

Maple Syrup Quality Control Manual

by Kathryn Hopkins, Extension educator

Bulletin #7038



Table of Contents

Cleanliness and Maple Syrup Quality	3
Sanitizers and Maple Syrup Quality	3
Quality Begins in the Sugarbush	3
Spouts	3
Buckets and Pails	3
Pipelines, Tubing and Conduits	3
<i>Installing Pipeline for High-Quality Production</i>	3
<i>Choosing Tubing for High Quality Production</i>	3
<i>Clean Tubing and Quality</i>	4
Tree Tapping	4
Tap Only in White Wood	4
Clean the Tap Holes	4
Sap Collection	5
<i>Timing is Important</i>	5
<i>Sap Gathering Pails</i>	5
<i>Be Observant</i>	5
<i>Sap Ice</i>	5
Sap Filtering	5
Sap Tanks	5
<i>Keep Tanks Clean Throughout the Season</i>	5
<i>Keep Tanks Cool and Covered</i>	5
<i>Storing Sap</i>	6
Quality Continues in the Sugarhouse: Processing Sap	6
Prompt Processing: One Key to High Quality	6
<i>Reverse Osmosis</i>	6
<i>Defoamer</i>	6
<i>Evaporator Pans</i>	6
Maple Syrup Quality Control Puts the Accent on Flavor	6

Syrup Density	6
<i>Low-Density Syrup</i>	7
<i>Density Check at Draw-Off</i>	7
<i>Syrup Refractometer</i>	7
<i>Hydrotherm</i>	7
<i>Light Transmittance Meter</i>	7
<i>Automatic Draw-off</i>	7
Syrup Filtering	8
<i>Care of Filters</i>	8
<i>Pressure Filters</i>	8
Quality Continues in the Sugarhouse: Syrup Packing	8
Packing in Bulk	9
Filling Drums	9
Filling Retail Containers	9
<i>Hot Packing</i>	10
<i>Avoid Stack Burn</i>	10
<i>Code All Syrup.</i>	10
Grading Syrup for the Retail Customer	11
<i>Grading Kits</i>	11
<i>Color</i>	11
Care and Storage of Canned Syrup	11
<i>Temperature.</i>	11
<i>Air</i>	11
<i>Time</i>	11
Reducing Lead in Syrup	11
<i>Equipment</i>	11
<i>Practices</i>	12
After Sugaring: Quality Begins for Next Season	12
Care of Evaporators	12
Painting Equipment	12
Storing Equipment	13
Cleaning Pipelines	13
Summary	13
Appendix	
Department of Agriculture, Food and Rural Resources Division of Regulations:	
Chapter 347: Maple Syrup Processing	14

Cleanliness and Maple Syrup Quality

The most important contributor to maple syrup quality is cleanliness. Microorganisms, bacteria and yeast are enemies of high quality syrup. They affect both color and flavor. Since these culprits are found on unclean equipment, and may grow rapidly in sap and syrup, careful sanitary practices are critical when you collect sap, and make, pack and store syrup.

Sanitizers and Maple Syrup Quality

Although cleanliness is a “must,” most cleaning compounds cannot be used in maple production. Household detergents, and soaps that have any fragrance, and iodine-based dairy sanitizers should not be used to sanitize syrup production equipment. They can ruin syrup flavor, making the syrup unsaleable.

One part unscented household chlorine bleach (such as unscented Clorox™) to 20 parts of clean water may be used for rinsing, but you’ll need to flush equipment afterwards with clean, clear water. Don’t use a stronger solution, or let the solution stand in galvanized equipment, because flavor problems may result.

Caution! Household chlorine bleach is generally a 5.25 percent sodium hypochlorite solution. Commercial bleaches are stronger. The “one part bleach to 20 parts water” noted in this manual refers to household bleach.

Remember that anything added to sap, even in minute quantities, will become concentrated as the sap is boiled to syrup, causing an off-flavor. Plenty of “elbow grease” and lots of

clean, hot water are the best cleaning agents for maple syrup equipment.

Quality Begins in the Sugarbush

The equipment you use will also have a big impact on your final product. Don’t use rusty or corroded spouts, buckets, or other maple utensils. Otherwise you may find toxic metals and metallic off-flavors in your syrup.

Spouts

Before using spouts, sanitize them. First, clean them and dip-rinse them in a chlorine bleach solution (one part of unscented chlorine bleach to 20 parts of water). Then rinse them thoroughly in hot water. (As a substitute for the dip-rinse, metal spouts may be boiled in clean water.) A sanitized spout will keep the tap hole open longer, increasing sap yield, and will help to keep tubing lines free of microorganisms.

Buckets and Pails

Scrub buckets and pails thoroughly by hand or by machine with hot water. If you use a chlorine bleach solution to sanitize them (one part unscented household chlorine bleach to 20 parts water), take care to rinse each bucket well. Do this at the end of the season so next year’s work is easier, and to prevent metal deterioration.

Pipelines, Tubing and Conduit

Installing Pipeline for High Quality Production

Pipeline, tubing and conduits help the sugarmaker get the freshest possible sap to the sugarhouse. “Down hill, straight and tight” is a slogan to keep in mind when installing tubing. Pipeline that sags, or is not pitched enough may retain sap, which can develop microorganisms as it ages, lowering

Household detergents, and soaps that have any fragrance, and iodine-based dairy sanitizers should not be used to sanitize syrup production equipment.

syrup quality. Use pipeline that's wide enough to move sap quickly, so you maintain the sap's high quality.

Choosing Tubing for High Quality Production

Install tubing that's specific for maple syrup production. Tubing companies have designed products that move large volumes of sap long distances in favorable conditions. Non-commercial materials, such as black plastic water pipe, which draws heat from the sun, should be used with care or not used at all. Sap flowing long distances in dark pipeline exposed to the sun may reach temperatures as high as 80 degrees, even though air temperatures are much lower.

Warm sap in lines, and later in storage tanks, encourages microorganism growth. To prevent this problem, dark colored pipe may be painted white with a non-toxic paint.

No matter what piping you use, be certain that lines have no sags; sags trap the sap, and permit bacteria growth.

