excessively long time. By detecting whether or not this reaction is occurring, you can forcibly stop the reaction and bottle your wines. Stopping the reaction can be done by lowering temperature, preservatives or filtration.

Typically, MLF is detected using a simple kit available from many wine supply houses. The kit consists of a gallon size container with a lid, chromatographic paper, developing sol-

vents and standards of malic, tartaric and lactic acid. Acetic acid may be added to this list if desired.

Procedure:

1. Handle the chromatographic paper by the edges only (your fingers contain acids). Draw a line with a pencil (do not use a pen because the ink will interfere with the results) parallel to the bottom of the paper, 1 inch from the bottom.

2. Using a micropipet or similar instrument (supplied in the kit), place a small spot of sample and the standard solutions on the line, separated by at least 2.5 cm. Duplicates of each spot are recommended. Label each spot with pencil below the line.

3. Allow the spots to dry in air and roll the paper into a tube. Staple the edges of the paper to hold it in this shape.

4. Add 70 ml of developing solvent to the container and insert the paper tube, spotted edge down. Securely fasten the lid onto the container.

5. When the developing solvent ascends to near the top edge of the paper, remove the paper from the jar and allow it to dry.



SO₂ analysis

Use of trade or brand names in this publication is for clarity and information: it does not imply approval of the product to the exclusion of others that may be of similar, suitable composition, nor does it guarantee or warrant the standard of the product.

6. When the paper has dried, the spots will appear yellow on a blue background. The acids present in each wine sample can be identified by locating the standard spot at the same level.

Remember that the presence of lactic acid is not conclusive evidence of MLF occurring in your wine. However, if the fermentation appears to be going longer than normal and the carbon dioxide production is slow but steady, this is good corroborating evidence.

Preservatives

Preservatives are chemicals used to prevent oxidative damage, microbial spoilage and to promote the desired microbial growth from fermentation.

Types of Preservatives

I. Sulfur Dioxide – antimicrobial, antioxidant

A. Potassium Metabisulfite – “Campden” tablets yields 75 ppm/gallon/1 tablet

B. Very pH dependent, lower pH, less SO₂ needed

C. 40 ppm free SO₂ usually sufficient unless pH > 3.4

D. Dry wines (pH < 3.4 and alcohol > 12%) are relatively stable and less dependent on SO₂

E. Taste threshold for most sensitive people is 70 ppm

F. SO₂ Analysis

Chemetrics test kit: Easy to use and accurate (no problems with handling chemicals)

1. after SO₂ addition, wait 20-30 minutes before sampling

2. follow procedure in test kit

II. Sorbic Acid – antifungal/antimicrobial

A. Source is potassium sorbate

B. Not active against bacteria in wines

C. Must be used with proper amount of SO₂

D. Use in wines with > 0.5 % residual sugar at bottling to prevent refermentation

E. Activity dependent upon alcohol level

1. higher alcohol, less sorbic acid needed

2. 200 ppm. usual treatment

- F. 1 gm Potassium sorbate/gallon = 200ppm – dissolve in small amount of wine before adding to batch
- G. Flavor usually not affected in sweet, fruity wines
- H. Measure amount carefully, analysis difficult. Add SO₂ before sorbic acid.

Ethanol Analysis by Ebulliometer

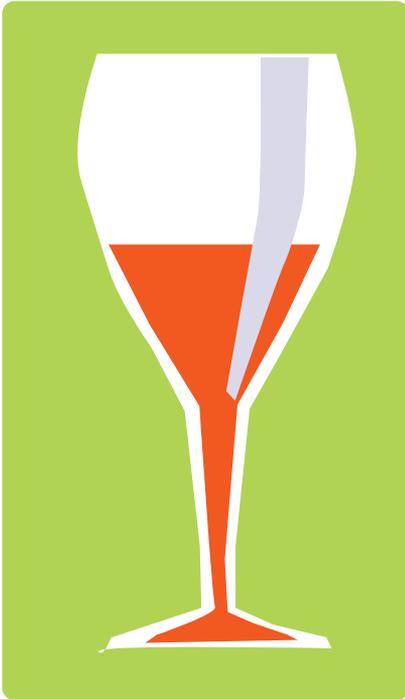
The determination of ethanol (EtOH) content of a wine is very important, not only commercially, but in home winemaking to determine how well your yeasts performed their responsibilities. The ebulliometer is a device that allows the determination of alcohol content by determining the difference in the boiling point of the wine versus that of pure water. By boiling the wine sample and measuring the temperature at which it boils, the alcohol content can be determined. The instrument consists of a boiler, reflex condenser, thermometer calibrated to read in tenths of a degree, a heat source (alcohol lamp), a measuring cylinder, and a sliding scale calculator.

