the best of Brew Your Own

GUIDE TO KEGGING

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Editor's Note

homebrewing is a great hobby . . . and kegging makes this great hobby even better. It makes it better by freeing brewers from the tedium of having to clean and sanitize a seemingly endless number of bottles per batch of beer. Kegging replaces all of them with one "big bottle" — and, there are other benefits as well. Benefits such as being able to alter the carbonation level of your beer if you don't like it and the ability to dry hop or adjust spicing levels (upwards, at least) in the keg. You can even bottle sediment-free homebrew from your keg, with the right equipment. Plus, let's face it, pouring beer from your very own keg is cool. At *BYO*, we love kegging and so we've collected our best kegging-related articles in this *Guide to Kegging*.

In this guide, we start with the basics — how to set-up and use a "regular" homebrew Cornelius keg system. You'll go from wondering what to do to pouring properly carbonated beer with a nice layer of foam in no time. From there, we'll also show you how to get a nitrogen system up and running, so you can pour the perfect pint of dry stout. And if you're interested in real ale (British-style ales conditioned and served from the same vessel), we've got an article on that, too.

Once you've learned the basics, there are more tips on getting the most from your kegging system. We'll show you how to refurbish used kegs, and how to properly clean and sanitize your kegs each time you use them. Is your beer too foamy, or does it pour flat? We address these very common problems in a section on balancing your system. We'll also lay out the options for carbonating your beer and how to use your keg to package sediment-free bottles of homebrew for competitions or parties. And finally, we'll also give you the serving options for when your new keg becomes several kegs.

Next we have a large section featuring all kinds of do-it-yourself projects for the homebrewer with a keg system. Build you own kegerator or a kegerator that can handle the beers for your whole homebrew club. Build gadgets to extend the usefulness of your kegging setup — such as a counter-pressure bottler — and tools to help you keep your keg and lines clean. Also, make your dispensing system look spiffy without spending a bunch of dough by building great looking draft towers or tap handles inexpensively.

Finally, we knew you'd still have some questions, so we got our Mr. Wizard Ashton Lewis to answer them. We picked a multitude of questions from over the years from our popular Q&A column on kegging, carbonation and more.

Cheers!

Chris Colby
Brew Your Own Editor

BASICS

INTRODUCTION to Kegging

by Andy Sparks

I don't think I had finished bottling my first batch of homebrew when I realized that my least favorite part of my new passion was messing with all those bottles. As with most new homebrewers, I was eager to pinch pennies any place I could so I went to the local pool hall where they only sold beer in long neck returnable bottles. The cool thing was that they only charged me $0.05 per bottle for the deposit and a case of bottles in a nice box for only $1.20, it seemed like a great way to save money. Well after washing the bottles and removing the labels, I started thinking I just might not be saving so much after all.

Pros and Cons of Kegging

After a few batches, I decided that I really liked the idea of having only one bottle to wash for each batch of beer, one really big stainless bottle. The pros of kegging seemed obvious to me. The ease of cleanup was great, but the ability to artificially carbonate my beers virtually overnight was the clincher for me. Another benefit is the ability to use a counter-pressure bottle filler to fill a few sediment-free bottles (for homebrew contests or to give to friends) from the keg. (See page 31 of this issue).

I really didn't stop to consider the cons of jumping into kegging my homebrew. As far as I was concerned "there were no stinkin' cons." The cons turned out to be manageable, but really should be considered before buying your system.

The main negative, besides the total expense of getting set up, would be the size of the kegs and the requirement that you refrigerate and serve from them standing upright. The most common 5.0-gallon (19-L) keg will fit in most refrigerators only after most of the shelves have been removed. Also, having draft beer on hand will require a certain amount of maintenance and cleaning of your draft equipment to keep everything operating smoothly. As far as I'm concerned, this is by far the most common problem with draft systems, homebrew or commercial — the lack of regular and thorough cleaning of the system.

The reason that I love having homebrew on tap is because you can pour as much or as little as you like. Unlike with bottles, with a keg you are not committed to finishing another 12 or 22 ounces (354 or 650 mL) — and who doesn't have time for another half glass of homebrewed goodness? Also, showing up at a party with a 5.0-gallon (19-L) keg of homebrew is a great way to make new friends!

Basic Kegging Setup

After a little deliberation, I placed my order for a homebrew kegging setup from my local homebrew shop. My setup was pretty typical. It came with one used, but reconditioned, "Corny" soda syrup keg, a 10 lb. (4.5 kg) CO_2 tank, a dual gauge CO_2 regulator, quick disconnects for both gas and liquid, a plastic spigot and all the needed hoses and clamps. I thought it was strange that they called these soda syrup kegs Cornies, but it turns out that the Cornelius Company was one of the main manufacturers of these and so they have picked up this nickname over time. (The kegs are also manufactured by Firestone and Spartanburg.) This is important because not all the parts from the different manufacturers are interchangeable. As such, whenever you disassemble more than one keg, be sure you know which parts belong to which keg.

Five-gallon (19-L) kegs are by far the most common size, but 3.0-gallon (11-L) and 10-gallon (38-L) versions can sometimes be found. (Even rarer are the 2.0-gallon (7.6-L), 2.5-gallon (9.5-L) and 15-gallon (57- L) varieties.)

I chose to go with the dual gauge regulator mainly because I figured two gauges must be better than one. With a dual gauge regulator, you have a gauge to display both the CO_2 tank's pressure and the pressure being applied to the keg. The pressure on the keg side is what we are most concerned with and is very low compared with the pressure in the tank. The high pressure gauge holds steady at around 800 PSI (at room temperature) as long as there is gas in the tank. Once this gauge starts dropping, you are out of gas.

Your gauge set should come with a special washer that fits between the gauge and the CO_2 tank. You should not use any type of thread tape on this connection and use the washer provided to ensure a proper seal. Most regulators today come with a ball valve for attaching the hose that will run to the gas side of your keg. This is convenient because you will want to occasionally shut off the gas to a keg without disconnecting it from your system. Most systems also include something called a check valve or a back flow preventer. These devices prevent beer from flowing back up the gas line and into your gauge. This may not seem like much of an issue, but when I explain force carbonating later, you will see that it can be surprisingly easy to do.

The quick disconnects you get will depend on what style of keg you have. They come in two different styles, ball lock and pin lock. The difference has to do with the type of connection posts at the top of the keg. These connection posts are used to connect the gas and the beer line to the keg. Because these kegs were originally made to hold soda syrup, the soda companies did not want their customers to be able to switch between the two brands so they made the connections incompatible with each other. It should also be noted that because the soda companies no longer use these kegs for syrup, the supply of these "used" kegs is unpredictable. Because homebrewers tend to prefer the ball lock style — which was used by Pepsi and soda companies other than Coke — those are becoming increasingly more expensive.

The type of quick disconnects I received with my setup was the ball lock style, but both types work just fine. Recently I have seen new universal ball lock replacement posts for pin lock kegs that

Photo courtesy of MoreBeer!

A typical homebrew kegging set up consists of a 5-gallon (19-L) Cornelius keg, 5 lb. (2.3 kg) CO_2 cylinder, regulator with gauges for tank pressure and line pressure, 3⁄16 ID tubing, posts (partially hidden) and cobra faucet.

might be useful if you really want to avoid the pin lock style. These look interesting with the only issue being that they are made of aluminum and might be harmed by the caustic nature of draft cleaning chemicals. As long as they are not soaked in caustic, I'm guessing they would be fine. Both ball lock and pin lock quick disconnects are easily disassembled by unscrewing the top of the valve with a large screwdriver. They should be disassembled and cleaned regularly to keep them fresh and clean.

The faucet I received is sometimes referred to as a picnic or cobra tap. It is usually made of black plastic and has a small lever on top. As inexpensive as these simple faucets are, they are surprisingly good for serving draft beer. They are super easy to clean and use. To take them apart, you only need to unscrew the top and pull it apart. To use them, just press the lever with your thumb. As with all beer faucets, you should always open it fully to keep the beer from spraying into the glass and creating a bunch of foam. These faucets can also be locked in the open position by rocking the lever forward which is nice for cleaning and flushing.

The CO_2 tank I received was a 10-lb. (4.5-kg) tank and that is a nice size to have. It is a nice balance between portability and volume of gas. You can find tanks that are smaller, such as 2.5-lb. (1.1-kg) and 5.0-lb. (2.3-kg) tanks — and these are nice and portable — but are top heavy when you get your gauges attached and they hold less gas.

You can also get larger CO_2 tanks like 20 lbs. (9.1 kg) and above, but these can be very heavy and hard to move, but they last a long time. I get my CO_2 refilled at a local welding supply company. They let me trade my empty for a full tank instead of refilling my tank. That is pretty normal, so don't get too attached to the shiny new tank that came with your setup.

The kegging system described here will allow you to dispense beer pushed with CO_2. If you would like to serve beers, such as dry stouts, pushed by "beer gas" — a mixture of nitrogen and CO_2 — you will need an entirely separate set of equipment. Beer gas, sometimes called Guinness gas, comes in a different cylinder and requires a different regulator (because the pressure in the cylinder is different). In addition, most nitrogen systems use special faucets to enhance the pour. (To set up a nitrogen kegging system, see page 11 of this issue.)

Anatomy of a Keg

The anatomy of a Corny keg is pretty much the same for both styles of kegs. There will be the keg body, made of stainless steel. Most kegs come with rubber handles on the top, but some have metal handles. On top of the keg will be the two connection posts and an oval shaped lid that is held on with a clamping mechanism. The lid usually has a pressure relief valve in the middle and uses a large rubber O-ring to seal. Look for lids that don't have any bends or dents in them.

A small dent on the edge of the lid can make it difficult to get it to seal well. The two posts on top of the keg will be where you connect the gas and beer lines. While these posts look similar, they are not interchangeable. The post for the gas is usually marked with the word "IN" near it, and at least for ball lock style kegs, its quick disconnect is usually colored gray. The post for liquid, in our case beer, is usually marked with the word "OUT" and often the quick disconnect for this side is black. "Grey is for gas, black is for beer" is an easy way to remember this, but this does not work for pin lock style kegs. For pin lock style kegs it is a bit easier because they use small pins protruding out from the post to latch onto. The gas post has two pins and the liquid side has three pins so it is obvious that they are different and cannot be connected incorrectly.

Used Kegs and Cleaning

My experience has been that the folks that wholesale reconditioned kegs to homebrew shops have wildly different ideas of what "reconditioned" means. For some, "reconditioned" means checking, testing and replacing all the rubber parts. For others it means they just dumped out the contents and pressure tested the keg. (For step by step instructions on how to refurbish a used keg, see page 22 of this issue.)

Once a keg is refurbished, or if you buy a new keg, it will still need to be taken apart and cleaned before each use. (The article on page 22 explains keg disassembly.) One helpful hint to ensure that the keg holds pressure when you reassemble it is to use keg lube. Keg lube is basically food grade grease used to lubricate the rubber parts of your draft system. Rub a tiny amount on the O-rings — especially the big ring on the lid — and this will seal off any microscopic links. It does not affect the flavor or head retention of your beer. This stuff goes a long way and one tube will last most homebrewers a lifetime.

Carbonating Beer

When it comes time to carbonate your beer, you can do that a few different ways. It is possible to naturally carbonate your beer in kegs just as with bottle conditioned beer. Some folks do prefer this method of carbonation but many prefer to force carbonate their beer as soon as it is good and clear. If you do want to naturally carbonate your beer, you might consider cutting off the last half inch (1.3 cm) of your liquid dip tub. This will help reduce how much yeast sediment is drawn into the tube and after the first glass or so you should not see much yeast being drawn up the draft line.

If you choose to force carbonate your beer, you can go about that a couple basic ways. I have also seen people use hybrid versions that combine both ways. For lack of an official name, I will call the first the "Crank-N-Shake" method and the second the "Set-N-Wait" method. Before we jump into the differences between the two methods, we need to talk a little about how CO_2 and water react together.

Carbon dioxide is interesting stuff in that it can be dissolved into liquid. This gives us the delightful fizzy sparkle we all know and love. The thing is that the amount of CO_2 that can be dissolved into liquid is related to the temperature of the liquid (beer in our case). The key thing to remember is that the colder the solution, the more

CO_2 it can hold. For this reason, the first step to force carbonating your beer is to get it good and cold. You can do this by placing your carboy in the refrigerator the night before or you can transfer your clear beer to a clean and sanitized keg and refrigerate that overnight. It is a good practice to squirt a little CO_2 into your empty keg before starting to transfer your beer into it to help reduce any oxidation in the final product.

To make this and the process of carbonation go as smoothly as possible, I like to add a small plastic "T" at end of my tubing. Off of each side of this "T" I attach two quick disconnects, one gas disconnect and also a beer disconnect. This way, when I want to direct CO_2 to the very bottom of the keg as in flushing or force carbonating I can attach the gas line onto the normal liquid post and force CO_2 down the liquid dip tube.

Once your beer is chilled to serving temperature and is transferred to your keg, you are ready to get started.

The "Crank-N-Shake" method is named because you basically crank up the pressure and shake the CO_2 into solution. If you choose to use the "Crank-N-Shake" method, attach your keg to the gas and turn the pressure on your regulator up to about 20 PSI. Some use higher pressure, but I really don't think that is necessary. Before you start, make sure your CO_2 tank is secure and will not get pulled over as you start to rock your keg back and forth. As you start to rock the keg, you will hear the CO_2 rush into the keg. As more and more CO_2 is dissolved into your beer, less CO_2 will rush in to take its place. If you keep shaking the keg, it will soon reach equilibrium and this sound of hissing gas will stop. Rock the keg for awhile, I find that about the time I'm getting sick of rocking it is about right, but shoot for about 10 minutes of gentle rocking.

Now you essentially have a big can of shaken beer. This is not the time to pour a sample. Place the keg back into the refrigerator and let it settle down. I usually let it sit overnight before giving it a try. If it needs a little more carbonation, you can take it out and shake it some more, but be careful because it is easy to overdo it. If you do over carbonate, you can reduce the level by unhooking it from the gas and repeatedly venting the pressure using the pressure relief value in the lid.

One valid criticism of the Crank-N-Shake method is that you have no idea how much CO_2 you are dissolving into the beer, and for most beer styles you want a specific amount. With trial and error, you can learn to get close to your carbonation goals; but if you want to hit a specific goal, the Set-N-Wait method is much better.

The Set-N-Wait Method

The "Set-N-Wait" method involves hooking the keg up to the gas at normal serving pressure, for me about 12 PSI, and letting it sit. It will reach the correct level of carbonation in two or three days. This is basically what the "Set-N-Wait" method is, because we know how much CO_2 can be held in solution at a given temperature, we can simply set the pressure to the correct level and just wait for the CO_2 to dissolve. Depending on how much fizz you want in your beer, and how much is appropriate for the style, you can adjust the total volumes of CO_2 you dissolve into your beer. (The table on page 78 will show you how much pressure to apply to get your tagret level of carbonation, based on the temperature of the keg.)

However, because most homebrew is stored at refrigerator temperature (38–40 °F/3.3–4.4 °C) and most "regular" beers are served at between 2.0 and 2.5 volumes of CO_2, a simple rule of thumb can be given — set your regulator to between 8 and 12 PSI, let the beer carbonate and adjust the pressure later if you want more or less fizz. (If you want to serve British-style ales at cellar temperature (around 52 °F/11 °C) with 1.8 to 2.0 volumes of CO_2, you will need to use an external thermostat on your beer fridge to set the temperature. At this temperature, set the gauge pressure to 8 to 12 PSI and you will get this lower level of carbonation.

This is by far the easiest carbonation method and I find that, for most of my beers, simply getting them chilled to serving temperature and putting them on gas at serving pressure will result in a nearly perfectly carbonated beer in about a week.

It is important to remember that if you accidentally have your gas line hooked up to your liquid post (an easy mistake to make), you set up a situation where beer can flow up the gas line and potentially into the gauge if not protected by a check valve. Even if you have a check valve, you still don't want beer up in your gas line that you will need to clean out. So be careful.

I have both a kegerator and a large three door commercial refrigerator that I use to hold my kegs. The kegerator is nice and has two chrome faucets on a stainless tower that sticks up from the middle. Faucets on a kegerator like this are exposed to room temperature and allow some beer to dry in them between uses. This means they require regular cleanings to keep them fresh. A sour faucet will ruin every beer poured from it. Contamination from a faucet can make its way back down the draft line and into the keg if allowed to go on long enough. The entire bottom of the three door refrigerator is dedicated to kegs. In there I use the picnic taps exclusively and they work great. Because they stay inside the refrigerator with the keg, they stay just as cold as the beer. They seem to stay fresher longer and are easy and quick to clean out if needed.

Cleaning Your Lines

Cleaning your draft equipment is vitally important to serving fresh beer. I use a product called Beer Line Cleaner that is made specifically to clean draft lines. This stuff is pretty strong, so you should be extra careful when using it. A little common sense goes a long way here; always follow the manufacturer's mixing and usage instructions. I have heard of others using other products to clean draft lines, but I really like using the stuff that is made to professionally clean draft lines.

My process is pretty simple; I mix up about a gallon (~ 4 L) of beer line cleaner and place it in the bottom of my dirty keg. I put the top back on, shake and roll the keg around for a minute or two, working it around good in the keg. After that I hook up the gas to the "IN" post and hook up a faucet to the "OUT" side. Turn the pressure up enough to push the cleaning solution out of the faucet.

I like to collect this in another keg or bucket for reuse if I have more than one keg to clean at a time. I usually don't rush this process; I let out about a cup and then let it sit for a few minutes before draining some more. I really like to have the cleaner stand in the lines for awhile to allow it to break down any gunk or beer stone in the line. As I mentioned, the cleaner is really strong so letting it stand in the lines for a long time or even overnight is not recommended. I repeat this process until the entire gallon (4 L) has been pushed through the system.

Pushing this volume of cleaner through the lines does a great job, but leaves them full of beer line cleaner. The next step is to flush the lines. You can use plain water, but I prefer to use a mild acid-based sanitizer, like Star-San or Sani-Clean to neutralize and rinse the residual cleaner from the lines and leave them packed with sanitizer. Once again, push the sanitizer through the lines with CO_2 pressure — when the pressure blows, it will leave sanitizer foam in the lines.

Dispensing Beer

Now that your beer is all carbonated in your kegs, there is only one thing left to do — pour some beer! Don't be discouraged if the first glass you pour is all foam. Foaming can be caused by several factors, one of which is dirty draft lines, but we will assume that since you just rebuilt your kegs and taps that will not be the problem. To completely understand the relationships between gas pressure, temperature, tap height and the diameter and resistance of the draft line can be quite complicated. (You can read about all these details on page 28 of this issue). However, because most homebrew is stored at the roughly the same pressure and dispensed at roughly the same height, most homebrewers find that beer pushed through 3.5 to 4.5 feet (1.1 to 1.4 m) of 3⁄16 ID tubing works well.

For the most part, if problems with foaming do arise, they can be resolved with the following technique. First, turn the pressure on the regulator down to around 2 or 3 PSI, then shut off the gas to the keg in question at the ball valve. Then, using the pressure relief valve, vent almost all the pressure from the keg. At this point, try to dispense a beer. Almost no beer should be coming out, maybe just a trickle. Then open the ball valve and check the pour again. The idea here is to gently sneak up on the proper serving pressure for your setup. Keep turning up the pressure until you get a nice foam-free pour. BYO

Andy Sparks owns The Home Brewery, a homebrew supply retail shop in Fayetteville, Arkansas.

NITROGEN Draft Systems

by Bill Pierce

Anyone who has ever had a Guinness Stout on tap knows the cascading off-white head surging and swirling above the nearly black liquid. The head is full of extremely fine bubbles, creamy on the tongue and an integral part of the signature of this world-famous beer. This is now emulated in cans and bottles of Guinness Draught, as well as by several other dry stouts, including Beamish and Murphys. Additional beers — such as Boddington's Pub Ale, Caffrey's Irish Ale and even Pyramid DPA in the US — have extended the concept to include other ale styles carbonated and served with nitrogen blends rather than solely with carbon dioxide.

Homebrewers need not feel left out, we can serve such distinctive beers, too. It's not that difficult to duplicate the "nitro pour" of your favorite pub draught. All it requires is some additional equipment beyond a standard keg set up and somewhat different carbonation and serving methods. In this article, I'll explain what it takes to do the job right and pour your beer proudly.

First, it's important to know what is occurring in these beers. For thousands of years, brewers have relied on the carbon dioxide (CO_2) produced during fermentation, and naturally dissolved in the beer, to provide bubbles and a tingling sensation when served and consumed. As the beer warms, the CO_2 comes out of solution as it is less soluble at higher temperatures. This is part of the flavor profile of nearly all beer styles; it's less so for some British ales, but almost no beer is entirely flat. Apart from cask ales, most tap beers are pressurized with additional carbon dioxide in order to force the beer through the lines and prevent staling due to contact with oxygen in the air.

Nitrogen gas (N_2) comprises around 78 percent of the Earth's atmosphere. Nitrogen is much less soluble in water or beer than carbon dioxide — around 80 times less at beer serving temperatures. And, it does not react with beer. In beers served with nitrogen — or, much more typically, a nitrogen-carbon dioxide blend — the nitrogen is forced along with the beer through tiny holes in the tap that create millions of nearly microscopic bubbles and a creamy, long-lasting cascading head.

American Pilsners have around 5,000 mg/L of CO_2 dissolved in them. In contrast, beers served with nitrogen typically contain around 2,400 mg/L of CO_2 and only about 20 mg/L of N_2.

Equipment

The components of a mixed gas dispensing system are similar to that for regularly carbonated beer, with a few important differences. You can use your Corny kegs to hold the beer, but the other equipment is different. Obviously one difference is the gas itself. The usual blend is 75% nitrogen and 25% carbon dioxide (occasionally the percentages vary) and is sold by many gas distributors. If your supplier does not have it, look in the yellow pages under "carbonic gas" and ask for "mixed gas," "beer gas" or "Guinness gas."

Mixed gas cylinders are slightly different from those that contain carbon dioxide. The threads on mixed gas cylinders are left-handed so that a mixed gas regulator cannot accidentally be attached to a CO_2 cylinder. Additionally, the gauges typically have higher maximum readings because both the storage and dispensing pressure of nitrogen is higher. If your homebrew supplier does not have mixed gas equipment, these items are available from many gas suppliers.

A major difference is the faucet for dispensing nitro beers, which is easy to distinguish from a typical tap because it is both taller and thinner. The key element is a small disc called a "restrictor plate" that impedes the flow of beer and gas, and forces them through tiny holes (usually five). Don't confuse a stout faucet with a creamer faucet; they are not the same thing and can't be usd interchangably.

The dispensing pressure for beers on mixed gas is considerably higher than for other beers, both because of the restrictor plate and the nature of nitrogen itself. Guinness recommends, and most bars push nitro beers with, about 30 PSI of gas pressure.

While nitrogen beers have a dense, creamy head, these beers are not highly carbonated. In fact, excessive carbonation may be objectionable because it adds a sharpness (from dissolved carbon dioxide that reacts with water to form carbonic acid) that is not part of the flavor profile of these beers. It also results in excessive foaming when being dispensed. Guinness Draught, for example, is carbonated only to about 1.1–1.2 volumes of CO_2. Most of this already occurs as the gas is dissolved in the beer during fermentation; little CO_2 is added later for force carbonation.

It's worth considering which beers may benefit from dispensing with mixed gas. Not all styles are appropriate for this method. For one thing, it tends to increase the perception of a beer's body or mouthfeel. This is ideal for low-gravity styles such as dry stout, but is much less desirable for beers that already have a high final gravity and considerable body.

Another result of mixed gas is to decrease the perceived bittering and hop aroma. Highly hopped and bitter beers will appear less so when served this way. Lagers tend to have an odd creamy quality that seems out of place.

Beer served on nitrogen is not the same as cask ale, which shares a low carbonation level but is typically dispensed with a hand pump that mechanically uses the vacuum pressure of air to draw the beer from the cask. This mixing of air with the beer causes flavor changes over time that traditional "real ale" partisans consider the hallmark of a properly-cellared beer. Some pubs attempt to imitate cask ale by serving their regular beers through a stout faucet with mixed gas, but this is a poor substitute for real ale and produces quite different results. (See the next article, on page 13 of this issue for how to serve cask conditioned ale at home.)

Consider nitro beer as practical only if you keg your beer. While some commercial breweries have developed systems for canning and bottling such beers, this is beyond the technology of homebrewers. The "widget" in the bottom of these cans and bottles is injected with a droplet of liquid nitrogen and added during filling. When the can or bottle is opened, the change in air pressure forces the nitrogen out of a tiny hole in the widget and diffuses it throughout the beer, resulting in a cascading head when it is poured, much like the tap version. Bottling without the widget does not result in the creamy head of a "nitro pour."

Using Your Nitro Setup

To prepare a beer for mixed gas, brew and ferment an appropriate style in the normal way, but carbonate it very lightly. For example, if a dry stout is fermented at 68 °F (20 °C), it will already have nearly 0.8 volumes of dissolved CO_2. Increasing this to the recommended 1.2 volumes would require only a little force carbonation if the beer is chilled to the recommended serving temperature of 43 °F (6 °C). Force carbonating should be done with pure CO_2; trying to accomplish this with mixed gas requires much more time. If you opt for priming the keg, use less than 1 oz. (28 g) of corn sugar for 5 gallons (19 L) of beer.

Although some brewpubs simply begin pushing carbonated beer with the nitrogen mix, others claim that you need to equilibrate the beer with the mixed gas. (Guinness kegs are shipped with nitrogen already dissolved in them.) This requires diffusing the gas into the beer. This can be accomplished by letting cold beer sit under high pressure, although — given the low solubility of nitrogen — this can take a week or more. A better way is to inject mixed gas into the beer through a stone. Turn the regulator to a pressure higher than the pressure in the headspace of your keg and bubble gas through the beer (releasing the headspace pressure occasionally). Ashton Lewis, of Springfield Brewing says, "We gas for 30 minutes, rest for 30 minutes and gas for 30 minutes."

Photo courtesy of Northern Brewer

Getting a nitro pour requires a mixed gas cylinder, regulator and a stout faucet.

Once the beer is ready to go, connect the gas fitting of the keg to the mixed gas regulator and cylinder, and the beer fitting to the dispensing line. Open the mixed gas cylinder fully, adjust the pressure at the regulator to a reading of 30 PSI (205 kPa) at 43 °F (6 °C) and test for a smooth pour, a cascading head without excessive foaming. Adjust as necessary.

Guinness very carefully instructs pubs and servers in the proper dispensing technique, but it really boils down to these six steps:

1. Use a clean, dry unchilled glass.
2. Hold the glass near the faucet at a 45-degree angle.
3. Pull the handle forward to the fully open position.
4. Fill the glass approximately three-quarters full.
5. Allow the head and the beer to settle for one to two minutes.
6. Fill the glass to the top as necessary so that the cascading head just climbs above the rim.

That's all it takes for "a perfect pint" and nitro nirvana. As the Irish say, "Slainte!"

Bill Pierce was Brew Your Own's *"Advanced Brewing" columnist.*

SERVING CASK
Conditioned Ales at Home

by Dave Louw

On a recent road trip through eastern Oregon, my wife and I finally got to visit a brewpub that has been on our list for a long time, Deschutes Brewing in Bend. The atmosphere and food were excellent, but obviously the star attraction was the beer. Getting to drink Mirror Pond, Black Butte Porter, and Obsidian Stout at the source was an unforgettable experience, though one beer in particular triggered that unique homebrewer war cry: "I have to brew that!"

Deschutes' Bachelor Bitter showcases complex toasty and nutty English malts, an earthy and floral hop bouquet, and complimentary fruity esters from the yeast. The brewery emphasizes each of these characters by serving the beer on cask as would be done with traditional real ales in Great Britain. The lower carbonation and cellar temperature make this 5.3% ABV beer drink very smoothly and we had no trouble downing a couple of pints in addition to all the other tasters that night. As we passed back through the area on the return trip we filled a growler to go.

While I have drank craft beer "on cask" at many breweries in the past that generally entailed the brewer simply putting some of their regular carbonated beer in a firkin serving it slightly warmer pulled through a beer engine. Each time I found the experience interesting, but the balance was off in the final product. Deschutes, on the other hand, made the cask character an integral part of the beer.

Returning home, thoughts of brewing and drinking real ale consumed my free time. I gathered and read everything I could find on the topic and began plotting my first batch. Those efforts ultimately culminated in a successful cask party. The experience convinced me that more homebrewers should brew and serve cask ales.

Cask Ale

Britain's Campaign for Real Ale (CAMRA, www.camra.org.uk) movement defines real ale as "a natural product brewed using traditional ingredients and left to mature in the cask (container) from which it is served in the pub through a process called secondary fermentation." As such, you can see that homebrewed beer that is carbonated in the bottle through the addition of priming sugar already shares a lot of traits with this packaging and serving technique.

Beyond this fairly broad definition, most drinkers would recognize real ale as typically having a lower carbonation level than most lagers and American ales, served at cellar temperatures (~50 °F/10 °C), appearing brilliantly clear, and showcasing the yeast character. All this leads to a supremely drinkable beer across many pints. Often time drinkers will identify a unique character in the beers at their favorite pub that develops over the time the cask is consumed.

Why would a homebrewer want to make cask ale at home? The most obvious reason is the same reason we brew anything. There are many styles of beer that are best experienced in their original cask form including English Pale Ales, Scottish and Irish Ales, English brown ales, porters, and stouts. In the US, we often have to settle for less than fresh bottled examples (which are often higher gravity and carbonation than their draught counterparts) or Americanized interpretations. Homebrewing is a way to drink something we could not easily buy.

For homebrewers who do not have the space, funds, or desire to have a dedicated kegerator, packaging in casks provides a great option for sharing a large amount of beer at once. Rather than cleaning, filling, and conditioning 50–100 bottles, you just deal with one cask. During conditioning you treat the cask like a primed bottle, leaving it somewhere at around room temperature to carbonate. Any closet should do just fine. When it comes time to serve, you only need to chill the cask down in a fridge or cellar for a short period of time. As I will describe below, the serving equipment is minimal.

