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BrewYour Own

THE HOW-TO HOMEBREW BEER MAGAZINE

SEPTEMBER-OCTOBER 2024, VOL. 30, NO. 5

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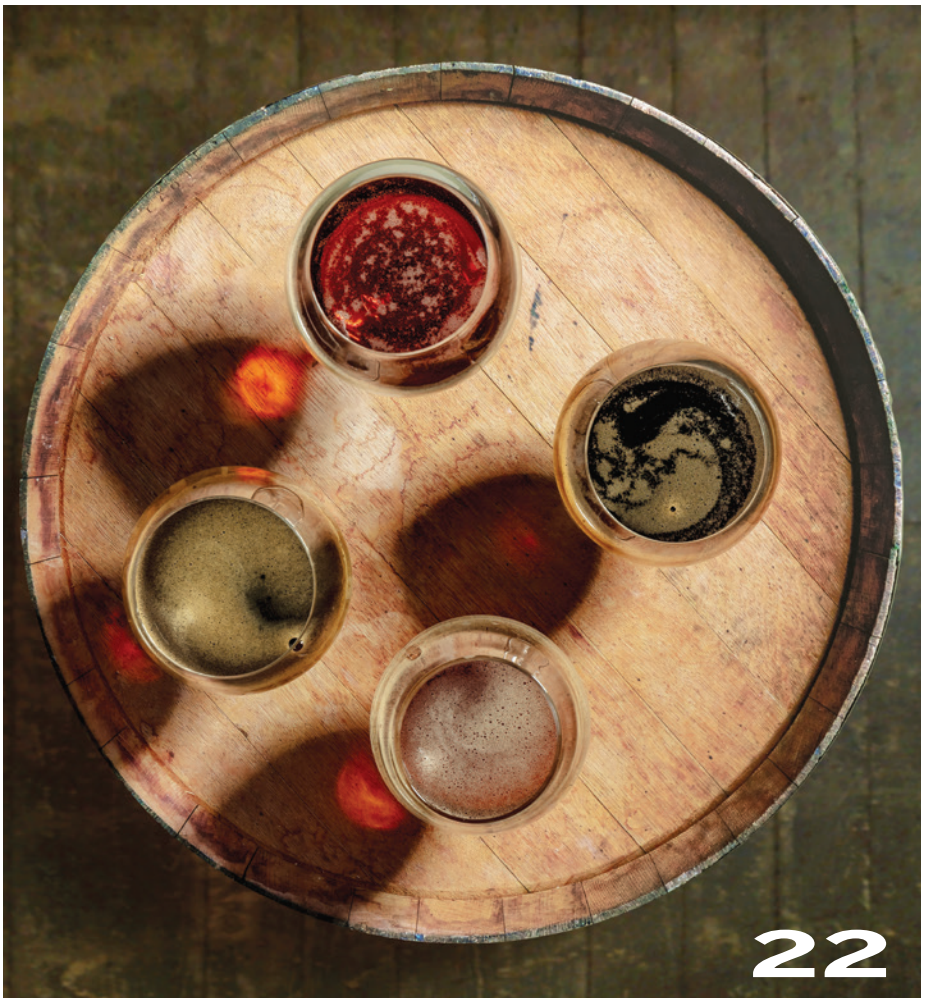

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by Martin Keen

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THE HOW-TO HOMEBREW BEER MAGAZINE

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RECIPE STANDARDIZATION

EXTRACT EFFICIENCY: 65%
(i.e. — 1 pound of 2-row malt, which has a potential extract value of 1.037 in one U.S. gallon of water, would yield a wort of 1.024.)

EXTRACT VALUES FOR MALT EXTRACT:
liquid malt extract (LME) = 1.033–1.037
dried malt extract (DME) = 1.045

POTENTIAL EXTRACT FOR GRAINS:
2-row base malts = 1.037–1.038
wheat malt = 1.037
6-row base malts = 1.035
Munich malt = 1.035
Vienna malt = 1.035
crystal malts = 1.033–1.035
chocolate malts = 1.034
dark roasted grains = 1.024–1.026
flaked maize and rice = 1.037–1.038

HOPS:
We calculate IBUs based on 25% hop utilization for a one-hour boil of hop pellets at specific gravities less than 1.050. For post-boil hop stands, we calculate IBUs based on 10% hop utilization for 30-minute hop stands at specific gravities less than 1.050. Increase hop dosage 10% if using whole leaf hops.

Gallons:
We use U.S. gallons whenever gallons are mentioned.

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Charles A. Parker/Images Plus

Q What is the experience that got you started in homebrewing?

I was a young Lieutenant in the Air Force in 1987, just out of college. A friend of mine had started brewing beer and he recommended a local brewing supply store. I was fascinated with the idea of making my own beer so I went over and bought a copy of Charlie Papazian's *Joy of Homebrewing* and read it cover to cover. Then I bought a plastic bucket and malt extract kit and the rest is history.

A Northern Brewer starter kit with my dad — we brewed a German altbier.

My wife bought me my first setup as a wedding gift in 1996. The kind with two white buckets, dry yeast of questionable origin, PVC tubing, and a red wing bottle capper. After I discovered Charlie Papazian, I was hooked. My brewing is much more consistent these days, but my equipment has vastly improved as well. The fascination with the black magic of brewing continues just the same. And I still have the buckets.

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suggested pairings at BYO.COM

Canning Yeast Starters

Making a yeast starter requires wort, which making is fairly time-consuming. If you ever wished that you could have starter wort on hand, ready to go at a moment's notice, you need to can it — the wort that is. By using the methods of home canning, you can make and store starter wort for use whenever you want.
www.byo.com/article/canning-yeast-starters/

Better Together: Club Barrel Shares

Maintaining a homebrew barrel program can be a lot of fun, but it is difficult by yourself if you want to use a full-size barrel. These are the perfect size for homebrew clubs, however. A New Jersey club shares how it successfully operates a two-barrel program for its members.
www.byo.com/article/better-together-club-barrel-shares/

Beyond the Barrel

Barrel-aged beers are wonderful, but barrels are also expensive, time-consuming, and take up a lot of space. With the wide array of oak alternatives available, they are also unnecessary. Explore the alternatives to barrels.
www.byo.com/article/beyond-the-barrel/

Choosing Tubes and Hoses

Pipes, tubes, hoses . . . there is a lot of confusion around these products, which may have to do with the vast amount of options that are laid in front of us. And, no, they are not all created equal. Explore the options out there so you can make sure your homebrewery is properly equipped with the right tubing.
www.byo.com/article/choosing-tubes-and-hoses/

MAIL

CHEERS FROM DOWN UNDER

I'm a homebrewer based in Australia and after some recent *Brülosophy* episodes on education and listening to their interview with *BYO* Publisher Brad Ring on Patreon, I want to support *BYO* through my digital subscription as I think you have done an amazing job for homebrewers. Over the years I have definitely learned from *BYO*. Sadly, our Aussie-based magazines related to homebrewing have all disappeared.