When this procedure is used, the temperature measurement must be made as closely as possible to the point at which boiling begins. As the wine boils, both water and alcohol will be vaporized, although alcohol will vaporize first, which will raise the apparent boiling point over time, leading to erroneous measurements. In addition, corrections must be made for the atmospheric pressure at the time of the measurement to compensate for the difference in the boiling point of the water.

Once the boiling point is measured, the tables provided with the instrument are used to determine the alcohol content of the wine. Most home winemakers don't own an ebulliometer, as they tend to be on the expensive side. Since they are used relatively infrequently, it may be preferred to share the ownership of one between a group of winemakers.



Ebullimeter



Measuring pH

The pH of a solution is a measure of the strength of the acidity or alkalinity of the solution. The common instruments used to measure pH values are meters and papers. pH papers are generally inaccurate, especially when measuring colored wines, and are not recommended for winemaking use. pH meters, although more expensive, are accurate regardless of the wine type or style, and are highly recommended. The pH of the wine directly affects the flavor, aroma, color, clarity and stability of the wine. pH is used to determine how much preservative (see below) to add to the wine. Most white

wines need to be in the pH range of 3.2 -3.4 and red wines in the range of 3.3-3.5 to be most acceptable to the palate. The pH can be lowered by adding acid or, in certain cases, increased by cold-stabilizing the wine.

Cold stabilization of wine is a technique that takes advantage of the relationship between potassium bitartrate and the pH of the wine. Although potassium bitartrate is soluble in grape juice, cold temperatures and alcohol reduce its solubility. At below pH 4.6, wine can be placed in cool conditions (between 25 and 40 degrees F work best), and excess potassium bitartrate will fall out of solution, increasing the pH of the wine. At pH levels above 4.6, the exact opposite of this effect will be seen, resulting in an increased pH and a poor-quality wine. In stabilizing a wine, check and adjust the pH of the wine to below pH 4.6 to prevent the maladjustment of the wine to a less stable product.



pH meters

Sanitation in the Wine Room

Sanitation in the wine room cannot be overemphasized. You do not want to ruin all of the hard work you did in preparing the must and fermenting your wine, only to have “uninvited guests” join the fun as you bottle or cork. Very simple solutions of sulfur dioxide or chlorine (200ppm) can be made up and kept on hand to sanitize everything in the area, thereby eliminating many typical winemaking problems. If you use Campden tablets to treat your wines, and citric acid to preserve fruits, you have all you need to keep your bottles and work area clean.

Three to four Campden tablets + 1 tbsp. citric acid in 1 gallon of water will do an excellent job of sanitizing bottles before you fill them with wine. Water should be warm. Very hot water \geq (180 °F,) can also be used for sanitizing. However, this is difficult to obtain in a home hot-water system.

If you follow a few basic sanitation rules in your wine room, you will be miles ahead in your overall quality.

1.Clean up spills as they occur.

2.Clean bottles thoroughly with hot water and a brush before sanitizing them.

3. Sanitize all bottles, hoses, jugs, carboys and fermentation vessels prior to storage and again prior to use.

4. Store all materials dry – allow everything to drain completely before storage.



Appendix A

Tennessee ABC Forms

1. Tennessee Wineries – Approval by Authorities of Jurisdiction
2. Rules of Alcoholic Beverage Commission
3. Background Information & Other Business Interests
4. Alcoholic Beverage Commission Credit Check
5. Application for Distilled spirits and Wine Brand Registration
6. State of Tennessee Alcohol Beverage Commission Questionnaire
7. Application for Winery License Under T.C.A. § 57-120 As Amended By Public Chapter No. 126, 1977
8. 573-207. Grape and Wine Law

The most current inspection report must be kept available at the facility for public disclosure to any person who requests to review it.