Finally, cask ale fascinates people. While I seldom have trouble attracting a crowd of friends to a party with free beer, the turnout for my first cask

party was astonishing. I had naively worried that the cask would go to waste because I would not get enough drinkers to finish the entire 5 gallons (19 L) in one night. To my surprise, a little over an hour after tapping the beer, I started seeing signs the cask was on its last legs. People eagerly downed multiple pints and the low alcohol level kept the discourse civil. I think they really enjoyed participating in something special and ultra-local. Few had experienced true cask ale and discussion between brewing friends and non-brewing friends was lively.

Equipment and Supplies

The equipment for brewing cask ale is no different than what you would use for any other beer. You can brew the beer as extract, mini-mash or all-grain and should expect similar results as with non-cask beers. Along the same lines, primary fermentation does not require any special procedures. Of course there will be different ingre-dients and techniques unique to the

1. Keystone Bung — Seat the keystone bung all the way.
2. Filling the Cask — Rack into the cask as you would with any keg. Note that I'm filling through the keystone bunghole, although the recommended approach is to fill through the shive bunghole.
3. Filled Cask — Pin all sealed up and labeled, ready to condition in a room temperature location.
4. Venting the Cask — A venting tool with blow-off hose ensures any gushing does not end up on the ceiling.
5. Cask with Chocks and Cooling Towels — The homemade wooden chocks are positioned two in the front and one at the back. Placing all three on a single towel prevents them from slipping out of place.
6. Ready to Tap — Before tapping be sure to sanitize the keystone and tap. Pull out the spile from the top as well.
7. Tapping — Here is the birthday boy lining up to drive the tap through the keystone. Note the large wooden mallet; this is the style I recommend.
8. Tapped — Turndown spout attached and ready to pour. Cheers!

styles you typically cask, but I will cover that later.

Packaging and serving require unique equipment, though. Northern Brewer (www.northernbrewer.com) has shown a consistent dedication to spreading the cask ale message and supplying homebrewers with everything they need. At the 2011 National Homebrew Convention in San Diego, for example, they brought several casks of homebrewed ale for demonstration and served them in the hospitality suite. I recall a particularly excellent mild ale they tapped on that Saturday. Additionally you'll find that their Brewing TV video podcast covers cask beers in a fair amount of depth. In any case, the easiest way to get into cask beer is to purchase their homebrew cask kit that includes a pin cask and all equipment short of a mallet and chocks.

The equipment itself can be broken into three categories: packaging, stillaging and serving. The packaging equipment is what you need to store and age your beer. It comprises the cask, keystone bung and shive bung.

Casks

Modern casks are typically stainless steel and very well built. They come in multiple sizes but the two most common are the pin (5.4 US gallons/20 L) and the firkin (10.8 US gallons/41 L) The sizes go up from there, but are more appropriate for a brew pub setting that can handle the significant challenge of moving around the increased weight.

Pins and firkins cost roughly the same, so the choice really comes down to how much beer you want to brew at once and how much you think you can consume before it stales.

Bungs

There are two holes in the cask itself that you bung up during the packaging process. The hole in the cask head is the keystone bunghole and the other one is the shive bunghole. The bungs can be either made of traditional wood or the more modern and consistent plastic. As far as I can tell, there is not a compelling reason to use one material

MATERIALS

Cask (pin (5.4 US gal./20.4 L) or firkin (10.8 US gal./40.9 L) size)
Keystone bung (plastic or wood)
Shive bung (plastic or wood)
Heavy wooden mallet
Three wooden chocks
Venting tool
Hard spile
Soft spile
Tap
Turndown spout (or beer engine)
Washer and Nut

RECIPE

Oxfordshire Ordinary Bitter
(6 gallons/23 L, all-grain)

OG = 1.034 (8.5 °Plato)
FG = 1.005 (1.3 °Plato)
IBU = 47 SRM = 9 ABV = 3.8%

This beer is ideal for the no-sparge method, which emphasizes the malt character. The 6-gallon (23-L) batch size is enough to fill a pin, with enough beer left over to fill a few 22 oz. bottles.

Ingredients

6.75 lbs. (3.1 kg) Maris Otter pale ale malt
1.2 oz. (34 g) UK dark crystal malt (75–80 °L)
1.2 oz. (34 g) black malt
9.5 oz. (270 g) granulated cane sugar
11 AAU UK Challenger hops (60 mins) (1.45 oz./41 g at 7.6% alpha acid)
0.25 oz. (7.1 g) Styrian Goldings hops (flameout)
0.25 oz. (7.1 g) East Kent Goldings whole hops (dry hop in cask)
1 tablet whirlfloc
White Labs WLP023 (Burton Ale) yeast
2 oz. (57 g) granulated cane sugar (for priming)
10 mL Biofine Clear finings (at venting)

Step by Step

Mill the grains and dough-in targeting a temperature of 151 °F (66 °C). Hold the mash at 151 °F (66 °C) until enzymatic conversion is complete (roughly 60 minutes.) Collect 7.25 gallons (27 L) of SG 1.026 wort. The total boil time will be 60 minutes. Add the bittering hops at the start of the boil and boil for 45 minutes. Add the whirlfloc tablet to encourage coagulation in the kettle with 15 minutes to go. At roughly the same time, turn off the flame, add the granulated sugar. Stir well before turning the flame back on to avoid scorching. Complete the boil and add the flameout hop addition before chilling to 68 °F (20 °C), racking, oxygenating, and pitching yeast. Ferment at 68 °F (20 °C) until fermentation subsides, roughly one week later.

Rack to cleaned and sanitized cask along with priming sugar solution. Condition for roughly two weeks at about 70 °F (21 °C). Chill cask to 50 °F (10 °C) and then vent through the shive. Add finings, plug shive with soft spile, and mix gently. Let the cask settle for at least 24 hours, switching the soft spile for a hard spile as soon as visible off-gassing completes. Set up for final serving at 50 °F (10 °C), tap and enjoy.

Based on the Brakspear Bitter clone recipe from "Brew Your Own British Real Ale," by Graham Wheeler.

Extract Option

Replace the Maris Otter pale ale malt in the recipe with 4.5 lbs. (2.0 kg) of malt extract. Steep the remaining grains for 30 minutes at 151 °F (66 °C) before adding the malt extract. Otherwise follow the rest of the recipe as described above.

over the other but I chose plastic because I was more confident I could properly sanitize it. Both bungs have a recessed and partially bored out center. Later on, you will knock these out and so you will need to replace the bungs for each batch. Their cost is less than that of the required crown caps to bottle an equivalent amount of beer so this is not a big deal.

Unlike Sankey kegs (and most other modern beer packaging vessels) traditional casks are stored and served in a horizontal position with the heads on the front and back rather than the top and bottom. Storing the keg, or stillaging, faces the challenge with that cask is round and so would roll around without something to keep it in place. In many commercial settings there are special racks for holding the casks.

Securing the Cask

For the homebrewer, the best choice is to make wooden chocks. You need three of them (I will explain why later) but these are the one item I have not found for sale. Making the chocks yourself is simply a matter of cross cutting a 2 x 4 at a 30 degree angle. You should also trim the tip off the sharpest point, so that the chocks do not hit each other when in use. While it may be tempting to make these out of a nice hardwood and apply a glossy finish, in practice rough-cut softwood is better. You want them to be somewhat rough so they don't slip out of place in use.

Once the beer has carbonated and is almost ready to serve, you will vent the pressure from the keg to get it to the level you desire. Doing so involves knocking the center, or tut, out of the shive bung. You can use a metal punch of some sort or purchase a venting tool that has a blow-off hose. The benefit of the venting tool is if your keg is over-carbonated the spray will be diverted through the tube into whatever catch-vessel you set up rather than shooting up at you and the ceiling.

Spiles

Once the keg is vented, your job as cellarmaster involves maintaining the right condition, or carbonation level. If the carbonation is higher than intended, you drive a porous wooden peg, or soft spile, into the shive bung. This allows excess carbonation to slowly leave the beer while preventing contaminants from entering the cask.

Once the beer is at the condition you want you replace the soft spile with a non-porous wooden peg, or hard spile, to seal it up. New spiles should be used for each batch since sanitizing the wood would be fairly difficult. Much like the bungs, this is not much concern as they are trivially cheap.

Gravity Tap or Beer Engine

Of course all of this effort is for naught unless you can get the beer out of the cask into a glass to drink. This is where the traditional tap comes in. The tap has a tapered end that you will drive through the keystone bung. A quarter turn valve controls the flow of beer. Taps typically have either one or two threaded fittings to allow attaching spouts or serving lines. Taps come in affordable plastic or in much more expensive and durable stainless steel. The brass taps common from earlier in the 20th Century have all but disappeared.

Which brings us to the biggest choice you have to make when serving cask beer. Do you want to go simple with a gravity spout or do you want to use a beer engine? While many beer drinkers automatically picture the ubiquitous beer engine when thinking of cask ale, its real practical purpose is for something homebrewers rarely face. At a pub, the casks are stored in the cellar and left undisturbed to prevent sediment from kicking up. This cooler room is often a floor below the pub. Rather than have the barman walk down to the cellar to pour each pint the beer engine (sometimes called hand pump) was developed. Basically the pump is a piston that fills and pours beer when the barman pulls the handle. Luckily this is much simpler for the homebrewer or someone serving at a festival because you can simply station the keg on a table or bar where you will be serving. There is no need for a fancy contraption to get the beer out of the cask as gravity is always at hand. A simple turndown spout can be fixed to the threaded fitting with a washer and nut. Turn the valve and beer comes flowing out to fill your pint glass.

The one trick you can employ with a beer engine that is not available on a gravity setup is using a sparkler. The sparkler is a fitting that goes on the end of the beer engine spout and forces the beer through lots of little holes. This agitation knocks a significant amount of CO_2 out of solution making the beer less gassy and helping to kick up a head and enhance the aromatics in the glass. Like many aspects of real ale serving, drinkers do not universally accept the use of sparklers. Given the roughly $500 price tag for a new beer engine in the US, it would be difficult to make the case for buying one based on the sparkler effect alone.

Cask Breather

The final piece of equipment to consider is something I will not go into much detail about. CAMRA's definition of real ale does not allow for additional CO_2 to be added to the beer so the cask is simply vented to the atmosphere. As the beer is served from the keg the air from around the cask is drawn in through the shive leading to oxidation and eventual spoilage. If the cellarman does not expect to serve the entire cask quickly enough a special valve called a cask breather can be used. Essentially it attaches to the shive and supplies CO_2 to blanket the beer rather than regular air.

The ingenious design of the valve ensures that the CO_2 is at atmospheric pressure to prevent over-carbonation. This could be a good solution for anyone who wants to drink their cask over a longer period of time.

Brewing for the Cask

While technically the wort production and fermentation for a beer you intend to serve in a cask is identical to any other beer, there are some things to keep in mind. When brewing any beer, you need to consider how all the aspects of the finished beer interplay. There are no hard and fast rules, but consider how to make the best use of the following characteristics.

Cask ale has a much lower carbonation level than many modern beers. Carbonation plays several important roles in beer. The carbonic acid "CO_2 bite" is greatly reduced in these beers so you must pay particular attention to any residual sweetness in the beer, which will effectively be heightened. Similarly, since carbonation can help dry out a beer you may want to replace some of the malt with simple fermentable sugars, as is commonly done in Great Britain. Finally, note that any roasty character in your beer will shift more towards a chocolate note rather than the acrid quality it can sometimes take in the presence of significant CO_2.

Since it is usually served at cellar temperatures, cask beer amplifies otherwise subtle flavors and aromas. Any harsh notes that might be imperceptible at colder temperatures will move to the forefront. Be extra careful on your fermentation and sanitation, as there is less room to hide. That said, these tend to be much more flavorful beers than macro-brewed light lagers. The drinker will notice the yeast, malt, and hop characters even more than usual. Splurge for quality grains such as the excellent choices from Simpson's, Thomas Fawcett, and Crisp Malting. Choose a characterful English yeast strain and experiment with temperatures that cause them to express their wonderful esters. Consider dry hopping your cask with fresh hops or the freshest quality hops you can find. On the positive side, you will likely be drinking this beer very fresh so you do not have to worry about losing character over time to staling.

In terms of timing, you are likely to be brewing a fairly low alcohol beer (though stronger beers like old ales and barleywines certainly are not out of the question). As such the time from brewing to consumption is actually quite short. Assuming a healthy pitch of yeast and a vigorous fermentation, you would be racking your beer to the cask with priming sugar after about 7 days and then drinking the final product at the three-week mark. Note that since this is a live beer, and there is active yeast in the cask, you do not have to worry as much about acetaldehyde and diacetyl problems you can otherwise get from taking the beer off the yeast too soon.

For my inaugural batch, I tracked down and slightly modified a recipe for traditional English Ordinary Bitter.

Packaging and Serving

Once primary fermentation completes, you are ready to package your beer in a cask. Prepare the cask by cleaning it well. Since the cask has smaller openings that prevent you from reaching into it like with corny kegs you might want to soak it in a hot solution of percarbonate based cleaner such as Powdered Brewery Wash (PBW.) You can gently put in the spile bung at this time to allow the cask to hold a full volume of cleaning solution while standing on one of it's heads with the keystone bunghole facing up. Rinse the keg well and then sanitize the shive and keystone bungs.

Use a heavy wooden mallet to drive the keystone bung into the cask to seal it. Do not use a metal hammer or anything that might damage the keystone hole surface because over the long run you may not be able to achieve a leak-free seal. A shot-filled dead-blow mallet can also work in a pinch. Rubber mallets often do not have enough heft and are simply frustrating to use as they bounce away. It takes a surprising amount of force to get the keystone bung to seat completely so invest in a substantial wooden mallet.

Prime the Cask

Once the keystone bung is in place, set the keg on its side with the shive hole facing upwards. At this point you may want to use the chocks you made to keep the cask from rolling around. Make your priming solution to achieve 1.5 to 2.0 volumes of CO_2 and add it to the cask through the shive hole. Then gently rack your beer into the cask, leaving a small amount of headspace. Seal up the cask by driving the shive bung home with a series of firm hits with your wooden mallet. There is a slight lip on the plastic bung and you want to drive it in all the way till the lip seats firmly against the cask. On my first attempt, I was shocked at how much effort this took but that was mostly because I was using a light 10-ounce (280-g) wooden mallet. I later upgraded to a 20-ounce (570-g) model, which was much easier to use.

Go ahead and roll your cask around a bit at this point to mix in the priming solution. Carefully inspect the keystone and shive bungs to make sure they're not leaking. A few good taps should solve any problems. If you are using wooden bungs and observe some leaking, know that they will soak up some beer and swell to seal any leaks within an hour or two.

Cask Conditioning

Now you wait. Just like when bottle conditioning beers, you want to store the cask in a room temperature location to allow the remaining yeast to work through the priming sugar and provide carbonation. This is a fairly forgiving process, though. The biggest things to avoid are storing the keg so cold that the yeast goes dormant without carbonating the beer or storing the keg so warm that the beer starts to degrade. Again, this is no different from bottle conditioning beers. Carbonation should take roughly a couple of weeks under ideal conditions.

When you know when you are going to serve the beer, you need to plan a few days ahead of the event. Ideally you want to store the cask on its side (with heads facing front and back and shive upwards) in the serving location for as long as possible for the yeast and other sediment to settle to the bottom of the cask. The trick of course is that you also need to get the cask down to serving temperature of 50 °F (10 °C). As a homebrewer I will assume you don't have a dedicated cellar at this temperature so I will tell you what I do. I put the cask in a fridge and set the temperature to 45 °F (7.2 °C), then pull it out and setting it up in its final location the morning of the event. I cover the cask with an insulating blanket of some form to keep it cool. This is when you definitely need those chocks you built. Place two under the front of the cask from the sides and one in the back with the sharper point facing forward. Set the keg up to be roughly level.

At least 24 hours before you serve the cask, you need to vent it to ensure you have the right level of carbonation, or condition. It is critical that the beer be at roughly serving temperature since a warmer beer will off-gas too much CO_2 (think of the gushing you see if you open a warm beer or serve a warm keg). Start by cleaning and sanitizing the shive bung surface. As mentioned under the equipment section earlier, drive the tut through the center of the shive bung into the cask using a sanitized metal punch or venting tool. Once any initial foaming subsides (which may be almost immediately for a beer that is already close to serving condition) it is time to fine the beer.

Fining the Beer

The goal of fining is to get the yeast and sediment to drop out and settle inside the bottom of the cask leaving brilliantly clear beer. There are multiple choices including isinglass, gelatin, and Biofine Clear. I personally prefer Biofine Clear as it is easier to use and is entirely vegetarian and vegan friendly (using it avoids awkward conversations where I would have to ask if people eat meat before handing them a pint of my beer.) Follow the directions for your fining of choice but in general I use about 0.34 fluid oz. (10 mL) of Biofine Clear in a 5.4 gallon (20 L) cask.

Once you have added the fining through the newly created hole in the shive bung, sanitize and gently press a soft spile into the shive hole. Rock the keg back and forth to ensure the fining is mixed well into the beer. Spray some sanitizer on and around the soft spile. You are looking to see bubbles from the gas coming through the spile as it leaves the beer. Check back on the cask regularly and spray with sanitizer to check for active venting. As long as you see a significant off-gassing, the beer is probably too carbonated. This is more art than science and you will learn over time what gets you the results you want. Once visible off-gassing (bubbling) subsides you want to lock in the remaining carbon dioxide.

Remove the soft spile and replace it by gently tapping in a hard spile.

To be clear, unless you have a mechanism for keeping the cask at cellar temperatures in its final serving location, it is likely that you will be venting the beer while you store it in a refrigerator. This is not a problem at all. In any case, as mentioned before I move the cask to the serving location the morning of the event to let it settle clear. The finings will be kicked up along with any yeast and will help re-clarify the beer.

Tapping the Cask

In a commercial setting, a cellarman will often tap a beer hours in advance of pouring the first pint to ensure that the disturbance has time to settle. Part of the fun of serving a homebrewed keg at an event is the showmanship of driving the tap through the keystone, so I like to wait till everyone shows up. At a recent event I had my neighbor do the honors. You can see the fun in a video I posted online at: http://www.youtube.com/watch?v=-xiaGOFikmd8.

In terms of technique, there's not much to it. Examine the keystone and ensure it is clean and sanitized, as the middle will be driven into the beer. Either brace the cask or have someone hold it in place. Remove the spile from the shive to vent the keg. Hold the tapered end of the tap against the center of the keystone and square to the keg. Make sure that the threaded fitting and valve is facing the direction you want as it is difficult to adjust later. With everything in place wind up and land a solid blow on the end of the tap to drive it directly into the cask through the keystone.

Be prepared to follow that up with a couple more taps if the first one does not complete the job.

If you are using a gravity spout, attach it to the threaded fitting on the tap with the supplied washer and nut. Connecting a beer engine is beyond the scope of this article, but it is pretty straightforward.

Pouring a beer is a simple task of opening the valve and filling the glass. The spile that you removed during the tapping should remain out as long as you are serving the beer, since make-up air needs to enter the keg to replace the beer you drink. If you take a break in serving the beer, immediately replace a sanitized hard spile into the shive bung to ensure that you don't loose too much carbonation.

If you look at a cask you will see that the level of the tap is higher than the lowest point when in serving position. If the cask is left in a horizontal position, there will be at least a half-gallon (2 L) of beer that you cannot pour. This finally answers the question of why we use three chock blocks on the cask. When you have served the cask down enough so that beer will not spill out of the shive hole, you want to tilt the cask forward in one smooth motion and then slide that rear center chock forwards. The final position is a little over 10 degrees forward such that the bottom front taper of the cask is effectively level.

That is it. Eat, drink and be merry.

Challenges

While packaging and serving cask beer is straightforward once you have done it a few times, it does have some unique challenges. Hopefully my experience and research can help mitigate some of them for you.

Getting the carbonation right can be a bit hit or miss. Ensuring you have healthy yeast, carefully following recipes or priming charts, and storing the cask at room temperature go a long way avoiding problems. It is easy to vent off a little excess CO_2, but it is not feasible to add carbonation when it comes time to serve the beer, so aim slightly on the high side when in doubt.

Beyond nailing your carbonation, the best cask ale is brilliantly clear with all yeast and sediment settled out of the beer. Those things affect the aroma and flavor of beer, so it is not simply a matter of looks. If you have haze problems, consider trying a different type or amount of fining. Also ensure that you are disturbing the cask as little as possible shortly before and during serving. If those do not work, then consider a different yeast variety that settles out more solidly.

Depending on the resources at your disposal, keeping the cask at the ideal 50 °F (10 °C) can also be a significant challenge. British pubs have come up with all kinds of mechanisms to cool casks that do not have the benefit of being kept in the cellar. Most of these are out of reach of the homebrewer as they involve glycol, pumps, and fancy stainless piping. You could, though, make an insulating jacket or cooler to cover the cask. Evaporative cooling is another alternative and relies on a damp towel on the cask to provide modest cooling. Finally, the old standby of bags of ice works, but pay attention to ensure that you do not accidentally cool the beer too much.

The challenge I thought would be the biggest issue may not be a concern at all. Once you have started serving the keg and drawing air, you effectively start a countdown before the beer is spoiled. The exact amount of time you have depends on numerous factors, but it is safe to say you have at least 12 hours and perhaps 36-48 hours. On a homebrew scale and without a cellar at a consistent temperature, it is best to plan to finish the keg by the end of the evening. If you want to serve and store the keg for longer than that you will want to investigate cask breathers and cooling jackets.

Or you could relax and have a homebrewed real ale. Invite over your friends, family, and neighbors and ask for their help. Make it a potluck or bring-your-own-meat BBQ and you will have an event that leaves a lasting impression.

Conclusion

While I have yet to replicate Deschutes Bachelor Bitter, the journey into cask ales has reinvigorated my brewing enthusiasm. I have a long list of styles I plan to brew and share with friends including dry stout, mild, southern English brown, ESB, and brown porter. See page 55 in the July-August 2012 *BYO* for more info about homebrewing real ale.

Dave Louw is a homebrewer from California and a frequent Contributor to Brew Your Own.

MINI KEGS & KEG Alternatives

by Andy Sparks

A 5.0-gallon (19-L) kegging setup is great if you have the space. Five gallons (19 L) is the volume of most homebrew recipes and carboys and other pieces of homebrewing equipment are often scaled to this size batch.

However, not everyone has the luxury of enough space to use a "full" kegging system. If you need your fridge space for food and don't have the space for a dedicated beer fridge, you need a different kegging solution.

Mini-kegs are an option for homebrewers looking to avoid bottling, but who don't have the space for a full kegging system. There are a few different types of mini-kegs on the market today with the most popular being the Party Pig from Quoin and the Tap-A-Draft from Sturman BG. Both systems use large PET plastic bottles to hold their contents and hold a smaller amount of beer than a full-sized 5-gallon (19-L) batch, but that is about all they have in common with each other.

The 2.25-gallon (8.5-L) Party Pig uses priming sugar to achieve natural carbonation in the "pig" along with a single use plastic pressurization pouch. After giving the pig a week or so to carbonate you activate the pouch inside to create pressure in the pig and force the beer out.

Mini-keg systems, such as this Tap-A-Draft setup, cost less and take up less space in your refrigerator.

To activate the disposable pressure pouch, you insert a hose into the beer faucet and using a small hand pump force air into the pig increasing the pressure inside until the pressure pouch activates. As the pouch inside expands it takes up the extra space as beer is consumed keeping the beer from going flat and forcing it out of the faucet. As far as I can tell, there is no way to force carbonate in a Party Pig — but if you have carbonated beer, you could use that to fill a Pig, which would be a great way to take a couple gallons of homebrew to a party.

I have also found that if you let the beer in the Pig sit for too long without drinking it, the pressure can build up inside the Pig to the point at which it can be difficult to depress the button on the faucet. If this ever happens to you, don't keep pushing on the button and take it outside. When the button does depress the beer will be coming out in a hurry and can cause a mess. Two party pigs would fall just short of holding a 5-gallon (19-L) batch.

The Tap-A-Draft, or TAD as its fans call it, is a more recent entrant into the mini-keg market. The Tap-A-Draft now comes with a 6-L (1.6-gallon) PET plastic bottle, so three bottles will almost handle a 5-gallon (19-L) batch. Tap-A-Draft does allow the homebrewer the choice of natural carbonation or forced carbonation through the use of small, disposable, CO_2 cartridges.

The manufacturer claims that it only takes two of these cartridges to dispense a whole bottle, if you plan on force carbonation, you will probably need more. It also makes a great way to take beer you have in a Corny keg to a party, just fill it up and grab a couple CO_2 cartridges and go.

A final option is reusable metal 5-L (1.3-gallon) mini-kegs, the type some craft brews are packaged in. Taps that use CO_2 cartridges, as well as gravity taps, are available for these and four of these kegs will hold a 5-gallon (19-L) batch with about a quart (~1 L) of room to spare.

TECHNIQUES

REFURBISHING and Cleaning Kegs

by Mike Heniff & Ralph Allison

Used Cornelius style kegs are widely available at reasonable prices. A considerable amount of money can be saved if you buy kegs that have not been worked on in any way and rebuild them yourself. This process requires nothing but a little time, a limited amount of mechanical skills and most of the tools should be in every kegger's tool kit.

Recently, I rebuilt two used 5-gallon (19-L) Cornelius kegs. Used kegs are not in pristine condition on the outside, however they should be fine on the inside where it counts. They should only have been used for soda syrup, such as that for Pepsi or Coke. (Note that almost all soda fountains have switched to the bag-in-a-box setup. So, if you buy a used keg that still has syrup in it, it may have been there awhile.)

New, Used or Reconditioned?

For those who either do not have the time, or do not want to go to the trouble, new Corny kegs are available. New kegs usually cost more than $100, but they are shiny, dent-free and their rubber gaskets and O-rings don't carry any off flavors or odors. Also, their poppet valves will not need to be replaced for some time. Reconditioned used kegs are also available, with typical prices starting around $35. When comparing prices between vendors, be sure to check on what has been done to the keg to recondition it. At a bare minimum, kegs should be pressure tested. Some sellers will also replace the O-rings and clean the keg. Others will additionally disassemble the keg, clean the dip tube and inspect and replace faulty poppet valves. In practical use, a fully reconditioned keg will work as well as a brand new one.

Coke or Pepsi, Pin Lock or Ball Lock

Corny kegs exist in two main styles, referring to the type of inlet and outlet connections on each type of keg: pin lock and ball lock. Pin lock kegs are ones that are used by Coca-Cola and are easily identified by the "pins" on the gas and liquid posts on the keg. Ball lock kegs are identified by the absence of pins on the gas and liquid posts and are used by the other soda companies. The "ball" name is derived from the ball bearings on the connectors that hold the connectors onto their respective posts.

The advantages of one style of keg over the other are minimal and most homebrewers choose by their personal preference. Ball lock fittings and gadgets seem to be more readily available than those for pin lock kegs. Also, ball lock kegs are easily disassembled using regular sockets and wrenches — a special notched socket is needed to disassemble a pin lock keg. Pin lock kegs are slightly shorter than ball lock kegs which makes them more likely to fit in tight refrigerators. Regardless of which style of keg you choose, the parts for each type of keg are not interchangeable, thus a pin lock keg cannot be converted to a ball lock keg and vice versa.

The connections and tools required vary by each manufacturer. For a pin lock keg, a 13/16" deep socket with special notches is needed (check your local or internet homebrew store or make one yourself). The gas in post is the one with two pins while the beer out post has three pins. For a ball lock keg, a combination wrench or deep socket will work for disassembly, in either 7/8" or 11/16" size depending on the keg manufacturer. The gas in post has notches on the hex base and can have either a 6 point or 12 point base. (Be sure to buy tools in the 12 point style, so that they will work on both types of fittings.) The beer out post has no notches along the 6 point hex base.

Cleaning the Outside

The outside of the keg can be cleaned using Bar Keeper's Friend, an oxalic acid based cleanser that is not harmful to stainless steel. This cleaner can be purchased in most grocery stores and works well on all stainless steel brewing vessels.

Use a soft nylon cleaning pad or sponge and follow the instructions on the can. Do not use steel wool or any other metallic cleaning pads. They will scratch the stainless steel, and sometimes embed small pieces of the steel in the surface, which will cause rust.

The popular heavy duty Scotch-Brite pads (or "green scrubbies") will also leave scratches in stainless steel. (The blue Scotch-Brite scrubbing pads and sponges — the ones that say "No Scratch" on the package — are fine.) Test your scrubbing pad on the outside of the keg first, before cleaning any surface that will contact beer.

Cleaning the outside of the keg is optional, but I prefer all of my equipment to be clean. If you are going to clean the outside, I strongly suggest doing it before disassembly. I also suggest wearing latex or rubber gloves, as it is a dirty process.

An alternative I have found, which is almost as good as using Bar Keeper's Friend, is to soak the kegs overnight in a mixture of 1.0 oz. of PBW (Powdered Brewery Wash) per gallon (7.5 g/L) of hot water. At this same concentration, a PBW solution heated to 120–160 °F (49–71 °C) will clean almost any stainless surface, without scrubbing, in 30 minutes. If you are cleaning multiple kegs, a 100-qt. (95-L) picnic cooler holds enough liquid to submerge a Corny keg.

Disassembling the Keg

Before starting disassembly, relieve any pressure in the keg by either lifting the relief valve or depressing the poppet valve on the top of the post with a small tool. I have a small piece of wood dowel that I use, so I am sure not to damage the poppet. Be sure to put a rag or towel over the relief valve or post prior to relieving the pressure, as there will most likely be some syrup remaining in the keg.

Once the pressure is relieved, remove the keg cover by lifting the latching lever, then lowering the cover into the opening and turning it slightly to align it. Remove and discard the lid O-ring.

You will need a ⅜" drive ratchet wrench and either an 11⁄16" or ⅞" deep socket to remove the posts. I bought both sizes at Home Depot for less than $5 each. Since some posts are eight sided and others twelve sided, I would suggest buying twelve point sockets in both sizes. In the case of my kegs, which are Firestone Challenger VI, I needed the ⅞" for both posts. Unless you are certain what type of socket you need for your keg, it is a good idea to bring the posts, or the whole keg, with you when you go to the hardware store. On one side of each of the handles on top of the keg on the "gas in" side, it will have "in" markings. Take a good look at that post so you are sure to install it in the right place during re-assembly. At a quick glance, they look to be identical, but there are subtle differences, one of which is a small difference in size.

Once the posts have been removed, I use a small jeweler's type screwdriver to get the O-ring on the posts started, then slip a slightly larger screwdriver in beside it and pry the O-ring high enough to be able to slip it off the post. In my experience, this normally prevents damage to the O-ring. It is not critical at this time because you will replace all of the O-rings with new ones, but will be good practice. Discard the O-rings.