I've been a craft beer enthusiast for many years but started brewing in earnest a couple of years ago to learn more about my favorite beverage. I only started with all-grain over the last 12 months (although I have done a lot of beers in those 12 months). I absolutely love it. I know *BYO* is U.S.A.-centric, but I'm sure I'll get heaps more from your subscription workshops, videos, recipes, and great content. Thanks for doing an awesome job for homebrewers worldwide.

Michael Barwell • *Mayfield East, Australia*

Publisher Brad Ring responds: "Thanks for the very nice comments about BYO *and also signing up as a new BYO+ member! While we are based in the U.S., for decades all our brewing articles, recipes, and projects have included metric equivalents so you should find all our content useful and relatable. Best of luck with your brewing."*

BOILING OAK CHIPS

Should wood chips purchased through homebrewing supply stores be boiled before use? I am leery about contaminating the beer in secondary or if chips are boiled then removing some of the oak essence by throwing out the water used to boil the chips.

Richard Romanowsky • *via email*

Your instinct is right that if you boil them you are going to be boiling off a lot of the flavor you want in your beer from the oak. There are numerous opinions on this subject, with many advocating for tossing the chips directly into your beer, others suggesting that a soak in high-proof alcohol has the benefit of killing any unwanted microbes (though others argue this will also extract much of the oak flavor of the chips if the leftover spirit is not also added to your beer). The likelihood of an infection coming from oak chips purchased from a reputable distributor is very small either way.

contributors

Tobin Bottman is a professional archaeologist and an avid homebrewer and home cook. He has worked in the field of archaeology for over 20 years and has been homebrewing since 2017. Surrounded by the vibrant and supportive brewing community in Portland, Oregon, Tobin enjoys brewing a wide variety of styles, but particularly loves using ingredients sourced from Oregon and the Northwest, including foraging for unique native ingredients. Tobin has a fantastic (and patient) spouse and three cats (none patient).

Tobin makes his *BYO* writing debut on page 34, detailing how he operates a home solera program where a portion of beer is emptied from a soured barrel and new wort is added to replace it every so often.

Martin Keen is a homebrewer and host of *The Brülosophy Show* on *YouTube*. He once brewed 99 Beer Judge Certification Program beer styles in 99 consecutive weeks. Martin has been posting homebrewing tips and experiments on *YouTube* for six years, generating over 7 million views. He is a graduate of the Wake Tech Craft Brewing Program. In his day job, Martin works for an IT company where he holds 400 patents.

In his first article for *BYO* beginning on page 40, Martin details the steps required to freeze yeast, and thus extending its usefulness by years.

Bill Jablonski is a Co-Owner of Draftnauts LLC, an independent installer of draft systems located in the Finger Lakes region of New York. After studying music and history in college, Bill became well-equipped for a life of working Wall Street, contaminated soil and groundwater investigation, and engineering inspection. Armed with a bunch of licenses and certifications in health and safety, construction, and asbestos, Bill set out to understand the dark arts of draft beer. Turns out the beer industry is a lot more interesting than all the rest.

Bill writes the "Advanced Brewing" column of this issue starting on page 49, offering practical advice on balancing a home draft system.

THE BREWERS

A POEM BY KIEV RATTEE

Beer is proof that God loves us and wants us to be happy.
–A quote, likely fabricated, attributed to Benjamin Franklin

I brew. Combine water, malted barley, hops, and yeast
in the quest to create what Galileo called, "Sunlight, held together by water."
Though he was talking about wine.

While milling my grains I envision the first straw hut brewers
crouched beside sorghum stews,
the alewives accused of witchcraft, the contemporary brewers
with their stainless tanks of water heating to mash temperature,
activating malt enzymes, converting starches into fermentable sugars
for *Saccharomyces cerevisiae* – yeast,
what the old English called *Godisgoode*, the single-celled
microorganism fungi that consume, multiply, create ethanol and carbon dioxide.
The microscopic disguised as magic.

The brewers peer over steaming cauldrons,
paddles in hand, guiding the elixir along its journey
from field to bottle, can, or keg.
They are in direct lineage from the acres of swaying barley
that become Maris Otter, Pilsner, Pale, Vienna, and Munich malt.
This is the maltster's promise:
To capture the field's energy in each kernel of grain
by germinating then arresting nature with heat
to lock sugars, starches, and proteins within each cereal seed.
The power of a star locked in each tiny husk.

And let us not forget *Humulus lupulus* – hops, the earth wolf,
the plant King Henry VI called a wicked weed, offering their bitterness
and aromatics to balance the malty sweet solution.
Bines climbing from Yakima to Hallertau, Žatec to the West Midlands, and beyond.

Oh, the exhilaration when each batch takes off, CO_2 gas
rising through the wort, and out through DaVinci's airlock
in energized, roiling bubbles as yeast convert the sugars to beer!
It's as though all the gods of fermentation
(Ninkasi, Siris, Acan, Nephthys, Siduri, Mbaba Mwana Waresa, and Aegir)
love us and want us to be happy.

Photo courtesy of Shutterstock.com

WHAT'S NEW

FLASH BREWING KITS

MoreBeer!'s Flash Brewing Kits allow homebrewers to brew a batch of beer in just 10 minutes. Designed for both novice and seasoned homebrewers, these recipe kits allow you to simply mix the ingredients with water and add yeast for fermentation. This streamlined process saves time while also simplifying brewing without sacrificing flavor. This is possible because the Flash Brewing malt recipes have been boiled and whirlpooled before being dried. Recipes include a HopBite™ shot for bitterness combined with a mix of traditional hop pellets and extracts for flavor. Flash Yeast™ ferments to produce clean beer that lets the malt and hops shine. There are currently seven different kits available for a variety of beer styles, ranging in price from $39.99–59.99. Learn more at www.morebeer.com

LALBREW POMONA™

LalBrew Pomona™ is the latest yeast strain from Lallemand. Pomona™ is a hybrid yeast that was selected for flavor and fermentation performance in hoppy beers. Named after the goddess of fruit trees, it produces a unique and juicy flavor profile with notes of peach, citrus, and tropical fruits. It is haze-positive for stable haze and has high biotransformation potential, making it ideal for hazy IPAs. In June it was released in 500-g packages and will be available to homebrewers in 11-g sachets soon. Learn more at www.lallemandbrewing.com/en/global/products/lalbrew-pomona/