ITEM	DESCRIPTION	WT.	ITEM	DESCRIPTION	WT.	SCORE
<input type="checkbox"/>	*01 Food		<input type="checkbox"/>	SEWERAGE		
<input type="checkbox"/>	*01 Source: sealed condition	5	<input type="checkbox"/>	Sanitary and valid water disposal	4	
<input type="checkbox"/>	*02 Original container, properly labeled	1	<input type="checkbox"/>	PLUMBING		
<input type="checkbox"/>	*03 FOOD PROTECTION		<input type="checkbox"/>	39 Inlets: maintained	1	
<input type="checkbox"/>	*03 Potentially hazardous food meets temperature requirements during storage, preparation, display, transportation	5	<input type="checkbox"/>	40 Cross-connection back siphonage: backflow	5	
<input type="checkbox"/>	*04 Facilities to maintain product temperature	4	<input type="checkbox"/>	TOILET & HANDWASHING FACILITIES		
<input type="checkbox"/>	*05 Temperature provided and conspicuous, accurate	1	<input type="checkbox"/>	41 Number: convenient, accessible, designated, installed	4	
<input type="checkbox"/>	*06 Potentially hazardous food properly thawed	2	<input type="checkbox"/>	32 Toilet rooms: enclosed, self-closing doors. Fixtures: good	2	
<input type="checkbox"/>	*07 Cross-contamination prevented: damaged/soiled food segregated	4	<input type="checkbox"/>	42 Toilet rooms: Tissue, hand cleaner, sanitary towels/paper		
<input type="checkbox"/>	*08 Food protection during storage, preparation, display, dispensing, packaging, transportation	2	<input type="checkbox"/>	GARBAGE & RECYCLE: DISPOSAL		
<input type="checkbox"/>	*09 Handling of food (cool min/max)	2	<input type="checkbox"/>	33 Containers or receptacles: covered, adequate number, insect-proof if relevant, pick-up frequency, clean	2	
<input type="checkbox"/>	*10 In use, food dispensing utensils properly stored	1	<input type="checkbox"/>	34 Outside storage area and enclosure: properly constructed, clean, controlled location	1	
<input type="checkbox"/>	*11 Personnel with infectious material	5	<input type="checkbox"/>	INSECT, RODENT, ANIMAL CONTROL		
<input type="checkbox"/>	*12 Hands washed and clean, good hygienic practices	5	<input type="checkbox"/>	35 Presence of insect/rodent/water openings protected, no animals	4	
<input type="checkbox"/>	*13 Clean clothes, hair restraints	1	<input type="checkbox"/>	FLOORS, WALLS & CEILINGS		
<input type="checkbox"/>	*14 Food contact surfaces: designed, constructed, maintained, installed, located	2	<input type="checkbox"/>	36 Floor: constructed, drained, clean, good repair, covering	1	
<input type="checkbox"/>	*15 Non-food contact surfaces: designed, constructed, maintained, installed, located	1	<input type="checkbox"/>	37 Walls, ceilings: attached equipment, constructed, clean, good repair; surfaces, installation, distress methods	1	
<input type="checkbox"/>	*16 Accurate thermometers, and chemical test kits provided	2	<input type="checkbox"/>	LIGHTING		
<input type="checkbox"/>	*17 Wash, hose water: clean, proper temperature	1	<input type="checkbox"/>	38 Lighting provided as required. Fixtures attached	1	
<input type="checkbox"/>	*18 Sanitization meet: clean, temperature, concentration, time	4	<input type="checkbox"/>	39 Rooms and equipment: washed as required	1	
<input type="checkbox"/>	*19 Equipment, utensils sanitized	2	<input type="checkbox"/>	40 DRESSING ROOMS		
<input type="checkbox"/>	*20 Food contact surfaces of equipment and utensils clean, free of abrasions, discolors	1	<input type="checkbox"/>	41 Rooms, linen, boxes: provided, located, used	1	
<input type="checkbox"/>	*21 Non-food contact surfaces of equipment and utensils clean	2	<input type="checkbox"/>	OTHER OPERATIONS		
<input type="checkbox"/>	*22 Clean equipment/utensils: storage, handling	1	<input type="checkbox"/>	42 Toxic items: necessary, properly stored, labeled, used	5	
<input type="checkbox"/>	*23 Single-service articles, storage, handling	1	<input type="checkbox"/>	43 Premises: maintained free of litter, unnecessary articles, cleaning, maintenance equipment properly stored	1	
<input type="checkbox"/>	*24 No re-use of single-service articles	2	<input type="checkbox"/>	44 Complete separation from sleeping quarters, laundry	1	
<input type="checkbox"/>	*25 WATER		<input type="checkbox"/>	45 Clean, soiled from properly stored	1	
<input type="checkbox"/>	*26 Source: sufficient available, hot & cold, proper pressure	5	<p>*CRITICAL ITEMS MUST BE CORRECTED AS SOON AS POSSIBLE AND NO LATER THAN TEN (10) DAYS. COMMISSIONER MUST BE NOTIFIED WITHIN FIFTEEN (15) DAYS OF SUCH.</p>			