Next, remove the dip tubes. You will notice the gas-in dip tube is short, and the liquid-out is long. The liquid-out tube is either straight or curved. Stick your hand through the opening and push up on each tube. They will usually slip out easily, but sometimes it requires a little effort. Once you have both dip tubes removed slip the O-rings off them and discard.

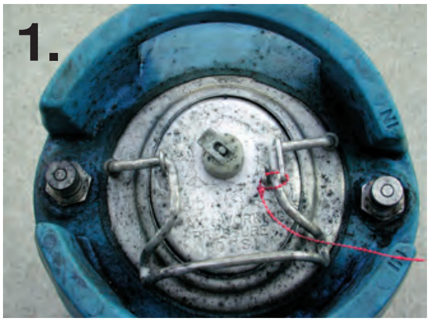
Cleaning Chemicals

It is now time to clean the inside. I like using PBW, however many homebrewers use the unscented version of OxiClean, whose active ingredients are sodium percarbonate and sodium carbonate. (The "oxi" in OxiClean refers to the fact that sodium percarbonate reacts with water to release hydrogen peroxide and sodium carbonate.) Other homebrew cleaners that contain sodium percarbonate include One-Step, B-Brite and Straight-A. PBW's material safety data sheet (MSDS) lists only sodium metasilicate (30%), although their website also claims that it includes sodium carbonate. (It is also widely believed to contain sodium percarbonate.) Another common brewing cleaner is TSP (trisodium phosphate). Because of environmental concerns with the release of phosphate into the environment, many products sold as TSP actually contain up to 90% sodium carbonate.

Cleaning the Inside

Put the cover, posts and dip tubes in the keg. I put the keg in the basement shower and pour my cleaner into the keg, then fill it with household hot water.

I like to run a tubing brush through the dip tubes a couple of times. Let the keg soak overnight, then give it, and the other parts, a thorough hot



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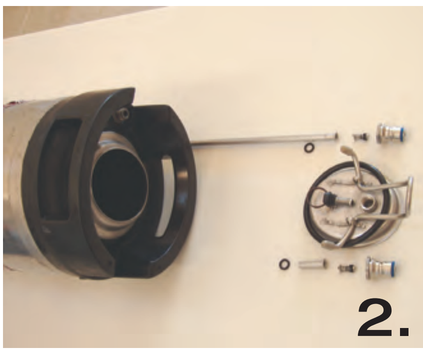

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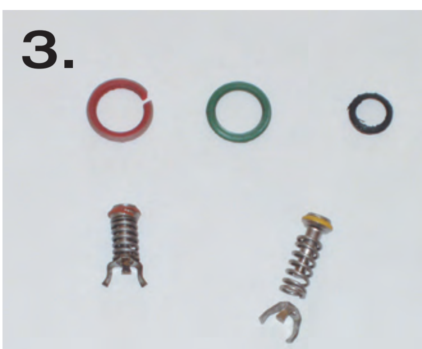

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water rinse. Turn the keg upside down and let it drain and dry.

Next, you will replace the O-rings you removed with new O-rings. You will need some food grade lubricant, such as Keg Lube, for this. Only a small film evenly spread on each O-ring is needed. First, lubricate and install the dip tube O-rings, and insert the dip tubes in the proper holes. Next, install the posts and tighten. Lubricate the post O-rings, and install them in the post grooves. Some homebrew shops sell colored O-rings for keg posts and I like to use a red one on the "gas in" post to identify it. Lubricate the large O-ring and fit it onto the lid. Install the lid and latch it.

Reassemble the keg in opposite order of disassembly. Install the long diptube on the beer out side, matched with the proper 3 pin or un-notched post on top. The diptube should fit just above the indentation or well in the bottom of the keg. When reassembling the posts, be sure that the poppets are firmly in their posts — or at least secure enough that they don't fall between the posts and the diptubes — while tightening. This will help you avoid damaging the feet of the poppets. When properly installed, the posts need little effort to tighten completely down.

In some kegs, the long beer dip tube does not have a notch to hold it in place. As such, it may spin while you are tightening the post. Be sure to hold the diptube in place while tightening so that the diptube is not jammed up on one side of the keg. The small diptube for the gas in side installs similarly, but goes on the notched or two pin post.

Finally, place the lid inside the keg and pull down on the lever making sure that the lid is seated directly in the middle of the lid opening and is not shifted to one side.

Testing for Pressure

Now that the keg is clean and rebuilt, it is time to check if it holds pressure. Connect the gas in disconnect to the gas in port and pressurize the keg to 12 PSI. That should be sufficient to seat the lid gasket. Use a small bowl and add a couple of teaspoons of dishwashing detergent to some tap water. Use a small (about 1 inch) paint brush, or a spray bottle, and liberally apply the detergent mixture to all of the gas fittings, connections and around the keg cover. If there are any leaks, you will see bubbles. If leaks are found, check the connections to make sure they are tight. When there are no leaks, pressurize the keg again to 12 PSI, and let it sit for a day. Use a pressure gauge attached to the "gas in" connector to monitor the pressure. (Some homebrew shops sell these, or build the spunding valve on page 61.) If the keg maintained pressure, it is refurbished and you are ready to go.

1. A used Cornelius (or Corny) keg before it has been cleaned and refurnished.
2. A disassembled keg showing all its parts, including the posts, poppets and dip tube.
3. O-rings get old and cracked and poppets eventually wear out. These will need to be replaced to refurbish a keg.
4. You don't need many tools to work on kegs, a couple wrenches, a ratchet and a long brush for the dip tubes.
5. If you use pin-lock kegs (Coke), you will need to buy a notched socket for your ratchet, or notch one yourself.
6. The tools for cleaning a keg. Use the blue scrubbies (not the green). The screwdrivers are for prying O-rings.
7. Once disassembled, all the parts of the keg can be soaked inside the keg. Hot PBW works great for cleaning. If you are cleaning multiple kegs, keep the parts for each keg separate (they aren't as interchangeable as you might think).
8. A clean keg (left) scrubbed with Bar Keeper's Friend compared to a yet to be cleaned keg.
9. When shopping for sockets or wrenches for your keg, bring the posts (if not the whole keg) with you.

Maintaining the Keg

Once your keg is in good shape, it is quite easy to maintain. Each time you disassemble the keg for thorough cleaning, inspect each of the parts. Replace any O-rings that are cut or dry-rotted to be sure that a proper seal can be maintained.

If, when assembling the keg, one of the posts will not hold a seal where the poppet seals against the post, first be sure that the post is properly tightened. If the poppet still won't seal, attempt to reseat the poppet by pressing the poppet down with a screwdriver or other firm object. Use a paper towel to protect yourself from the spray if there is liquid in the keg. If it still won't seal, then it's time to change that poppet. (It's likely the rubber O-ring at the head of the poppet is damaged, one of the feet are damaged, or the spring has worn to the point that it will not expand enough).

Many homebrew shops carry a range of poppets for each of the different keg manufacturers. Be sure to check the manufacturer of the keg so that you can choose the proper poppet. Alternately, bring the old poppet with you for comparison when you get your new one.

During use, sometimes it can be increasingly difficult to fit one of the connectors onto the post. When this happens, be sure you are using the proper connector for the post. If it is still difficult (or even impossible) to fit the connector over the post, wet the O-ring with water or apply a tiny amount of Keg Lube or other lubricant meant for beer fittings. The O-ring on the outside of the post may need to be changed if it is damaged or dry-rotted. If a new O-ring doesn't solve the problem, then the post or connector is damaged and will need to be replaced. Be sure to check the manufacturer of the keg so that you can choose the proper post and poppet combination.

Cleaning and Sanitizing

Cleaning and sanitizing a well-maintained keg is critical to protect the beer from contamination, which can cause a myriad of off-flavors. Performing a cleaning step each time before sanitizing is highly recommended. Cleaning and sanitizing the keg follows the same basic procedure as refurbishing the keg. However, routine cleaning should be much easier as there is less soil to remove and you will not need to replace any O-rings or poppets unless they have worn out.

To clean the keg, completely disassemble it and soak in a cleaning solution. Five Star PBW is a popular choice amongst homebrewers and works well. After filling the keg with cleaning solution, use the keg to hold all of the other parts including the O-rings. After cleaning, be sure to rinse the keg and all parts well. The keg can be cleaned while assembled, but it is not recommended since cleaners are generally hard to rinse and large yeast or hop deposits can get trapped in the springs of the poppets and can be difficult or impossible to clean without disassembling the posts.

After cleaning, sanitize the keg using a good, no-rinse sanitizer such as Iodophor or Star San. This can be done while the keg is unassembled or assembled. To sanitize unassembled, just soak each part in the sanitizer in the keg just as was done for cleaning. For sanitizing assembled, assemble the keg, fill with sanitizing solution, and soak. Be sure to press down on each poppet after filling the keg with solution so that each dip tube will release the trapped air and fill with sanitizing solution. If you sanitized the keg assembled, top off the keg if necessary, fit the lid, and push the sanitizing solution out with CO_2. The keg is now full of CO_2, with little or no oxygen present, and ready to be filled.

Mike Heniff also wrote about Baltic Porters in the December 2004 issue of BYO. *Ralph Allison has been brewing off and on since the mid 1960s.*

CARBONATING
Options

by Marlon Lang

All brewers know that the yeasty-beasties they pitch chew up the sugar in their wort and make carbon dioxide (CO_2) and alcohol. However, when the party is over and the sugar is gone, the amount of CO_2 dissolved in beer fermented at atmospheric pressure is usually too low for our tastes.

It should be intuitive that if you put the beer in a closed container and pressurize it with CO_2, you can dissolve more CO_2 into the beer than you can without pressure. It may not be intuitive, but if you chill the beer at a given pressure, you can also dissolve more CO_2. The chart on the facing page shows the relationship between pressure, temperature and dissolved volumes of CO_2. Select the temperature of your keg (in °F) from the column on the left and the carbonation level you desire (in volumes of CO_2) from the row on top. The number in the space where these two intersect is the gas pressure (in PSI) to apply to your keg.

Homebrewers that use kegs have had three basic methods to force-carbonating their kegs — (1) pressurize-and-wait, (2) pressurize-and-shake or (3) inject the CO_2. The exact machinations used by homebrewers to force carbonate their kegs, including hybrids of these methods, are as numerous as fleas on a dog's back. However, with the acquisition of a simple device, there is a fourth possibility — (4) pressurize-and-measure.

With the pressurize-and-wait method, you chill the keg, connect your CO_2 cylinder and set the CO_2 pressure to give the desired dissolved volume of CO_2 at the keg temperature. Then, you wait. This method will give very consistent results. But, there are some disadvantages. The waiting time is usually weeks. This is because the rate at which the CO_2 will dissolve is dependent upon the surface area of beer exposed to the CO_2 and Corny kegs are very "vertical," leaving a comparatively small surface area per volume of beer. Also, if you have

A rotometer measures gas flow through it. Using one can help you fine tune your carbonation levels.

even a small leak at an O-ring or fitting, you will empty your CO_2 bottle in a New York minute. The ultimate disadvantage of this method is that it takes a very long time to find out if it worked, and if so, how well. And if it didn't, you wait some more.

With the pressurize-and-shake method, you chill the keg, connect your CO_2 cylinder and set the CO_2 pressure to give the desired dissolved CO_2 volumes or higher. Then, you shake the keg. The advantage of this method over pressurize-and-wait is that the surface area exposed to CO_2 is greatly increased so the carbonation time is much shorter.

Injecting CO_2 into the keg sometimes takes the low-tech form of attaching the gas to the "OUT" post of the keg. The idea is that the gas travels down the long dip tube and bubbles up through the beer. To do this, you need to switch your keg fittings so your regulator can be attached to the "beer/OUT" post. You can also bubble CO_2 into a keg using a carbonation stone. (See Thom Cannell's article, "Keg Lid Carbonator," March-April 2004 *BYO* for one way to do this.)

The results from the shaking method will be quicker, but less reproducible than the waiting approach. (And, you will be using up some of your foam-positive proteins in the process.) However, the pressurize-and-measure method removes all doubt. To use the pressurize-and-measure method, you need one additional piece of hardware — a rotometer. A rotometer is a small flow measuring device. The thing-uh-ma-bob that does the job is a

Keg Carbonation Chart

carbonation (in volumes of CO_2)

temperature (in °F)	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0
32	1.6	3.5	5.4	7.3	9.2	11.0	12.9	14.8	16.7	18.5	20.4	22.2
33	1.9	3.9	5.8	7.8	9.7	11.6	13.5	15.4	17.3	19.2	21.1	23.0
34	2.3	4.3	6.3	8.2	10.2	12.1	14.1	16.0	18.0	19.9	21.8	23.8
35	2.7	4.7	6.7	8.7	10.7	12.7	14.7	16.7	18.6	20.6	22.6	24.5
36	3.1	5.1	7.2	9.2	11.2	13.3	15.3	17.3	19.3	21.3	23.3	25.3
37	3.5	5.6	7.6	9.7	11.8	13.8	15.9	17.9	20.0	22.0	24.0	26.1
38	3.9	6.0	8.1	10.2	12.3	14.4	16.5	18.6	20.6	22.7	24.8	26.8
39	4.3	6.4	8.6	10.7	12.8	15.0	17.1	19.2	21.3	23.4	25.5	27.6
40	4.7	6.8	9.0	11.2	13.4	15.5	17.7	19.8	22.0	24.1	26.2	28.4
41	5.1	7.3	9.5	11.7	13.9	16.1	18.3	20.5	22.6	24.8	27.0	29.2
42	5.5	7.7	10.0	12.2	14.4	16.7	18.9	21.1	23.3	25.5	27.7	29.9
43	5.9	8.1	10.4	12.7	15.0	17.2	19.5	21.7	24.0	26.2	28.5	30.7
44	6.3	8.6	10.9	13.2	15.5	17.8	20.1	22.4	24.7	27.0	29.2	31.5
45	6.7	9.0	11.4	13.7	16.1	18.4	20.7	23.0	25.4	27.7	30.0	32.3
46	7.1	9.5	11.8	14.2	16.6	19.0	21.3	23.7	26.0	28.4	30.7	33.1
47	7.5	9.9	12.3	14.7	17.2	19.6	22.0	24.3	26.7	29.1	31.5	33.9
48	7.9	10.4	12.8	15.3	17.7	20.1	22.6	25.0	27.4	29.8	32.3	34.7
49	8.3	10.8	13.3	15.8	18.3	20.7	23.2	25.7	28.1	30.6	33.0	35.5
50	8.7	11.3	13.8	16.3	18.8	21.3	23.8	26.3	28.8	31.3	33.8	36.3
51	9.1	11.7	14.3	16.8	19.4	21.9	24.5	27.0	29.5	32.0	34.5	37.1
52	9.6	12.2	14.8	17.3	19.9	22.5	25.1	27.6	30.2	32.8	35.3	37.9
53	10.0	12.6	15.3	17.9	20.5	23.1	25.7	28.3	30.9	33.5	36.1	38.7
54	10.4	13.1	15.7	18.4	21.1	23.7	26.3	29.0	31.6	34.2	36.9	39.5
55	10.8	13.5	16.2	18.9	21.6	24.3	27.0	29.7	32.3	35.0	37.6	40.3
56	11.3	14.0	16.7	19.5	22.2	24.9	27.6	30.3	33.0	35.7	38.4	41.1

First select the temperature of your keg (in °F) from column on the left side. Then select the carbonation level you want from the top row. The number where the two selections intersect is the gas pressure (in PSI) to apply to your keg.

small tube with a ball in it. The diameter of the tube gradually increases from bottom to top. Gas flows from bottom to top, lifting the ball — which is also called the float. The more gas flow, the higher the ball raises. You can find them on eBay for $15.

It doesn't matter what size you buy, although smaller is better. It doesn't matter what the calibration is, either. Standard cubic feet per hour (SCFH) is a common measure of airflow, but firkins per fortnight is just fine. Connect your rotometer to the CO_2 bottle. Select the correct pressure and temperature required to reach your desired level of carbonation. Then, start carbonating by shaking the keg. Keep shaking and watch the rotometer float. Eventually the ball will fall, indicating the flow of gas has stopped (or been reduced to below the level the rotometer can measure). When the ball falls and will not rise no matter how much you shake the keg, no more CO_2 is dissolving and the beer is carbonated. Voilà! Your keg is carbonated to the correct level.

At this point, experienced "shakers" might be asking, "Why not just set the regulator for the correct temperature, shake and listen for when the gas stops hissing or the regulator stops 'groaning?'" As you shake a keg during force carbonation, you can hear all sorts of noises from your tank and regulator when the flow of CO_2 is sufficiently high. As you approach CO_2 saturation, however, the noises diminish. The reason to use a rotometer is that it is more sensitive than your ears are. The float will still show that gas is flowing beyond the point that you can hear any noise. If you want to bring your keg up to your target level of carbonation, and know when you can quit shaking, use a rotometer.

Once you've carbonated the beer, you'll need to let the beer settle to let the carbonation dissolve more finely into the beer. Give it at least a week and it will be much better behaved. BYO

Marlon Lang was a frequent contributor to Brew Your Own *magazine.*

BALANCING
Your Draft System

by Bill Pierce

One of the real pleasures of homebrewing is serving your own beer from your own tap. A properly set up and maintained home dispensing system allows you to pour correctly carbonated beer that has the appropriate head and appearance for style. However, it can also be the source of frustration if things are not done right. You can end up with a glass full of foam or flat and lifeless beer, depending. Both of these pitfalls can be avoided with a little knowledge and planning.

The Science Behind the Bubbles

During fermentation, one molecule of glucose is broken down into two molecules of ethanol and two molecules of carbon dioxide (CO_2). The CO_2 that is produced is soluble in beer and results in residual carbonation.

All beer contains at least some dissolved CO_2, and most styles are additionally carbonated, whether by fermentation of added sugar or by "force carbonation" with additional CO_2.

The total amount of CO_2 dissolved in the beer is measured in "volumes," which is the volume the gas would occupy if it were removed from the beer and kept at standard temperature and pressure (STP — 32 °F (0 °C) and 1 atmosphere of pressure) divided by the volume of the beer. This is also used to describe the carbonation level of a beer. For example, American lagers generally are carbonated to about 2.6 volumes of CO_2. Less carbonated styles such as many British ales can have a carbonation level as low as 1.2–1.3 volumes, while some sprightly German wheat beers may be carbonated to levels above 4.0 volumes.

The solubility of CO_2 increases as the temperature decreases. There is also some decrease in solubility as the specific gravity increases, but the effect is small and can be disregarded for the gravity of beer. The solubility of CO_2 also increases with increasing gas pressure. In order to achieve the correct volumes of gas in beer, it must be stored under pressure (either in bottles or kegs).

May the Force (Carbonation) Be With You

The correct procedure for force carbonating beer to the appropriate carbonation level is outlined in the previous article on page 26 of this issue). To summarize, you can set the regulator pressure to the appropriate level (from the formula below, a carbonation chart or brewing software) and let the beer carbonate over a period of several days. Or you can use the "rock and roll" method (which is less exact but requires less time) of setting the regulator to a high pressure and shaking the keg vigorously for several minutes and repeating several times over a period of a couple of hours. A third method is to use an airstone, which greatly increases the surface area and reduces the required time.

The formula for setting the regulator to the correct pressure, P (in pounds per square inch, or PSI) for the desired level of carbonation, V (in volumes of CO_2) at a beer temperature of T (in °F) is:

$$P = -16.6999 - (0.0101059 * T) + (0.00116512 * T^2) + (0.173354 * T * V) + (4.24267 * V) - (0.0684226 * V^2)$$

Problems Down the Line

Assuming the beer is carbonated to the appropriate level, it still has to make its way from the keg, through the line, out the tap and into the glass — and this is where problems can occur.

If the dispensing pressure is too low, the beer will pour too slowly and excessive foaming can result, to the point where little beer and mostly foam ends up in the glass. Furthermore, over time the beer in the keg will lose carbonation as more CO_2 comes out of solution as it attempts to achieve equilibrium with the headspace. At extreme underpressure, the beer can become nearly flat. If the dispensing pressure is too high, it, too, can result in excessive foam from the beer pouring too quickly from the tap. With time, the beer will become overcarbonated as more CO_2 goes into solution, further complicating the situation.

At lower than the correct pressure, in addition to low carbonation, the line will tend to collect bubbles and pockets of CO_2 where it has come out of solution, especially just above the keg and behind the faucet, as well as in places where the temperature is warmer. These pockets will become larger the longer the time period between dispensing beers. The first beer will have a shot of foam, followed by clear beer, followed by more foam. After pouring a few beers, the problem may dissipate, only to return again after a rest. Low-pressure problems also tend to show themselves early when a keg is nearly full.

At higher than optimum pressure, there will be overcarbonation and symptoms similar to those that occur at low pressure. The difference is that they tend to appear and grow worse as the keg is emptied. If a fresh keg is foamy, the odds are that it is not an overpressure problem. The reason is that, as the keg empties, more CO_2 occupies the larger headspace as the difference between the equilibrium pressure and dispensing pressure increases. Again this causes excessive foaming when the beer is first dispensed, until there is less CO_2 and more beer in the line.

A Matter of Balance

Calculating the correct dispensing pressure and making changes to the system is known as "balancing" and is critical to pouring a perfect beer. Balance is not only dependent on the carbonation level and the temperature of the beer, but several other factors also enter into the equation. These include the overall height difference between the keg and the tap, the length and diameter of the dispensing line and the type of tap being used. Changes to any one of these will change the balance of the system.

Between the keg and the tap, there is resistance to the flow of the beer. Gravity (the difference in height) accounts for 0.5 PSI per foot (11.3 kilopascals per meter), a positive value if the tap is located above the keg, negative if the tap is below it. A standard beer faucet has a resistance of 2 PSI (13.8 kPa); the shank adds another 1 PSI (6.9 kPa). A picnic or "cobra" tap has a resistance of about 0.5 PSI (3.4 kPa). Additionally, the beer line itself offers the following resistance based on the inside diameter. These figures are for flexible vinyl beverage tubing:

3/16 in. (4.75 mm) inside diameter (ID):
  3.0 PSI/ft. (67.9 kPa/m)
1/4 in. (6.35 mm) ID:
  0.8 PSI/ft. (18.1 kPa/m)
5/16 in. (7.94 mm) ID:
  0.4 PSI/ft. (9.0 kPa/m)
3/8 in. (9.53 mm) ID:
  0.2 PSI/ft. (4.5 kPa/m)

The material out of which the beer line is made affects these ratings. As such, your beer line may vary from these numbers. If your tubing is meant specifically for beer lines, its resistance might be found on the manufacturer's page online. If not, these numbers are a good starting point for your calculations, which may have to be adjusted by trial and error later.

Finally, some additional pressure is necessary to achieve a proper flow rate. The generally accepted desirable pour rate for beer is considered to be

Your beer is under pressure. This pressure must be balanced to produce the perfect pour.

1 US gallon (3.8 L) per minute or 1 US pint (473 mL) per 7–8 seconds. For most systems, a value of 5 PSI (34.5 kPa) is sufficient for balancing calculations.

Assuming that the other values remain the same, the easiest way to balance the system is to adjust the line length so that the total resistance of the system equals the carbonation pressure minus the required 5 PSI (34.5 kPa) for a proper flow rate. Round the result to the next highest foot (0.3 meter).

For example, for a pale ale that is carbonated to 2.3 volumes of CO_2 at 46 °F (8 °C), the correct carbonation pressure (from the force carbonation formula) is 13 PSI (89.6 kPa). The beer is dispensed through a standard shank and beer faucet at a height of 2 ft. (60.9 cm) above the center of the keg.

Here are the calculations for the required length of 3⁄16 in. (4.75 mm) diameter beer line in order to balance the system:

Gravity resistance: +2 ft. (60.9 cm) * 0.5 PSI/ft (11.3 kPa/m) = 1 PSI (6.9 kPa)

Shank resistance: 1 PSI (6.9 kPa)

Faucet resistance: 2 PSI (13.8 kPa)

Fixed resistance of the system (not including the line): 2 + 1 + 1 = 4 PSI (13.8 + 6.9 + 6.9 = 27.6 kPa)

Carbonation pressure of the beer (2.3 volumes of CO_2 at 46 °F/8 °C): 13 PSI (89.6 kPa)

Pressure required to dispense beer at 1 gallon (3.78 liters)/minute: 5 PSI (34.5 kPa)

Pressure needing to be balanced: 13 - 5 = 8 PSI (89.6 - 34.5 = 55.1 kPa)

Resistance to be supplied by the line: 8 - 4 = 4 PSI (55.2 - 27.6 = 27.6 kPa)

Resistance of 3⁄16 in. (4.75 mm) ID beer line: 3 PSI/ft. (67.9 kPa/m)

Length of 3⁄16 in. (4.75 mm) ID line required to achieve 8 PSI (55.1 kPa) resistance: 4/3 = 1.33 ft. (40.5 cm)

Rounded to next highest foot (0.3 meters): 2 ft. (61 cm)

Therefore, 2 ft. (61 cm) of 3⁄16 in. (4.75 mm) ID diameter tubing will balance this system for the example beer.

(Note: This length seems short by homebrew standards because 5 PSI is a higher "overpressure" than most homebrewers use. Lowering the dispensing pressure to 0.5–1.0 PSI will result in a line length more in line with usual homebrew setups. Experiment with flow rates to find one you like.)

Achieving New Balance

Of course you may choose to serve a variety of styles at different carbonation levels and perhaps at different temperatures. This will affect the system balancing equation somewhat. You can recalculate the new carbonation pressure and line length necessary to balance the system, and adjust the dispensing pressure and replace the line with the proper length. If the difference is small, you may choose to ignore the slight imbalance; balancing a system does not require extreme precision. Or you may use what is called a "choker," a short length of smaller diameter line installed at the faucet shank. A more elegant solution is to purchase and install a line restrictor, which allows you to vary the flow of beer through the line. These devices are available from draft beer equipment suppliers.

In reality, you will likely balance your kegging set-up once, then use the same beer line length for all your beers, provided they are all carbonated to similar levels. If you change your set-up — for example, because you bought or built a new kegerator — you willl need to balance it again.

Keep in mind the number yielded from the calculations above is only as good as the quality of the estimates of resistance for your equipment. If your beer line has more or less resistance than the figures quoted here, your calculations will be off. However, unless the particulars of your system are far different from average, the equations above should get you within the ball park. And, when you do the calculations, save them in your brewing notebook for use later if you change your dispensing set-up and are using the same type of beer line.

When setting up your dispensing system, keep in mind that beer line is cheap. Do the calculations for balancing the system, but then start with a length of beer line that is substantially longer than the equations suggest. Try this and shorten the line length, if needed. On a system with more than one beer line, you will only need to do this once. When you find a beer line length that works, simply cut all your lines to that length. (This assumes all your beers are being conditioned at the same temperature and pressure.)

Try to maintain an even temperature throughout the system. Carbon dioxide tends to come out of solution and collect in warm places, especially near the tap. This is why you may want to discard the first small amount of beer and foam that is in the line after the system has not been used for a while. If the taps are enclosed in a tower, insulate the lines or provide them with a supply of cold air.

Beer that has been recently carbonated by cranking up the regulator pressure and shaking the keg may pour with a lot of foam because the carbon dioxide has not dissolved evenly into the beer. Whenever you are balancing your system, use a keg of homebrew that is fully conditioned. Otherwise, you will get a bad pour even when the system is balanced. Beer line deposits also can increase restriction and cause dispensing problems. This is another reason to regularly clean the lines and taps. And finally, keep your glassware clean, well rinsed and free of soap deposits — and store them at room temperature. Frozen glasses or mugs will cause foaming and greatly reduce beer aroma and flavor. The proverbial "frosty mug" is a gimmick that does not improve the quality of the beer. BYO

Bill Pierce is a frequent contributor and was Brew Your Own*'s "Advanced Brewing" columnist.*

COUNTER-PRESSURE Bottling

by Chris Colby

back when I was a graduate student in Boston, I threw a lot of homebrew parties at my apartment on Commonwealth Avenue. I remember explaining over and over to my guests that they had to pour the bottle-conditioned beer into a glass because of the sediment in the bottles. I must have given that speech 50 times per party. If only so I could have relaxed and enjoyed my parties, I wish I could have served my homebrew from sediment-free bottles back then.

Later on, I got a kegging system that allowed me to serve sediment-free homebrew, but my bottled beer still had the yeast sediment from bottle conditioning. Finally, I learned of a procedure that allows homebrewers to produce sediment-free bottles — counter-pressure bottling.

In counter-pressure bottling, finished beer is moved from a keg to a bottle. No sugar is added at bottling and the beer doesn't need to bottle-condition to carbonate. If the kegged beer is sufficiently conditioned, you will have clear, carbonated beer in the bottle . . . and no yeast sediment.

The main challenges of counter-pressure bottling are to retain the beer's carbonation and minimize its exposure to oxygen during the transfer. When performed correctly, almost all of a beer's carbonation is retained when it is counter-pressure bottled. Likewise, with a little practice, the beer can be transferred with minimal exposure to oxygen. Oxygen speeds staling reactions in beer. So, the less oxygen your beer encounters, the longer it will taste fresh.

Advantages

There are several benefits to counter-pressure bottling beyond saving explanation time at parties. The yeast in homebrew bottles is a minor inconvenience for homebrew served at home, but it can become a major problem when you try to transport or ship homebrew. Yeast gets disturbed and it takes time, sometimes a couple of days, to settle back down. And even then, the beer may take on some off-flavors from the roused yeast. Many homebrewers buy a counter-pressure filler just for shipping beer to contests. With counter-pressure bottling, you can also bottle the last few beers from a keg to make room in the fridge for fresh kegs.

Disadvantages

One drawback to counter-pressure bottling is the initial cost. Counter-pressure fillers cost around fifty dollars (more for all stainless versions), and you need to have a kegging system. In addition, counter-pressure fillers have interior spaces that can't be seen by the homebrewer. Unless you clean the filler thoroughly after each use, deposits can build up inside the unit. Like the crud that forms in tap lines, you don't want this stuff touching your beer. Soaking the filler in TSP or PBW immediately after use, then rinsing thoroughly with hot water, should keep everything clean.

Bottling beer with a counter-pressure filler takes a little more effort, especially with regard to set-up, than standard homebrew bottling. However, few homebrewers with counter-pressure fillers bottle

A full set-up for bottling sediment-free beer from a keg — a keg, gas cylinder and counter-pressure bottler.