If you use pipe that is not designed specifically for sap collection, it must be of high grade, the kind that is designed for drinking water. Be certain that all tubing is made of food-grade materials.

Clean Tubing and Quality

Clean tubing is vital to maximize production of high-quality syrup. Sanitize tubing right after the last sap run. Some producers force a chlorine bleach solution through the tubing (one part unscented household chlorine bleach to 20 parts water). They leave this solution in the lines for a day or two, after making certain that the lines are completely filled.

Be sure all solution is thoroughly rinsed from the lines. In addition to

flushing with water after the use of a chlorine solution, many producers allow the first sap to run onto the ground. This gives tubing an extra rinse at the beginning of the new season, which is important for two reasons:

- (1) even though most traces of chlorine will evaporate during the sap boiling process, the sodium or salt remains, and becomes concentrated in the syrup, ruining the flavor; and
- (2) some sugarmakers and researchers feel that rodents may be attracted by the salt, so rinsing at both the beginning and the end of the season can help reduce rodent damage.

A hot water/air-mixture can be forced through the sap lines as an alternative to the chlorine bleach sanitizing process. The turbulence of the air mixed with water is an effective cleaner, and leaves no chlorine residue that could contaminate the sap.

Whatever procedure you choose, be absolutely certain to rinse all chlorine from lines and tanks. Don't let any chlorine solution to enter the lines that may end up in the evaporator.

Tree Tapping

Tap Only in White Wood

Drill all tap holes into healthy, clean, white wood. Generally a depth of not more than 1½ inches is recommended. When dark-colored wood shows in a hole, that tap should not be used. A bad tap hole will yield little or no sap, and may spoil the flavor of large amounts of syrup.

Clean the Tap Holes

Insert spouts right after drilling. Tap them in gently to avoid any unnecessary damage to the tree. When removing wood chips, use a twig or other clean

Whatever procedure you choose, be absolutely certain to rinse all chlorine from lines and tanks. Don't let any chlorine solution enter the lines that may end up in the evaporator.

tool to brush them out. Blowing into the hole to remove chips is an unsanitary practice. It will contaminate the tap hole.

Warning: Don't use paraformaldehyde pellets. In the past, paraformaldehyde pellets were recommended for use in tap holes; some out-of-date sugaring manuals still suggest their use. Research shows that the use of paraformaldehyde pellets can damage the trees, so they are now illegal. Similarly, the use of denatured alcohol as a disinfectant for tapholes is also illegal in Maine.

Sap Collection

Timing is Important

Gather sap promptly, especially when temperatures are above freezing. Fresh, clean sap that has been kept cool during collection and prior to boiling will produce syrup that is one to two grades higher than old, contaminated sap. Since higher quality syrup commands a higher price, it makes sense to collect and boil sap as quickly as possible.

Sap Gathering Pails

Gather sap from buckets in containers that are specifically for that purpose. Don't use pails that have contained non-food products.

Be Observant

Maple sap and syrup pick up off-flavors easily. Be sure that particles from exhaust pipes of tractors do not float into gathering pails or tanks. If sap has contact with any petroleum product it is especially dangerous.

Sap Ice

Ice formed in sap buckets can help keep sap cool in storage; however, many sugarmakers throw it away

because they believe that it contains very little sugar. With today's high fuel costs, you may wish to check the sugar content of melted ice before deciding whether or not to keep it.

Sap Filtering

You'll need to filter sap through multiple filters, first through a coarse filter to remove bark, small wood shavings and debris, then through a finer filter. Removing foreign materials from the sap before it is evaporated will usually upgrade syrup by at least one grade, a higher price for a small investment. Change all sap filters often and keep them clean to avoid off-flavors. (Please see manufacturer's information regarding the care of filters.) For filtering sap, many sugarmakers use filtering materials that are available from maple equipment suppliers.

Sap Tanks

Keep Tanks Clean Throughout the Season

Rinse and scrub gathering and storage tanks with hot water between runs, when practical. Be cautious if you're using a chlorine solution. Make sure that everything the sap has come in contact with has been thoroughly rinsed, so that no chlorine residue remains. The solution should not be permitted to remain in the tanks, since chlorine has corrosive effects on galvanized metal.

Keep it Cool and Covered

Tanks should be located outside the sugarhouse, preferably on the north or northwest side, away from direct sunlight. A loose covering over the storage tanks will prevent rain and foreign materials from lowering the quality of the sap.

No matter what piping you use, be certain that lines have no sags; sags trap the sap, and permit bacteria growth.



Sap gathering pail

Storing Sap

Sap should not be left long in tanks when weather is above freezing; the quality of the sap will begin to deteriorate, producing lower-grade syrup.

Quality Continues in the Sugarhouse: Processing Sap

Prompt Processing: One Key to High Quality

For the highest quality syrup, evaporate sap as quickly as possible. Holding sap in buckets or tanks lowers the quality of the syrup produced from that sap. Always try to evaporate sap completely before stopping. Generally, a shallow sap depth and a hot fire make for rapid syrup production, and high-grade syrup.

Reverse Osmosis

Reverse osmosis units are becoming more common. They allow the sugarmaker to remove large quantities of water before the conventional evaporation process. As with all sugaring equipment, cleanliness is critical. Follow the manufacturer's suggestions for cleaning. If you use an anti-bacterial storage solution, or any sanitizing solution, be sure to rinse thoroughly with clean water before processing sap to avoid off-flavor and/or syrup contamination.

Defoamer

Use as little defoamer as possible, and be sure it's fresh. Old defoamer becomes rancid, and causes a rancid flavor in syrup. Excess use of some defoamers can also cause "fatty" off-flavors.

If you use vegetable oil because of special market requirements (religious or dietary) take care to use the smallest

possible amount. In recent years, some off-flavors due to vegetable oil have occurred; the vegetable oil flavor tends to especially affect the light amber grade syrup.

Evaporator Pan

Keep pans clean. Change draw-off sides often to prevent the accumulation of niter (sugar sand), which can cause scorching and off-flavored syrup. In recent years producers have noted an increase in off-flavored syrup due to burnt niter. When evaporating with reverse osmosis concentrate, niter build-up is faster, requiring more frequent change of draw-off sides. Should any scorching occur, shut down and clean up the burned area to prevent off-flavors in the next batch of syrup.