UPCOMING EVENT

BYO NANO CON ONLINE

OCTOBER 25
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Learn from craft brewing industry experts with live online sessions covering Brewery Operations, Business Operations & Sales, and Start-Ups. Join nano breweries (and nanos-in-planning) online for a full day packed with interactive seminars and Q&A panels geared just for you — the small-scale commercial brewery, or brewery-in-planning, working on smaller systems. All sessions will be recorded and available for later viewing as a NanoCon attendee so you will not miss any sessions even if they take place at the same time or you can't join live on October 25. Learn more at www.nanocon.beer

AN OVERABUNDANCE OF HOPS

BarthHaas released its 2023/2024 World Hop Harvest and World Beer Market Reports that show an increase in hops harvested, even with fewer acres worldwide dedicated to growing hops and a decline in beer production. The decrease in beer production is one of the reasons for the current overproduction of hops and a call to further reduce hop production.

World hop acreage declined by 3.3 percent in 2023. The U.S. once again had the largest hop acreage worldwide (55,000+ acres) even though acreage declined 8.9%. Germany produces the second most hops worldwide (~51,000 acres) and remained constant in hop-growing acreage. The two countries make up 75% of the world's hop volume. Despite the reduction in acreage, worldwide hop production increased 11.5% in 2023. The mean alpha acid content of 10% in 2023 was only slightly below that of the previous year. The proportion of aroma hops in both crop and alpha yield fell by three percent, while there was a corresponding increase in that of bitter hops. "The alpha balance accumulated in recent years still shows a significant market oversupply. Hop acreage must be reduced to bring production volume into line with lower demand and to return the market to something approaching equilibrium," stated Heinrich Meier, the author of the BarthHaas Report.

Part of the reason for the lesser demand for hops has been a difficult economic situation worldwide that has played a role in beer production falling by 0.9%. That includes a decline in production of 5.6% in the U.S. and 3.3% decline in Germany.

Read the entire report at https://www.barthhaas.com/resources/barthhaas-report/download-report

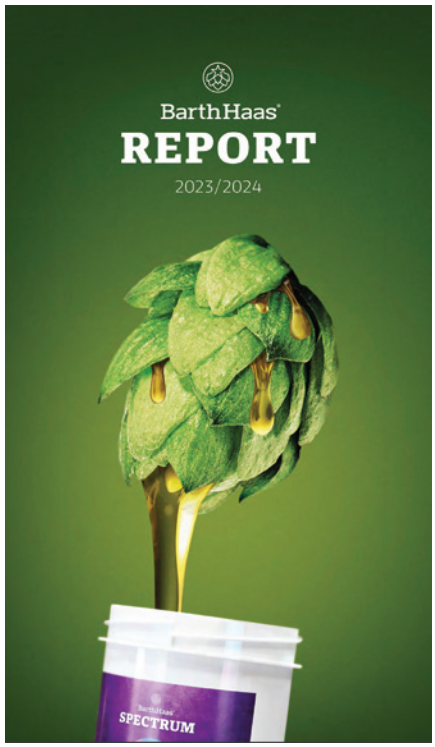


Photo courtesy of BarthHaas

BYO REPLICATOR

BY DEREK DELLINGER

DEAR REPLICATOR, Fall Ale from Frost Beer Works holds a special place in my heart. Instead of a traditional honeymoon, my husband and I opted for a "beermoon" in which we toured breweries in New Hampshire, New York, and Vermont in the fall of 2015. It was a great trip! We stumbled across Frost Beer Works in Hinesburg, Vermont, where Fall Ale really stood out. It tasted like taking a bite out of a crisp pile of leaves on a bright Vermont, autumn day — in the best way! The beer has since been retired, but I would love to brew it myself to remind us of that time.

Staci Oswald
Granville, New York

Most breweries geek out on developing recipes, refining process efficiencies, and helping educate consumers on the nuances of the many, many different beer styles available today. But at Frost Beer Works, located in the small town of Hinesburg, Vermont, with a population below 5,000 people, that level of dedication doesn't stop with the beer itself.

Frost, founded in 2014 by homebrewer Garin Frost, went so far as to develop its own in-house software management system for tracking the business's brewing, packaging, inventory, and distribution. Their homebrewed automation software plays a significant role in enabling Frost to manage four brews per day with only two employees in the brewhouse at a time. But it's not the whole story — the technological geekery doesn't stop with software. Frost also utilizes a dedicated dry hop machine, a centrifuge, equipment for oxygen testing in packaged product, miscellaneous lab equipment for beer analysis, and an Aber Perfect Pitch to maximize fermentation consistency.

Steven Nelson, Brewer and Operations Manager at Frost, is amazed by the efficiency of the operation himself. "I find the best example of what we're able to do at Frost Beer Works is our production output: We packaged 7,329 barrels of beer last year with five production employees on a 10-bbl system."

These numbers are indeed impressive — many breweries with a 10-bbl brewhouse produce only a few hundred barrels of beer per year.

Nelson says the focus on efficiency frees the brewery up from having to worry too much about chasing market trends. While Frost's lineup is led by hazy IPAs, the brewery produces a number of different styles, and ultimately tries to stick to its strengths of always refining and ever improving, regardless of style.

"We're really not too focused on new trends, as illustrated by our rather minimalistic branding," Nelson says. "We put our efforts towards improving on what we do well and being able to do it better every time. That being said, within our hazy IPA portfolio, we do have a line of Research Series beers where we experiment with different hop blends, grain bills, and yeast blends."

Other experiments in the brewery's past include various riffs on seasonal styles. One such beer, Fall Ale, became something of an underground hit in the Green Mountain State. Described as "a multigrain harvest ale with malt-forward flavors," the beer deviated from its highly-spiced autumnal cousins and instead went in the direction of a classic strong ale, brewed with Simpsons Golden Naked Oats®, crystal rye, and malted barley from a local maltster. This unique assemblage of grains imparted toasty, bread crust flavors, a smooth caramel sweetness, and a deep, structured body.

Nelson remains a fan of maltier styles, describing himself as "someone who enjoys stouts in the summer." However, as many brewers have observed in recent years, seasonal styles often struggle within the current distribution paradigm, where distributors by-and-large simply prefer to stock up on hazy IPAs.