A counter-pressure bottler fills bottles with carbon dioxide, then beer.

the entire keg, as this would be time-consuming. Instead, only a few bottles — usually for bringing to a party or shipping to a contest — are filled. The rest of the beer is left to be dispensed from the keg.

Connecting the System

To set up your counter-pressure system, you'll need your counter-pressure filler, a keg of beer, a CO_2 tank and the required connecting tubing. (Your filler should have all the necessary tubing supplied when you buy it.) To begin set-up, take the filler and close all the valves. Likewise, turn the gas off on your CO_2 tank. Unless you like the sight of beer spraying or the sound of CO_2 hissing, don't connect the filler to anything until you're sure all the valves are closed. Connect the CO_2 tank to both the keg and the filler. This is usually done by splitting the gas-out line with a "T" connector. One line goes from the CO_2 tank to the "in" connector on your keg (as usual); the other connects to the filler. Finally, connect the beer-out line from the keg to the filler. (Some counter-pressure fillers require the beer to flow downhill into the bottles. If this is the case with your filler, elevate the keg.)

The keg of beer should be cold, carbonated and conditioned. The colder the beer is, the better. Carbon dioxide (CO_2) dissolves more readily in cold beer, so you will have fewer problems with foaming (from CO_2 breakout) in cold beer. Ideally, your keg should be around 32 °F (0 °C). (The freezing point of normal-strength beers is slightly lower than this. Stronger and sweeter beers have a freezing point significantly below this.) Since some carbonation is inevitably lost during the process, your beer should be fully carbonated. You may, in fact, want to slightly overcarbonate your beer prior to counter-pressure bottling to compensate for this loss. To do this, simply increase the CO_2 pressure by two to three PSI overnight. Don't go nuts with the carbonation, however, unless wrestling with wildly foaming beer bottles is your idea of a good time.

It's always good to have a couple hand towels or a roll of paper towels on hand, as it's relatively easy to spill a little beer while counter-pressure bottling. You'll also need your bottle capper, caps and — of course — clean and sanitized bottles.

Bottling the Beer

Once the filler is connected, check again that all the filler valves are off and open the valve on the gas cylinder. Opinions differ on how much pressure should be applied for counter-pressure bottling. I've seen pressures from 3–15 PSI recommended. Lower pressures allow you to fill the bottles slowly, but CO_2 can break out of solution fairly easily when beer enters the bottle and is exposed to a lower pressure than the level at which it had been conditioned. Higher pressures move the beer faster, but the filler is more likely to pop off the bottle while filling. And the beer can suddenly start foaming when the filler is pulled off and the beer experiences a large pressure drop. I usually just leave the pressure at the level at which the keg was conditioned, usually somewhere between 8–12 PSI, depending on the beer style.

Purging the Bottle

The first step in counter-pressure bottling is to fill the bottle with carbon dioxide (CO_2), displacing the air that was formerly there. Filling the bottle with CO_2 first will minimize the amount of oxygen the beer encounters during the transfer.

To fill the bottle with CO_2, place the filler on the bottle and make sure the stopper is securely positioned in the opening of the bottle. Next, open the gas-in valve and then crack open the "bleeder" valve. Once the bleeder valve is open, you'll hear the gas hissing and the bottle will begin filling with CO_2. Gas from the cylinder is flowing through the filler tube to the bottom of the bottle. Since CO_2 is heavier than air, it will form a "blanket" on the bottom of the bottle. As this "blanket" rises, it displaces the bottle's existing air (approximately 20 pecent of which is oxygen) and forces it out of the bleeder valve.

After 10 or 12 seconds, the bottle should be full (depending on how far open you cracked the bleeder valve). You can't see CO_2, so you'll just have to estimate how much CO_2 is enough. I try to think of how much gas escaping the bleeder valve it would take to fill a balloon the size of the bottle I'm filling. Once the bottle is "gassed," close the bleeder valve first, then close the gas valve on the filler.

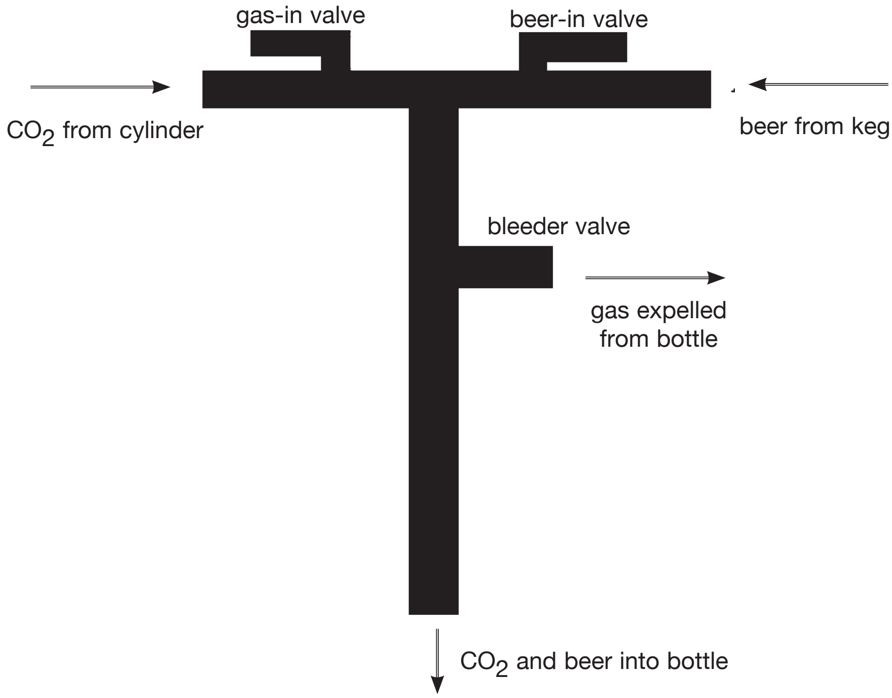
The valve on the gas cylinder remains on throughout filling.

Transferring the Beer

The second step in counter-pressure bottling is to fill the bottle with beer. The filler's tube extends almost to the bottom of the bottle. So during the transfer, the bottle is filled from the bottom, under a blanket of CO_2. This minimizes foaming and aeration, because there's always bound to be some stray oxygen in the bottle, even after it's purged with CO_2.

To fill the bottle, open the beer-in valve. Beer will not start flowing yet because the pressure in the bottle is equal to the pressure pushing the beer. Counter-pressure bottling is named for the opposing pressures at this stage. To get the beer to flow, crack the bleeder valve. Once the bleeder valve is opened, the pressure in the bottle will decrease and the beer will start to flow. The farther you open the bleeder

Counter-Pressure Filler



valve, the faster the beer will flow. You should aim to fill the bottle slowly enough that foaming is controlled. A little foam on top of the beer is OK, good even, but the bottle shouldn't quickly fill with foam. Once the bottle is filled, close the bleeder valve first, then close the beer valve on the filler.

If you are using a gravity-flow counter-pressure system, the beer will start flowing (downhill) immediately after opening the beer-in valve.

Some counter-pressure bottlers have a pressure gauge built in to the bottler. The pressure difference between the keg and the counter-pressure relief valve should ideally be about 3 PSI. With this pressure differential, you can fill a bottle in 5–10 seconds. Of course, in the absence of modifying your bottler with a gauge, you'll just have to estimate this differential from your fill rate. Try opening the beer-in valve until the beer just foams, then close the valve a bit and aim to fill the bottle within 5–10 seconds. You can fill the bottles to the level of commercial beers, or you can go a little higher. Either way gives good results.

Capping

The final step in counter-pressure bottling is capping. Capping should be done as quickly as is feasible. Cap each bottle right after filling it rather than filling several bottles, then capping them all. While the bottle is uncapped, carbonation is being lost and the beer is being exposed to oxygen. The loss of carbonation is relatively slow, of course. Think about opening a bottle of beer. The carbonation dissipates over time, but your beer doesn't instantly go flat. So move quickly during this step, but don't worry overly much about it.

To begin capping, check that all the valves on the filler are closed. If any of the valves are opened, you will lose beer or CO_2 when you take the filler off the bottle. I also take the time at this point to ensure that I have a bottle cap and my capper ready. Remove the filler from the bottle and it set aside. Now quickly place a cap on the bottle and crimp it closed with your capper.

Ideally, you should try to cap over foam. When foam rises in the bottle, it displaces the gas above it. In doing so it displaces any oxygen in that gas. While filling, adjust the flow rate so a bit of foam forms on top of the beer. Once you remove the filler, the beer will likely start foaming some more. Place the cap on top of the bottle and wait for the foam to rise to the top, then cap. You may need to lightly hold the cap on with your finger to stop it from being knocked off while the foam is rising.

If the beer is not foaming, you can either just cap the beer or try to induce foaming. To induce foaming, take another beer bottle and lightly tap the top of the just-filled bottle. Be careful, though — if you hit the bottle too hard it will foam uncontrollably. (If you're like me, you've probably seen this performed as a prank, turning the victim's beer into a geyser.) This takes a bit of practice. Don't try it unless you are willing to risk losing some beer and having a mess to clean up.

Conditioning

Counter-pressure bottled beer can be served immediately. You will notice, however, that newly-bottled beers won't make the "phsst" sound of escaping gas when opened. Initially, the gas pressure in the bottle's headspace is equal to the atmospheric pressure at the time the beer was bottled. Over time, CO_2 from the beer will diffuse out of solution and pressurize the headspace. This is why some homebrewers feel that it is best to minimize the amount of headspace in the bottles. The smaller the headspace, the less carbonation is lost from the beer to pressurize the headspace.

At first, counter-pressure bottling can seem complicated. There's tubing running all over the place and four valves (counting the main valve on the CO_2 tank) to keep track of while filling. Just keep in mind that, any time you're unsure of how to proceed, you can turn all the valves off and figure it out or look it up. Also keep in mind that all the valves should be closed whenever you hook up the system and whenever you take the filler off a bottle. Although counter-pressure bottling initially seems complicated, it gets easier with practice. BYO

Like the bottles described here, Chris Colby is frequently full of beer and gas.

Multiple Kegs + Multiple Taps

by **Chris Colby**

At some point, your first keg will likely get some companions. Even with recent rises in prices, used Corny kegs are still fairly cheap and most active homebrewers brew often enough that having just one keg would not be feasible. With only one keg, you'd need to wait until you finished it to rack your next beer into it. Plus, if you are using a chest freezer, or even a refrigerator, to serve your beers, you have room for more kegs.

You can add more kegs to your inventory without changing your kegging system, but you could only have gas pressure on one keg at any given time. You could force carbonate two or more kegs independently, then move the gas in line each time you wanted to serve a beer. Presuming your kegs were sealed properly, this would work. But, it would be a hassle — and it would entail opening the fridge or freezer door every time you wanted to pour a beer (something that would not be necessary if you had installed taps on your fridge or freezer). A better solution is to have a separate gas line for each keg, all fed off the same gas cylinder.

The cheapest and easiest solution is either a "Y" splitter or a "T" splitter. With either of these, you connect your gas line to the splitter, then run two lines from the splitter to two kegs. If you're serving beer from an upright fridge or a fridge kegerator (both which usually hold two kegs), this is a good option, although there is one possible drawback. Because the two kegs will be connected, gas from the headspace of one will, over time, diffuse over to the other keg. If one of the kegs contains a highly aromatic beer, the other may start smelling like it over time. And, if one of the kegs suddenly loses pressure, gas (or beer) from the other will get forced into the keg with lower pressure. (This problem can be avoided with check valves, see below.)

For best results, clamp the beer lines to the splitter, don't just push the tubing over the barbs. Gas pressure is likely to push the tubing off if it isn't clamped. When you split the gas line this way, both kegs will be under the same amount of pressure (as indicated on the gauge on your gas cylinder). You do not need to adjust your CO_2 pressure when splitting gas lines.

You could theoretically use "Y" or "T "splitters to keep splitting beer lines to accommodate any number of kegs, but this would quickly become an inelegant solution. Another option for multiple beer lines is a manifold or distributor. These usually take the form of a metal (aluminum, stainless or brass) rectangular box with a nipple on the end for the gas inlet connection and two or more nipples along one side for directing gas to individual kegs. Each gas out nipple will have a valve, so you can turn off the gas to individual lines, and each valve will also have a check valve, to prevent backflow. (In other words, headspace gas or beer from one keg won't get pulled into another if it starts losing pressure.) Manifolds will also have a place for mounting screws, to hold the manifold in place. Common manifolds include 2, 3, 4, 6 or 8 outlets, and manifolds can be daisy chained to accommodate more kegs. If you have a chest freezer with several kegs, this is your best option. If you have an upright fridge kegerator, a 2-way manifold may be a better option than simply a splitter. Although it costs more, you will have the benefits of the check valves and the ability to turn the gas off to one keg at a time.

In a multi-keg set up linked by a splitter or one or more manifolds, all the kegs will be under the same amount of gas pressure. If you want to serve beers with different levels of carbonation, you have two options. The first option is obvious — you could get a gas cylinder and regulator gauge for every pressure you wanted to serve at. For example, you could have a CO_2 tank that supplied gas to your lightly English style ales and another supplying gas to your spritzy German hefeweizens. Each tank, could of course — through the use of splitters or manifolds — service several kegs.

A multi-gauge regulator would also allow you to condition beer at two (or more) different gas pressures from the same cylinder. A multi-gauge regulator has two or more gauges for the pressure to the kegs in addition to the gauge for the tank pressure. There are also multi-gauge regulator extenders that are essentially like the manifolds described earlier, but with adjustable gas pressure at each node. Multi-gauge regulators are, as you might expect, more expensive than using a manifold, but the advantage is that they give you complete control over the pressure in each beer line. BYO

PROJECTS

BUILD YOUR OWN Kegerator

by Forrest Whitesides

This project is a two-tap kegerator. It's not an inexpensive project, but the benefits are tremendous and well worth the money, in my opinion.

Refrigerator or Freezer?

Before you can get started buying all of the needed hardware, you need to decide if your kegerator is going to be housed in a refrigerator or chest freezer. Using a refrigerator is generally less expensive overall and requires less equipment, but a decent-sized chest freezer can usually accommodate more kegs (and thus taps). I opted to go with a refrigerator because it fit my brewing needs (and available space) and required minimal hardware.

PARTS LIST

1 refrigerator
2 Cornelius kegs
2 shanks
2 forward-sealing faucets
2 tap handles
2 10' (3-m) lengths of beer line hose (3⁄16 ID)
2 beer "out" disconnects
4 hose clamps (for beer line)
1 CO_2 tank
1 dual-gauge regulator
3' (1 m) air line hose (¼" ID)
1 "Y" splitter (for air line hose)
6 hose clamps (for air line)
2 gas "IN" disconnects
caulk
keg lube

TOOLS

elelctric drill
⅞" hole saw
screwdriver

A traditional-sized refrigerator can typically hold four or five kegs. If you plan to have more than five or six taps, a chest freezer is most likely your best choice. I've seen chest freezer kegerators with 10 or more taps.

To figure out how many kegs a given fridge or freezer will hold, trace around the bottom of a Cornelius keg on a piece of cardboard, cut it out, and take that with you when you go to look at your options. If you don't have a keg yet, you can just draw an 8-inch (20-cm) diameter circle instead of tracing the bottom. Also be sure to measure for vertical clearance. A typical ball-lock keg with the disconnects attached is about 26" (66 cm) high. Vertical clearance isn't usually an issue with full-size refrigerators or chest freezers, but it's good to know the height of the kegs when trying to squeeze just one more into a tight space in the back of the fridge.

Kegs, Shanks and Faucets

Now that you've got your refrigerator, it's time to pick out hardware: kegs, shanks, and faucets.

Used kegs are the cheapest way to go, and are generally very reliable. You can typically find used, pressure-tested 5-gallon (19-L) Cornelius kegs for about $30– $40, whereas new kegs are about $100. If you buy used, it is imperative to replace all of the rubber seals and poppets before using it for homebrew. It'll only cost about $10 total and will guarantee that your beer doesn't end up tasting like whatever was in the keg before you bought it.

A good rule of thumb is to have at least one more keg than you have taps. This allows you to have at least one beer conditioning in the keg and ready to go when you finish off one of your other beers and a tap becomes available.

For a refrigerator-based kegerator, you'll need a shank and a faucet head to make each tap (Photo 1). The shank fits through a hole drilled in the refrigerator door, and via beverage tubing connects the keg to the dispensing faucet. Some shanks have a permanently attached hose barb, while others use a tail piece and wing nut to attach the barb. Either type will work just fine. The other end of the shank has a threaded collar that mates with the faucet. This is a great system, as it allows any faucet to be used with any shank. This comes in handy if you want to upgrade your faucets at a later date.

There are many faucets available on the market right now, ranging from cheap brass units to high-end stainless with a brushed nickel finish. If you have the money, I highly recommend the forward-sealing style faucets. They're easier to keep clean (and they look really cool). But any faucet will work, so there's no need to spend a lot on faucets right away.

CO_2 — Hit the Gas

The heart of any kegerator is the gas that pushes the beer. In the vast majority of cases, this will be CO_2, but could also be a nitrogen/CO_2 mix. Gas cylinders most commonly come in 5-lb.(2.3-kg), 10-lb. (4.5-kg) and 20-lb. (9.1 kg) sizes, but both smaller and larger sizes are available.

A gas regulator is required as well. It attaches to the cylinder and allows you to set the pressure of the gas imposed on the keg, which is how you set and adjust the carbonation level in the beer. Dual-gauge regulators also show how much pressure is remaining in the cylinder, so that you'll know when it's almost empty (Photo 2).

If you plan on having several beers on tap, you'll also need some way to push the gas to each keg. This is typically done with a manifold that splits the line from a single gas cylinder into many output connections. For splitting off to just two kegs, you can use an inexpensive "Y" adapter that screws into the regulator.

If you plan on serving beers that require different carbonation levels, this will require either a separate CO_2 cylinder and regulator or a double regulator attached to just one cylinder.

For starting out, however, a simple dual-gauge regulator is more than adequate.

Other Equipment

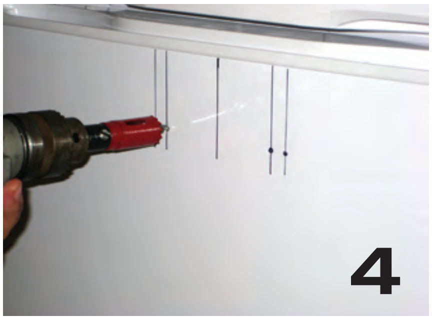
For each keg in your kegerator, you'll need: a liquid and gas disconnect, a length of gas and beverage tubing, and a pair of hose clamps.

One other critical piece of equipment for your kegerator is a drip tray. These are usually made of stainless steel and are surprisingly expensive. For attaching to a refrigerator door, you'll need one that has a mounting bracket (as opposed to drip

Each tap in your kegerator will need a shank (left) and a faucet (right). The shank size is standard, so you can upgrade the faucet later.

A CO_2 tank with a dual gauge regulator provides the gas to keep the beer carbonated and push it through the lines. For multiple taps, the gas line must be split.

Magnets being glued to the back of a drip tray. This makes removal for cleaning easier. Drip trays can also be bolted into place.



Mark the spots on your fridge door that will be drilled. The door does not contain coolant lines.

The shanks installed through the drilled holes. These can be sealed with caulk, if you feel that is necessary.

The faucets screw onto the outside of the fridge door. At this point, the hard part is done. You're almost ready to pour beer.

Put your gas line over the barbed fitting on the regulator, and clamp it down. For multiple taps, this line will lead to a splitter.

trays that just lay flat under vertically mounted taps). Instead of screwing mine into the door, I glued some felt-backed magnets to the tray (Photo 3). This makes it easier to remove the tray for cleaning, moving the kegerator, etc. While not required, you'll also certainly want some swanky tap handles for your faucets. (See page 66 for instructions on building your own.)

Where Do I Get This Stuff?

Most homebrew suppliers that stock kegging equipment also offer refrigerator conversion kits. They also stock beverage and gas tubing and other consumables. There are also vendors that specialize in kegging equipment only, including full kits.

Finding a local supplier for CO_2 can seem like a daunting task. Look for welding supply shops and local businesses that refill or recharge fire extinguishers. These are usually the best places to get your cylinder refilled. You cannot mail order filled CO_2 cylinders, so you will have to find a local or relatively local source for filling.

Before you buy a brand-new shiny cylinder, be aware that most shops will not fill your tank while you wait. Instead, they will exchange your empty tank for a different full tank, much like how a propane exchange program works. Be sure to ask your local supplier if they will fill your personal tank or if they do exchanges only.

There has been a lot of discussion about the "grades" of CO_2 that are available. Almost any place where an individual can purchase CO_2 in small amounts will be selling food-grade gas. There is also industrial-grade CO_2, which has more impurities than food-grade gas. If in doubt, ask your supplier which grade they sell. A good supplier knows the difference and will inquire about the end use of the gas.

Most paintball supply shops also will fill CO_2 cylinders. However, you must be absolutely sure that they are using food-grade CO_2. Ask before you get your tank filled.

Convert the Fridge

This is actually the easiest part of the whole project. All you need is a drill and a ⅞-inch hole saw. Just drill a hole through the refrigerator door for each tap you intend to have. That's about all there is to it. For my kegerator, I opted for two taps to start off with, but there is plenty of room to add at least one more.

Before you drill, you'll want to measure and mark the door. First take a look at the inside of the refrigerator door to verify the locations of shelving supports. It is best not to drill through these supports, as you may want to keep the shelves for holding bottled homebrew or odds and ends related to brewing. Now you can mark off your center points for drilling (Photo 4).

The resulting holes should be a tight fit for the shanks. Work them through the hole and tighten the nuts on the inside of the kegerator (which is what your fridge now is, officially) (Photo 5). For a little extra thermal security, you can seal the edges of the holes with a little silicone caulk before you tighten down the nut. I have not found this to be necessary, but if your shank holes aren't quite clean and neat, it might not be a bad idea.

Once the retaining nuts are tightened down on the shanks, screw the faucets into the shank collars and you're ready to hook up the kegs and gas (Photo 6). You're almost there.

Some homebrewers like to keep the CO_2 cylinder outside of the kegerator to make room for an additional keg. This requires drilling and insulating an extra hole in the side or back of the fridge to run the gas tubing into the kegerator. This can be a very tricky operation, because the sides, top, and back of a refrigerator are generally the places where the coolant lines are run. Drilling through one of these coolant lines will permanently ruin your kegerator. Determining the location of coolant lines on various makes and models of refrigerators is beyond the scope of this article. Proceed with caution if you plan to go this route.

Testing, Testing

Attach the regulator to the cylinder, and make sure the connection is tight (but do not over-tighten). Slip one end of a length of gas tubing over the hose barb on the regulator's shut-off valve and secure it tightly with a hose clamp (Photo 7). The other end of the gas tubing goes on the gas quick disconnect fitting (which is usually grey and plastic) and should also be secured with a hose clamp (Photo 8).

Attach the grey gas disconnect to the "IN" post (also called a plug) on a keg filled with tap water (or sanitizer if you prefer). Set the regulator to about 8 to 10 PSI and open the valve on the cylinder. You'll hear the gas enter the keg. Now take a spray bottle filled with either soapy water or a standard strength solution of Star San sanitizer and spray the connections on the regulator and the disconnect. Watch closely for bubbles, as this is a sign that CO_2 is leaking. If you see bubbles, turn off the gas and retighten the connection nearest to where the bubbles occurred. Keep doing this procedure until you don't see any bubbles. Even a very tiny leak will leave you with an empty cylinder in a very short time.

Now attach the beverage tubing to the hose barb on the liquid disconnect (usually black pastic) and the hose barb on the shank and secure both connections with a hose clamp (Photo 9). As a staring point, use about 10 feet of beverage tubing. Attach the liquid disconnect to the "OUT" post on the keg, turn the gas back on, put some kind of container under the tap, and pull the handle toward you to open it. The water in the keg will now flow out through the faucet. Watch the beverage out side for liquid leaks. Tighten and reseat connections that show any leakage at all.

If you think you're having trouble with the keg seals, apply a thin coat of food-grade lubricant to all rubber parts (seals and gaskets). This is commonly available at homebrew supplies and is often simply called "keg lube."

Kegging Time

Go ahead and take a full keg of your homebrew and put it in the kegerator. Let it chill overnight (or about 12 hours) before hooking up the CO_2.

There are a few ways to go about force carbonating the beer. The first way is to set the regulator to 8 to 12 PSI (a common serving pressure range) and let it sit for about a week or so. Another (faster) way is to set the regulator to about 25 to 30 PSI for a few days, and then back it down to about 10 PSI. The "quick and dirty" method (which you might use if you had just transferred beer to the keg and you had guests arriving that same day) is to crank the gas to about 35 PSI for a few minutes, disconnect the gas, and then shake the keg vigorously for a minute or so. Repeat once or twice more, then chill for an hour and serve. This method isn't ideal, but it will work in a pinch.

Getting your system in balance takes some trial and error and some patience. As a baseline, I recommend starting off with 10 feet (3 m) of beverage line and use 10 PSI for the serving pressure. The general consensus is that a good serving temperature is between 36 and 40 °F (2.2–4.4 °C), although some styles may warrant a slightly higher temp. And of course, personal taste will be the final deciding factor.

The parameters listed above will get you in the general ballpark and should result in an excellent first kegging experience. For some handy formulas to help get your system fully tuned to your liking, check out http://kegman.net/balance.html. Also, see the article on page 28 for more on balancing your system.

The setup may be intimidating at first, but in no time you'll be enjoying your brew on tap with friends and family. It's a beautiful thing (Photo 10). Also, you can easily swap tap handles and even faucet types easily. For example, here's the same kegerator (Photo 11), but it has the stout tap instead of the regular tap shown in Photo 10.

A kegerator is a great addition to any home brewery. With it, you'll have a dedicated serving station (with enough room inside to store a few yeast samples, etc.) and reason to get out there and brew.

Forrest Whitesides' first kegged beer was a milk stout brewed with coffee malt and fermented with Belgian yeast.

The gas line(s) connect to the keg(s) via the "gas in" post. The first time you apply pressure, you should check for leaks.

Beverage line connects the "beer out" post to the tap on the kegerator. Keeping these lines clean is very important.

Tap handles can be as fancy or utilitarian as you'd like. And, they can easily be changed as kegs change.

A homebrewed stout being poured from a stout faucet. Pushing beer with nitrogen is another option for this kegerator.

CLUB Kegerator

by Tony Profera

What would prompt a group of homebrewers to build a system that can dispense 11 different beers at the same time? For the past 10 years, the Carolina BrewMasters (a homebrew club from Charlotte, North Carolina) has organized a beer festival known as "Charlotte Oktoberfest." In 2007, over 6,000 beer lovers attended and sampled from over 240 homebrewed and commercial beers. The event raised over $50,000 for charities, including the Multiple Sclerosis Society and the Juvenile Diabetes Research Foundation.

Serving 25–35 5.0-gallon (19-L) Cornelius kegs of homebrew to thirsty event patrons over a 6-hour period was becoming increasingly problematic. With a desire to showcase club homebrew at the festival, the organizing committee agreed to fund the materials to build a custom festival draft dis-

pensing system. Two design plans were proposed to the committee. The design selected is actually the smaller of the two! It was quickly determined that the larger design, although impressive, would have blown the budget. So, it was shelved for the smaller design that was approved and has come to be known as "Junior."

The call was put out to Carolina BrewMasters for parts donations. The local Charlotte homebrew shop (Homebrew.com) came through and donated a great many of the draft parts needed. Long time club members Scott Wallace and David Jones stepped up to assist with the build. If you are considering building a similar system of this kind, support cannot be underestimated!

Meet Junior

Junior is a serving platform with a 7-foot (2.1-m) bar front. It has 11 taps arranged into two "Irish coffin" towers, each with five taps, and a central tap run through a Randall. The kegs reside under the bar, contained in rolling carts that make them easy to swap out. The gas cylinders are housed in a cart that fits between the two keg carts. Each tower has its own CO_2 cylinder. The whole bar dissembles easily and the base and bar top fold flat, so they take up relatively little space for transportation and storage.

The Draft Towers

"Irish Coffin" style draft towers are made from solid 1" red oak. Equally spaced holes are drilled into the serving side faces of the draft boxes to accommodate the faucets (as seen in Photo 1) . The tower's lids remove for access to the faucets, shanks, tail pieces, and hoses (as seen in Photo 2). The interiors of the draft boxes have been coated with several layers of marine grade polyurethane. Interior joints are sealed with aquarium silicone to

OVERALL SYSTEM DESIGN FEATURES

- Lift-off draft towers and bar top with folding bar base.
- 8 Ventmatic forward-sealing stainless steel faucets. Stainless steel shanks and tail pieces.
- 2 stainless steel stout faucets for the dispensing of stouts and porters with beer gas (85% nitrogen – 15% CO_2).
- 2 oak "Irish Coffin" style draft towers.
- Rolling oak cart to support the CO_2 and beer gas tanks.
- Redundant CO_2 manifolds with shut-off valves and back flow preventers for each line.
- Extra large tubs to hold up to 5 pin-lock or 6 ball-lock kegs on ice each (Note: ball-lock kegs are typically narrower than pin lock kegs).
- Rolling tub carts for mobility.
- 2 self-draining stainless steel drip trays under the faucets — a drain hose runs from the drip plates hrough bar top to small plastic containers that sit beneath the rolling carts. It's maintenance free.
- Quick setup and portability — the bar breaks down and folds to permit transport in the bed of a full-sized pickup truck.