Maple Syrup Quality Control Puts the Accent on Flavor

Maple syrup flavor must be guarded from sap to store shelf. Flavor can be damaged from contaminated, unfiltered, or old sap, new and used filters, caramelized sugar, fermentation and mold, detergents, chemicals and rust.

Syrup Density

Maine law requires maple syrup to be evaporated to a density greater than 66 percent Brix at 68 degrees F. Remember that syrup having a density reading below 66 percent Brix is illegal. Such syrup is more likely to ferment. Syrup with a density above 68 percent Brix may crystallize, causing consumer complaint. Various instruments can be used to check the density: hydrometers, hydrotherms, refractometers and light transmittance meters. For best results, know how the instrument works and how to protect its accuracy.

Low-Density Syrup

The principal causes of low-density syrup:

- Not making an adjustment of syrup temperature when checking density with a hydrometer.
- Using an inaccurate hydrometer.
- Inaccurate adjustment of heavy-density syrup.
- Steam condensing on surfaces, and running into the last containers of syrup to be packed. The last syrup in the tank should not be canned unless checked carefully for proper density.

Density Check at Draw-Off

Use a deep container of small diameter (hydrometer cups are convenient) so that the hydrometer may be floated immediately after each draw off. Lower the hydrometer gently. Be sure that the hydrometer does not touch the bottom or sides of the hydrometer cup. Make the reading at the point on the hydrometer stem that is level with the surface of the syrup (not the top of the meniscus).

Syrup Refractometer

Syrup refractometers are instruments that may be used to test maple syrup density. They are available through maple equipment dealers. If you use a refractometer, be sure to follow instructions. Occasionally, problems can occur that are due to incorrect calibration of the instrument, leading to light or heavy syrup. Also, producers and the Department of Agriculture have found that some instruments do not consistently provide accurate readings when testing hot syrup. You can check a refractometer by comparing measurements to those taken with an accurate, tested hydrometer and a thermometer, or a refractometer.

Hydrotherm

Hydrotherms are special hydrometers with thermometers built in to locate the point on the hydrometer to measure standard density syrup. It is used like a hydrometer but allowed to sit for 30 to 40 seconds for the thermometer column in the hydrotherm to warm or cool to the syrup temperature. The Department of Agriculture does not recommend using hydrotherms because they are not calibrated to a standardized scale.

Light Transmittance Meter

A light transmittance meter is a newer tool that is used to check syrup color. In a light transmittance meter, a syrup sample is checked for color by passing light through the sample. The percent of light transmission is compared to light transmission rates set for different grades. When using one, you need to be sure there are no fingerprints on the syrup test bottle, and that the syrup sample has no bubbles or cloudiness. Any of these conditions may diminish the light that is transmitted through the sample and therefore lowers the grade of the sample.

Automatic Draw-off

Automatic draw-offs are not completely accurate. Change the draw-off side often, within hours, not days, or when your scoop shows niter beginning to build up in the pan. Using a hydrometer or refractometer, test the first syrup drawn off at the new side. Adjust the draw-off frequently each day, using a hydrometer or refractometer, to establish the right adjustment.

Important Note: Do not scoop near the automatic draw-off until after it shuts off. Scooping near the draw-off will change the density reading of the



Hydrometer

drawn-off syrup. Clean the control when changing sides. Nylon scouring pads (unscented and soap-free) are helpful. Never use steel wool. It will scratch the pan and speed the build-up of niter.

Syrup Filtering

Care of Filters

Filters can impart off-flavors to syrups, making the product unfit for sale. Do not store filters in mothballs, cedar closets, airtight containers, or near scented materials. Clean filters thoroughly, dry thoroughly, and store

in a cloth bag in clean, dry, airy, storage. Chlorine bleach should not be used to clean filters.

Despite repeated washings, rinsings and airings, filters that have been washed with bleach still impart off-flavors to syrup. Scented

cleansers, fabric softeners, and “dryer sheets” should not be used either. New filters and pre-filters must be thoroughly boiled in clean water (not in sap pans) and air dried (in the sun if possible). Use the “sniff” test to provide an added check for your filters. Musty old filters, or new chemical-smelling filters should not be used.

The use of synthetic filters as pre-filters (“cone” type or “flat type” filters) save much labor. When they are used, more effective filtration results, and the heavy filters may be in service longer between cleanings. Wash and dry pre-filters often in pure, hot water.

Old, threadbare filters will cause cloudy syrup. Hold filters up to bright light to check for filter problems (cloudy syrup must be graded substandard). Remember to filter hot syrup (210 degrees F) immediately after removal from the pan. Do not stir syrup through the filter.

Pressure filters

Clean all pressure filter parts thoroughly with hot water prior to each reassembly.

Filter plates have numbers or patterns that indicate how the filter press should be assembled. Line up each numbered plate and smooth each cloth so that there are no creases. Put a thin rod through the plates during assembly to help maintain the correct position. Care taken with the assembly of pressure filter units will help to prevent niter in finished syrup, and loss of finished syrup.

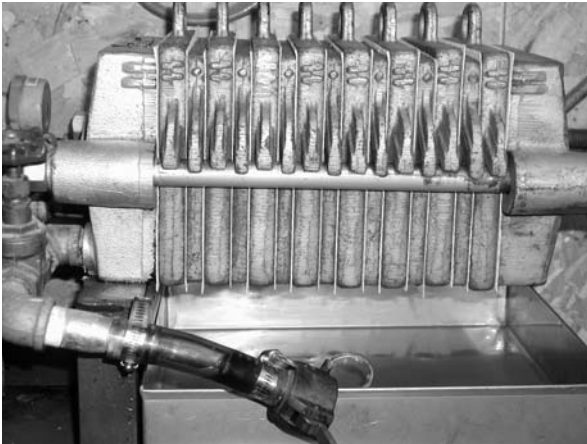
Experiment to find the exact amount of filter aid (food grade Diatomaceous Earth) needed to filter the syrup.