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Appendix C

BATF FORMS

1. Brochure: "Grape Wine Labels"
2. Winery Information by Department of Treasury: Bureau of Alcohol, Tobacco and Firearms
3. "Information for Wineries" by Bureau of Alcohol, Tobacco and Firearms
4. National Historic Preservation Act
5. Application for Basic Permit under the Federal Alcohol Administration Act
6. Application to Establish and Operate Wine Premises
7. Signing Authority for Corporate Officials
8. Power of Attorney
9. Wine Bond
10. Environmental Information
11. Supplemental Information on Water Quality Consideration under 22 U.S.C. 1341 (a)
12. Formula and Process for Wine
13. Application for and Certification/Exemption of Label/Bottle Approval
14. Application for Employer Identification Number
15. Special Tax Registration and Return Alcohol and Tobacco
16. United States Government: Information
17. Requisition for Forms or Publications
18. Brochure: Liquor Laws and Regulation for Retail Dealers

Appendix D

Part 110 Current Good Manufacturing Practices in Manufacturing, Processing, Packing or Holding Human Food.

Subpart A – General Provisions.

110.1 Current good manufacturing practices.

110.3 Definitions.

110.10 Personnel.

110. 19 Exclusions.

Subpart B – Buildings and Facilities.

110.20 Plants and grounds.

110.35 Sanitary operations

110.37 Sanitary facilities and controls.

Subpart C – Equipment

110.40 Equipment and procedures.

Subpart D – [Reserved]

Subpart E – Production and Process Controls

110.80 Processes and controls

110.93 Warehousing and distribution

110.110 Natural or unavoidable defects in food for human use that present no health hazard

Subpart A – General Provisions

110. 1 Current good manufacturing practices

The criteria in 110.10, 110. 19, 110.20, 110.35, 110.37, 110.40, 110.80, 110.93 and 110.110 shall apply in determining whether the facilities, methods, practices and controls used in the manufacture, processing, packing or holding of food are in conformance with or are operated or administered in conformity with good manufacturing practices to assure that food for human consumption is safe and has been prepared, packed and held under sanitary conditions.

110.3 Definitions.

The definitions and interpretations contained in section 201 of the Federal Food, Drug and Cosmetic Act are applicable to such terms when used in this part. The following definitions shall also apply:

(a) "Adequate" means that which is needed to accomplish the intended purpose in keeping with good public health practice.

(b) "Plant" means the building or buildings or parts thereof, used for or in connection with the manufacturing, processing, packaging, labeling or holding of human food.

(c) "Sanitize" means adequate treatment of surfaces by a process that is effective in destroying vegetative cells of pathogenic bacteria and in substantially reducing other microorganisms. Such treatment shall not adversely affect the product and shall be safe for the consumer.

110.10 Personnel.

The plant management shall take all reasonable measures and precautions to assure the following:

(a) Disease control: No person affected by disease in a communicable form, or while a carrier of such disease, or while affected with boils, sores, infected wounds or other abnormal sources of microbiological contamination, shall work in a food plant in any capacity in which there is a reasonable possibility of food or food ingredients becoming contaminated by such person, or of disease being transmitted by such person to other individuals.