DRAFT SYSTEM PARTS LIST

- (8) Ventmatic forward-sealing stainless steel faucets
- (2) stainless steel stout faucets
- (1) Chromed tap and faucet tower for “The Hopinator”
- (10) 2 ½” beer shanks, nuts, and tailpieces (stainless steel)
- (10) Black plastic faucet flanges
- (10) Black plastic tap handles
- (2) stainless steel drip trays: 20” x 5”
- (80’) Beer hose — 3/16” thick wall
- (2) Dual-gauge CO_2 regulators
- (1) Dual-gauge beer gas regulator
- (3) Regulator cage guards (optional)
- (10) Plastic CO_2 regulator to tank washers
- (2) CO_2 gas manifolds (each with 5 or 6 outlet flared shutoff valves with back-flow prevention)
- (1) SS tee splitters (3 way or 4 way) - optional
- (12) “Beer In” Cornelius keg connectors – ¼” Flare end (ball lock style)
- (6) “Beer In” Cornelius keg connectors – ¼” Flare end (pin lock style)
- (12) “Gas in” Cornelius keg connectors – ¼” Flare end (ball lock)
- (6) Gas In Cornelius keg connectors – ¼” Flare end (pin lock)
- (50) ¼” female hose end flare fittings
- (50) Oetiker stainless steel step less hose clamps (for ⅜” thick wall beer line)
- (80’) 1” x 3” solid oak trim hardwood
- (40’) 1” x 6” solid red oak (draft towers and tank cart)
- (4) ½” x 4’ x 8’ clear premium oak-veneered plywood
- (24) Premium-grade 8’ x 2” x 4” pine or maple
- (1) Large tube aquarium sealant
- 20” water filter with clear acrylic housing (Pentek 3G — no: 150568)
- (2) SS tower cylinders (1/8” x 6 1/2 x 10”)
- (2) ⅜” threaded rod, nuts and washers (for SS cylinder attachment)
- (4) 1” x 1” x 10” Aluminum cross members (for SS cylinders attachment)
- (10) 5/16” T-Nuts (to secure bar top to the fold out base)
- (10) 5/16” x 2” hex head bolts and washers
- Assorted screws, nails, staples as needed.
- (1 qt./1 L) Dark red wood stain — color: Merlot (Olympic)
- Waterproof wood glue – (Titebond 3)
- (2) Locking slide bolt latches (secures base when closed)
- (2 qt./2 L) marine spar urethane
- (25–35) Cornelius kegs of your finest homebrewed beer (5 gallons/19 each) *** THIS IS THE MOST IMPORTANT PART ***
- (2) Very large plastic tubs (US Plastics)
- ¾ plywood double for bases to tub carts
- (8) non-swivel 8”-10” pneumatic wheels (Harbor Freight Tools)
- (16) 5/16” x 1 ½” bolts, nuts, washers (secure wheels to tub carts)

waterproof the boxes.

Dispensing samples from side by side draft towers permit two pour teams to work simultaneously. Each tower and its taps are totally independent, ensuring that at least one side is pouring at all times.

Each draft tower sits on a 6” (15 cm) diameter stainless cylinder. Inside, another 2 ½” (6.4 cm) diameter cylinder is welded to a cross member (as seen in Photo 3). This inner cylinder is used to run the beer lines through the bar top surface down to the kegs. At the bottom of the large cylinder, a stainless steel plate (with several small holes drilled) has been welded to hold ice. This fabrication was done to

permit ice to be poured into the top of the draft towers and down into the cylinders to chill the beer line. As the ice melts it drains through the small drilled holes into the red poly tubs. All good theory, but with continual pouring, the beer does not require additional chilling.

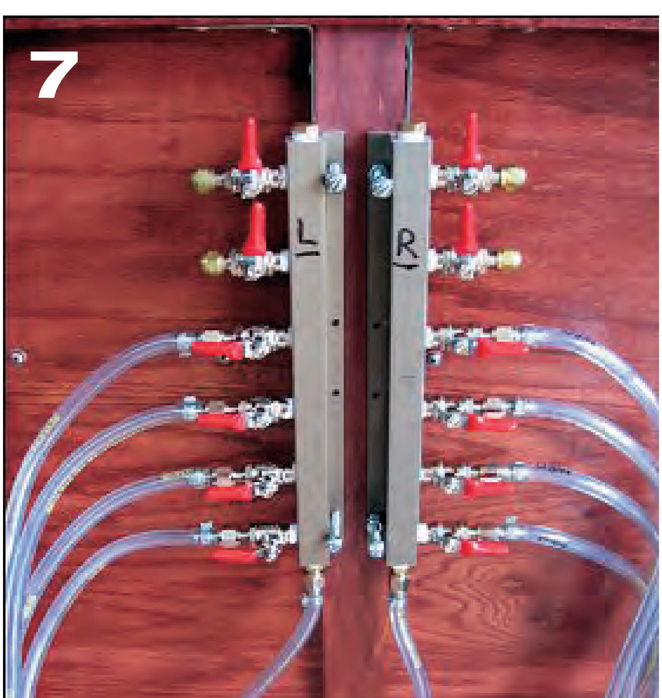
The cylinders sit inside cutout 1” (2.5 cm) oak flanges on the bar top. The draft boxes are bolted (with threaded rod) through the cylinders to the bottom of the bar top. Long aluminum round bar cross members ensure a firm hold.

The Base and Bar Top

The base framework is made from standard sized 2” x 4” pine and is skinned with ½” oak veneered plywood (as seen in Photo 4).

To attach the bar top to the base holes, T-nuts were installed in the base frame prior to attaching the finish plywood. This allows the bar top to be securely bolted to the base using six hex head bolts.

This lift off bar top is constructed from a 2" x 4" framework and skinned with a ½" oak-veneered plywood. With the bar top bolted to the base, the structure becomes very rigid and stable. An ⅛" hardboard panel screwed to the underside of the bar top supplies a storage area for draft hoses when not connected to the kegs. The bottom surface of the base has 8 strips of HDPE (cutting board)

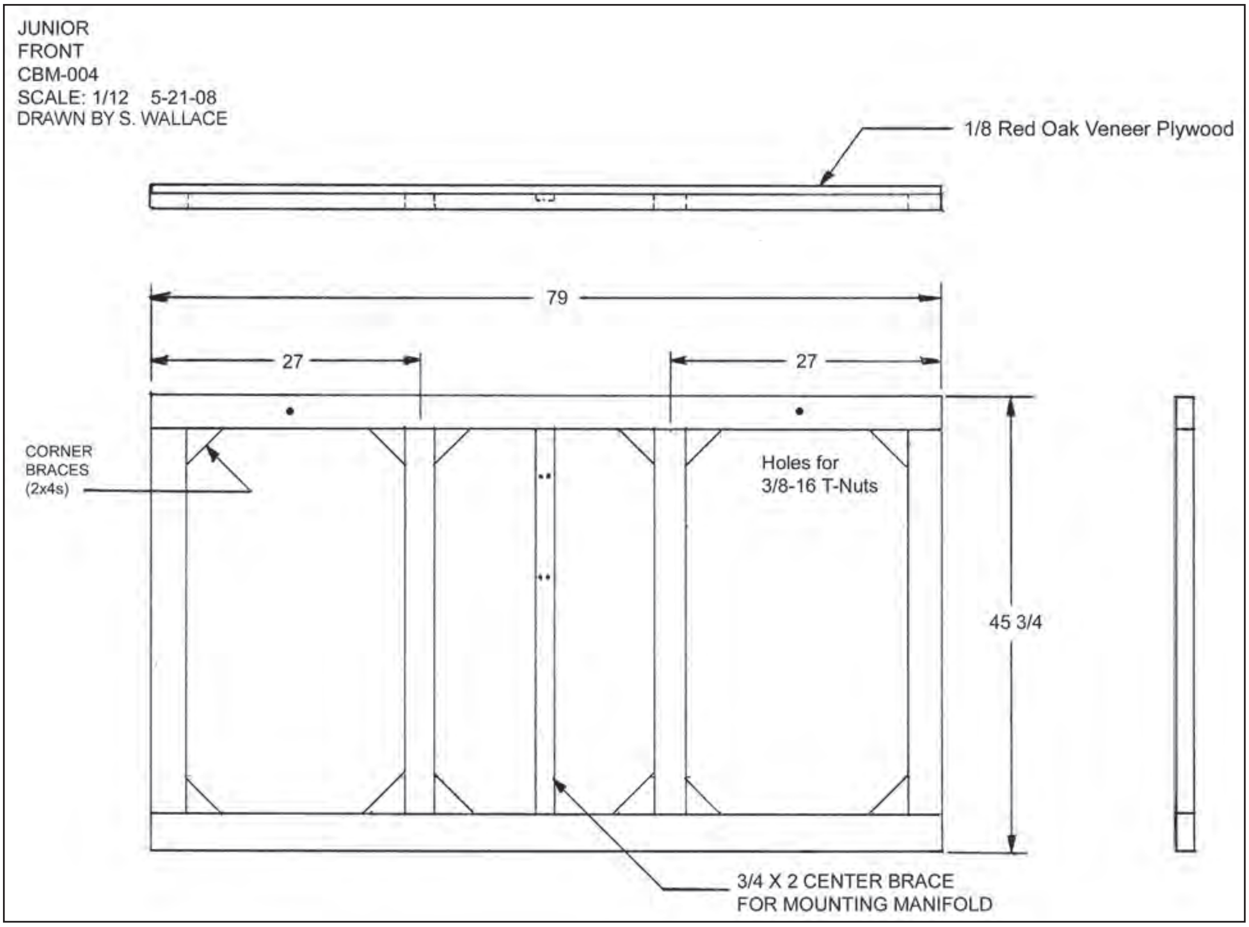


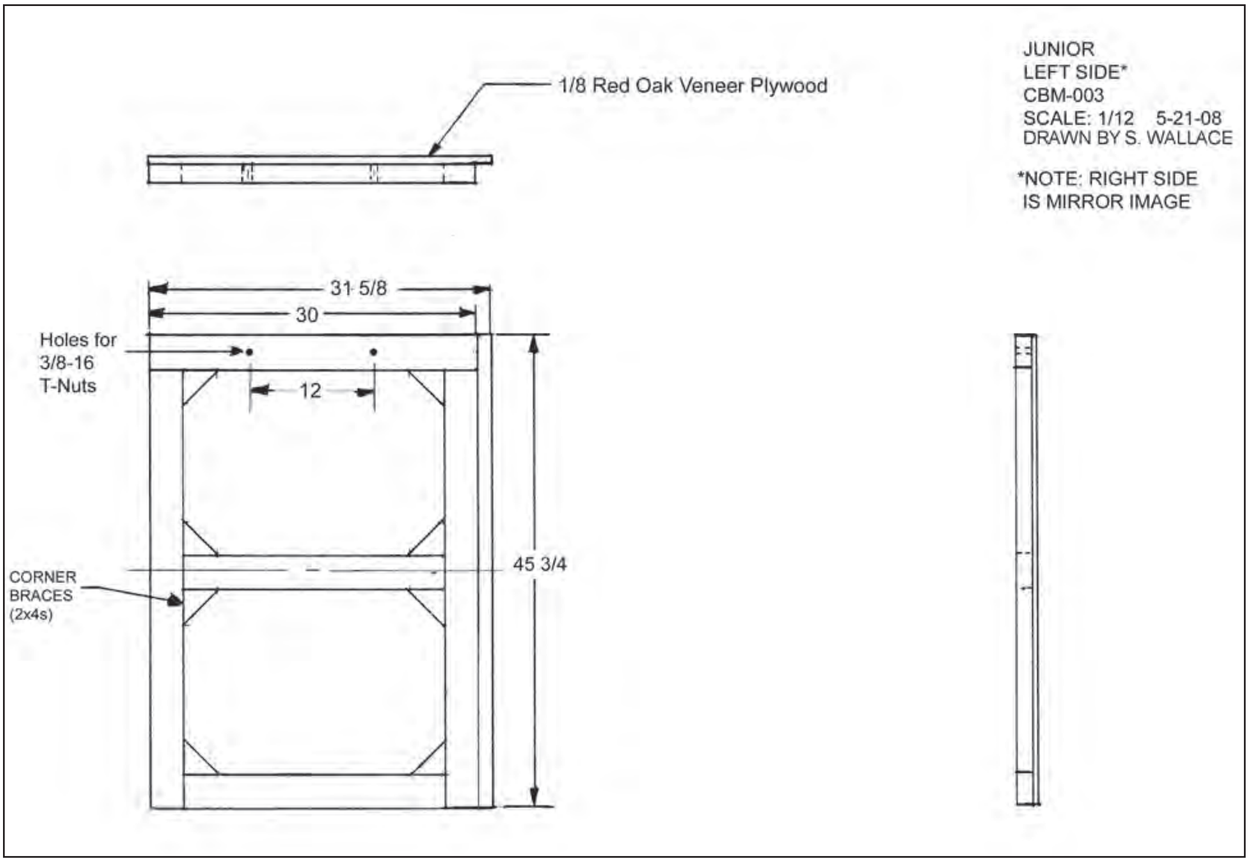
installed to protect the wood from ground moisture, and scratch damage.

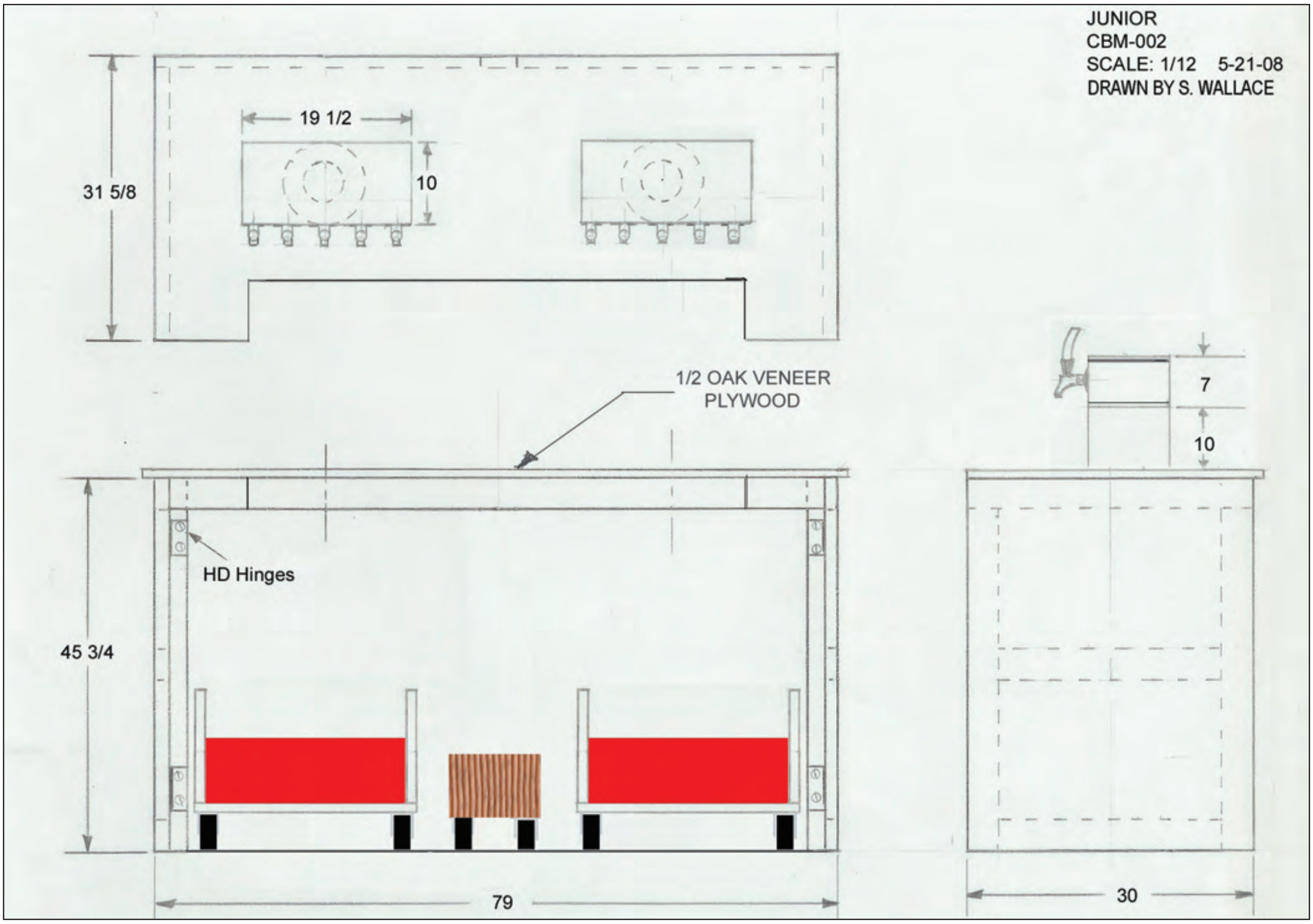
The outward faces of the bar base are trimmed with 1" x 4" maple strips and ¼" round molding for a finished look. All wood surfaces are stained Merlot Red. Several coats of spar urethane have been rolled on for protection from the elements and beer.

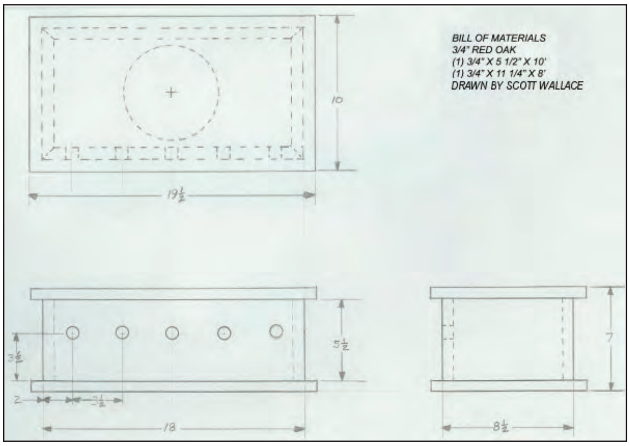
Tubs and Carts

Large, heavy-duty food service poly tubs are used to hold up to six kegs on ice each. They sit on rolling carts made from 1 ½" marine grade plywood (as shown in Photo 5). Non-swiveling casters with large pneumatic tires were installed to permit the carts to roll in and out to perform keg maintenance without turning the festival site into a mud bog.


JUNIOR
FRONT
CBM-004
SCALE: 1/12 5-21-08
DRAWN BY S. WALLACE
1/8 Red Oak Veneer Plywood
79
27
27
CORNER
BRACES
(2x4s)
Holes for
3/8-16 T-Nuts
45 3/4
3/4 X 2 CENTER BRACE
FOR MOUNTING MANIFOLD


1/8 Red Oak Veneer Plywood
JUNIOR
LEFT SIDE*
CBM-003
SCALE: 1/12 5-21-08
DRAWN BY S. WALLACE
*NOTE: RIGHT SIDE
IS MIRROR IMAGE
31 5/8
30
Holes for
3/8-16
T-Nuts
12
45 3/4
CORNER
BRACES
(2x4s)





This works surprisingly well. Sometimes the simplest solutions are the ones that work best.

Gas Cylinder Cart, Tanks and Gas

An oak cart is used to hold the CO_2 and beer gas tanks needed to run the draft system (see Photo 6). Donated wood (to build the cart) was originally purchased to construct a baby's cradle 17 years earlier. It now bears the name "Sam's Cradle" to pay homage to her. We believe Sam is pleased by this. In use the cart resides between the two keg tubs near the gas manifolds (as seen in Photo 10).

DESIGN DRAWINGS

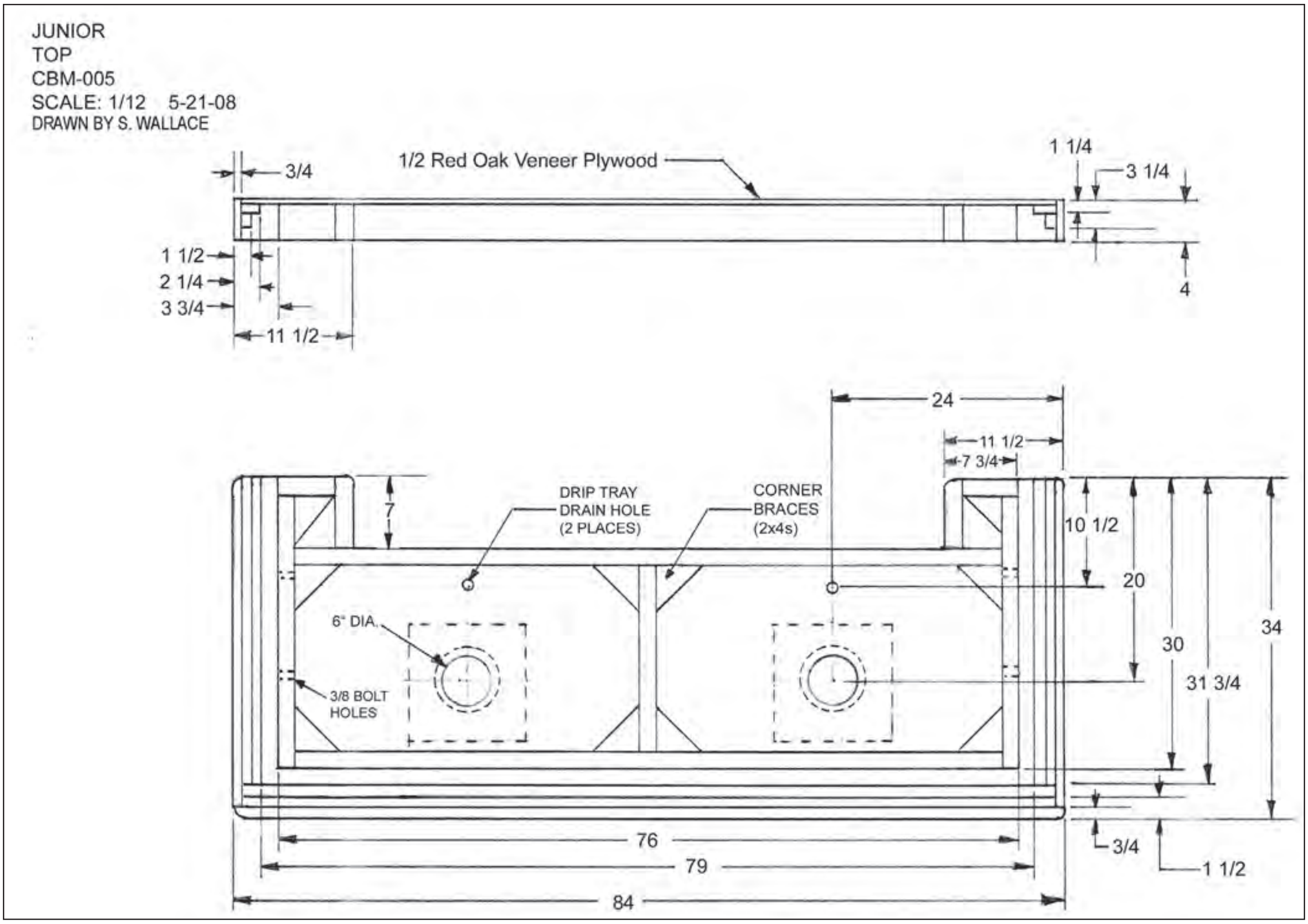
The details and dimensions of Junior can be seen in the design drawings, drawn by Carolina BrewMaster Scott Wallace.

The front and side views of the bar's base can be seen on page 44. The full bar (top, side and back, with towers in place) can be seen on page 45 along with the plans for the Irish coffins (top, front and side). On page 46, drawings of the bar top (with tower placement) and the design of the stainless steel support cylinders can be found.

The scale of each drawing is provided and all measurements are given in inches.

From Plans to Performance

Many have asked how it performed on festival day? We think better than expected! Junior was well-behaved and served up the homebrew in style.


JUNIOR
TOP
CBM-005
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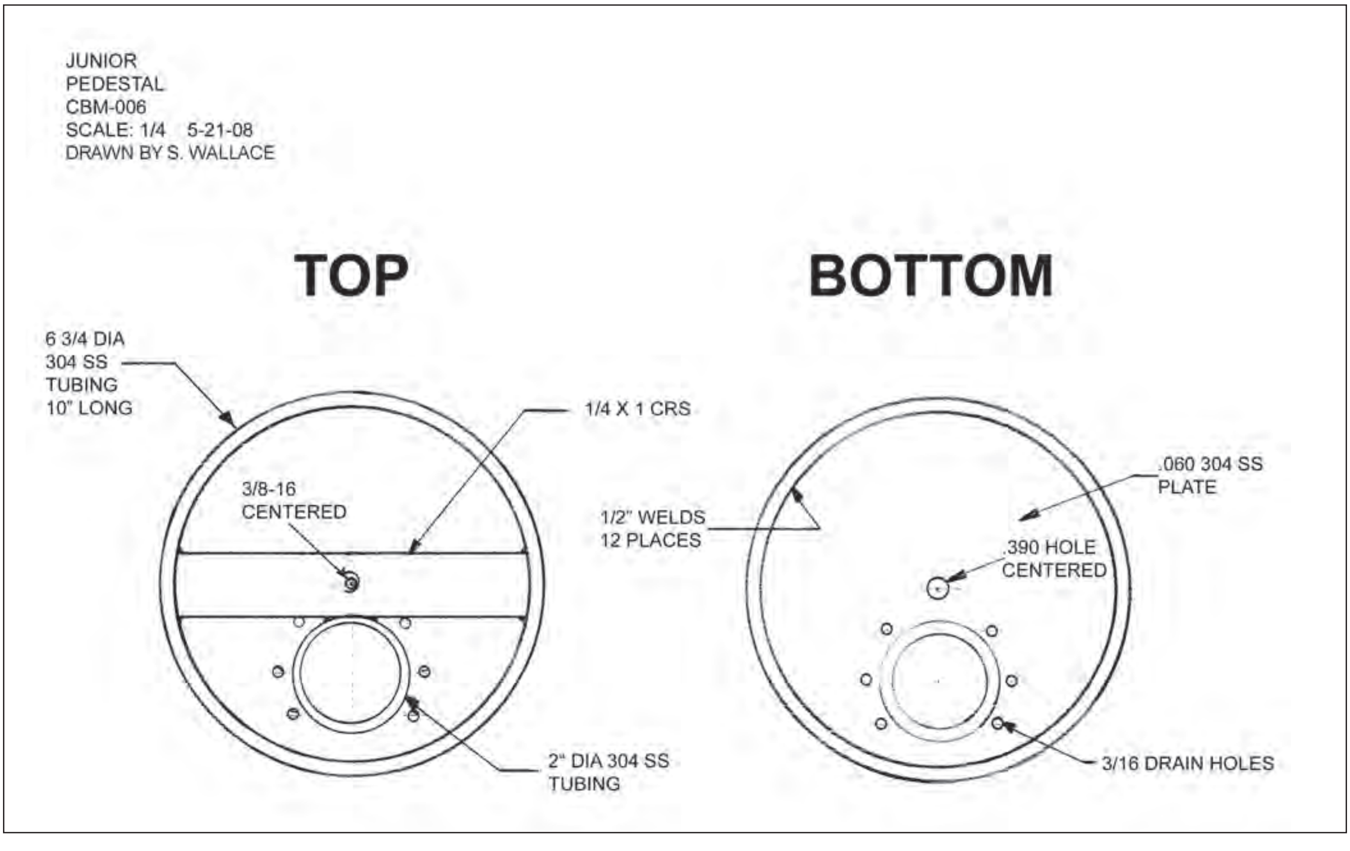
1/2 Red Oak Veneer Plywood
1 1/4
3 1/4
1 1/2
2 1/4
3 3/4
4
11 1/2
24
11 1/2
7 3/4
7
DRIP TRAY
DRAIN HOLE
(2 PLACES)
CORNER
BRACES
(2x4s)
10 1/2
20
6" DIA.
3/8 BOLT
HOLES
30
34
31 3/4
76
79
84
3/4
1 1/2


JUNIOR
PEDESTAL
CBM-006
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DRAWN BY S. WALLACE
TOP
BOTTOM
6 3/4 DIA
304 SS
TUBING
10" LONG
1/4 X 1 CRS
3/8-16
CENTERED
1/2" WELDS
12 PLACES
.060 304 SS
PLATE
.390 HOLE
CENTERED
2" DIA 304 SS
TUBING
3/16 DRAIN HOLES

Gas Manifolds

For redundancy, each draft tower has its own dedicated CO_2 tank and distribution manifold. Each of the keg's gas lines are controlled by a shutoff valve with backflow preventer. The two manifolds are bolted side by side to the interior of the bar base, and can be removed for storage and maintenance (see Photo 7). Four additional manifold ports are available for future tap expansion.

The Hopinator

It's no surprise that we hopheads crave hop flavor! A device called a Randall can be used to infuse fresh hop flavor into any beer. Most often, it is used when pouring IPAs and pale ales. Using a modified water filter housing, the canister is filled with fresh aroma hops (such as Simcoe or Cascades) and the homebrew is pushed by CO_2 pressure through a filter bed of hops immediately before the pour. (The idea for, and name of, the Randall originated with the Dogfish Head brewery.) Unfortunately, many Randalls exhibit foaming and flow issues that force their operators to continuously adjust the CO_2 pressure, hop quantity, and hose length before giving up and abandoning its use, or pouring the beer into a large pitcher for sampling once the foam dissipates. A redesign of this system was needed to overcome the obstacles. The Hopinator, as we call it, is the result of that redesign effort. Several design features were employed to improve overall function, ease of use and to reduce foaming.

The beer enters the canister through a custom-machined stainless steel tube. Tube holes are concentrated near the base to force the beer to filter through most of the hops. The Hopinator uses a 9-foot (~3-m) length of thick wall beer line. The beer hose is wrapped around the large diameter support shaft (as seen in photo 11). Extreme efforts were made to keep the beer line from making any abrupt turns, which might cause turbulence. I think it's a great design, but don't just take my word for it, it was one the winners in the 2008 *Popular Mechanics* DIY Rally Competition. The Hopinator can also be built as a stand-alone project. (See the December 2008 issue of *BYO* for instructions to build this project.)

System Setup
Portability And Storage

This entire system was designed to disassemble and fold to make it as portable as possible. The draft towers and stainless steel cylinder pedestals are attached using threaded rod and cross members. The bar top attaches to the base with bolts screwed into T-Nuts installed in the base. The sides of the bar base fold in on three heavy duty door hinges, and lock to the base with slide bolt locks (see Photo 8). A simple (wooden 2" x 4") upright cradle ensures the bar top and base are safely stored until needed (see Photo 9).

To recap, our serving platform (Junior) has a 7-foot (2.1-m) bar front and 11 taps. The taps are arranged into two "Irish coffin" towers, each with five taps, and a central tap run through a Randall, which we call the Hopinator. The kegs reside under the bar, contained in rolling carts that make them easy to swap out. The gas cylinders are housed in a cart that fits between the two keg carts. Each tower has it's own CO_2 cylinder. The whole bar dissembles easily and the base and bar top fold flat, so they take up relatively little space for transportation and storage. BYO

Tony Profera is a Charlotte, North Carolina-area homebrewer and a member of the Carolina Brewmasters homebrew club. He has written several articles for Brew Your Own.