Filter papers should be changed often enough and the pressure regulator should be watched to avoid building up of pressure and bursting of filter paper; careful monitoring of the filter press will help to avoid cloudy syrup.

Quality Continues in the Sugarhouse: Syrup Packing

Most sugarmakers will find it advantageous to pack some syrup in consumer-size containers during the producing season. However, at least part of the crop should be packed in bulk containers for later reheating and packing. Bulk containers offer these advantages when used for long-term storage:

- Packing syrup closer to the date of



Clean all pressure filter parts thoroughly with hot water prior to each reassembly.

sale reduces the possibility of grade change in the consumer size container. This is especially important when packing in plastic jugs.

- The potential of metallic flavors from cans is reduced.
- Reheating at packing time renews the fresh maple flavor.
- The possibility of rusty containers is lessened.
- The producer has greater versatility in meeting the current market demand for a specific container size and style, but also maintain the potential for bulk sale.
- The potential of waste due to leftover, unwanted sizes is eliminated.
- You can blend different “runs” to achieve greater uniformity of product.
- For small producers, five-gallon cans offer similar advantages to the 30-gallon barrel.

Packing in Bulk

Here are some tips for successful bulk packing:

- Always examine bulk containers before filling.
- More bulk syrup is downgraded or ruined due to storage in drums that are in poor condition than by any other single storage cause.
- Use a flashlight to examine the interiors of drums.
- Use only bulk storage barrels or five-gallon cans that are rust-free, clean and dry. Steam cleaning is the best assurance of completely clean barrels.
- “Sniff” test the barrel and do not use if a foreign odor is present.

- If you are buying new barrels, purchase stainless steel barrels.

Filling Drums

For the best results fill containers or drums with hot syrup (above 180 degrees), and fill them full. Any air space in the drum may cause problems. Use new gaskets; tighten bungs as soon as possible. Keep a sample from each drum in your freezer and identify each sample and its drum number. Then you can repack the syrup without opening additional drums. Remember to store drums in a cool, dry place, and to educate your bulk customers in the proper storage and handling of bulk syrup.

Filling Retail Containers

Here is a list of suggestions that will help you ensure a high-quality product ready for retail sale.

- Open the cartons in which syrup cans are packed so that the empty cans are upside down. Keep the cans in that position until they are filled, so foreign material can't get inside.
- Closely examine all containers. Return any that are damaged by excess flux or solder, dents or other imperfections. Do not fill cans that have any rust.
- “Sniff” test empty containers. This will sometimes help you cull out unusable containers.
- Fill containers full to assure correct volume for the consumer, and to minimize airspace, that contributes to product spoilage.



A variety of retail syrup product containers.

Hot Packing

“Cold” pack has caused more spoilage of syrup than almost any other factor. Always pack syrup hot! When packed at the right temperature, the hot syrup will sterilize its container, preventing spoilage. Then, when properly sealed, a vacuum will be created, preventing contamination.

The lowest safe temperature for packing syrup is 180 degree F when the cap goes on. Syrup that is left uncapped for a few moments can cool sufficiently and collect enough yeast and mold spores from the air to spoil some cans in an otherwise perfect lot.

Research by Dr. MariaFranca Morselli of the University of Vermont Maple Research Center indicates that packing syrup at temperatures higher than 180 degrees F (but not higher than 200 degrees F) will result in fewer trouble-causing microorganisms.

However, if temperatures are raised too high for too long, new niter may precipitate, causing cloudiness. (Refiltering reheated syrup can eliminate cloudiness.) Continue to check temperature with a sterile thermometer immediately prior to filling the container.

For best results when heating syrup, use a continual flow method rather than heating a large volume of syrup in a vat. Some syrups may deteriorate in both color and flavor when heated in large vats or pans, and held until canned in retail containers. If the syrup is continually flowing through several compartments, while heating, it will retain most of the original flavor and quality. This also makes it easier to maintain the correct packing temperature (180 degrees and above).

Remember, the last container filled from any batch may not be of correct density. When a cover is used on filter tanks, condensation may cause the last syrup to be thin. If no cover is used, the last syrup may be heavy.

When sealing plastic containers, be sure inner seals are in container caps when they are put on.

After capping the hot syrup, immediately lay each container on its side, neck down, to sterilize the air pocket and cap. Check the closure for leaks.

When containers are cool, spot checking a few cans for density, color and flavor is strongly recommended. This will insure that the syrup meets the standards for which it is labeled.

Avoid “Stack Burn”

“Stack burn” is grade change caused by hot containers of newly canned syrup stacked together, intensifying the heat, and prolonging the cooling time. Stack

If you are interested in testing your syrup for lead, contact any of the following labs:

Analytical Laboratory
Department of Plant, Soil & Environmental Sciences
5722 Deering Hall, Rm. 407
University of Maine
Orono, ME 04469-5722
Phone: 207-581-2917
Cost: \$50.00

Agricultural and Environmental Testing Lab
220 Hills Building
University of Vermont
Burlington, VT 05405

New Hampshire Public
Health Labs
Attn. George Robinson
6 Hazen Dr.
Concord, NH 03301
Phone: 603-271-4784

burn can change a low Grade A Medium Amber syrup to Grade A Dark Amber. This is a common cause of grade violations.

To prevent stack burn, make sure you cool cans quickly. Space cans apart so that air may circulate around them. Do not place cans in cartons or on pallets until cool. A fan may help to speed the cooling process.

Code All Syrup

Code each batch of syrup as it is packed. If problems are found later, positive identification will allow you to recall only the syrup from the lot that is defective.

Grading Syrup for the Retail Container

Grading Kits

Grading is an important step in your production process. First, be sure that your grading kit is accurate, and right for your operation. You can't grade a round bottle of syrup in a kit intended for square bottles, or by using bottles of different sizes. This can cause off-grade syrup. Also, colored glycerin grading guides fade with age. After one year, most of these temporary guides are off-grade. Check old kits, or replace them.

Color

Proper grading can only be done against a correct background. A clear, blue sky is ideal; a fluorescent light is better than a regular incandescent bulb.

Syrup should not be graded too close to the minimum. Allow a little extra premium color, especially when packing in plastic or ceramic containers. Stored syrup tends to darken in color, particularly when packed in plastic and ceramic jugs.