(b) Cleanliness: All persons, while working in direct contact with food preparation, food ingredients, or surfaces coming into contact therewith shall:

(1) Wear clean outer garments, maintain a high degree of personal cleanliness and conform to hygienic practices while on duty, to the extent necessary to prevent contamination of food products.

(2) Wash their hands thoroughly (and sanitize if necessary to prevent contamination by undesirable microorganisms) in an adequate hand-washing facility before starting work, after each absence from the work station and at any other time when the hands may have become soiled or contaminated.

(3) Remove all insecure jewelry and, during periods where food is manipulated by hand, remove from hands any jewelry that cannot be adequately sanitized.

(4) If gloves are used in food handling, maintain them in an intact, clean and sanitary condition. Such gloves should be of an impermeable material except where their usage would be inappropriate or incompatible with the work involved.

(5) Wear hair nets, headbands, caps or other effective restraints.

(6) Do not store clothing or other personal belongings, do not eat food or drink in areas where food or food ingredients are exposed or in areas used for washing equipment or utensils.

(7) Take any other necessary precautions to prevent contamination of foods with microorganisms or foreign substances including, but not limited to, perspiration, hair, cosmetics, tobacco, chemicals and medicines applied to skin.

(c) Education and training: Personnel responsible for identifying sanitation failures or food contamination should have a background of education or experience, or a combination thereof, to provide a level of competency necessary for production of clean and safe food. Food handlers and supervisors should receive appropriate training in proper food-handling techniques and food protection

principles and should be cognizant of the danger of poor personal hygiene and insanitary practices.

(d) Supervision: Responsibility for assuring compliance by all personnel with all requirements of this Part 110 shall be clearly assigned to competent supervisory personnel.

110. 19 Exclusions.

The following operations are excluded from coverage under these general regulations; however, the commissioner will issue special regulations when he/she believes it necessary to cover these excluded operations: Establishments engaged solely in the harvesting, storage or distribution of one or more raw agricultural commodities, as defined in section 201(r) of the act, which are ordinarily cleaned, prepared, treated or otherwise processed before being marketed to the consuming public.

Subpart B - Buildings and Facilities

110.20 Plant and Grounds

(a) Grounds: The grounds about a food plant under the control of the operator shall be free from conditions that may result in the contamination of food including, but not limited to, the following:

- (1) Improperly stored equipment, litter, waste, refuse and uncut weeds or grass within the immediate vicinity of the plant buildings or structures that may constitute an attractant, breeding place or harborage for rodents, insects and other pests.
- (2) Maintaining roads, yards and parking lots so that they do not constitute a source of contamination in areas where food is exposed.
- (3) Inadequately drained areas that may contribute contamination to food products through seepage or food-borne filth and by providing a breeding place for insects or microorganisms.

If the plant grounds are bordered by grounds not under the operator's control of the kind described in paragraphs (a) (1) through (3) of this section, care must be exercised in the plant by inspection, extermination or other means to effect exclusion of pests, dirt, and other filth that may be a source of food contamination.

(b) Plant construction and design: Plant buildings and structures shall be suitable in size, construction and design to facilitate maintenance and sanitary operations for food processing purposes. The plant and facilities shall:

(1) Provide sufficient space for such placement of equipment and storage of materials as is necessary for sanitary operations and production of safe food. Floors, walls and ceilings in the plant shall be of such construction as to be adequately cleanable and shall be kept clean and in good repair. Fixtures, ducts and pipes shall not be so suspended over working areas that drip and condensate may contaminate foods, raw materials or food-contact surfaces. Aisles or working spaces between equipment and between equipment and walls shall be unobstructed and of sufficient width to permit employees to perform their duties without contamination of food or food-contact surfaces with clothing or personal contact.

(2) Provide separation by partition, location or other effective means for those operations that may cause contamination of food products with undesirable microorganisms, chemicals, filth or other extraneous material.