BUILD A Draft Tower

by Forrest Whitesides

Getting a kegging system up and running at home is a worthwhile project for any homebrewer. However, assembling all the necessary components is rarely an inexpensive venture. If you decide to go with a mini-fridge or chest freezer as the base for your kegerator, one

1

major cost center is the draft tower, which is the fancy-looking chrome pipe to which the dispensing faucets are mounted. A tower with a single faucet costs an average of about $75–$100 for a new "economy" unit, and the price goes up from there for fancier hardware and multiple faucet options.

But don't let that deter you, because you can build your own draft tower from PVC for a fraction of the cost of a new metal tower. The prime directive for this project is to get your system up and running as inexpensively as possible; you can always upgrade the hardware at a later date as finances allow. And with PVC, it's trivial and cheap to add additional faucets, unlike with a traditional metal draft tower. You can even make your own per-faucet drip trays for less than $5 each.

Tower Pieces

The body of the draft tower is composed of a PVC pipe, a flange and a pipe cap (Photo 1). There are quite a few options for capping the draft tower (Photo 2). The default (and simplest) option is to cap the tower using a 3-inch (7.6 cm) rounded PVC pipe cap ("slip fit," which means it's not threaded and just slips on the pipe). There are other options, however, such as 3-inch (7.6 cm) flat-top slip-fit pipe caps, 3-inch female adapters (one side is slip fit and the other is female pipe thread) and 3-inch (7.6 cm) threaded flush-fitting drain plugs. And there are also similar drain plugs with the square nipple on top. You can also opt for a "test cap," which fits directly into the end of the pipe and

2

Build your own draft tower from PVC piping and save money. This project is easy to build and looks great.

3

4


5

sits perfectly flush. There are other options, but the above are more than adequate and all are relatively cheap (under $5).

Measure, Cut and Fit

Draft towers come in a range of heights and widths, with 12 inches (30 cm) from mounting flange to the top cap and about 3 inches (7.6 cm) around being typical. You can build your tower shorter or taller than this, depending on your specific situation.

Keep in mind that the flange will elevate the pipe between 1 and 2 inches (2.5 and 5.1 cm) above the kegerator, but will also require about 1 inch (2.5 cm) pipe insertion for a snug and sturdy fit.

So make sure you measure and mark the pipe height with one end fully inserted in the flange. Also, all but the "test cap" pipe fitting will add to the overall height.

Materials, Parts and Tools for the Tower:

- 3-inch (7.6 cm) diameter PVC pipe (commonly sold in 2-foot/61 cm lengths)
- 3-inch (7.6 cm) PVC end cap (slip fitting)
- U.S. standard floor-mount toilet flange (4-inch exterior/3-inch interior diameter) (10 cm/7.6 cm)
- Mounting bolts, washers, and nuts (¼-inch bolts are standard)
- PVC cement
- Paint (optional)
- Foam insulation (optional)

For the faucet:

- Short faucet shank (3 inches/7.6 cm or less), or a dedicated right-angle tower shank
- Dispensing faucet and tap handle
- Shank hookup hardware (depends on shank type)
- Beverage tubing.

Tools:

- Drill with ½-inch (1.3-cm) hole saw bit
- PVC pipe cutter tool (or a hack saw or hand saw)
- Angle grinder, RotoZip or hack saw with metal-cutting blade (for straight shanks)
- Hand file (optional)

Use hacksaw or PVC cutting tool to cut the pipe to length. If the cut isn't perfectly even and level, don't worry because both ends of the pipe will be hidden from view by the flange and the end cap (unless you opt for the test cap, in which case you will need to be a little more careful when cutting). You can also file down higher edges to make the cut more level, if desired.

Drill, Baby, Drill

With the three tower components fit together snugly, consider where you want the faucet to be mounted. If you plan to do multiple faucets, figure out how you want them arranged and experiment with the shanks to make sure everything will fit as you have imagined it. Many single-faucet towers have the mounting holes about 1 to 2 inches (2.5–5.1 cm) below the bottom of the cap.

Typically, with two or three faucets, the mounting holes are put at different heights to make sure there is not an internal space conflict with the shanks, fittings, and tubing. With most types of the smaller right-angle shanks, you have the option to fit two faucets side by side at the same height.

Mark the hole(s) center with a Sharpie or similar marker (Photo 3), and drill a pilot hole. A ⅛-inch bit is fine for this. The pilot hole gives the hole saw's guide bit something to grab onto. This is not necessary, but it only takes a few seconds, and helps to keep the guide bit from wandering when drilling starts. The hole saw will make a nice ½-inch (1.3 cm) hole that is a snug fit for straight shanks (Photo 4). If you intend to use the more compact right-angle shanks that are designed specifically for draft towers, check the diameter, as some of them require a larger hole.

Shank It Up

By far, it is much easier to go with a shank that was designed for a round draft tower. Just pop it through the hole and tighten the nut on the inside or follow the mounting instructions that come with it (Photo 5). But you can save about $15 if you go with a standard 3-inch (7.6-cm) shank designed for mounting on flat surfaces.

6

7

Make your own cheap drip tray

While you're at the store picking up the parts for your new draft tower, you might as well spend an extra $4 and get the parts for a nice drip tray. There are a few different ways you could go, but the easiest, cheapest, and best-looking option I've found is a combination of two parts: a 4" PVC flat-top drain cap (slip fit) and a 4" PVC drain grate. At my local big-box, both the cap and the drain grate were $1.75. Simply turn the cap upside down and set the grate into it. Done! It's a nice round drip tray that not only is easy to clean, it can also serve as a pint glass holder while pouring.

For bonus points, paint the drip tray for a nice finished look. I painted the cap black and the grate metallic silver (see the photo above). Make sure the paint is fully cured before using.

The 3-inch (7.6-cm) shank is a little too long to accommodate a tail piece, wing nut and tubing. So I cut mine down with my trusty RotoZip and a metal cutting wheel. You could also use an angle grinder, a Dremel with an EZ-Lock metal cutoff wheel or even a hack saw with the right blade. Be sure to wear safety goggles when cutting metal.

After cutting the shank to size, you may need to use a ½-inch washer as a spacer to allow the shank nut to tighten fully against the inside of the tower. If you go the cheaper route, save yourself a lot of time and frustration by using a tailpiece with a 90-degree hose barb. A straight tailpiece is going to make for a much tighter fit in an already cramped space. Whatever type of shank you use, do a full fitting to make sure everything is spaced properly before painting.

To Glue, Or Not To Glue

The top cap should not be glued to the tower. You will need to remove it to gain access to the shank to change tubing in the future, or perhaps you will want to add another faucet at some point. A properly seated cap will have a snug fit and will not come off during typical usage.

You may, however, want to glue the tower to the flange base. Depending on which brand or type of flange you end up with, the fit may not be tight enough without glue to hold it steady during use. If you decide to glue the tower to the flange, follow the instructions on the PVC cement can to ensure a nice strong joint. Cement the pieces together before you paint.

Paint It Black

Adding a little paint to the tower is optional, but is also a cheap and easy way to class it up a bit, or make it match your serving area better. The most obvious color that comes to mind is silver or some sort of metallic finish. However, I have found that most metallic paints that work with plastic do not look very realistic once applied. Of the brands that I tested, the one that looks the most realistic is Valspar's "Brilliant Metal" series (I tested 66010 Silver). Therefore, I chose to go with lightly-glossed black paint for the majority of the finish, instead. I used Rust-Oleum "Specialty Plastic" paint (211338 Black).

Clean all parts to be painted prior to spraying. You may or may not need to prime the PVC first (check the label on your paint). Two coats, at least, is a good idea (Photo 6). The paint may take some time to dry enough to be handled for reassembly. If the tower or any fittings feel tacky to the touch at all, give it some more time (sometimes a few days) to fully cure.

Now to reassemble. Refit your dispensing hardware first (Photo 7). Then connect the pipe, flange and cap. Your new draft tower is now ready to be secured to your kegerator. (The process for this will vary greatly depending on the kegerator type and size.) When you purchase your PVC flange, take it over to the nuts-and-bolts section of the store and size out some proper fastening hardware.

Forrest Whitesides is a frequent contributor to Brew Your Own *and a regular on the Final Gravity Podcast.*

JOCKEY Box

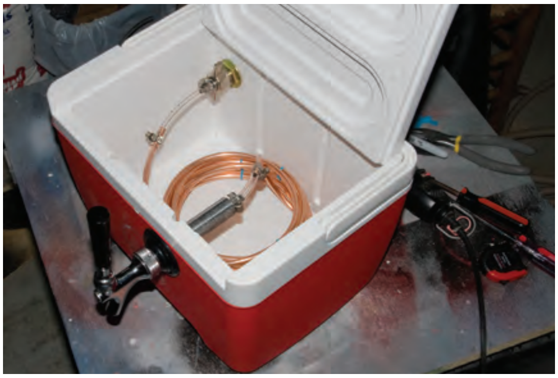
by Forrest Whitesides

You have your kegerator set up and running smoothly; your friends love to drop by and drink your homebrew on tap. But now you (and they) want to bring your finely crafted brew out and about to parties, picnics, and other social gatherings. You could build a portable kegerator (see *BYO*'s "Projects" in the May-June 2011 issue), but there is a cheaper and simpler alternative that also opens up the possibility of serving multiple kegs on the go: a jockey box.

A jockey box is a "just-in-time" beer chilling and dispensing rig made from an insulated cooler, a coil of metal tubing, and standard draft dispensing hardware. The jockey box is packed with ice (and a little water) to get the coil cold. Beer is pushed from the keg into the jockey box, which cools the beer as it travels through the chilled metal and is then dispensed through a standard draft faucet. This allows for cold draft beer to be served in any place where electric refrigeration is not possible.

Commercial jockey boxes are often made using a plate chiller to cool the incoming beer. These are very efficient chillers, and somewhat similar to the wort plate chillers used in commercial and homebrewing. As you might expect, these chillers are not cheap, and so our jockey box project will use more common metal tubing — stainless steel (although it can be built with copper as well), which is available at most hardware stores.

Copper is amazingly efficient at heat transfer (it has tremendously high thermal conductivity). It is great for any project related to chilling, such as immersion chillers, however copper can be the source of some negative consequences when it comes in contact with finished beer, which has a lower pH than wort. Copper has the potential to cause staling post-fermentation because it catalyzes staling reactions, including the production of hydrogen peroxide and can oxidize the alcohols to aldehydes. There is also potential for copper to lead to copper poisoning (nausea, vomiting) from too much exposure. If you don't want to worry about it, go with stainless steel — it's more expensive and harder to bend, but non-reactive.



Tools and Materials

Tools

- Drill with ⅞-inch hole saw
- Rotary tool (Dremel) or hack saw with metal cutting blade
- Adjustable wrench
- Flathead screwdriver

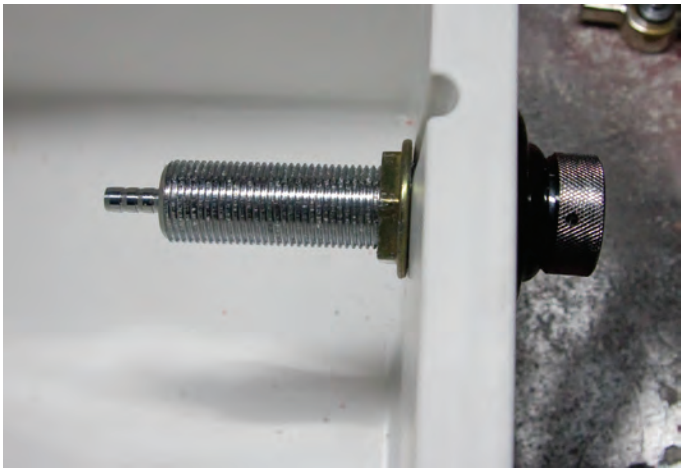
Parts

- Insulated cooler (the size will depend on how many taps you plan to add. For a single tap, the cooler can be very compact.)
- 2x Beer shanks — one for beer in to the box; one for beer out.
- 3x Shank nuts
- Wing nuts and tail pieces, as needed
- Dispensing faucet
- 20 feet of pre-bent stainless steel tubing: ¼-inch OD
- 1 foot (approximately) of vinyl tubing: ⅜-inch OD
- Hose clamps
- Teflon pipe tape

1. PLAN FOR DRILLING

I used a fairly small cooler (2.25 gallons/8.5 L), but there is enough space for two taps and coils, so I drilled the faucet hole (front of cooler) a little off center. This way, I can add a second faucet in the future and have both taps the same distance from the center and maintain a neat, symmetric look.

The position of the beer inlet hole (back side of the cooler) isn't all that critical, as you can easily bend the copper and vinyl tubing to accommodate the shank. However, for multiple inlets, spacing them far apart can be helpful in getting each coil to fit neatly.



2. DRILL AND TEST SHANK

Both the faucet hole and inlet hole should be ⅞-inch. Measure off your center points (measure twice!) and drill out the holes.

I used a faucet shank that has a hose barb attached. I just happened to have it handy for this project, but any type of beer shank will work, provided that it is long enough to extend enough threading through the wall to accommodate a shank nut, wing nut and tailpiece.

3. MODIFY THE SHANK

I decided to spec my jockey box with standard beer shanks for both the inlet side and faucet side. I have seen many similar projects that make use of brass compression fittings for the inlet hardware, but I wanted to keep everything compatible with standard kegging equipment. However, this requires that one of the shanks be modified to make it into what amounts to a long pipe nipple. It's also possible to use brass compression fittings instead, but I find the shank to be far easier to work with in the long run and more solid. It takes three or four separate brass fittings to make the connection through the thick wall of the cooler, and the total cost is about the same as a beer shank and wingnuts anyway. Plus, with the shank you can cut it down to fit precisely the thickness of your cooler.

4. CUT TO FIT, INSTALL

Start by cutting off the non-threaded portion of the shank (the end where the faucet screws in to the collar). Now fit the cut shank through the inlet hole, screw a shank nut (the flat hex nut that comes with the shank) on the inside of the cooler, and then screw on a wing nut with the tailpiece attached. Push the shank towards the inner wall until the shank nut is flush with the cooler wall. Now screw another shank nut onto the shank on the outside of the cooler until it is flush with the outside wall. A wing nut uses about ⅜-inch of the threads, so mark the shank approximately ½-inch out from the edge of the nut.

Remove the nuts from both ends of the shank and cut it off where you made the mark. A rotary tool or hacksaw will work fine. Be sure to wear safety goggles when cutting metal, especially if using a power tool. Reassemble the inlet hardware to make sure everything fits.

5. CHOOSE YOUR COIL

As I mentioned earlier, and as you can see in the photo above, you can build your jockey box with either copper tubing or stainless steel. Copper works, and you can bend it yourself, but I recommend going with a pre-bent stainless steel coil. Not only will you not have to worry about the metal reacting with the beer, but you also won't have to go to the trouble of bending the tubing — which requires purchasing or borrowing a stainless steel bending tool. Many homebrew suppliers sell stainless steel coils in various lengths, such as this one pictured here from MoreBeer! (which runs about $80). Be sure you know the dimensions of the cooler before you purchase a coil, however, so that it will fit inside the cooler when you assemble the finished project. You may need to have a coil cut down to size.

Photo courtesy of MoreBeer!

6. FINAL CONNECTION

With the faucet and inlet shanks cut, fit, and secured, all that remains is to connect the coil to the shanks. Cut two short lengths of vinyl tubing and slide them onto the hose barbs on the shank tailpieces. Onto the inlet side vinyl tubing, slide two hose clamps and then insert one end of the copper coil into the vinyl tubing; tighten one clamp on the hose barb and the other where the vinyl overlaps the copper tubing. Repeat the same procedure for the faucet side hardware. Now secure the faucet to the front shank and connect the vinyl tubing from a keg to the outside inlet tailpiece. Next, test the box for leaks. Once leak testing is complete, load the box with ice and a little water. Hook up a keg of homebrew and experiment with gas pressure and hookup tubing length to get it dialed in for a smooth pour. BYO

Forrest Whitesides is a frequent contributor to BYO.

KEG & CARBOY Cleaner

by Bill-John Neidrich

here's a project that was inspired by Doc at The Brewing Network (check it out at www.thebrewingnetwork.com) — a setup using a submersible pump to recirculate cleaning solution through an overturned keg or carboy. A main spray head cleans the body of the vessel and auxiliary lines feed cleaning solution through the gas in and beverage out dip tubes.

As with any project, the equipment and materials you use can be swapped out based on availability, your preference or your budget. With that being said, the parts and equipment list below is what I used from bottom to top. I built this project using imperial copper pipe fittings. If you are interested in building this project in a country where metric pipe fittings are the norm, you will need to modify the parts list and build accordingly. Stainless steel tube and Swagelok-type fittings will resist erosion from strong alkaline and acidic cleaners, so using stainless is another good alternative to copper. Plus, if you use Swagelok you don't have to do any welding or soldering. Also, you can use PVC pipe if you don't want to solder.

This pumped up bucket project cleans and sanitizes carboys and kegs with ease.

parts and equipment list

- A large saucer
- A 5-gallon (19-L) bucket with lid
- A pump. The pump is really the heart of this beast. I used a ⅙ HP WaterAce R6S Utility Pump with a max flow of 25 GPM. I then wandered around with the pump in hand at the hardware store for what seemed like hours to find the right fittings to adapt it down to the ½" copper pipe.
- I used a monster copper female threaded fitting x 1" sweat
- One copper 1" to ¾" reducer bushing
- One short section of copper ¾" pipe
- One copper ¾" x ½ x ½ tee
- One copper ½" sweat to ½" mpt
- One brass ½" fpt ball valve
- One brass ½" mpt close nipple
- One brass ½" fpt tee
- Two nylon ½" mpt x ⅜" barb fittings
- Two sections of ⅜" vinyl tubing each 16" long
- Four small hose clamps
- Two 5⁄16" barb x ¼" flare swivel nuts
- One gas in keg quick disconnect (QD)
- One beverage out keg QD
- Some ½" copper pipe
- One bulbus copper "water hammer air chamber" for the spray wand

Note: You don't need to have the quick disconnects (QD) dedicated to this cleaner but an extra set is useful so you don't need to remove them from your draft system just to clean a keg.

Since the initial build four years ago, I've added a heat stick so I can heat the cleaning solution right in the pump bucket and I've added a rotating spray head to perform a more thorough cleaning job.

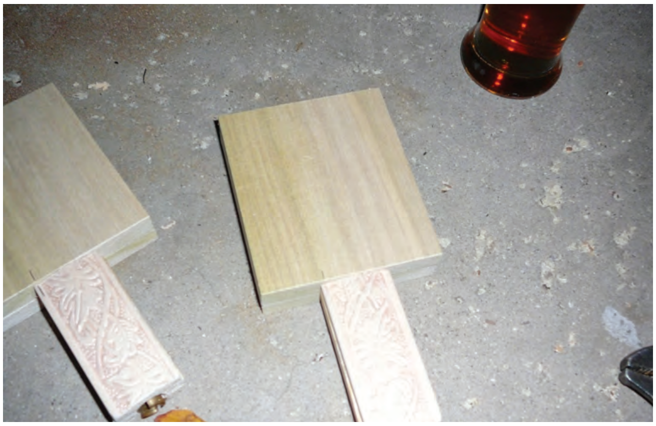
Important: Water and electricity can cause serious electrical shock. The pump should be plugged into an outlet with GFI protection.

1. THE BUILD

You'll want to dry fit everything together before any parts are soldered so you're sure to get the correct heights and lengths. You'll also want to find the location of any screwed in fittings when they are tight. Take your main threaded fitting and screw it into the pump. Then mark the direction that the ball valve needs to go. This mark will be used to align the fittings when they are soldered. Also make sure you design your cleaner so the ball valve is a few inches below the rim of the bucket.

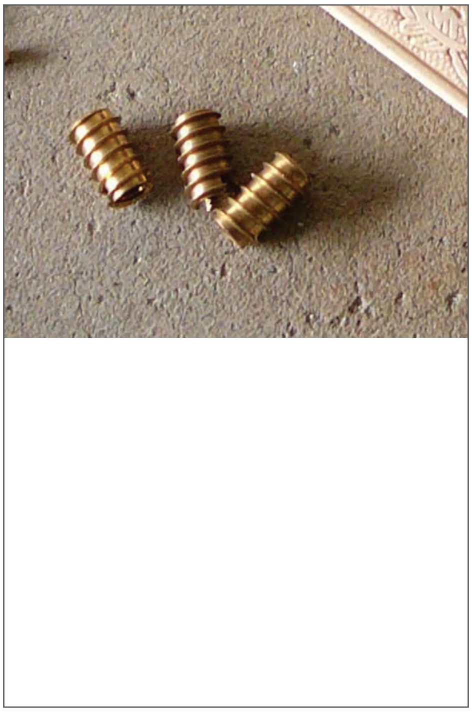
2. THE BALL VALVE

Solder your parts up again making sure that your ball valve will be pointing in the correct direction when the unit is connected to the pump. Do not solder the pipe going up to the main spray head you will want to leave it free so you can add different length pipes for your various cleaning applications.



3. PUT IT TOGETHER

Assemble all of the pieces that get attached to the pump. Thread on the ball valve, the nipple, the tee, and the hose barbs. Press one end of each section of tubing over the nylon hose barbs and clamp them in place with two hose clamps. Press the two $\frac{5}{16}$" barb by $\frac{1}{4}$" flare fittings into the open ends of the tubing and then clamp them in place with the two remaining hose clamps.



4. MODIFY THE BUCKET

You will need to modify your bucket lid by cutting a hole for the keg opening and the QDs. My cutout is an odd shape to accommodate both ball and pin lock kegs. You'll also need to cut a slot in the edge for the cord. I had to drill holes around the edge of the lid to allow liquid trapped in cavities to drain back into the bucket.

To support the weight of a carboy on top, I used a hole saw to cut a large hole capable of fitting the carboy's neck in a scrap piece of 2 x 6 (see Figure 6). It adequately held the carboy but was awfully unstable so I used a jig saw to create a chamfer around the hole. This improved carboy stability tremendously. I have also seen people use milk crates and the like to hold the carboy.

5. MEASURE THE RISERS

You will want to solder the union on to the water hammer bulb. Once that's done you can start measuring out the lengths of copper pipe (risers) you need to get the spray head 4 to 6 inches (10 to 15 cm) from the top of your vessels. I use a shorter riser while cleaning carboys and a longer one when cleaning kegs. I put a slight bend in my risers in order to center the pipe in my bucket. Using a pair of pliers slightly deform each end of the riser so that it fits snugly into the fittings on the pump and the spray bulb. This will prevent the riser or bulb from separating due to water pressure. Using a 3/32" drill bit, drill as many holes as you can into the top of your spray head. You may need a number of bits, and use a vice or drill press if you can. Don't hold it while you're drilling. You may want to add dimples to the bulb with a punch prior to drilling to help keep the bit from wandering. To specifically target that stubborn kräusen line in your carboys, you can add a few holes along the sides of the bulb or your riser.

6. USING THE CLEANER

To clean carboys I shut the ball valve, place the wooden cradle over the spray head, and then slide the carboy over the spray bulb. When cleaning kegs I install the QDs on the lines, open the ball valve half way, and put the lid on the bucket. Then I place the keg over the spray bulb and connect the QDs. The keg rests right on the bucket lid (I may end up needing to reinforce the lid with something as I have cracked it). Everything should be good to go. I highly recommend using Powdered Brewery Wash (PBW), it foams far less than OxiClean and does not foam at all when heated over 100 °F (38 °C). If it's needed, foam control can also be used to prevent a foamy mess. Solution for cleaning carboys should not be heated over 100 °F (38 °C) to prevent the thermal shock from cracking the glass. Kegs can be cleaned with 150 °F (66 °C) solution, which will clean more effectively. BYO

Bill-John Neidrich is a Process Engineer by profession and a professed brew gadget freak. He is a member of the Ithaca Practitioners of Alemaking (I.P.A.) homebrew club in Ithaca, New York. More of Bill-John's projects can be seen at www.flickr.com/photos/billjohnn.

MAKE A Counter-Pressure Bottler

by Reg Pope

For most homebrewers who brew long enough, kegging eventually becomes part of their process. The primary advantage of kegging is that only one packaging vessel needs to be cleaned and sanitized as opposed to dozens. However, in addition to that, there is a certain convenience factor. Kegs are perfect for the moderate term storage needs of the homebrewer, as well as home bar dispensing and picnic applications. Still, there are some occasions — such as contests or homebrew club meetings — for which we might wish to have bottled homebrew. The counter-pressure filler is a device that allows brewers to transfer conditioned beer from a keg to a bottle. This transfer occurs under pressure, which minimizes the loss of carbonation that would occur by simply running beer from a tap into a bottle or growler.

My counter-pressure filler was assembled with parts costing a total of $28 obtained from a neighborhood plumbing supply store and assembled in less than an hour.

The long central tube delivers CO_2 to the receiving bottle. This purges the air from the bottle and allows for its pressurization. It also delivers the carbonated beer. This is accomplished by opening and closing the valves in the proper sequence, and by using a venting assembly, which is a sort of sleeve that fits over the central tube and is fitted with a stopper that seals the bottle so it retains the 4–6 PSI of pressure used during bottling.

Assembly begins with the upper part of the unit. All threads are coated with teflon tape. The two ball valves are connected to the sides of one of the tees using the brass nipples. (See Photo 1.)

The ¼" threaded to ¼" compression fitting is connected to the bottom of the tee and the length of ¼" copper tubing is connected to that. (This is shown in Photo 2.)

The venting sleeve is constructed by attaching the ¼" threaded to ⅜" compression fitting to one side of the remaining tee. The ⅜" tubing is connected to that and cut. It doesn't need to be any longer than a couple of inches. Tape the threads of the bushing and insert it in the center of the tee. Again, treat the threads of the needle valve and screw it into the bushing (as is shown in Photo 3).

Photo 4 shows the assembly before the needle valve is attached to the tee.

The remaining ¼" threaded to ¼" compression fitting attaches to the other end of the tee. Before doing so, however, it must be reamed out. This fitting is designed to affix to the end of a length of tubing and there is a small lip of material inside the fitting that butts up against the end of that tubing. This lip must be removed using the drill to allow the fitting to "float" over the ¼" tubing.

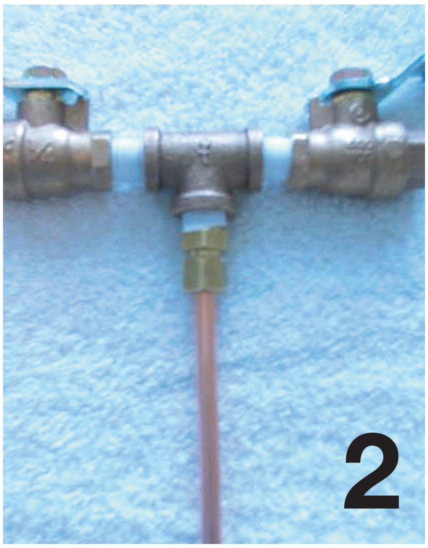
Once assembled, the venting sleeve slips over the ¼" tubing of the main body and is

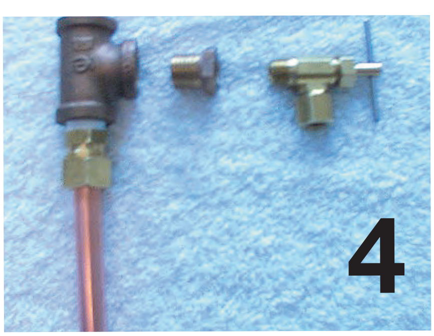
Tools and Materials

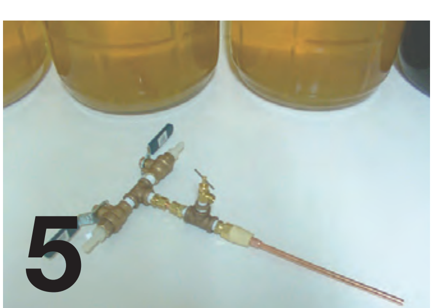
Tools list:
Wrenches/pliers
Tubing cutter
Drill with ¼" bit
Teflon tape

Total cost as shown: $28 (US)

Parts list:
¼" bronze tees (2)
¼" brass ball valves (2)
¼" OD copper x ⅛" MIP angle needle valve (1)
¼" brass nipples (2)
¼" X 1/8" brass bushing (1)
¼" threaded – ¼" compression fitting (2)
¼" threaded – ⅜" compression fitting (1)
¼" copper tubing (16 inches)
⅜" copper tubing (6 inches)
¼" barbed fittings (2)
Rubber stopper (1) sized to fit bottle or growler







> "It takes some practice to coordinate the steps and keep the pressures in all of the vessels . . ."

secured with the ¼" threaded to ¼" compression fitting.

The ¼" tubing extends out and through the ⅜" tubing and is cut to the appropriate length to reach within an inch (2.5 cm) of the bottom of the bottle being filled. The stopper is placed on the ⅜" tubing, moved as far up (toward the compression fitting) as it will go, and cut to a length just below the bottom of the stopper. If it's too long, it will suck beer out of the bottle during venting.

Add ¼" barbed fittings for the "beer in" and "gas in" lines, tighten all fittings, and assembly is complete.

Theory and use of the filler is described in detail on page 31 of this special issue but the basic process is as follows:

Once the unit is sanitized, close all of the valves. Connect poly tubing lines to the barbed fittings on the filler from your CO_2 bottle and keg of conditioned beer. Place the filler on the clean bottle with the stopper snugly in the neck. Open the needle (bleeder) valve, then open the "gas in" valve. Allow CO_2 to flow into the bottle and out the bleeder for a few seconds to purge the air from the bottle. Close the bleeder valve and allow the bottle to equilibrate to dispensing pressure (4–6 PSI). Close the "gas in" valve. Open the "beer in" valve. If everything was done correctly up to this point, nothing will happen.

Slowly open the bleeder valve. The idea is to release just enough pressure from the bottle to allow the pressure in the keg to move beer into it, but not enough to allow a sudden degassing of the beer. Control the pressure release carefully by opening the valve only as much as necessary and by closing it periodically as required. When the bottle is filled, close the valves, gently break the seal of the stopper, remove the filler, and cap the bottle.

Ideally, when you remove the bottler, the beer will start to foam and flow out of the bottle. If you quickly cap over this foam, you will minimize the amount of oxygen your beer is exposed to. Cap each bottle as you go; do not fill a row of bottles, then cap.