Frost has experimented with several malt-forward seasonal options over the years, playing with ingredients like maple syrup and rye to add a local spin to classic styles. Additionally, Frost takes the opportunity to reuse barrels to create even more variety within its lineup.

"We send about twelve barrels of our Heavy Imperial Stout base beer into freshly emptied local Bourbon barrels yearly for a barrel-aged stout release," Nelson says. Once those barrels have been emptied of stout, the brewery refills the barrels with another rotating beer style that ages over the summer in order to maximize the use of the wood and release a unique beer for the fall.

"We've focused our tinkering efforts on creating consistency with all the beers we make, which actually is less so on the recipe development side," says Frost. "We focus more on yeast pitching accuracy, aeration, oxygen contamination prevention, packaging quality, and production practices to reduce the amount of labor and effort required, putting us in a position to produce the maximum amount we can in our facility."

Frost's highly efficient setup serves as a reminder that brewing is ultimately a business, and given the market, a business that needs to operate as efficiently as possible. This lean approach to brewing means not every beer gets to stick around — and some fan favorites, like Fall Ale, have to be retired. But that, of course, only creates the opportunity for another enticing challenge for the curious homebrewer.

One feature of Frost's Fall Ale that will provide an extra avenue of experimentation for homebrewers was the use of local malts. Fall Ale called upon malt from Peterson Quality Malts, a small maltster based in North Ferrisburgh, Vermont, which has since ceased operations. In order to replicate the beer as closely as possible, your own local or regional independent maltster may offer unique alternatives.

FROST BEER WORKS' FALL ALE CLONE

(5 gallons/19 L, all-grain)
OG = 1.069 FG = 1.015
IBU = 25 SRM = 18 ABV = 7.2%

INGREDIENTS

10 lbs. (4.5 kg) 2-row pale malt
1.6 lbs. (0.73 kg) crystal rye malt
1.6 lbs. (0.73 kg) Simpsons Golden Naked Oats®
12 oz. (340 g) heritage crystal malt (65 °L)
12 oz. (340 g) Munich malt
7.2 AAU Simcoe® hops (60 min.) (0.6 oz./17 g at 12% alpha acids)
White Labs WLP001 (California Ale), Wyeast 1056 (American Ale), or SafAle US-05 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

With the goal of creating a highly dextrinous wort, mash in with 2.75 gallons (10.4 L) of 166 °F (74 °C) strike water to achieve a rest temperature of 154 °F (68 °C). Hold at this temperature for 60 minutes.

With sparge water at 170 °F (77 °C), collect about 6 gallons (23 L) of wort. At the start of boil, add hops and set timer for 60 minutes.

When the boil is complete, chill wort to slightly below fermentation temperature, around 66 °F (19 °C). Aerate wort if using liquid yeast and then pitch yeast. Ferment around 68 °F (20 °C) until complete. Prime and bottle condition or keg and force carbonate to 2.5 volumes CO_2.

FROST BEER WORKS' FALL ALE CLONE

(5 gallons/19 L, extract with grains)
OG = 1.069 FG = 1.015
IBU = 25 SRM = 18 ABV = 7.2%

INGREDIENTS

6.6 lbs. (3 kg) light liquid malt extract
8 oz. (230 g) Munich dried malt extract
1.6 lbs. (0.73 kg) crystal rye malt
1.6 lbs. (0.73 kg) Simpsons Golden Naked Oats®
12 oz. (340 g) heritage crystal malt (65 °L)
7.2 AAU Simcoe® hops (60 min.) (0.6 oz./17 g at 12% alpha acids)
White Labs WLP001 (California Ale), Wyeast 1056 (American Ale), or SafAle US-05 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Steep the crushed specialty grains in a muslin bag in 6 gallons (23 L) of water as it heats to 170 °F (77 °C). Afterwards, remove bag and allow to drain back into the kettle. Bring liquid to a boil, then remove kettle from heat and carefully stir in malt extract. When dissolved, return to heat.

At the start of boil, add hops and set timer for 60 minutes. When the boil is complete, chill wort to slightly below fermentation temperature, around 66 °F (19 °C). Aerate wort if using liquid yeast and then pitch yeast. Ferment around 68 °F (20 °C) until complete. Prime and bottle condition or keg and force carbonate to 2.5 volumes CO_2. BYO

Photo courtesy of Frost Ale Works

Inside the 10-barrel brewhouse at Frost Ale Works, where a two-man crew will brew up to four batches in a single day.

BY DAWSON RASPUZZI

USING BARREL ALTERNATIVES

If you don't have a barrel but want to brew oak-aged beer, barrel alternatives are great options, as these two experts share.

I have used granules, chips, cubes, sticks, spirals, staves, as well as small and large barrels. There are even extracts that you can use to dose a beer. Generally, the smaller the format of the wood (e.g., granules versus cubes) means more surface area in contact with the beer and quicker extraction. While quicker extraction might be useful in some circumstances, more important is the quality of the wood and the quality of the process used to make it. My favorite is spirals from The Barrel Mill, which I have used extensively. This format is easy to use and much easier to remove from the beer when done. Spirals come in various lengths and they are easy to break into shorter pieces if needed.

In general, American oak has a bolder flavor with more vanilla notes. French oak has a more subtle oak flavor and an overall sweeter impression. Hungarian oak has what some consider to be smooth or more subtle vanilla notes. Regardless of the origin, those flavors of vanilla, caramel, and butterscotch depend on the toast or char level. Firing the wood creates melanoidins as heat from the fire breaks down carbohydrates into sugars. It is toast or char that creates flavors ranging from light vanilla to espresso and more.

My go-to favorite is a blend of light-toast American and medium toast French oak, but I also really like using Spanish cedar, cypress, sugar maple, and amburana. The only problem with some of these wood species is that they are available in limited formats.

If you are new to wood aging beer, start with higher-alcohol beers (>9% ABV), as they will not sour as quickly should there be bacteria or wild yeast introduced with the wood. Imperial stouts are always great with wood aging. The residual sweetness is a nice counterbalance to the tannins from the wood, and any vanilla and caramel notes from the wood are nice with the chocolaty notes of the stout.

I also like wood-aged Pilsner, golden ale, Kölsch, or hefeweizen with woods like Spanish cedar, cypress, sugar maple, and amburana. You can try wood with anything. Using chips or cubes, you could experiment with just a growler or Mason jar of beer to see how well a particular wood affects the flavor. If you like it, then you can age the rest of the beer.