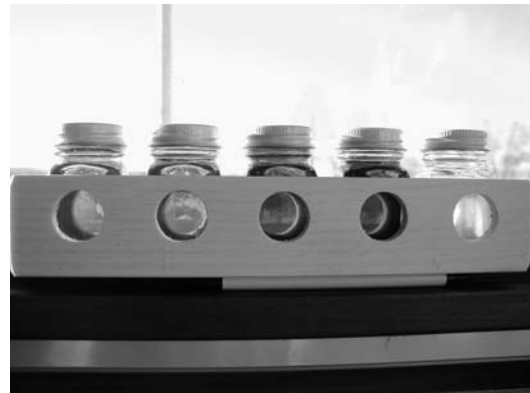
Care and Storage of Canned Syrup

The three main enemies of all stored syrup are temperature, air, and time.

Temperature: Store syrup in a clean, dry place of cool (if not refrigerated), uniform temperature. Some producers use a household air conditioner in the storage room to retain syrup quality, protecting grade and price.

Air: Even small heads of air in containers can cause problems. Be sure to completely fill all containers.

Time: When packing or repacking into retail-size containers, plan to fill only the amount that you will sell within the next few weeks. Retail containers may lose their sales appeal, and the syrup may lose flavor, color and grade when stored for long periods. (Grade loss is especially true of plastic containers, in which syrup has been found to darken as much as one grade in only three months.)



Grading is an important step in your production process. First, be sure that your grading kit is accurate, and right for your operation.

Reducing Lead in Syrup

The lead content of most maple syrup is extremely low, even when made with lead containing equipment. However, the only way to know the lead content of your syrup is to have it tested. Maine testing services are available at the University of Maine. If tests show your syrup has lead levels within acceptable levels (below 250 ppb

in Vermont), then your use of older equipment is satisfactory, provided you manage your equipment properly and retest periodically.

Samples sent for lead testing should be representative of most of your syrup. Try to sample syrup from several syrup batches and try to sample syrup made at the beginning and end of a sap run. Sample only syrup that has received the final filtering. Collect samples in a clean glass or plastic container and combine into one lot. Send the required amount, usually only a few ounces, to the lab of your choice.

Lead does not come from trees. Sap collected using lead-free plastic materials has virtually no lead in it. Sap collecting and syrup making materials that contain lead include: 50/50 solder, used before 1995 for evaporators, tanks and some buckets (Leader Evaporator switched to lead-free solder in 1991); galvanized equipment made before 1994; most brass and bronze; and terneplate, an alloy with a high lead content used for some older equipment.

Sugar sand concentrates any lead in the sap as it is formed so it should also be treated as lead containing. Roadside dust and dirt may also contain lead. In tests of several models, all older metal spouts added lead to maple sap. Very old spouts may be made of terneplate and will leach large amounts of lead into the sap. Lead-free metal spouts are now available. Not all buckets are equal when it comes to lead. In tests, Wheeling buckets added the least amount of lead, while old "tin" buckets added the most. Some old buckets have shinier terneplate bottoms; beware of these.

Lead containing buckets begin to leach lead into sap within the first few hours, and continue to add lead to sap

as long as it is in contact with metal surfaces. Storage of sap in buckets for several days, which may occur when sap runs slowly, can result in very high sap lead concentrations.

Galvanized and lead-soldered tanks also add some lead to sap, although usually less than buckets, because their surface-to-volume ratio is smaller.

In an evaporator, a lead-soldered back pan adds more lead than a lead-soldered front pan, due to the many solder seams. The lead content of partially made syrup often decreases in the front pan, as lead is

precipitating and sticking to the pan in the form of sugar sand.

After the evaporator is shut down, lead will continue to accumulate in the partially boiled syrup from lead solder. Draining the front pan into buckets and adding the syrup again once boiling resumes, reduced lead accumulation.

Cleaning the front pan with water may remove some of the sugar sand (source of lead) but also re-expose lead solder (source of lead). Water cleaning had little effect on syrup lead concentration. Frequently cleaning a lead-soldered pan with acid will likely result in higher syrup lead content.

Sugar sand may contain extremely high amounts of lead, depending on the concentrations of lead in the evaporator. Good filtering is essential for keeping lead out of syrup.

In tests, cone filters were as effective as filter presses in removing lead. A large percentage of lead in syrup is in a dissolved form, however, which is not filterable.

Bronze used in the manufacture of gear pumps usually contains lead, and these pumps can add lead to sap and syrup. Unnecessary pumping, particularly

of sap, should be avoided. Other pump models are available which contain little or no lead.

Old milk cans frequently containterneplate, an alloy with a high lead content, and should never be used for syrup filtering or storage.

Syrup kept in older, heavy galvanized barrels have a much higher lead content after 8 months of storage. Newer galvanized barrels do not add appreciable lead in the same amount of time.

Reprinted with permission from T. R. Wilmot and T.D. Perkins, *Keeping Lead Out of Maple Syrup: A Guide to the Use of Sap Collecting and Syrup Making Equipment* (Burlington: University of Vermont, 2000). Available at <http://www.uvm.edu/~pmrc/LeadOut.pdf>

After Sugaring Quality Begins for the Next Season

To ensure quality for next year, clean all equipment as soon as possible at the close of the maple season.

Care of Evaporators

Some producers allow sap to ferment in English tin or stainless steel pans. If this method is used, watch the fermenting action carefully. When scale loosens, scrub with a nylon pad. If fermenting sap is left in pans too long, serious damage may result. Rinse with clear water, and dry. If chemical cleansers are used, be sure to rinse thoroughly to prevent possible damage to the pan, and off-flavors next season.

Materials that collect on the underside of the evaporator during the season are generally corrosive to metal; if corrosive deposits are permitted to remain until the next season, holes may result in the bottom of the front pan, or

in the flues. To avoid damage, clean the underside of the front pan, and use a brush to clean the flues. You can buy special flue brushes from maple equipment suppliers.