It takes some practice to coordinate the steps and keep the pressures in all of the vessels where they need to be to facilitate the process, and even with such practice there will still be a little carbonation loss. It will be far less however than it would be if the filler had not been used. Ensuring that the beer (and the bottles) are well chilled will help as well. This unit is designed as an economical alternative to the common (but more pricey) stainless steel versions. Although stainless is preferable, this setup is adequate for infrequent use and, in the author's tests, did not contribute to any significant degradation of beer quality during short exposure times. BYO

1. The ball valves, which control the flow of carbon dioxide and beer into the unit, are connected to a tee.

2. The central tube is connected via a compression fitting to the tee.

3. The venting sleeve and needle valve are attached to their tee.

4. The needle valve prior to attachment to the tee (note the bushing).

5. The finished counter-pressure bottling unit.

Reg Pope of Nampa, Idaho, is a homebrewer and former food scientist.

BUILD YOUR OWN
Spunding Valve

by Marc Martin

having brewed on some large scale and pilot systems in breweries around the Portland, Oregon area, I have been able to pick up some tricks that can be readily adapted to homebrewing. One of these techniques is the capping of a bright tank for the retention of carbon dioxide (CO_2) produced late in fermentation. This produces naturally carbonated beer. For homebrewers, the most logical vessel for a sealed secondary fermenter is the Cornelius keg. The challenge becomes how to retain enough carbon dioxide pressure to provide for the right level of natural carbonation, but to vent any excess pressure.

Nine years ago, I sought to solve this problem. The best way I found was to build a version of the valve and gauge system, called a spunding valve, that is used in large commercial systems. An adjustable pressure relief valve and a 0–30 PSI gauge are the main two things needed. To connect these to the inlet side of a Corny keg, I used a brass Y adapter (one MPT "in" side and two FTP "out" sides), a standard ball lock fitting and a brass coupler (FTP on both ends) to connect the ball lock fitting to the Y adapter. All threads use plumbers pipe fitting tape to prevent leakage.

To create your own naturally carbonated homebrew, simply transfer your beer into a sanitized Corny keg when your beer is 2–5 points above your estimated terminal gravity. For example, if your yeast is 80% attenuative and your starting gravity was 1.050, your target final gravity is 1.010. Thus, you should transfer your beer when a reading of about 1.015 is achieved. Place your pressure relief valve and gauge on the inlet tube side of your keg and keep the keg at normal fermentation temperatures. Check it daily and watch the pressure in the keg build.

To calibrate the adjustable pressure relief valve, you only need to monitor the pressure gauge. When it slightly exceeds your desired carbonation pressure (I generally shoot for 14 PSI) turn the top adjuster counter clockwise until pressure just starts to bleed

Parts List:

- Brass Y adapter and brass coupler
- Pressure relief valve (the one I used is mad by the Schrader Bellows Co. in Akron, Ohio.)
  The part number is RV01A1N030
- 0–30 PSI gauge

off. Watch the gauge and when 14 PSI is indicated turn the adjuster back in (clockwise) until the pressure stops escaping.

After 4 or 5 days, turn the relief valve adjuster back in (clockwise) ½ turn and monitor the gauge for another day. If the pressure does not increase, you know that all secondary fermentation has ceased and the proper carbonation level has been retained.

It may be a good idea to let the beer sit a few days before chilling, especially if the yeast strain you used is prone to leaving residual diacetyl.

An added bonus is that you need not transfer your beer again. It is well

> With a spunding valve, you can retain the carbon dioxide of late fermentation to naturally carbonate your homebrew.

carbonated and ready to chill. Your secondary fermenter also doubles as your serving tank. Cheers! BYO

Marc Martin is Brew Your Own *magazine's Replicator.*

SIMPLE Tap Cleaner

by Forrest Whitesides

Tap lines are pressurized to keep out the air, which prevents the keg from losing carbonation or spoiling the beer in the keg. However, each time you disconnect an empty keg and replace it with a fresh one, a small amount of beer or beer residue can get trapped in the line from the old keg. This residue can sit in the lines and cause a buildup of bacteria, yeast and mold, which can negatively impact the flavor of the beer.

This easy-to-build draft line cleaner project will clean your beverage lines quickly and cheaply.

This tap cleaner is not only inexpensive to build, it's incredibly simple to use, doesn't require your kegs or CO_2 to work — and cleans your lines and fixtures in no time. It will provide tremendous utility in the form of saving time, minimizing losses to infection, and helping to avoid sour- or funky-tasting beverage lines. There's nothing worse, perhaps, than great beer served through dirty lines — especially a great beer that you brewed yourself, and the simple tap cleaner project presented here will keep your lines and faucets clean and funk-free.

Parts and Equipment List

As with any DIY project I embark on, the prime directives are "effective" and "low cost." This one, in particular, meets both directives. Here's what you'll need to put together a simple, effective tap/line cleaner:

Parts and tools

- Brass fitting: ⅜" male pipe thread to ¼" hose barb (Watts A-193)
- Beverage tubing: approximately 3 feet of ¼" ID
- Gasket: a single gasket from a fliptop Grolsch-style bottle; or you can cut your own from a sheet of gasket rubber
- Two small hose clamps
- One 1- or 2-liter plastic soda bottle with cap (I recommend having a few extra caps on hand in case you mis-drill)
- If your shanks require a beer nut to connect tubing, you'll need that as well.

Tools:

- Hand drill with ¼" twist bit
- Round hand file

1. ASSEMBLE THE PARTS

For quick cleaning during a keg change-out, you may simply want to use the beverage tubing already connected between your liquid-out disconnect and the tap. During a more extensive cleaning job, you may wish to use a dedicated section of tubing just for the tap cleaner bottle and soak your beverage lines in a separate container.

2. PUTTING IT TOGETHER

The process to put the tap cleaner together is very straightforward. The only tricky part is getting the drilling just right. It is important to get the hole as close to the center of the bottle cap as possible; otherwise, the brass fitting may not fit properly and the hole in the cap will not line up with the hole in the gasket.

Drill a ¼" hole in the center of the bottle cap. The hose barb end of the fitting will not quite clear the ¼" hole, so you'll need to slightly widen the hole with a round file. Widen the hole in small increments, and check for a snug fit each time you widen. You could also scrape out the hole with a utility knife or another sharp implement, but a round file makes for quick work in this case. If you don't have a round file on hand, I highly recommend picking one up for your toolbox, as they come in handy quite a bit more often than you might think.

3. ADD THE GASKET

Remove any plastic burs that were extruded during the drilling and filing process, and then lay the Grolsch gasket flat in the bottle cap (see photo). If the hole in the gasket doesn't line up with the hole in the cap, you may need to start fresh with an undrilled cap and the get the hole closer to the center.

4. MAKE IT LEAK FREE

Now push the hose barb end of the brass fitting through the holes in the gasket and bottle cap (see photo). It should be a very tight fit, otherwise you may run into trouble keeping a seal when the bottle is full of cleaning solution. I have built three of these tap cleaners for testing before writing this article, and all three kept a tight, leak-free seal without the use of any kind of sealant. However, you can use 100% silicone caulk as a sealant if you wish. Apply it between the bottle cap and the gasket and also where the brass fitting presses against the gasket. If you are unsure which caulk to choose, you can pick up some "aquarium sealant" at your local pet store, as it is 100% silicone.

5. ADD THE HOSE CLAMP

Slip the beverage tubing over the exposed hose barb. This will be a tight fit, and you may need to heat the tubing under running hot water in order to soften it up enough to facilitate the barb. Slip on a hose clamp and tighten it. Now screw the completed cap assembly into the bottle to check that the fitting clears the screw threads on the bottle. Give the setup a test run with plain water at the sink to be sure your fittings are all tight. If not, go back and troubleshoot where you see leaks. You may need to start again with a new bottle if the fittings seem loose. If there are no leaks, you are now ready to clean those taps!

6. CLEANING YOUR TAPS

Fill the bottle with your cleaning solution of choice. I use Beer Line Cleaner (BLC) or Powdered Brewery Wash (PBW), followed by a flush with clean, warm water, and finished off with a mild StarSan solution. Attach the tap cleaner's tubing to a faucet shank, and then hold the bottle above the level of the shank. Open the tap to allow the flow to start from the bottle. You will find that because there is no vent on the tap cleaner, you will have to squeeze the bottle periodically to keep the flow moving. If you are using quick disconnects, they will need to be removed or opened to allow the solution to flow. Sanke couplers can be locked into the "open" position. Dispense ¼ of the bottle and then close the tap to let the solution sit in the lines and the faucet for a few minutes, then continue dispensing the cleaning solution.

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BUILD A
Tap Handle

by Ken Lenard

I have to admit that I'm not very handy. So it is with great irony that I find myself writing an article about how to build something. But even though I may not be handy, I like to come up with catchy names for my beers and create labels. I don't really bottle much anymore, so I had a dilemma — where am I going to put a label? On a tap handle of course!

The design for these handles came to me just from browsing around my local hardware store. I knew that I wanted to make some handles, but I wasn't sure exactly what I would need until I got there. I had this particular design in mind because I wanted to showcase my labels, which are rectangular. If you have a different shaped label, choose your materials accordingly. I've seen homebrewers use all kinds of things for tap handles. Last year my son's baseball team won a tournament. The kids and coaches both got trophies so there were two in our house. The trophy featured

These easy-to-make handles will give your labels the attention they deserve.

parts and equipment list

(TO MAKE EIGHT 7-INCH/18 CM-TALL TAP HANDLES)

- 48 or more inches (122 cm) of 3.5-inch wide, 0.5-inch thick decorative wood trim
- 24 or more inches (61 cm) of 0.5-inch (1.25 cm) thick plain trim
- 64 inches (163 cm) of 3.5-inch (9 cm) wide, 0.5-inch thick plain wooden planks (for beer label mounting)
- 8 ⅜-inch-16 faucet adapters
- 8 small drawer pulls (0.5-inch/ 1.25 cm across)
- Wooden dowels
- Wood glue
- Liquid Nails adhesive
- Mitre box
- Saw
- Drill with 15/64-inch drill bit
- Vice
- Metal snips
- Measuring tape
- Pencil
- Spray mount glue
- Spray paint

a nice, 7-inch (18 cm) wooden baseball bat. My son's trophy was proudly displayed on a shelf in our basement, but mine got taken apart and used as a tap handle. Nothing like a Home Run Red Ale, baby!

The result for these handles came out better than I originally envisioned. They are very sturdy due to a wooden dowel inside the handle (as well as some sturdy glue) and they do not flex at all when I pull on a tap to pour a beer. Now, whenever someone comes down to my basement bar, they'll know exactly what's on tap!

1. CHOOSE YOUR MATERIALS As I mentioned, before I started this project I took a trip to my local mega-hardware store for inspiration. As I stood in the "decorative trim piece" section, it occurred to me that I needed to make a "stem" piece that would accept the faucet adapter and then I would create a separate, larger piece (the "face") which would display the label. I thought it would be nice to fashion the whole thing out of a single piece of wood, but this requires skills and tools that I do not possess. I had heard of people using staircase spindles, which I considered. But they are pricey and when the handle was finished, it would look like a staircase spindle. I found some pieces of trim that had a leafy design on them. I immediately concluded that the manufacturer had a hop vine in mind when they made them. You can use any type of decorative design you would like, of course.

2. PLAN THE DESIGN The shape of the trim allowed me to place the pieces back to back to create a thick stem. The leafy pattern would show on both sides so that I could put a different label on each side of the handle so each handle I made could be used for two different beers. Just the two pieces of decorative trim together wasn't thick enough to accept the drilled hole for the faucet adapter, so I found another flat trim piece that I could sandwich between the leafy trim pieces to make the whole stem thicker. Next, I found some plain poplar planks that were 3 ½ inches (8.9 cm) wide, ½ inch (1.3 cm) thick and 4 feet (1.2 m) long. I cut these pieces in to 4-inch (10-cm) tall pieces to create the "face" of the handle. I envisioned the tap handle with the bottom of the stem drilled out to accept the faucet adapter, the top of the stem drilled out to accept a wooden dowel and the bottom of the face drilled out to accept the other end of the dowel.

3. FIND THE HARDWARE As I walked through the store, I found the kitchen hardware section and looked at the various drawer pulls. I was envisioning using them as a sort of finial that could be fastened to the top of the handle. The hardware came in a dizzying array of shapes and colors and I picked a few that looked good, so choose whatever you find appealing. I also found the faucet adapters in this department. The threads on the adapters are very coarse and there is usually a slot on one end so you can use a screwdriver to drive the adapter into the handle. The faucet adapters are readily available at many hardware stores and many homebrewers have screwed them into sawed-off table legs, antlers, lava rock and so on to serve as impromptu tap handles.

4. MAKE YOUR CUTS On the day I started on the handles, I got everything ready and set up a work area in the garage. I don't have a lot of room above my faucets (there is a TV there), so I knew I wanted the entire handle to be about 7 inches (18 cm) tall. Since the poplar planks I bought were 3 ½ inches (9 cm) wide, I printed out one my labels so it would be about 3¼ inches (9 cm) wide. If you want a larger label, be sure to get wider planks for the handle faces. Lay the label down on the plank and make a line with a pencil where the plank should be cut. The piece should be about 4 inches (10 cm) from top to bottom. Since the wood (I used poplar) is only ½-inch (1.3-cm) thick and the stem was thicker, I cut two pieces of poplar and placed them back-to-back and glued them together. You can also use 1-inch-thick pieces. Next, cut the trim pieces into 3-inch (7.6-cm) lengths. Place the pieces with the leaf pattern facing out and place a flat trim piece (which was the same width) between them and glue them together.

5. DRILL IT When the glue is dry, drill a hole in the bottom of one of the poplar pieces. The hole is drilled to accept the wooden dowel so it is important to make the hole as straight as possible. When I built my taps, this is the step where some skill would have been handy. I placed the poplar face into a vice and carefully drilled the hole and then another one in the top of one of the stems. I fitted the dowel in place and assembled the two pieces. My cuts were square and the holes for the dowel were straight. Then I placed the stem into my vice so I could drill out the 15⁄64" hole for the faucet adapter. I did this with the trim piece in a vice and a corded drill. I drilled the hole and grabbed one of the adapters. I placed it into the hole and started to turn it. It went in crooked. I took it out and started again. It was a little better but my three glued-together trim pieces were starting to break apart. I drilled the hole out a little wider and tried again. Success! Have a slightly larger drill bit on hand in case this happens to you.

6. FINISHING TOUCHES I took the handle down to my faucets and tried it out. It wobbled a little so I readjusted the adapter until the handle spun like a top. Then I placed some glue into that hole to keep the adapter where I wanted it. Once you have it working as you would like, take the dowel out, place some glue into both holes and replace the dowel. Put the entire handle together, straighten it and lay it to the side to dry.

The final step is drilling a hole in the top of one of the handles for the "finial." Choose a drill bit that fits the size of the drawerpulls you choose. Once the hole is drilled, cut the head off the screw with a pair of snips and then place the cut end of the screw into the centered hole. Then screw the finial onto the top.

Finally, I primed all of the handles and then painted them in various colors. When the paint was dry, I glued the finial screws into the holes and attached the hardware. BYO

Ken Lenard is a homebrewer from the Chicago area.

COMMON KEGGING QUESTIONS ANSWERED

by Ashton Lewis

Homebrewers never have a shortage of questions about brewing or kegging beer. So in this section, we'll tackle common questions homebrewers have asked *Brew Your Own* over the years related to kegging in our popular "Mr. Wizard" column. The questions and answers should help you through many troubleshooting scenarios you'll face as you keg your homebrew.

FRESH FLAVOR AND OFF FLAVORS

How long will my beer stay fresh in the keg?

The topic of beer shelf-life and freshness after packaging does not have any hard and fast rules because beers differ in their ability to stay "fresh" after packaging. In general, beer flavor changes much more slowly over time when stored cold. "Freshness" is affected by numerous variables, but the key factors for unfiltered beers are microbiological contamination, oxidation and yeast autolysis.

Microbiological spoilage is a concern of all brewers regardless of size. Off-flavors associated with wild yeast and wort bacteria manifest themselves very rapidly and are usually detectable within a week after wort production. These beers are frequently surrendered to the porcelain god and never make it to the bottle or keg stage of their lives. Other contaminants, such as lactic acid bacteria (*Lactobacillus* and *Pediococcus* species), grow much slower and can take weeks or months to rear their ugly heads. When they have grown enough to be detected, the contaminated beer may taste sour and have a very noticeable diacetyl aroma. Clean yeast, short fermentation lag times and excellent sanitation practices greatly reduce the risk of having beer contaminated with these sorts of organisms.

Many commercial breweries add an additional level of security and either sterile-filter their beer to remove bacteria that may be present or pasteurize the beer prior to or after packaging to kill any bugs that may be lurking around. Pasteurizing in the bottle or can is the most effective method of protecting beer from microbiological spoilage and about 85% of the bottled or canned beer volume sold in the United States is pasteurized in the package. Some brewers pasteurize the beer prior to packaging, using similar technology to a milk pasteurizer, but the beer can be re-contaminated during packaging (like sterile filtered beer), making this technology more challenging to use. Homebrewers and most craft brewers do not use pasteurization or sterile filtration because these methods can be expensive and can alter beer flavor when used improperly.

While microbiological contaminants radically alter beer flavor, oxidation makes beer taste stale or old. Oxidation causes beer to lose that "brewery-fresh" flavor that is the hallmark of all exceptional beers. Oxidation has been the focus of brewery research for decades and is a very well-understood topic. Brewers today address oxidation beginning at the milling stage and stay focused on the issue during all stages of beer production. However, there is no step of the brewing process more sensitive to oxidation than packaging because beer is transferred into a bottle or keg full of air (modern commercial fillers address this problem, and homebrewers have a few options in this regard).

Any foaming or splashing during filling causes air pick-up and the headspace of gas in the package is another source of air. This headspace does not get displaced by carbon dioxide and is much different than the headspace of a secondary fermenter in this respect. Instead, the oxygen slowly works its way into the beer, reacts with assorted compounds and causes oxidation. Certain metal ions, like iron and copper, can do the same thing. This explains why stainless steel is the metal of choice.

Finally there is yeast autolysis. Bottle-conditioned beers certainly have their benefits. Yeast are able to absorb some oxygen and help to reduce oxygen levels. Bottle-conditioned beers typically have a creamy, tight foam and the method is traditional with its own special feel However, yeast will autolyze in the bottle given sufficient time and the result is a distinctive flavor. If the yeast load is low in the bottle, the flavor can be very appealing, as is the case with champagne, but if there is too much yeast in the bottle the beer will begin to develop the aroma of decaying yeast. Yeast autolysis also might smell like soy sauce or Vegemite.

Big brewers have a pretty good idea how long their beer will stay fresh because they can control how their beer is handled in distribution and have a lot of history tracking shelf-life. Anheuser-Busch (AB), Miller and Coors give their beers between 110 and 140 days on the market before they are supposed to be taken from the shelves — yes, old beer is supposed to be pulled from the shelves and returned to the brewery, where it is destroyed.

I believe AB has been pretty clever with their "born-on" date because they are calling the bluff of small brewers who tout fresh beer as the best beer. Sadly, many microbrewed beers are far from fresh when purchased and AB has lured some brewers who cannot properly control their beer in the market into putting a freshness date on their bottle. Most small brewers opt for a longer "best-before" period because they lack the turnover of the major players and don't want their beers to seem old based upon a date stamp.

To make matters worse, the big guys usually have better bottle fillers than the little guys and pasteurize their beer. In other words, they are beating many small brewers at the "brewed local, fresh beer" game that the little guys invented.

You are in a much stronger position to monitor freshness than commercial brewers are because you have absolute control over the beer. Use clean yeast, keep the brewery clean, minimize air pick-up during bottling and you will be well on your way to producing a beer that will stay fresh for at least 60 days after packaging. Store it hot and this period will be reduced, store it cold and it will become longer. In my experience, refrigerated homebrew can taste excellent 4 months after packaging. The thing to do is to taste your beer and develop your own theory on the subject. You can then improve shelf-life by simply focusing on those techniques in your process that can use improvement.

How long can I safely store my kegs at room or refrigeration temperature before the flavor is affected?

The answer to this question has plagued brewers since beer was first conceived or however it came into being. Many famous scientists studied the spoilage of beer and wine, and Louis Pasteur developed the heat-preservation technique now called pasteurization for beer, not milk. If brewers only knew how long their beer would last after packaging, distribution and packaged beer control would be so much easier.

The homebrewer has it pretty simple, however, because the palate can tell when the beer no longer tastes good. The simple answer to this question is that your beer's flavor will remain unaffected by storage until your palate is able to detect that it has changed! At this point, you may want to have a party and drink the rest of the beer before it becomes bad. Or if you detect the change in flavor at the same time it becomes bad, then you probably will want to dump the beer.

This advice sounds crude, but it works. Most pub brewers use their palate as the best indicator of beer freshness.

Do bottles or kegs keep beer fresh longer?

So how do bottles differ from kegs? If bottled properly, they really should have similar storage properties. The big difference with bottling a five-gallon batch versus kegging a five-gallon batch is roughly 48 bottle fills compared to one keg fill. A keg is easy to painstakingly fill. A keg can be filled to the brim with water and then completely filled with carbon dioxide by pushing the water out of the keg with the gas. Then you rack the beer into the CO_2-filled keg, essentially eliminating any possible contact with O_2. Oxygen pick-up is a non-issue using this method. The other thing about a keg is that you don't have to pull the fill tube out of it, thus exposing the beer to the environment, like you do with a bottle filler.

When you bottle, you may have some bottles that are about as low in oxygen as the keg and you probably will have others with higher levels. This results in variability within the batch — some will taste great after two months and some may taste oxidized. Of course, the real joy of bottling is convenience and the added flexibility of sharing your brews without having to bring your friends to your keg or hauling your keg around town!

Whether kegging or bottling, beer will not have any sort of shelf life if the key principles of sanitation, good yeast, healthy fermentations and careful racking practices are not used. Beer contaminated with bacteria or beaten up by sloppy racking practices is doomed. For those brewers who filter, this practice can do much more harm than good if proper filtration techniques are not followed. If everything is done correctly up to the point of filling, you will have maximum shelf-life, provided you use filling techniques that minimize oxygen pick-up and then store your bottled or kegged beer cold.

How can I get soda pop flavor out of my keg so my beer tastes like beer?

Ahhh, the old root-beer beer. This reminds me of a time when I screwed up a beer experiment with the remnants of a root beer experiment. We had three groups in our brewing lab class and each group would brew a beer that had one ingredient or process step changed. The results were assessed both analytically and with sensory evaluation. So, as we tasted the beer from my group, my colleagues began focusing on the odd aroma from the beer. In the end I had to confess that I had tainted the beer keg with root beer!

Unfortunately, when beer is tainted with a flavor like root beer, there is nothing that can be done to rescue it. However, several measures can be taken to ensure that the problem will not reoccur in later batches of beer.

I learned a lesson because I tried everything imaginable to free the rubber gaskets and O-rings from the pungent odor. I soaked them in bleach, sodium hydroxide and acid. I boiled them, steamed them and even let them bake in the hot sun. Nothing worked. Finally, I spent a few bucks and replaced all the rubber parts of the keg and the keg no longer reeked of eau de root.

I love root beer and have been serving it to customers for the last five years, but I take a few precautions. For starters, I have a complete set of rubber and plastic components (gaskets, measuring cups, hoses, etc.) that are used only for root beer. I also have kegs that are only used for root beer.

The next precaution is Draconian: The root beer keg is tapped in a stand-alone keg cooler. The reason for not running root beer lines in the same bundle of lines carrying beer is that root beer flavors can actually migrate out of the root beer line and into adjacent beer lines. This seems unbelievable, but it can and does happen. There are special beer lines on the market that are designed to prevent this from occurring, but I don't want to take any chances.

Breweries are not the only places that quarantine root beer. Soda bottlers do the same thing to prevent everything they produce from having that birch root, wintergreen, star anise, licorice and vanilla zip that's known as root beer.

What could cause an iodine or strong chemical taste in my kegged beer?

Chemical off-flavors are frequently encountered in beer and can be caused by numerous factors. The most obvious cause comes from traces of cleaning or sanitizing chemicals left on equipment surfaces after use. Chemicals containing chlorine and iodine are well known contributors of chemical off-flavors if the compounds remain on the equipment. Of the two, chlorine is the worst because it can combine with malt phenols to form a class of compounds called chlorophenols, which have a pronounced medicinal aroma. Iodine sanitizers usually cause no problems if used at their recommended concentration.

Some brewers encounter problems with chlorine even without using chlorinated sanitizers. These problems are often traced to chlorinated tap water. If brewers use chlorinated tap water for rinsing brewing equipment, then chlorophenol off-flavors may arise. One well known craft brewer had a problem with chlorophenols in his fruit beer that was eventually traced to the fruit. The fruit source had been rinsed at the farm with chlorinated water and this chlorine was being introduced to the beer at the time of fruit addition. This problem took some good detective work to solve.

Medicinal aromas can also come from wild yeast contamination. In fact the classic indicator of wild yeast contamination in beer is a distinct phenolic aroma. This aroma is often likened to cloves or the smell of standard bandages.

These are all possible explanations to your problem, but I don't think they are the real culprit. All of your beers from all kegs would taste off if it were due to your chemical selection or city water, and wild yeast attacks probably would not be limited to one keg, although that is certainly possible.

I think the most probable cause of the off-flavor is leftover flavors in the keg gaskets. I think you have an old root beer keg on your hands, and the aroma in beer is not iodine or medicinal but root beer. The most notable aromas in root beer are phenolic by nature and do smell somewhat medicinal.

They are also next to impossible to completely remove from rubber gaskets they contact. Take your suspect keg apart and remove all rubber O-rings and gaskets and replace them. Most homebrew stores selling kegs and kegging equipment will carry or have the ability to order replacement parts.

CARBONATION

Is there a rule of thumb to use for the appropriate levels of carbonation for different styles of beer?

In the United States, carbonation level is expressed in volumes of carbon dioxide. A volume of carbon dioxide is defined as the volume of gas that could be removed from a volume of beer at 68 °F (20 °C) at one atmosphere of pressure. For example, a liter of beer with 2.5 volumes would fill a 2.5-L bag with carbon dioxide if all the gas were removed at 68 °F (20 °C) and atmospheric pressure. This really is a weird unit of measure! Almost all other countries express carbon dioxide in grams per liter, a much more obvious expression of concentration.

Most beers in the United States contain between 2.5 and 2.6 volumes of CO_2. Beers such as Bud, Miller and Coors fall into this carbonation range. These same beers served on draft have slightly lower levels of CO_2 and fall about 0.05 to 0.1 volumes lower than their bottled brethren. Bottled lagers from Europe have a little less carbonation, about 0.1 volume less, than American lagers, but they seem dramatically less fizzy because most European lagers are all-malt, and that has a dramatic effect on beer body.

Traditional English ales served from casks have very low levels of CO_2, usually somewhere around 1.8 volumes. Since beer at 55 °F (13 °C) contains about 1.3 volumes of carbon dioxide when it is sitting in an unpressurized carbon dioxide environment, English ales fall at the very low end of the CO_2 scale when compared with other beers from around the world. Bottled ales tend to be higher in carbonation, but they still have less than most lagers. Typical values fall between 2.2 and 2.4 volumes of CO_2.

The wheat and fruit beers of the world, such as Berliner weiss beers, Bavarian hefe-weizens, Belgian wit beers, and lambics, have very high levels of CO_2 to give them a light and refreshing palate. These beers have CO_2 levels ranging from three to four volumes. Like Champagne, these beers are often served in fluted glassware that presents them with a certain elegance.

Some generalizations can be drawn about carbonation and flavor. Beers that have complex palates usually have lower levels of CO_2, so the beer's true identity isn't masked by carbonation. Beers with less complex palates that are meant to be served ice cold typically have more carbonation. Since carbonation stimulates the trigeminal nerve, the nerve that is also stimulated by spicy foods, some noted brewing experts have given these beers the nickname "pain beers."

Pain beers often derive a significant portion of their flavor from the carbonation, and many taste downright nasty when allowed to lose their high level of carbonation.

When craft beers are dragged into the picture, things get a little jumbled. Most craft beers have complex palates, leading one to speculate that they also have low CO_2 levels. However, many craft beers have CO_2 levels equaling or exceeding American lagers. When consumed, the beers don't seem to be overcarbonated because their full flavors are able to carry a higher level of CO_2 without seeming unbalanced.

This just shows that rules of thumb are useful guides but cannot be rigorously applied to all scenarios. It is up to the brewer to discover the right level of carbonation.

What is the proper way to force carbonate a keg of homebrew?

The easiest and best way to properly carbonate your beer is to exercise a little patience and to equip yourself with the proper tools. In the case of carbonation, a gas table (see page 78 for a carbonation table) is a pretty important tool.

With table in hand, you can select your desired carbonation level at the temperature your beer is being stored. Ideally you should carbonate your beer at the same temperature you will use for serving. Once you know the desired level of carbonation and the beer temperature use the gas table to determine the required gas pressure. This pressure is what the regulator on your tank will be adjusted to.

Once you have your gas plan, attach your keg to the carbon dioxide tank adjusted to the pressure dictated by your gas table and wait. A batch of homebrew is small and the headspace pressure will equilibrate with the beer in about 3 days. The only thing you can do to speed this method up is to periodically shake the keg. Some people want to bubble the gas through the dip tube in the keg, but this really does not speed things up much because the gas bubbles are too large and zip through the beer before much gas diffuses into solution. It also causes foaming. Take my advice and just hang tight! You can periodically shake the keg to speed things up, but whatever you do, avoid the temptation of cranking the regulator higher than what your gas table states and shaking the keg.

What is wrong with the "crank and shake" method since so many homebrewers recommend it?

The "crank and shake" method to carbonate beer, which has a scrumptious name, is widely suggested and is probably the crudest method imaginable for carbonation. It is simply bad advice given by a fairly large number of people.

Carbon dioxide solubility is affected by two variables you can control; beer temperature and carbon dioxide pressure. The goal of carbonation is usually to dissolve somewhere between 5 to 6 grams of carbon dioxide per liter of beer (in US terms this equates to 2.5 to 3.0 volumes). The units are not important; the important thing is that we have a tangible goal to carbonation.