(3) Provide adequate lighting to hand washing areas, dressing and locker rooms, and toilet rooms and to all areas where food or food ingredients are examined, processed or stored and where equipment and utensils are cleaned. Light bulbs, fixtures, skylights or other glass suspended over exposed food in any step of preparation shall be of the safety type or otherwise protected to prevent food contamination in case of breakage.

(4) Provide adequate ventilation or control equipment to minimize odors and noxious fumes or vapors (including steam) in areas where they may contaminate food. Such ventilation or control equipment shall not create conditions that may contribute to food contamination by airborne contaminants.

(5) Provide, where necessary, effective screening or other protection against birds, animals and vermin (including, but not limited to, insects and rodents).

110.35 Sanitary operations

(a) General maintenance: Buildings, fixtures and other physical facilities of the plant shall be kept in good repair and shall be maintained in a sanitary condition. Cleaning operations shall be conducted in such a manner as to minimize the danger of contamination of food and food-contact surfaces. Detergents, sanitizers and other supplies employed in cleaning and sanitizing procedures shall be free of significant microbiological contamination and shall be safe and effective for their intended use. Only such toxic materials as are required to maintain sanitary conditions, for use in laboratory testing procedures, for plant and equipment maintenance and operation, or in manufacturing or processing operations shall be used or stored in the plant. These materials shall be identified and used only in such manner and under conditions as will be safe for their intended uses.

(b) Pest control: No pests shall be allowed in any area of a food plant. Effective measures shall be taken to exclude pests from the processing areas and to protect against the contamination of food on the premises by pests. The use of insecticides or rodenticides is permitted only under precautions and restrictions that will protect against the contamination of food, food-contact surfaces and food-packaging materials.

(c) Sanitation of equipment and utensils. All utensils and product-contact surfaces of equipment shall be cleaned as frequently as necessary to prevent contamination of food and food products. Nonproduct-contact surfaces of equipment used in the operation of food plants should be cleaned as frequently as necessary to minimize accumulation of dust, dirt, food particles and other debris. Single-service articles (such as utensils intended for one-time use, paper cups, paper towels, etc.) should be stored in appropriate containers and handled, dispensed, used and disposed of in a manner that prevents contamination of food or food contact surfaces. Equipment used in the plant shall be cleaned and sanitized prior to such use and following any interruption during which such utensils and contact surface may have become contaminated. Where such equipment and utensils are used in a continuous production operation, the contact surfaces of such equipment and utensils shall be cleaned and sanitized on a predetermined schedule, using adequate methods for cleaning and sanitizing. Sanitizing agents shall be effective and safe under conditions of use. Any facility, procedure, machine or device may be acceptable for cleaning and sanitizing equipment and utensils if it is established that such facility, procedure, machine or device will routinely render equipment and utensils clean and provide adequate sanitizing treatment.

(d) Storage and handling of cleaned portable equipment and utensils. Cleaned and sanitized portable equipment and utensils with product-contact surfaces should be stored in such a location and manner that protects product-contact surfaces from contamination.

110.37 Sanitary facilities and controls

Each plant shall be equipped with adequate

sanitary facilities and accommodations including, but not limited to, the following:

(a) Water supply. The water supply shall be sufficient for the operations intended and shall be derived from an adequate source. Any water that contacts foods or food-contact surfaces shall be safe and of adequate sanitary quality. Running water at a suitable temperature and under pressure as needed shall be provided in all areas where the processing of food, the cleaning of equipment, utensils, containers or employee sanitary facilities require them.

(b) Sewage disposal. Sewage disposal shall be made into an adequate sewerage system or disposed of through other adequate means.

(c) Plumbing shall be of adequate size and design and adequately installed and maintained to:

(1) Carry sufficient quantities of water to required locations throughout the plant.

(2) Properly convey sewage and liquid disposable waste from the plant.

(3) Not constitute a source of contamination to foods, food products or ingredients, water supplies, equipment or utensils or create an unsanitary condition.