Painting Equipment

If sap tanks or other equipment needs to be painted, use a non-toxic epoxy paint. Paint meeting these standards is available from a maple equipment dealer. Painting at the close of the season, as opposed to the beginning of a new season, allows time for odors to dissipate, reducing the possibility of off-flavored syrup.

Storing Equipment

Store all equipment where it will remain dry, lessening the potential of rust.

Cleaning Pipelines

There are many different ways sugarmakers have developed to clean tubing. The following three are probably the most common:

1. *Pulling Up and Cleaning:* To do the best job, laterals should be rolled up and tied in bundles, taken to the sugarhouse for cleaning and then stored under cover. Before doing this, number the system so it can be rehung the next year. This is best done by painting numbers or letters on trees and putting a tag with a corresponding number or letter on the tubing. You don't have to number each tree, usually every fifth or sixth one is adequate.

There are countless variations of identification systems, but the important thing is that the laterals go up in the same place next year. Once the laterals are numbered, roll them

The most important contribution to the production of high quality maple syrup and syrup products, is cleanliness and attention to detail in all parts of the production process.

up into bundles of about 25 taps. Take each bundle to a tank filled with cleaning solution and fill the bundle with solution. This can be done by pumping solution into the bundle or mounting the bundle on a rack that rotates the bundle through the solution. Let the bundles sit in the sun for one or two days and flush them with clean water. As an added precaution, some sugarmakers let the first sap run through the lines onto the ground. The same procedure works well for cleaning main lines. The rinse step is particularly important in preventing off-flavors.

2. *Cleaning in Place:* Many sugarmakers leave their tubing up in the woods year round and clean it in place. They usually do this by hooking up a vacuum pump to the lower end of the line, going to the top with a bucket of cleaning solution, pulling a spout, placing it in the bucket so solution is sucked through the tubing, then capping the spout and moving to the next. Some tubing manufacturers make fittings that are tight under positive pressure as well as vacuum. With this type of fitting, the cleaning solution can be pumped from the lower end of the line back up the system.
3. *Commercial Systems:* Maple equipment suppliers have commercial pipeline cleaning equipment which consists of a portable compressor pump that injects air with the cleaning solution, thus increasing the turbulence in the tubing, and improving the cleaning action. Some producers have purchased these in conjunction with one or more other sugarmakers to share the expense.

Summary

The most important contribution to the production of high quality maple syrup and syrup products, is cleanliness and attention to detail in all parts of the production process. Producers should be careful to protect their efforts and financial investment and produce the highest quality syrup possible. A high quality product adds to the image of Maine-produced maple products as well as to the producers' profit level.

Appendix

01-001 Department Of Agriculture, Food & Rural Resources – Division Of Regulations

Chapter 347: Maple Syrup Processing

Summary: The purpose of this chapter is to set forth standards for licensing and regulations for maple syrup processing.

1. **Definitions.** For purposes of this chapter and unless the context otherwise indicates, the following words shall have the following meanings.
 - A. "Adequate" means that which is needed to accomplish the intended purpose in keeping with good public health practice.
 - B. "Maple Syrup" means the liquid food derived by concentration and heat treatment of the sap of the maple trees (*Acer*) or by solution in water of maple sugar (maple concentrate) made from such sap. The solids content of the finished maple syrup shall not be less than 66% (sixty-six percent) or more than 69% (sixty-nine percent) by weight (in Brix units) at 68° Fahrenheit. Alternatively, the word "syrup" may be spelled "sirup" or "sirop."
 - C. "Department" means the Maine Department of Agriculture, Food And Rural Resources.
 - D. "Food contact surfaces" means those surfaces of equipment and utensils with which maple syrup comes in contact.
 - E. "Plant" means the building or buildings or parts thereof, used for the manufacturing, processing, packaging, labeling or holding of maple syrup within the State of Maine.
2. **Premises**
 - A. The grounds of the outer premises of the maple syrup plant shall be reasonably clean.
 - B. Sewage and waste water shall be disposed of sufficiently far from the premises so as not to pose a risk of contamination.
3. **Plant Construction and Design**
 - A. The plant is to have a roof to protect evaporator from the elements and condensation.
 - B. The fire shall be vented so as to prevent smoke and ashes from contaminating the syrup.
4. **Equipment and Utensils**
 - A. Equipment and utensils shall be adequate for their intended use.
 - B. Equipment shall be designed to prevent food contamination.
 - C. Light bulbs, fixtures, 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.
 - D. Equipment shall be kept in a clean, sanitary condition at all times and sufficiently free from rust so as not to pose a risk of product contamination.
 - E. Only new containers shall be used for finished product.
5. **Sanitary Facilities and Controls**
 - A. The water supply shall be ample for all operations and shall be obtained from a potable public or private supply. Private water supplies shall be tested yearly.
 - B. All utensils and product contact surfaces of equipment used in the plant shall be cleaned prior to use and following any interruption during which such utensils and contact surfaces may have become contaminated.
 - C. Handwashing facilities shall be available.
 - D. The pipeline tube shall be cleaned with a 5% chlorine solution and rinsed prior to use and following any interruption during which the tube may have become contaminated.

6. Labeling

- A. Each container shall bear;
 - 1. The name of the product.
 - 2. Contents by volume.
 - 3. Name and address of manufacturer or distributor and zip code.
 - 4. The grade of the product, as determined in accordance with 01-001 Code of Maine Regulations, §892-A. Official grade standards for maple syrup (Official Standards for Maple Syrup Grades).

7. Personnel

- A. No person suffering from any communicable or contagious disease shall be employed in or about an establishment where maple syrup is manufactured.
- B. Personnel shall wear clean outer garments when working in the processing areas.
- C. No tobacco shall be used in any form in the plant.

8. Licensing

- A. Application and Fee. Application for approval for Maple Syrup Processing Plants shall be filed annually with the Department of Agriculture, Food And Rural Resources. A license fee of \$15.00 shall accompany each application if more than 15 gallons of Maple Syrup is manufactured, processed, packaged, or held for sale by the applicant. A license fee of \$1.00 shall accompany each application if 15 gallons or less is manufactured, processed, packaged or held for sale by the applicant. In order to allow for the staggering of license expiration dates, initial licenses may be issued for a period exceeding twelve months. In such cases, the initial license fee shall be increased in proportion to length of the license period.
- B. Inspection and Issuance. Before a license is issued or renewed the Department shall inspect the premises of the applicant.