Longer extraction times create different flavors in the beer. The general consensus is that the beers can become more tannic with longer extraction times. Taste the beer each week to see how it is progressing. Once the flavor is right, get the beer off the wood. One trick to maximize extraction and reduce waiting time is to recirculate the beer across the wood. Commercially, they use a pump, but homebrewers can swirl the vessel or invert the keg every few days to accelerate and maximize extraction.

I don't recommend soaking oak alternatives in a spirit in hopes of replicating the flavor from a spirit barrel. The oxidation and development of flavors over time in the wood is not something you can recreate in a sealed bottle over a short time. Instead, soaking the wood in the spirit leaches out the wood flavor you want to add to your beer. You might as well just pour the spirit into the beer instead. If you do soak the wood in a spirit, then consider pouring all of that spirit into the beer too, so you retain the wood flavor. Some folks soak their wood in a spirit hoping it will kill any organisms present, but that is not a good reason to do it either. Heat, in the oven or through canning, is the best option for ensuring sanitary wood products.

I don't recommend soaking oak alternatives in a spirit in hopes of replicating the flavor from a spirit barrel.

Jamil Zainasheff is an award-winning brewer, author, beer judge, and podcaster. In 2021, Jamil retired from Heretic Brewing Company, the 37-barrel Fairfield, California, brewery and distillery he and his wife started in 2010.

Desi Hall had a long career as a chef before becoming a sales associate with The Barrel Mill in Avon, Minnesota. Whether making beer, wine, or finishing spirits, he finds that wood can create endless possibilities of flavor, which encourages his curiosity and drives his search for the perfect craft beverage.

When choosing barrel alternatives, the first thing I consider is availability: Can I get these again if I like them, and how consistent is the product? I also consider volume displacement for the vessel I am using (do I have enough room to add the amount of the alternative I need to achieve the contact rate for aging?). And clean-up: How much work is it to get the alternative out of the vessel? Toast level is another consideration. Lighter toast tends to give the perception of fruit while the darker toast lends more sweet notes (caramel, butterscotch, toffee).

When you're looking for the added flavor and complexity of a spirit along with the oak you should remember to drink the premium spirits and use a good-quality budget brand for soaking your oak alternative. Use the smallest vessel possible to soak a spiral and use only enough liquid to saturate the spiral. The goal is to add spirits to the spiral without leaving anything behind in the soaking vessel, but if there is some left behind it can be added as a liquid oak extract or tossed out.

When considering contact time, depending on the species of wood, you can achieve the desired flavor in as little as 24 hours, but in most cases four weeks will give full extraction from a spiral. Something I tell everyone that wants to use any barrel alternative is to always taste it early and taste it often. Many times brewers get bad results because they wait too long to take the first sample and end up over-oaking.

You can get the oak and spirit flavors from alternatives, but the thing you don't get compared to a barrel is oxygenation. Oxygen has a large effect on the final taste, aroma, and mouthfeel of the finished beverage. There has been a lot of experimentation around micro-oxygenation, and by forcing oxygen into the solution we can get much closer to resembling a barrel.

Of course, barrel alternatives go beyond oak. One of my favorite combinations currently is a pale ale aged on Spanish cedar. The Spanish cedar adds notes of citrus, grapefruit peel, and a light spice.

BY ASHTON LEWIS

YEAST SLANTS

Plus: What exactly is candi sugar and defining “cold crashing”

Q I’VE HOMEBREWED FOR MANY YEARS BUT SHIFTED TO SMALL BATCHES THESE LAST 5 YEARS. I’VE ALWAYS BREWED WITH DRY YEAST DUE TO COST. BUT I WANT TO EXPAND BEYOND ENGLISH ALES AND S-04. I’M GETTING READY TO START MY YEAST BANK AND AM TRYING TO FIND INFORMATION ON PITCH RATES AND SMALL-SCALE YEAST STARTERS. I BREW BATCH SIZES BETWEEN 1–2.5 GALLONS (4–10 L). I’M THINKING I CAN BUY A PACKAGE OF LIQUID YEAST, MAKE 7 OR 8 SLANTS, AND PITCH IN A 2-GALLON (8-L) BATCH AND HAVE ENOUGH TO BREW ALL YEAR WITH THOSE SLANTS.

LEE NAGEL
BRANSON, MISSOURI

A I think I am following your plan and will rephrase so that what follows is clear. You want to buy a single liquid pack, “borrow” a bit to prepare 7–8 slants, and use the balance for your first brew. When you go to brew again, you will take a slant, make a propagation, and then pitch. This is the part that is a bit unclear. Slants are typically used multiple times where an inoculation loop is used to transfer a bit of yeast into a flask with wort or onto a Petri dish. You could use fewer slants, but I will roll with one slant for each brew and offer a hack on saving a step when using the slant.

The short answer is yes; you have a solid plan to reduce yeast costs per brew. For what it’s worth, you can also make slants by starting with a slurry made from dried yeast and treating the same as a liquid culture. This answer may be all the information you need to confirm your plan, but I will take the opportunity to provide more information about what this method looks like to brewers who have not made slants and who may want to give this a try.

Let’s start by defining a slant. In micro jargon, a slant refers to some sort of solid growth media prepared in a test tube that is allowed to solidify at an angle. The growth media is usually made by purchasing powdered media that include nutrients, agar (a carbohydrate that forms a gel after boiling and cooling), vitamins, and minerals. Specialty growth media may contain selective compounds that select for certain organisms, inhibitors that prevent growth of certain microbes, and/or indicators, such as pH indicators and stains, that help microbiologists understand more about what is growing on the media.

In the brewing world, slants are primarily used to store yeast for intermediate durations by applying cells to the surface of the slant with a loop, allowing a “lawn” to grow on the surface of the slant, then transferring to a refrigerator for storage. Slants are often covered with sterile mineral oil to prevent water loss from the media during prolonged storage; this method allows slants to be stored for many years without issue. Because the yeast applied to a slant is typically taken from a pure culture, the most common growth media is wort agar, a general-purpose media commonly used to grow yeast and mold.

A good rule used to determine propagation volume is for the final wort volume to contain 10% yeast slurry. Discussions about microbiology are always done using metric terms, so I will stick to milliliters and liters for clarity. In your case, you will want a prop volume of about 750 mL to pitch a 2-gallon

Photo by Doug Piper

Adding a single colony of yeast from a Petri dish is a common first step in building up a yeast population ready to pitch into wort.

(8-L) batch. I brew 5-gallon (19-L) batches and would need a prop volume of about 2000 mL. I round to convenient volumes because it's much simpler to use increments of 100 or 250 mL when assembling basic lab supplies and these are indeed rules of thumb where close enough works well enough.