(4) Provide adequate floor drainage in all areas where floors are subject to flooding-type cleaning or where normal operations release or discharge water or other liquid **waste on the floor.**

(d) Toilet facilities: Each plant shall provide its employees with adequate toilet and associated hand-washing facilities within the plant. Toilet rooms shall be furnished with toilet tissue. The facilities shall be maintained in sanitary condition, protected from splash, dust and other contamination. and kept in good repair at all times. Doors to toilet rooms shall be self-closing and shall not open directly into areas where food is exposed to air-borne contamination, except where alternate means have been taken to prevent such contamination (such as double doors, positive air-flow systems, etc.). Signs shall be posted directing employees to wash their hands with cleaning soap or detergents after using the toilet.

(e) Hand-washing facilities: Adequate and convenient facilities for hand washing and, where appropriate, hand sanitizing shall be provided at each location in the plant where good sanitary practices require employees to wash or sanitize and dry their hands. Such facilities shall be furnished with running water at a suitable temperature for hand washing, preparations, sanitary towel service or suitable drying devices, and, where appropriate, easily cleanable waste receptacles.

(f) Rubbish and offal disposal: Rubbish and any offal shall be so conveyed, stored and disposed of as to minimize the development of odor, prevent waste from becoming an attractant and harborage or breeding place for vermin, and prevent contamination of food, food-contact surfaces, ground surfaces and water supplies.

Subpart C - Equipment

110.40 Equipment and procedures

(a) General. All plant equipment and utensils should be (1) suitable for their intended use, (2) so designed and of such material and workmanship as to be adequately cleanable, and (3) properly maintained. The design, construction and use of such equipment and utensils shall preclude the adulteration of food with lubricants, fuel, metal fragments, contaminated water or any other contaminants. All equipment should be so installed and maintained as to facilitate the cleaning of the equipment and of all adjacent spaces.

(b) Use of polychlorinated biphenyls in food plants. Polychlorinated biphenyls (PCBs) represent a class of toxic industrial chemicals manufactured and sold under a variety of trade names, including: Aroclor (United States); Phenoclor (France); Colphen (Germany); and Kanaclor (Japan). PCBs are highly stable, heat-resistant and non-flammable chemicals. Industrial uses of PCBs include, or did include in the past, their use as electrical transformer and capacitor fluids, heat transfer fluids, hydraulic fluids and plasticizers, and in formulations of lubricants, coatings and inks. Their unique physical and chemical properties and widespread, uncontrolled industrial applications have caused PCBs to be a persistent and ubiquitous contaminant in the environment, causing the contamination of certain foods. In addition, incidents have occurred in which PCBs have directly contaminated animal feeds as a result of industrial accidents (leakage

or spillage of PCB fluids from plant equipment). These accidents in turn cause the contamination of food intended for human consumption (meat, milk and eggs). Since PCBs are toxic chemicals, the PCB contamination of food as a result of these accidents represents a hazard to human health. It is therefore necessary to place certain restrictions on the industrial uses of PCBs in the production, handling and storage of food. The following special provisions are necessary to preclude accidental PCB contamination of food:

(1) New equipment, utensils and machinery for handling or processing food in or around a food plant shall not contain PCBs.

(2) On or before September 4, 1973, the management of food plants shall:

(i) Have the heat exchange fluid used in existing equipment or machinery for handling processing food sampled and tested to determine whether it contains PCBs, or verify the absence of PCB's in such formulations by other appropriate means. On or before Sept. 4, 1973, any such fluid formulated with PCBs must be replaced with a heat exchange fluid that does not contain PCBs.

(ii) Eliminate from the food plant any PCB-containing food contact surfaces of equipment or utensils and any PCB-containing lubricants for equipment or machinery that is used for handling or processing food.

(iii) Eliminate from the food plant any other PCB-containing materials wherever there is a reasonable expectation that such materials could cause food to become contaminated with PCBs, either as a result of normal use or as a result of accident, breakage or other mishap.

(iv) The toxicity and other characteristics of fluids selected as PCB replacements must be adequately determined so the least potentially hazardous replacement is used. In making this determination with respect to a given fluid, consideration should be given to (a) its toxicity; (b) the maximum quantity that could be spilled onto a given quantity of food before it would be noticed, taking into account its color and odor; (c) possible signaling devices in the equipment to indicate a loss of fluid, etc.; and (d) its environmental stability and tendency to survive and be concentrated through the food chain. The judgment as to whether a replacement fluid is sufficiently nonhazardous is to be made on an individual installation and operation basis.