When adding carbon dioxide to beer using a gas cylinder, as opposed to bottle conditioning, it is best to begin the process with cold beer since carbon dioxide solubility increases as the beer temperature decreases. If your goal is a normal level of carbonation you will be targeting about 5 g/L or 2.5 volumes of carbon dioxide. Consulting a gas solubility chart will tell you that if your beer is 38 °F (3 °C) the corresponding equilibrium carbon dioxide pressure for 5 g/L of carbon dioxide is 13 PSIG (the "G" indicates that this is gauge pressure instead of absolute). What this means is that if you supply 13 pounds of regulated carbon dioxide pressure to a keg of beer maintained at 38 °F (3 °C) that the beer will absorb carbon dioxide until equilibrium is reached. The important thing about this method is the use of a properly functioning regulator and an accurate pressure gauge. That's an article unto itself, so I will let that thought linger. If you have a properly functioning regulator, gas will flow into the keg as your beer absorbs carbon dioxide. This continues until the headspace pressure ceases to drop over time and that is when the process ends.

In a small keg this takes about three to five days to complete if you simply hook the gas up and leave your beer alone. In larger batches, the process takes longer since the headspace area is small compared to the beer volume.

Commercial brewers' carbonation stones and in-line gas injection systems are used to create a much larger gas surface area and to reduce the time required for carbonation.

You can do this at home by shaking your keg. The important thing, however, is to crank up the regulator to a pressure based on your carbonation goal. Otherwise, the whole endeavor is absolutely aimless. That's why this method has the lovely nickname, "crank-n-shake."

So why do people do this? One thing drives this method: speed. If you crank the pressure above the equilibrium target the gas drives into solution at a faster rate. The same is true with all types of equilibria. Take mashing as an example. If you put your mash pot into an oven maintained with a very good thermostat at, say, 152 °F (67 °C) the mash will eventually reach 152 °F (67 °C). This takes hours so we use a higher temperature for heating and then turn the heat down as the temperature approaches the set-point. This is pretty easy to control because we can easily measure temperature with a thermometer and we can respond to this information by reducing the heat and avoiding an over-shoot. But when carbonating we cannot measure the carbon dioxide content of the beer continuously and often end up with overly gassy beer.

So the next time you brew a batch of beer, finish by 1) chilling the beer before initiating carbonation, 2) using the proper equilibrium pressure for carbonating your brew, 3) exercising a little patience — a few shakes a day won't hurt if you cannot resist the urge.

Is there a way to fix an over-carbonated keg?

I prefer to package beer in kegs for several reasons. Besides being convenient, perhaps the best thing about a keg is that it's very easy to change the carbonation level in a beer. In your case, you either added too much priming sugar or went overboard with your carbon dioxide pressure during the carbonation step. Whatever the reason, the problem can be solved simply by releasing the top pressure on the keg. This method works to drop the carbonation level, but unfortunately, it's not a real sexy technique.

If you drop the head pressure in the keg, it will slowly return as the carbon dioxide in the beer re-equilibrates with the headspace in the keg. If you have a Cornelius keg, make sure the lid re-seals properly, or you could lose a lot more carbon dioxide than planned.

After a few hours, you can hook your gas supply back up to the keg at your normal dispense pressure and check the level of carbonation. You may need to repeat this method a time or two, depending on how badly you over-carbonated your beer! Although this is a nuisance, it is definitely a solvable problem. That's the beauty of kegged beer. If the beer were bottled instead of kegged, then you would be out of luck.

How can I use nitrogen to carbonate my beer?

The process of adding nitrogen to beer is referred to as nitrogenation. This is somewhat of a misnomer since nitrogenated beers also contain carbon dioxide and the gas blend used for the process is usually 75 percent nitrogen and 25 percent carbon dioxide. This mix is used to dispense draught Guinness Stout and is easy to find in markets that have draught Guinness.

Nitrogenated beers typically contain very low amounts of carbon dioxide, around 2.4 g/L or 1.2 volumes, and an even lower concentration of nitrogen of about 20 mg/L. "Typical" beers contain about 5 g/L of carbon dioxide and no nitrogen. The concentration of nitrogen is much lower than the carbon dioxide content because nitrogen is not very soluble in liquids. When dispensed through a special faucet, the nitrogen "breaks out" of the beer and forms very small, stable bubbles. Nitrogen foams are much more stable than carbon dioxide foams because the atmosphere is about 79 percent nitrogen and there is not much driving force between the gas concentration in the bubble and the concentration in the atmosphere. That's why "nitro" beers have such awesome, stable foam. The density and creaminess of the foam also adds a terrific mouthfeel to the beer.

Like many brewers, Mr. Wizard loves nitrogenated beers and has some rules of thumb on the procedure. For starters, don't bother nitrogenating any beer unless you have the proper faucet. There are many "stout" faucets on the market that are based on the Guinness faucet. All of these faucets have a disc with small holes inserted in the beer flow path and a device called a "flow straightener" placed after the disc. As beer flows through the holes in the disc there is a large reduction in pressure and this pressure drop causes the nitrogen and carbon dioxide to break out of solution. If the gas blend is just right you get a great glass of milky looking beer that settles out with a perfect head.

The other piece of equipment that is very important is a carbonation stone. I recommend the type of stone that can be connected to a stainless-steel rod and attached to the "out" fitting on a Cornelius soda keg. The stone is important because nitrogen is insoluble and it really helps to have small bubbles dispersed in the beer during the nitrogenation procedure. The key is getting the right gas blend. Too much carbon dioxide results in a large foamy head that doesn't settle properly — and too much nitrogen results in "wild beer" that will foam uncontrollably. Too little dissolved gas produces a pint that just seems flat. Now for the steps required for proper nitrogenation:

Step 1: Rack your beer to a keg after fermentation is complete (add finings if desired) and pressurize the headspace of the keg with mixed gas (75 percent nitrogen and 25 percent carbon dioxide) to a pressure of 10 to 15 PSI. This pressure is used to seal the keg and does not serve to nitrogenate the beer. Do not pressurize with 100 percent carbon dioxide because the beer will absorb too much.

Step 2: Transfer the keg to the coldest place you can find, preferably a refrigerator set at about 34 °F (1.1 °C), and allow the beer to clarify. I recommend about two weeks.

Step 2 (alternate): Filter the beer after holding cold for about one week. I have found that nitro beers pour much better when they are free of yeast.

Step 3: Make sure your beer is cold (between 34 and 38 °F/1.1–3.3 °C)) and connect the mixed gas supply to the carbonating stone and set the pressure regulator to 30 PSI. Gas will bubble though the beer until the headspace pressure reaches 30 PSI. After the headspace pressure is at 30 PSI, slowly loosen the pressure- relief fitting on the top of the keg until you hear a very low flow of gas escaping from the fitting. Allow the mixed gas to slowly bubble through the beer for 30 minutes. (If foam begins to come out of the fitting, tighten the fitting and allow the beer to rest for 30 minutes before continuing the slow bleed.) After this 30-minute purge, tighten the pressure-relief fitting and allow the beer to rest for 30 minutes, then do another 30-minute purge.

Step 4: Hook up the mixed gas to the headspace of the keg and set the pressure regulator to 30 PSI. Let the beer sit still for a few hours before pouring.

Step 5: Pour yourself a pint of nitro homebrew! If the foam seems excessive you should use a lower pressure the next time around and if it seems a bit flat you can repeat Step 3, using a higher pressure.

CONDITIONING IN A KEG

When you cold condition beer in a keg, does it matter whether it is carbonated or not?

I prefer to cold condition after carbonation, because you can remove yeast by racking the beer from keg to keg without worrying about having enough yeast in the beer at bottling time or having yeast that is too tired to work.

The traditional method of lagering, in which the beer is transferred to the lagering tank with some fermentable sugars and healthy, active yeast, gets the carbonation step knocked out in the first few days. The remaining weeks of lagering allow the yeast to mature the beer flavor (by reducing diacetyl, a buttery flavor) and give the beer sufficient time to become very clear. This is the essence of cold conditioning. Some brewers cold condition flat beer before bottling to achieve flavor maturation and clarity. This method works, but the carbonation step must be addressed. Many find it is easiest to use bottled carbon dioxide for carbonation of these beers. The yeast load is very low, and they wish to keep the beer very clear without worrying about the slug of yeast at the bottom of the keg or bottle.

Others want to have a naturally conditioned beer and find it easiest to add a small dose of vibrant yeast to the beer at bottling time. Both methods work, and they both have their pros and cons. I happen to like the all-in-one nature of the traditional lager process.

What is the best way to separate an ale from the yeast before I transfer beer to a keg? I want to do this to cut down on any off-flavors that the dead yeast might add to the beer.

One of the best ways for homebrewers to clarify beer is to simply move the carboy to a refrigerator and hold it cold (38 °F/3.3 °C is ideal, but anything colder than the final serving temperature should work) for at least a week. Chilling your beer will accomplish several important things.

The most obvious effect of chilling is that a big portion of the total yeast in suspension will "flocculate" or drop to the bottom of the fermenter.

Chilling your beer will also help to promote a reaction between proteins and tannins or polyphenols that results in chill haze. The great part of having chill haze at this stage of the game is that it will settle to the bottom of the fermenter. In a commercial brewery, the settling time takes weeks, but, luckily for homebrewers, the beer depth in a carboy is about two feet and the settling time is measured in days, rather than in weeks.

Depending on the flocculation characteristics of the yeast strain, this method may produce clear beer or it may do very little to improve clarity.

A more active approach to yeast removal is to use a fining agent, such as isinglass. Isinglass finings are a very pure form of collagen and are derived from fish swim bladders. When hydrated in an acid buffer solution, the collagen protein becomes positively charged. When you add this solution to beer, the collagen will act like a big net to bind yeast cells and drag them to the bottom of the fermenter. There are some isinglass preparations available today that are treated with the acid buffer and then dried. They can simply be re-hydrated in water before use to make preparation easier. I have always wondered how this practice first got started!

The last common option available is filtration. Few homebrewers filter their beer because filtration equipment is usually on the expensive side and, if done improperly, filtering can quickly ruin great beer. However, when the process of filtration is carefully and properly performed, the result can be very gratifying. I have heard countless brewers, both commercial and hobbyist, bash filtration. Detractors of filtration claim that it strips flavor and color from beer and makes beer taste watery. While this can happen if certain types of filters are used, especially membrane filters, it is the exception. Most commercial beers are filtered to produce a brilliant beer. Some styles, like hefeweizen, cask ale and bottle-conditioned beers, are unfiltered, but you will find that most other styles are typically filtered.

Whether you rely on cold storage, isinglass or filtration, you can reduce your yeast load. By reducing the amount of yeast in beer you can worry less about autolysis (yeast death) and will also have a clearer beer that better displays the colors of the malts used in the brew. One factor that you should be mindful of is that bottle conditioning becomes difficult when too little yeast is present and impossible when there is none! Some brewers who bottle condition actually filter their beers "bright" and then add a small dose of healthy yeast along with priming sugar just prior to bottling.

Does it matter if my ales are primed, carbonated, and aged in the keg at room temperature and then put in the fridge when ready for dispensing?

Bottle- and keg-conditioned ales must go through several key steps before they can be refrigerated and enjoyed.

The first step is to estimate the volume of beer and to add an appropriate amount of priming sugar for carbonation. Most brewers use less sugar to prime an equivalent volume of beer in a keg compared with bottles. After the beer is primed and the container sealed, it should be transferred to a suitable environment for the carbonation or conditioning step. The normal temperatures for conditioning range from 60 to 70 °F (16–21 °C) for ale and 40 to 55 °F (4.4–13 °C) for lager.

During conditioning the yeast produce carbon dioxide from the priming sugar and also mature the beer flavor by absorbing butter-like diacetyl and green apple-esque acetaldehyde molecules and converting them into flavorless compounds. These changes are good changes and will occur in seven to 14 days in ales that are stored in the 60 to 70 °F (16–21 °C) range. Lagers will take longer and use a different procedure, but your question is about ales, so I will stick to ales!

Once the good changes brought on by conditioning have occurred there are other changes that will begin to occur that may have a negative effect on your beer's flavor. The first bad thing to come will be yeast autolysis (yeast death and decay). Autolyzed yeast not only has an unpleasant flavor but the intracellular goo that is excreted during autolysis is rich in enzymes and nutrients. Some of the enzymes secreted, such as proteases, damage beer foam. Others, specifically esterases, change the aroma of fresh beer. As far as the nutrients released from decaying yeast cells go, they make great bacteria food. In fact many commercial breweries continually purge yeast that settles to the bottom of aging tanks. This practice is used as a preventive measure against bacterial growth.

Another change that will eventually occur in beer is oxidation. Although minimizing oxygen pick-up during beer transfers and beer packaging will reduce the rate of oxidation, oxidation is inevitable. In the early stages of oxidation, beer takes on a wet paper or wet cardboard aroma that some American imported-beer drinkers have learned to love! As the beer oxidizes more, it begins to smell like honey and eventually takes on aromas typically found in sherry and over-ripened dried fruits such as raisins and prunes. Beer drinkers fond of the rich flavors found in aged barleywines, Belgian strong ales, and the like are responding positively to oxidation, but in most beers oxidation is definitely considered a defect.

These negative changes can be delayed by minimizing the amount of yeast that is transferred into the bottle or keg, minimizing oxygen pick-up, and by using cold storage temperatures. If you store your kegs at room temperature before tapping, they may taste great for two to three weeks and begin going downhill after that period. If they are refrigerated after conditioning, they can last for months and still taste great. In a nutshell, after your been has been aged it is best to cool it for longer term storage.

BOTTLING FROM A KEG

How does a counter-pressure bottle filler work?

A counter-pressure bottle filler is designed to deliver a carbonated product into a bottle without excessive foaming. The basic idea behind these devices is to first pressurize the beer bottle to the same pressure as the keg holding the beer. After the bottle is pressurized and the beer valve allowing beer to enter the bottle is opened, the beer will only begin to flow if the keg is placed higher than the bottle.

The beer flow will stop quickly as the forces pushing it from the keg and those slowing it from entering the bottle become equilibrated. When this happens, the bottle vent is opened and the beer flow will continue until the bottle is full. Then, the pressure in the bottle is slowly relieved and the filler is removed from the bottle. If everything went right, there is little foam coming out of the bottle and a cap can be quickly placed on the bottle.

Can you give me tips on using a counter-pressure bottle filler without the bottles over-foaming?

If there are problems, what I would check first is the length of the fill tube. One of the most important rules of bottle filling is to gently fill the bottle. There are two types of filler-tube designs used in commercial breweries: long-tube and short-tube fillers.

Short-tube fillers fill the beer by directing its flow to the inside walls of the bottle, and the beer cascades down the sides of the bottle during filling.

Long-tube fillers extend all the way to the bottom of the bottle and allow the beer to fill from the bottom up without excessive turbulence. If the tube ends farther from the bottom, the beer will start to foam as it falls from the bottom of the fill tube to the bottom of the bottle. If your fill tube is too short, extend it.

The next rule of bottling is that beer foam breeds more beer foam. This is because gas is released from beer when nucleation sites are present. Nucleation sites include rough spots on a beer contact surface, such as an etched glass, crystals in beer (for example when salt is added to beer), and beer foam. Toward the end of filling the bottle, leave some space at the top and do not allow any beer to squirt out of the gas vent valve. If the bottle is filled all the way up, beer will squirt out of the vent tube during the depressurizing step and foam will form. If you allow beer to squirt out of the vent tube during filling, foam will form. In both cases more foam will form when you remove the fill tube. This rule applies not only to filling beer bottles at home but is also used in commercial bottle machines. In fact the fill tubes on a commercial filler are designed so that beer cannot be filled all the way to the top of the bottle.

On the same line of reasoning, the beer bottle itself is often the culprit of foaming, especially when returnable bottles are used for bottling. Glass is not always a smooth surface and imperfections in glass make beer foam. When beer bottles are cleaned and re-used at the brewery, the surface of the bottle becomes etched and this problem is exacerbated. Filling a wet bottle is easier than filling a dry bottle because a film of water on a bottle's surface is smoother than a dry surface and, you guessed it, results in less foaming. Commercial filling lines have a bottle rinser preceding the filler to ensure that beer is filled into wet glass. These rules are the basics of bottling and when used on most beers things usually go pretty well. If I sound a little unsure, it's because bottling usually provokes brewers to swear a bit more than do other operations. Bottling beer is never a sure thing. Two variables that often throw a kink into the mix are beer carbonation level and beer temperature. I prefer to choose a pressure and temperature combination that results in the carbonation level I am after and allow the beer to carbonate over several days. This method is more predictable and reproducible than high-pressure carbonation followed by a reduction in keg pressure.

How long does homebrew bottled by a counter-pressure filler remain good?

This is the question that every brewer who bottles their beer wants answered, and the answer depends on your bottling techniques. When carbonated beer is bottled, the shelf-life clock starts ticking. With very few exceptions, dissolved oxygen increases when beer is transferred to a bottle. Even commercial brewers with the most modern fillers equipped with bottle pre-evacuation features constantly worry about oxygen pick-up at the bottle filling stage.

Oxygen is public enemy number one when it comes to beer stability, be it bottled or kegged beer. Most counter-pressure fillers are designed so that carbon dioxide can be purged through the fill tube and out of the top of the bottle prior to filling. This helps reduce the oxygen in the bottle and oxygen pick-up during filling. During filling it really helps to minimize splashing, because beer foams when splashed and also picks up more oxygen. Most counter-pressure fillers have long fill tubes that extend to the bottom of the bottle and this minimizes splashing.

Once the beer has been gently transferred to the bottle, the fill tube is removed and the bottle prepared for capping. This step is critical. The idea is to get the beer to controllably foam so that the air in the bottle headspace is displaced with foam and only then is the bottle capped. This is easier said than done.

Sometimes the beer sits in the bottle and does not foam and other times it gushes out of the top like a geyser at Yellowstone. I like the former situation because it is easy to make beer foam, either by knocking the bottle on the counter or by rapping gently on the side with a plastic screwdriver handle. Geysers can be avoided by properly cooling your beer prior to bottling. The last protective measure to ward off oxygen pick-up is to use bottle caps with an oxygen-absorbing liner. These caps can make a good system better, but are not able to prevent oxidation without these other preventive measures in place.

Beer bottled using a counter-pressure filler under ideal conditions should remain fresh for at least two months and typically will stay fresh for four months. This is assuming the beer is kept cool or cold, is unfiltered and is not some high-alcohol behemoth — these giant beers will last much longer and some of the changes brought about by aging affect these beers in a positive way. In general, darker beers have a better shelf-life than light beers because compounds responsible for beer color are also play an anti-oxidant role.

The most difficult beers to bottle are the really light styles like Pilsners and American-style lagers. If bottled improperly, these lighter beers can show signs of oxidation within days of bottling, especially if stored warm.

How much difference in carbonation levels can I expect, filling from a counter-pressure bottle filler or just filling from the keg with an extension tube on a party tap?

The amount of carbonation lost during filling is heavily influenced by the carbonation level of the beer being filled.

Highly carbonated beers lose more carbonation when bottled compared to beers with lower levels of carbonation. It is almost impossible to give hard numbers, but based on personal experience, you will lose a considerable amount of carbonation if you simply fill bottles from a tapped keg.

I use a long-tube, counter-pressure filler to fill 22-ounce (650-mL) bottles. The fill tube extends to the bottom of the bottle and gently lets beer in as the counter pressure in the bottle is slowly vented. My filler allows me to fill one bottle in 40 seconds, which is fast enough for my needs. I know from carbonation measurements taken before and after filling that my beers lose about 0.25 volumes of carbon dioxide (they drop from 2.65 to 2.40 volumes). More sophisticated fillers typically lose only about 0.05 volumes of carbon dioxide during filling.

Another real issue to consider when bottling beer is oxygen pick-up. The rule of thumb in a commercial brewery is that oxygen pick-up becomes increasingly more important as the beer nears completion.

The reason is simple; yeast is capable of mopping up oxygen when it is active and yeast activity rapidly decreases after fermentation. In the case of filtered beer, there is no yeast activity because there is no yeast!

There are some very fancy bottling systems, used by commercial brewers, that use a vacuum-evacuation technique to remove oxygen from the bottle and short filling tubes that allow the beer to cascade down the surface of the bottle. These fillers work very well in respect to carbonation retention, low oxygen pick-up and speed, but are out of reach for homebrewers.

The best filler for the homebrewer is a long-tube, counter-pressure filler. This technique will fill your bottle without losing too much fizz, your main concern, and will also do an excellent job of minimizing oxygen pick-up.

My advice is to use the hose from your keg to fill a glass or mug — but not to fill bottles.

Determining Carbonation: Volumes of CO_2

Pounds per Square Inch Applied

	0 psi	1 psi	2 psi	3 psi	4 psi	5 psi	6 psi	7 psi	8 psi	9 psi	10 psi	11 psi	12 psi	13 psi	14 psi	15 psi	16 psi	17 psi	18 psi	19 psi	20 psi	21 psi	22 psi	23 psi	24 psi	25 psi	26 psi	27 psi	28 psi	29 psi	30 psi
30°	1.75	1.82	1.92	2.03	2.14	2.23	2.36	2.48	2.60	2.70	2.82	2.93	3.02																		
31°	1.73	1.78	1.88	2.00	2.10	2.20	2.31	2.42	2.54	2.65	2.76	2.86	2.96																		
32°	1.70	1.75	1.85	1.95	2.05	2.16	2.27	2.38	2.48	2.59	2.70	2.80	2.90	3.01																	
33°	1.68		1.81	1.91	2.01	2.12	2.23	2.33	2.43	2.53	2.63	2.74	2.84	2.96																	
34°	1.65		1.78	1.86	1.97	2.07	2.18	2.28	2.38	2.48	2.58	2.68	2.79	2.89	3.00																
35°	1.63			1.83	1.93	2.03	2.14	2.24	2.34	2.43	2.52	2.62	2.73	2.83	2.93	3.02															
36°	1.60			1.79	1.88	1.99	2.09	2.20	2.29	2.39	2.47	2.57	2.67	2.77	2.86	2.96															
37°	1.58				1.84	1.94	2.04	2.15	2.24	2.34	2.42	2.52	2.62	2.72	2.80	2.90	3.00														
38°	1.55				1.80	1.90	2.00	2.10	2.20	2.29	2.38	2.47	2.57	2.67	2.75	2.85	2.94														
39°	1.53					1.86	1.96	2.05	2.15	2.25	2.34	2.43	2.52	2.61	2.70	2.80	2.89	2.98													
40°	1.50					1.82	1.92	2.01	2.10	2.20	2.30	2.39	2.47	2.56	2.65	2.75	2.84	2.93	3.01												
41°	1.48						1.87	1.97	2.06	2.16	2.25	2.35	2.43	2.52	2.60	2.70	2.79	2.87	2.96												
42°	1.45						1.83	1.93	2.02	2.12	2.21	2.30	2.39	2.47	2.56	2.65	2.74	2.82	2.91	3.00											
43°	1.43						1.80	1.90	1.99	2.08	2.17	2.25	2.34	2.43	2.52	2.60	2.69	2.78	2.86	2.95											
44°	1.40							1.86	1.95	2.04	2.13	2.21	2.30	2.39	2.47	2.56	2.64	2.73	2.81	2.90	2.99										
45°	1.38							1.82	1.91	2.00	2.08	2.17	2.26	2.34	2.42	2.51	2.60	2.68	2.77	2.85	2.94	3.02									
46°	1.35								1.88	1.96	2.04	2.13	2.22	2.30	2.38	2.47	2.55	2.63	2.72	2.80	2.89	2.98									
47°	1.33								1.84	1.92	2.00	2.09	2.18	2.25	2.34	2.42	2.50	2.59	2.67	2.75	2.84	2.93	3.02								
48°	1.30								1.80	1.88	1.96	2.05	2.14	2.21	2.30	2.38	2.46	2.55	2.62	2.70	2.79	2.87	2.96								
49°	1.28									1.85	1.93	2.01	2.10	2.18	2.25	2.34	2.42	2.50	2.58	2.66	2.75	2.83	2.91	2.99							
50°	1.25									1.82	1.90	1.98	2.06	2.14	2.21	2.30	2.38	2.45	2.54	2.62	2.70	2.78	2.86	2.94	3.02						
51°	1.23										1.87	1.95	2.02	2.10	2.18	2.25	2.34	2.41	2.49	2.57	2.65	2.73	2.81	2.89	2.97						
52°	1.20										1.84	1.91	1.99	2.06	2.14	2.22	2.30	2.37	2.45	2.54	2.61	2.69	2.76	2.84	2.93	3.00					
53°	1.18										1.80	1.88	1.96	2.03	2.10	2.18	2.26	2.33	2.41	2.48	2.57	2.64	2.72	2.80	2.88	2.95	3.03				
54°	1.15											1.85	1.93	2.00	2.07	2.15	2.22	2.29	2.37	2.44	2.52	2.60	2.67	2.75	2.83	2.90	2.98				
55°	1.13											1.82	1.89	1.97	2.04	2.11	2.19	2.25	2.33	2.40	2.47	2.55	2.63	2.70	2.78	2.85	2.93	3.01			
56°	1.10												1.86	1.93	2.00	2.07	2.15	2.21	2.29	2.36	2.43	2.50	2.58	2.65	2.73	2.80	2.88	2.96			
57°	1.08												1.83	1.90	1.97	2.04	2.11	2.18	2.25	2.33	2.40	2.47	2.54	2.61	2.69	2.76	2.84	2.91	2.99		
58°	1.05												1.80	1.86	1.94	2.00	2.07	2.14	2.21	2.29	2.36	2.43	2.50	2.57	2.64	2.72	2.80	2.86	2.94	3.01	
59°	1.03													1.83	1.90	1.97	2.04	2.11	2.18	2.25	2.32	2.39	2.46	2.53	2.60	2.67	2.75	2.81	2.89	2.96	3.03
60°	1.00													1.80	1.87	1.94	2.01	2.08	2.14	2.21	2.28	2.35	2.42	2.49	2.56	2.63	2.70	2.77	2.84		

Temperature of Beer (Degrees Fahrenheit)

Carbonation Priming Chart For Kegs, Casks and Bottles

The amount of carbonation in bottle-conditioned, keg-conditioned or cask-conditioned homebrew is dependent on two things — the residual level of carbon dioxide after fermentation and the amount of carbonation obtained from the priming sugar.

To get the level of carbonation you desire in your homebrew, choose a level of carbonation, then subtract the amount of residual carbonation in your beer after fermentation. This is the amount of carbonation you need to add via priming sugar. The amount of carbonation produced by two different priming agents (glucose monohydrate and sucrose) in 5 gallons (19 L) of beer is given in the chart to the right.

For example, let's say you fermented an American pale ale at 68 °F (20 °C) and plan to carbonate it with corn sugar (glucose monohydrate). You decide that you want your carbonation level to be 2.4 volumes of CO_2. Next, you see that you should have 0.85 volumes of CO_2 in your beer after fermentation at 68 °F (20 °C). Subtracting 0.85 from 2.4 gives you 1.55 volumes of CO_2, the amount of carbonation required from the priming sugar. From the charts on this page, you see that adding 4.5 oz. (128 g) yields 1.53 volumes of CO_2, which is pretty close to your target.

Levels of Carbonation in Various Beer Styles

Style	Volume of CO_2
American ales	2.2–3.0
British cask-conditioned ales	1.5–1.8
British bottle-conditioned ales	2.0–2.2
German weizens	2.8–5.1
Belgian ales	2.0–4.5
European lagers	2.4–2.6
American lagers (bottled or canned)	2.5–2.8
American lagers (kegged)	2.4–2.7

Residual Carbonation Left Over After Fermentation

Temperature (°F/°C)	Volumes CO_2
47 °F (8.33 °C)	1.21
50 °F (10.0 °C)	1.15
53 °F (11.7 °C)	1.09
56 °F (13.3 °C)	1.04
59 °F (15.0 °C)	0.988
62 °F (16.7 °C)	0.940
65 °F (18.3 °C)	0.894
68 °F (20.0 °C)	0.850
71 °F (21.7 °C)	0.807
74 °F (23.3 °C)	0.767
77 °F (25.0 °C)	0.728
80 °F (26.7 °C)	0.691
83 °F (28.3 °C)	0.655

Priming with glucose monohydrate (dextrose monohydrate)

Glucose.H_2O (oz.)	Glucose.H_2O (g)	Volumes CO_2/19 L
1.0	28.3	0.34
1.5	42.5	0.51
2.0	56.7	0.68
2.5	70.9	0.85
3.0	85.0	1.02
3.5	99.2	1.19
4.0	113	1.36
4.5	128	1.53
5.0	142	1.70
5.5	156	1.87
6.0	170	2.04
6.5	184	2.21
7.0	198	2.37
7.5	213	2.54
8.0	227	2.71
8.5	241	2.88
9.0	255	3.05

Priming with sucrose

Sucrose (oz.)	Sucrose (g)	Volumes CO_2/19 L
1.0	28.3	0.39
1.5	42.5	0.59
2.0	56.7	0.79
2.5	70.9	0.98
3.0	85.0	1.18
3.5	99.2	1.37
4.0	113	1.57
4.5	128	1.77
5.0	142	1.96
5.5	156	2.16
6.0	170	2.36
6.5	184	2.55
7.0	198	2.75
7.5	213	2.95
8.0	227	3.14
8.5	241	3.34
9.0	255	3.54

Kegging vs. Bottling Comparison

Number of Bottles or Kegs Required

	size of batch			
type of package	5 gallons (19 L)	10 gallons (38 L)	15 gallons (57 L)	20 gallons (76 L)
12-oz. (0.35 L) bottles	53.3	106	160	213
22-oz. (0.65 L) bottles	29.1	58.2	87.3	116
1-L (34-oz.) bombers	18.9	37.8	56.8	75.7
2-qt. (1.9-L) growlers	10	20	30	40
1-gallon (3.8-L) jugs	5	10	15	20
5-L (5.3-qt.) mini-kegs	3.8	7.6	11.4	15.1
6-L (6.3-qt.) Tap-A-Draft	3.15	6.3	9.5	12.6
2-gallon (7.6-L) Cornelius keg	2.5	5	7.5	10
2.25-gallon (8.5-L) Party Pig	2.22	4.4	6.7	8.8
2.5-gallon (9.5-L) Cornelius keg	2	4	6	8
3-gallon (11-L) Cornelius keg	1.7	3.3	5	6.7
5-gallon (19-L) Cornelius keg	1	2	3	4
10-gallon (38-L) Cornelius keg	-	1	1.5	2