I like starting with the pitch volume because that helps plan the propagation schedule. The general method followed for yeast propagation is to use 1:10 dilution steps. In your case, that final 750-mL propagation volume is made by adding 75 mL of growing yeast slurry to 675-mL wort. A quick start to yeast activity is important when propagating yeast, just like it is during beer fermentation, because maintaining sterile conditions is impossible without specialized microbiological equipment and methods. This is true at home and in most yeast labs because of the transfer steps involved. The bottom line: Don't make the first step too dilute because it risks the chance of growing unwanted microbes.

Adding a single colony from a Petri dish to 10–25 mL wort is a typical first step. However, slants have a lawn of yeast, not single colonies. This works to your favor because you can make your first step from slant to wort into 75 mL by picking up the equivalent of about one peppercorn-sized "scoop" of yeast from the lawn. At this point, you can save your slant for another prop or throw it away. You should see yeast activity in your flask within 1–2 days and will want to transfer the entire 75 mL into your 675-mL flask in two to three days. At the end of day five, it's time to pitch into your 2 gallons (8 L) of wort.

For 5-gallon (19-L) brewers like me, our prop volumes are 200 mL and 2000 mL. Going from a slant to 200 mL is too big of a jump, so we need to start out with 20 mL. One way to do this is to make up a 20-mL starter in a flask. Another way is simply pouring 20 mL of wort on top of the slant. For this to work, properly sized test tubes (~50 mL) containing ~15 mL of media are required. This is the time savings hack mentioned earlier.

That's about all the specifics I think are needed to answer your question, though key techniques omitted that readers should be aware of are media preparation, wort/media sterilization, proper use of inoculation loops, and proper transfer techniques. These are all critical for successful micro work. The good news is that none of these methods require much specialized equipment, and they are all relatively easy to perform at the proficiency required for success in the homebrewery.

Q I HAVE A BASIC QUESTION THAT HAS BEEN GNAWING AT ME FOR A WHILE AND SOURCES ONLINE HAVEN'T ANSWERED IT TO MY SATISFACTION. WHAT EXACTLY IS CANDY SUGAR/CANDY SYRUP?

BEN SMITH
AUGUSTA, GEORGIA

A Candy sugar (or "candi" sugar as it is commonly spelled) has a long history in Belgium because of the busy trading port of Antwerp. Until the 19th century, Europe did not produce sucrose, what is now known as table sugar, and relied on sugar imports. According to history about this trade found on Candico's website, Venetian galleys brought the very first cargoes of cane sugar into Antwerp in 1317. And it is in this area where sugar processing in Belgium turned into a specialized industry serving confectioneries, bakeries, coffee cafés, and, of course, breweries.

There are three forms of candi sugar used by breweries: Rock sugars, free-flowing and semi-soft sugars, and liquid sugars (sometimes called candi syrup). Contrary to basic definitions about candi sugar found scattered around the internet, these are not different forms of the same basic raw material. The solid sugars are the oldest types and are what were produced by Belgian sugarmakers for centuries. Chemically, these products are all based on sucrose from sugar cane or sugar beets (sugar beets are what brought sugar to Europe in the 19th century). Sucrose is a disaccharide made up of glucose and sucrose. Unlike maltose, a disaccharide containing two molecules of glucose, sucrose is a non-reducing sugar and is unable to react with amino acids and proteins in the Maillard reaction because the reactive part of glucose that binds with an amino acid in the first step of the Maillard is bound to fructose. This means that when cane and/or beet juice is heated, color development through the Maillard reaction does not happen. This is why colorless sugar crystals can be produced by boiling off sufficient water to result in crystallization.

And this brings us to the first type of candi sugar used by brewers; crystallized cane and/or beet sugar. This type of candi sugar is sold in large, irregular lumps, commonly called rock sugar, or as free-flowing granules. If the latter sounds like common table sugar, it's because they have the same chemical composition. Colorless candi sugar is a handy ingredient to boost beer ABV without adding other flavors or boosting body from unfermentables.

Clear rock sugar can be used for the same purpose but is not commonly used by commercial breweries these days because it takes longer to dissolve and is more difficult to handle. Although rock sugar is not commonly used in commercial brewing, many people associate rock sugar, aka rock candy, with candi sugar. Although crystalline candi sugar and rock candy are both forms of sucrose, some candi sugars contain sugars other than sucrose and are colored.

Colored types of candi sugar either contain molasses and/or are processed to allow color development from Maillard and caramelization reactions. Like the Maillard reaction, caramelization is a non-enzymatic browning reaction. But unlike Maillard browning, caramelization does not require amino acids or reducing sugars. In the case of sucrose, caramelization occurs at temperatures above 338 °F (170 °C). If sucrose syrups are acidified and heated, the bond joining glucose to fructose can be broken to form in-

vert sugar. Because glucose is a reducing sugar and able to react with amino acids above certain pH values depending on the amino acid, Maillard reactions are possible. The bottom line is that a wide range of colors and flavors can be made by adjusting process conditions, making candi sugars more than just a clean source of fermentable sugar.

This is where the range of products grows. Caramelized candi sugar tends to crystallize because sucrose solutions that are hot enough to caramelize also contain too little water to remain liquid when cooled. However, when sucrose is "inverted" by acid hydrolysis and then concentrated, liquid candi syrups can be produced because glucose prevents sucrose crystallization upon cooling. Invert sugars can also be cooked to develop color, often after increasing pH, resulting in a wide range of syrup colors. Table 1 shows differences among candi syrups produced by Tiense Suiker in Belgium.

Table I: Differences among candi syrups and sugars

Measurement	Clear Candi Syrup	Colored Candi Syrups	Soft Candi Sugars
Reducing Sugars	57–63%	44–58%	1–3%
Sucrose	30–38%	42–56%	≥ 94.5%
Water	23.9–25.5%	20.3–21.1%	≤ 2.5%
Color	colorless	300–2700 °L	85–710 °L

Hopefully that sheds some light onto the ins and outs of candi sugar. It's definitely an ingredient that is useful in brewing many Belgian beer styles. Picking the right one is up to you.

Q I'M PRETTY NEW TO THE HOMEBREWING HOBBY SO I'M STILL LEARNING THE LINGO. I KEEP SEEING THE PHRASE "COLD CRASH AFTER FERMENTATION IS COMPLETE" IN MANY RECIPES AND I CAN INFER THAT IT MEANS TO COOL THE BEER QUICKLY. BUT IS THERE MORE TO IT?