(3) For the purposes of this section, the provisions do not apply to electrical transformers and condensers containing PCBs in sealed containers.

Subpart D - [Reserved]

Subpart E - Production and Process Controls

110.80 Processes and controls

All operations in the receiving, inspecting, transporting, packaging, segregating, preparing, processing and storing of food shall be conducted in accordance with adequate sanitation principles. Overall sanitation of the plant shall be under the supervision of an individual assigned responsibility for this function. All reasonable precautions, including the following,

shall be taken to assure that production procedures do not contribute contamination such as filth, harmful chemicals, undesirable microorganisms or any other objectionable material to the processed product:

- (a) Raw material and ingredients shall be inspected and segregated as necessary to assure that they are clean, wholesome and fit for processing into human food and shall be stored under conditions that will protect against contamination and minimize deterioration. Raw materials shall be washed or cleaned as required to remove soil or other contamination. Water used for washing, rinsing or conveying food shall be safe and of adequate sanitary quality.
- (b) Containers and carriers of raw ingredients should be inspected on receipt to assure that their condition has not contributed to the contamination and deterioration of the products.
- (c) When ice is used in contact with food products, it shall be made from potable water and shall be used only if it has been manufactured in accordance with adequate standards and stored, transported and handled in a sanitary manner
- (d) Food-processing areas and equipment used for processing human food should not be used to process nonhuman food-grade animal feed or inedible products unless there is no reasonable possibility for the contamination of the human food.
- (e) Processing equipment shall be maintained in a sanitary condition through frequent cleaning, including sanitization where indicated. Insofar as necessary, equipment shall be taken apart for thorough cleaning.

(f) All food processing, including packaging and storage, should be conducted under such conditions and controls as are necessary to minimize the potential for undesirable bacterial or other microbiological growth, toxin formation, deterioration or contamination of the processed product or ingredients. This may require careful monitoring of such physical factors as time, temperature, humidity, pressure, flow-rate and such processing operations as freezing, dehydration, heat processing and refrigeration to assure that mechanical breakdowns, time delays, temperature fluctuations and other factors do not contribute to the decomposition or contamination of the processed products.

(g) Chemical, microbiological or extraneous-material testing procedures shall be used where necessary to identify sanitation failures or food contamination, and all foods and ingredients that have become contaminated shall be rejected, treated or processed to eliminate the contamination where this may be properly accomplished.

(h) Packaging processes and materials shall not transmit contaminants or objectionable substances to the products, shall conform to any applicable food additive regulation (Parts 170 through 189 of this chapter) and should provide adequate protection from contamination.

(i) Meaningful coding of products sold or otherwise distributed from a manufacturing, processing, packing or repacking activity should be used to enable positive lot identification to facilitate, where necessary, the segregation of specific food lots that may have become contaminated or otherwise unfit for their intended use. Records should be retained for a period of time that exceeds the shelf life of the product, except that they need not be retained more than two years.

(j) Storage and transportation of finished products should be under such conditions as will prevent contamination, including development of pathogenic or toxigenic microorganisms, and will protect against undesirable deterioration of the product and the container.

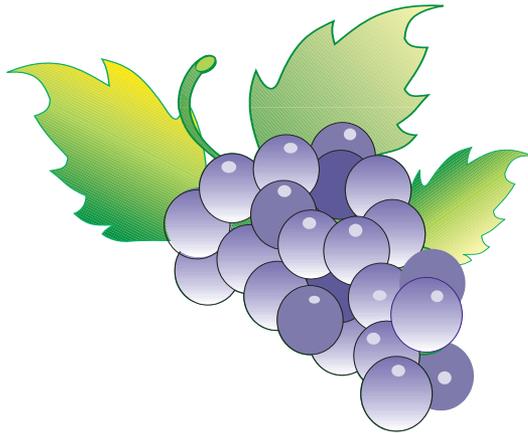
110.93

Storage and transportation of finished food shall be under conditions that will protect food against physical, chemical and microbial contamination, as well as against deterioration of the food and the container.

Appendix E

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Charles L. Norman, Dean.