The Commissioner shall, within 30 days following receipt of application, issue a license to operate any Maple Syrup Processing Plant which is found to comply with 22 M.R.S.A., Chapter 551, Subchapter I and the provisions of this chapter. When any such applicant, upon inspection by the Commissioner, is found not to meet such requirements, the Commissioner is authorized to issue either a temporary license for a specified period not to exceed 90 days, during which time corrections specified by the Commissioner shall be made by the applicant for compliance or a conditional license setting forth conditions which shall be met by the applicant to the satisfaction of the Commissioner.

Statutory Authority: 10 MRSA § 2625, 22 MRSA §§ 2153, 2154, 2167, 2168 and 2169

Effective Date: January 25, 1983

Effective Date (Electronic Conversion): May 4, 1996

01-001 Department Of Agriculture, Food & Rural Resource – Division Of Grading Services

Chapter 117: Official Standard For Maple Syrup Grades

Summary: The purpose of this chapter is to establish official standards for grading maple syrup in the State.

1. Definitions

- A. Buddy Flavor/Buddiness. Buddy flavor or buddiness means the unpleasant flavor characteristic of syrup made from sap collected from maple trees as they come out of dormancy.
- B. Clean. Clean means that the syrup shall be practically free from foreign material such as pieces of bark, soot, dust, or dirt.
- C. Cloudiness. Cloudiness means the presence, in suspension, of fine particles of mineral matter, such as malate of lime, niter, sugar sand, calcium malate, or other substances that detract from the clearness of the syrup.

- D. Color. Color has reference to the color of maple syrup when examined by means of the U.S.D.A. permanent glass color standards for maple syrup. The color standards are available only from the approved supplier under a license from the U.S. Department of Agriculture.
- E. Consumer Size Container. Consumer size container means a container which has a volume capacity of less than one gallon, as determined when the liquid is 680 F. Consumer size containers include, but are not limited to, quart, pint and fluid ounce subdivisions of the gallon.
- G. Fairly Good Color. Fairly good color means that the syrup color is darker in color than the U.S.D.A. Dark Amber Glass Color standard, but is not off-color for any reason.
- H. Good Color. Good color means that the syrup color is bright and typical of maple syrup prepared from sound, properly gathered sap.
- I. Maple Sugar. Maple sugar means sugar made exclusively by the evaporation of pure maple syrup or pure maple sap.
- J. Maple Syrup. Maple syrup means the liquid food derived by concentration and heat treatment of the sap of the maple trees (*Acer*) or by solution in water of maple sugar (maple concentrate) made from such sap. The solids content of the finished maple syrup shall not be less than 66% (sixty six percent) by weight (brix) at 680 Fahrenheit. Alternatively, the word "syrup" may be spelled "sirup."
- K. Serious Damage. Serious damage means any defect that seriously affects the edibility or market value of the syrup. Badly scorched syrup, buddy syrup, fermented syrup, or syrup that has any distasteful foreign flavor or disagreeable odor shall be considered as seriously damaged.
- L. U.S. Department of Agriculture Color Standard. U.S. Department of Agriculture Color Standard means the official U.S. Department of Agriculture Permanent Glass Color Standards for Maple Sirup.

2. Grade Nomenclature

Grade nomenclature may be prefixed-with the name of the state of manufacture or the letters "U.S." or words "United States" where applicable.

3. Determining the Grade of a Lot

The grade of a lot of maple syrup covered by these standards is determined by the procedures set forth in the "Regulations Governing Inspection and Certification of Processed Fruits and Vegetables, Processed Products Thereof, and Certain Other Processed Food Products" (7 C.F.R. 2852.1 through 2852.83); PROVIDED:

- (1) When certifying the color of a sample that has been officially drawn and which represents a specific lot of maple syrup, the lot shall be considered as being of one color if the number of color deviants does not exceed the acceptance number in the appropriate sampling plan. Any lot of maple syrup in which the number of color deviants exceeds the acceptance number shall be designated as a lot of "mixed color."
- (2) No deviants for "serious damage" shall be allowed in grades above substandard.

4. Transition

Containers of maple syrup sold or offered for sale for human consumption may be graded and labeled pursuant to this Chapter from the effective date of this Chapter until January 1, 1982. As of January 1, 1982, all containers of maple syrup sold or offered for sale for human consumption must be graded and labeled pursuant to this Chapter.

Authority: 7 M.R.S.A. § 892

Effective Date: April 7, 1981

Effective Date (Electronic Conversion): May 4, 1996

§892-A. Official grade standards for maple syrup

1. **Definitions.** As used in this section, unless the context otherwise indicates, the following terms have the following meanings.
 - A. “Brix” means the scale used to measure the specific gravity of maple syrup. [1991, c. 326, §2 (new).]
 - B. “Damage” means any defect that affects the color, appearance, flavor, aroma, edibility or shipping quality of maple syrup. [1991, c. 326, §2 (new).]
 - C. “Light transmission” means the ability of maple syrup to transmit light as determined optically by means of a spectrophotometer. [1991, c. 326, §2 (new).]
 - D. “Maple syrup” means the liquid derived by concentration and heat treatment of the sap of the maple tree. [1991, c. 326, §2 (new).]
 - E. The symbol “%Tc” means the percentage of light transmission through maple syrup, measurable by a spectrophotometer using matched square optical cells having a 10-millimeter light path at a wavelength of 560 nanometers, the color values being expressed in percent of light transmission as compared to A.R. Glycerol fixed at 100% transmission. [1991, c. 326, §2 (new).]