IAN O'MALLY
WORCESTER, MASSACHUSETTS

A Cold crashing is a topic that seems to have become hot lately with more and more mentions in social media groups about this catchy brewing term. Like many trending homebrewing topics, cold crashing is a term borrowed from craft brewing jargon.

Back in the old days when lager beers were aged in cold cellars stocked with ice during the winter, cooling from fermentation to cold lager temperatures took time because tanks were air cooled. Lager fermentation and aging practices changed following the advent of commercial cooling in that brewing was not limited to cooler months. However, lager tanks were still air cooled because tanks equipped with cooling jackets and coils had not yet been commercially used for brewing. In the days of air cooling, beer cooling was a slow process where tank temperatures typically dropped just 1–2 °F (0.5–1 °C) per day. This equated to 10–20 days between lager tank filling and arriving at the final lagering temperature. I am focused on lagers here because ale brewing historically did not include deep cooling.

Enter the modern era of brewing beginning in the middle of the last century when stainless steel tanks were first used, and cooling jackets became a common feature. The brewing process started to change where cooling efficiency improved and production times gradually shortened. Although established commercial breweries with cold lager cellars did not abandon their existing cellars, they did begin building fermenters with cooling jackets (as opposed to internal coils) and the use of beer chillers became increasingly common. Fast forward to today, brewers of all types typically cool to 28–34 °F (-2 to 1 °C) before clarification (if performed) and packaging.

Because all modern commercial tanks are equipped with cooling jackets, brewers can rapidly cool a tank from fermentation to cold-aging temperatures in 24–36 hours. Some brewers refer to this practice as deep cooling, because the beer becomes very cold, and others call it crash cooling because it occurs very quickly. "Cold crashing" is a smash up of both terms. What's so special about this process? For the commercial brewers it's all about time and money. In practice, however, some brewers prefer stepping down beer temperatures gradually because of concerns about off-flavors related to shocking yeast during rapid chilling. Whether this is a legitimate concern or not is a different question, but this concern means that not all brewers are in a race against the clock. Aside from time savings, I cannot find any data showing that rapid beer chilling improves beer quality versus slowly chilling to the same temperature.

That's what cold crashing is, but what does it mean to the homebrewer? Unless special effort is taken to slowly reduce the set point of a refrigerator or a fermenter, cold crashing is going to happen at home because our batch sizes are small and cool very rapidly. Brülosophy did an Exbeeriment titled "Cold Crashing Speed: Immediate vs. Gradual in a Munich Helles" in 2020 indicating no sensory difference between the two test beers.

When I was a young brewer, we would say something like "transfer into a keg for secondary, toss the keg into the fridge after fermentation is complete and the pressure is where it needs to be for natural carbonation, wait long enough for the chunky stuff to settle, then enjoy." These days, brewers say "pressure ferment your lagers, forget about secondary because that's what dad did, cold crash it, and tap it." To this grumpy old dude, looks to me like the same basic thing using a more modern name! BYO

BY GORDON STRONG

OLD ALE

An aged British strong ale

There are so many different varieties and examples of old ale that a single definition doesn't really do it justice, style-wise.

OLD ALE
BY THE NUMBERS

OG:	1.055–1.088
FG:	1.015–1.022
SRM:	10–22
IBU:	30–60
ABV:	5.5–9%

Photo courtesy of Shutterstock.com

My understanding of old ales has evolved considerably since I began learning about beer. I used to think of them as smaller English barleywines, but that definition is problematic. Then I thought about them as having some kind of barrel aging or light sourness associated with age, but that also doesn't work in all cases. Finally, I thought they were like English winter warmers, with a chewy malt character, but again, that doesn't fully hit the mark. I guess the problem is that there are so many different varieties and examples of old ale that a single definition doesn't really do it justice, style-wise.

It's not just me that has a problem categorizing old ales. English beer historian Martyn Cornell, writing in *Amber, Gold & Black,* said that old ale is a name given to any strong aged pale or brown beer. He likewise notes that old ale and barleywine meanings have changed over time, with barleywine being a much more recent name applied to stronger beers. Michael Jackson continually called Thomas Hardy's Ale an old ale rather than a barleywine, but he was differentiating not on style parameters or sensory profile, but the aging characteristics of the beer. He too said, "it is not always easy to determine the difference between an old ale and a barley wine" (*New World Guide to Beer,* 1988).

Ray Daniels, in a presentation from the 1997 National Homebrewers Conference, said that there were three types of old ale – strong milds, strong (perhaps darker) bitters, and blended ales. He cited English publican Mark Dorber as the source of this classification. Martyn Cornell likewise suggested in his *Zythophile* blog that there are probably groupings of Burton-style strong ales, darker strong ales, and pale strong ales as types of English strong ale, and that calling them barleywines or old ales wasn't really practical.

So where does this leave me, the humble categorizer of beer styles? Pretty confused, actually. The problem is that beer enthusiasts often have a single example of old ale in mind when they discuss the style, but that these commercial examples don't share a common sensory profile. My solution to this problem was to introduce the British Strong Ale style in the 2015 Beer Judge Certification Program (BJCP) Guidelines, to complement the English Barleywine style. Old Ale became an 'overlay' of these two styles, where an age component or aging potential was evident. Overlay means that the style parameters overlap the other two styles, which is something the guidelines typically tries to avoid.

Old Ale is style 17B in the BJCP Style Guidelines. Contrast this style with styles 17A British Strong Ale and 17D English Barleywine as part of the Category 17 Strong British Ale definition to see that we are talking about beers stronger than milds, bitters, and brown ales, but that are not dark like porters and stouts. As with all things British beer related, there is considerable room for disagreement and discussion.

HISTORY

While the name "old ale" has been used for hundreds of years in England, this shouldn't be taken as an understanding that it represented a style or that it has not changed over time. Old ale was a name given to stronger beers that were stored, aged, or kept. Think of the historical usage of "mild ale" — an unaged, running, or fresh ale, possibly strong. Old ale is the aged counterpart, and is akin to what was called a stock ale in the U.S. — a stronger ale that could be used for blending or to be enjoyed separately.

Some English recipes had versions for keeping (often containing a "K" in the name) that were more highly hopped. I guess this is the beer equivalent of reserve wines, something intended to be cellared (either at the brewery or once released) and enjoyed later.