[1991, c. 326, §2 (new).]
2. **Maple syrup grades.** The following grades are established as the official maple syrup grade standard for the State.
 - A. “Grade A Light Amber” means pure maple syrup that is free of any material other than pure, clear liquid maple syrup in sanitary condition; has a color no darker than the federal Department of Agriculture’s visual color standard light amber or has a color for light transmittance not less than 75.0%Tc; has a delicately sweet, original maple flavor; and has a density of at least the equivalent of 66.0° Brix at 60° Fahrenheit Modulus 145. Grade A Light Amber maple syrup must be free of sugar crystals and may not be damaged in any way. [1991, c. 326, §2 (new).]
 - B. “Grade A Medium Amber” means pure maple syrup that is free of any material other than pure, clear liquid maple syrup in sanitary condition; has a color no darker than the federal Department of Agriculture’s visual color standard medium amber or has a color for light transmittance between the range of 74.9%Tc to 0.5%Tc; and may have a flavor that is more pronounced than that of Grade A Light Amber, but that is not strong or unpleasant. Grade A Medium Amber must meet the density requirement of Grade A Light Amber. Grade A Medium Amber maple syrup must be free of sugar crystals and may not be damaged in any way. [1991, c. 326, §2 (new).]
 - C. “Grade A Dark Amber” means pure maple syrup that is free of any material other than pure, clear liquid maple syrup in sanitary condition; has a color no darker than the federal Department of Agriculture’s visual color standard dark amber or has a color for light transmittance between the range of 60.4%Tc to 44.0%Tc; and may have a flavor that is stronger than that of Grade A Medium Amber, but that is not sharp, bitter, buddy or off-flavor. Grade A Dark Amber must meet the density requirement of Grade A Light Amber. Grade A Dark Amber maple syrup must be free of sugar crystals and may not be damaged in any way. [1991, c. 326, §2 (new).]
 - D. “Grade A Extra Dark Amber” means pure maple syrup that is free of any material other than pure, clear liquid maple syrup in sanitary condition; has a color for light transmittance between the range of 43.9%Tc to 27.0%Tc; and may have a flavor stronger than Grade A Dark Amber. Grade A Extra Dark Amber must meet the density requirements of Grade A Light Amber. Grade A Extra Dark Amber maple syrup must be free of sugar crystals and may not be damaged in any way. [1991, c. 326, §2 (new).]
 - E. “Commercial Grade” means pure maple syrup that is free of any material other than pure, clear liquid maple syrup in a sanitary condition; has a color for light transmittance less than 27.0%Tc; and may have a strong flavor. Commercial Grade maple syrup must be free of sugar crystals and may not be damaged in any way.

Commercial Grade maple syrup may not be placed in packaged maple syrup containers and may not be sold, offered for sale or exposed for sale as packaged maple syrup. [1991, c. 326, §2 (new).]

- F. *Substandard* means bulk maple syrup that fails to meet the requirements of any other grade. Such syrup may not be placed in packaged maple syrup containers and may not be sold, offered for sale or exposed for sale as packaged maple syrup. [1991,

§893. Labeling of maple syrup

All containers of maple syrup sold or offered for sale for human consumption by any person, partnership, association, firm or corporation shall be labeled with the grade, the volume, name and address of the producer or packer, together with the producer's or packer's seal in such form as approved by the commissioner on the cap of the container which must be so affixed that the container cannot be opened until such seal is broken. Any marking which indicates pure Maine maple syrup shall be used exclusively upon pure maple syrup produced within the State of Maine and which has not been bleached or lightened in color by artificial means. [1979, c. 541, Pt. A, § 57 (amd).]

The words "Maine Maple" shall not be used alone or in combinations with other words on a label or container to designate the flavor of the contents unless all of the maple flavoring of the contents is a pure maple, produced in this State. [1967, c. 104 (new).]

§894. Labeling containers

Any person, partnership, association, firm or corporation shall not sell or offer for sale in any place, or serve in any hotel, restaurant or other public eating place any maple sugar, maple confection or candy or maple syrup or any product labeled or represented as such that is in any way combined, interfused or diluted with cane or other sugars or any substance without distinctly marking, stamping or labeling the article or the package containing the same or the advertisement of or menu statement thereof with an accurate and descriptive name of such article and in the case of maple sugar and maple syrup, the percentage in which maple sugar or maple syrup enters into its composition. In case of maple confection or candy a list of the ingredients thereof shall be listed in the order of their volume. The word "maple", "mapled", "mapleing" and words of similar import, except as printed in the percentage statement shall not appear in any manner on the said article in which a product of maple sap is so combined, interfused or diluted, unless the word "blend" appears immediately before, after, above or below said word or words of similar import in equal prominence with the word "maple" or similar term, or unless the term "maple flavored" appears in similar fashion on the label. [1967, c. 104. (new)]

895. Advertising

Any person, partnership, association, firm or corporation, when quoting the price, shall include the grade on all flyers, newspapers, radio and television advertisements. [1967, c. 104 (new).]

§896. Exemptions

Any producer selling to another producer or packer is exempt, except if containers are labeled with a grade, the contents of that container shall meet the grade marked on that container. [1979, c. 541, Pt. A, § 58 (amd).]

898. Violations

Any person, firm or corporation who shall violate any of the provisions of sections 891 to 898 or neglect or refuse to comply with any of the provisions required in those sections or in any way violates any of those provisions commits a civil violation for which the following forfeitures may be adjudged: [1977, c. 696, § 78 (rpr).]

1. First violation. For the first violation, a forfeiture not to exceed \$100; and [1977, c. 696, § 78 (new).]
2. Subsequent violations. For each subsequent violation, a forfeiture not to exceed \$200. [1977, c. 696, §78 (new).]
c. 326, §2 (new).]

[1991, c. 326, §2 (new).]

Notes

© 2002, updated 2007

Prepared by the University of Maine Cooperative Extension in cooperation with the Maine Department of Agriculture, Food and Rural Resources, Division of Quality Assurance & Regulations, the Vermont Department of Agriculture and the Maine Maple Syrup Producers Association.

www.extension.umaine.edu

A Member of the University of Maine System

Published and distributed in furtherance of Acts of Congress of May 8 and June 30, 1914, by the University of Maine Cooperative Extension, the Land Grant University of the state of Maine and the U.S. Department of Agriculture cooperating. Cooperative Extension and other agencies of the U.S.D.A. provide equal opportunities in programs and employment. 10/07

For a printed copy of the UMaine Extension publications catalog, call 800-287-0272 (in Maine) or 207-581-3792 (TTY 800-287-8957).