In more modern times, the name old ale continues to be used but it is not applied consistently to beers with a common profile (or history). Regional differences certainly exist in the U.K., and many examples are fairly unique or idiosyncratic. Think about a malty but unaged beer like Old Peculier, the vatted, aged, somewhat sour Gale's Prize Old Ale, and bottle-conditioned barleywine-like beers such as Fuller's Vintage Ale and Thomas Hardy's Ale. In the craft era, modern attempts at creating New World examples that are inspired by classic versions has further expanded the style, including attempts to simulate age effects with additional ingredients.

The presence of "old" in the name of a commercial example is in no way an indicator whether it is an old ale. The term seems to be a popular name for stronger beers that had been properly aged, but can be found on barleywines and other beers in addition to old ales. The name and notion old ale are certainly English, even if there isn't a consistent usage. Michael Jackson in *Beer Companion* muses that "some call their products old ales, others do not" and talks about multiple variations, while highlighting that it could be aged or merely traditional in style. Roger Protz in *The Taste of Beer* argues that it is a "beer that acquires its maturity, flavor, ripe condition, and smooth flavor by aging."

SENSORY PROFILE

Describing a sensory profile for a style with so many variants is a challenging task, but perhaps we can tackle the problem in a structured way. As defined for judging purposes, an old ale is simply an aged British strong ale. Purists will point out that old ales do not actually have to be aged, but simply suitable for aging, but we are separating these two broad styles based solely on age character.

OLD ALE

(5 gallons/19 L, all-grain)
OG = 1.075 FG = 1.015
IBU = 40 SRM = 21 ABV = 8%

INGREDIENTS

10 lbs. (4.5 kg) U.K. Maris Otter pale ale malt
2.2 lbs. (1 kg) dark Munich malt
8 oz. (227 g) CaraPils® or dextrin malt
2 oz. (57 g) chocolate malt
2 lbs. (907 g) Invert #3 or D-90 candi syrup
10.8 AAU Styrian Golding hops (60 min.) (2 oz./57 g at 5.4% alpha acids)
1 oz. (28 g) First Gold hops (5 min.)
Wyeast 1469 (West Yorkshire Ale), White Labs WLP037 (Yorkshire Square Ale), SafAle S-04 yeast
¾ cup corn sugar (for priming)

STEP BY STEP

This recipe uses reverse osmosis (RO) water. Adjust all brewing water to a pH of 5.5 using phosphoric acid. Add 1 tsp. of calcium chloride to the mash.

This recipe uses a single-infusion mash. Use enough water to have a moderately thick mash (1.5 qts./lb.). Mash the malts at 154 °F (68 °C) for 60 minutes. Raise the temperature to 168 °F (76 °C) and recirculate for 15 minutes. Sparge slowly and collect 6.5 gallons (24.5 L) of wort.

Boil the wort hard for 75 minutes, adding hops at the times indicated in the recipe. Add the sugar during the last 10 minutes of the boil.

When the boil is complete, chill the wort to 68 °F (20 °C), aerate if using liquid yeast, and then pitch the yeast and ferment until complete.

Rack the beer, prime and bottle condition, or keg and force carbonate as usual.

OLD ALE

(5 gallons/19 L, extract with grains)
OG = 1.075 FG = 1.015
IBU = 40 SRM = 21 ABV = 8%

INGREDIENTS

6.8 lbs. (3.1 kg) pale liquid malt extract
1.5 lbs. (0.64 kg) pale Munich malt extract
2 oz. (57 g) chocolate malt
2 lbs. (907 g) Invert #3 or D-90 candi syrup
10.8 AAU Styrian Golding hops (60 min.) (2 oz./57 g at 5.4% alpha acids)
1 oz. (28 g) First Gold hops (5 min.)
Wyeast 1469 (West Yorkshire Ale), White Labs WLP037 (Yorkshire Square Ale), SafAle S-04 yeast
¾ cup corn sugar (for priming)

STEP BY STEP

Use 6.5 gallons (24.5 L) of water in the brew kettle; heat to 158 °F (70 °C). Steep the malt for 30 minutes in a mesh bag, then remove the grains from the kettle. Turn off the heat.

Add the malt extracts and stir thoroughly to dissolve completely. Turn the heat back on and bring to a boil. Boil the wort for 60 minutes, adding hops at the times indicated. Add the sugar during the last 10 minutes of the boil.

When the boil is complete, chill the wort to 68 °F (20 °C), aerate if using liquid yeast, and then pitch the yeast and ferment until complete.

Rack the beer, prime and bottle condition, or keg and force carbonate as usual.

Old ales are stronger-than-average English ales, so they should have an alcohol content higher than bitters, brown ales, and milds, often in the 6–8% ABV range. They are darker than pale, but not black; many are brownish. They tend to have a malty balance, and may have noticeable residual sweetness. Aging can affect this balance, as aged bottle-conditioned beers tend to become drier over time.

As a stronger English ale, the flavor profile will typically feature fruity esters from fermentation, but also developed through age. Complex malty flavors with caramel, toffee, treacle, and molasses can develop, complementing the typical bready, biscuity, nutty base of many English ales. Bitterness can vary, but the balance is often malty-sweet. Some paler examples can have stronger bitterness. Aging also affects how bitterness is perceived.

The maltiness often is accompanied by a medium to full body and a somewhat chewy texture, although this can thin out with age. Carbonation can be moderate and balanced in younger examples, becoming less carbonated over time. Old ales are often described as having a soft texture, in contrast with sharpness. I think of this in how the beer finishes, and the type of aftertaste it leaves – malty, smooth, soft, and warming.

The age character does not have to be extreme, and often can be mistaken with other familiar flavors in English beers, such as caramel and dried fruit. Examples aged for a longer time may develop more positive oxidation notes that suggest Port, Sherry, or Madeira. Commercial versions may be blended and use some barrel aging, which can introduce a light acidity. This is not required, but is also not a fault. Any oxidation notes present should be positive and enjoyable.

If we could define sensory attributes by mood, Michael Jackson may have set the proper tone with this description: "It should be a warming beer of the type that is best drunk in half pints by a warm fire on a cold winter's night." I wouldn't want to see that description on a BJCP scoresheet in a competition, but if you are trying to understand what the style evokes, it's spot on. I personally think of them as tasting like stronger dark milds or unspiced winter warmers. Yes, there are examples that are not like this, but this is what most people will think of if you hand them an old ale.

BREWING INGREDIENTS AND METHODS

Old ale is a traditional English product, so British methods and ingredients are typical. The English brewing tradition uses single-infusion mashes, although many commercial breweries parti-gyle their stronger beers. For homebrewers, single-infusion mashes that produce only old ale are certainly reasonable. Pale ale malt is usually the base, but this can be supplemented with a variety of grains such as corn and wheat. Crystal malt can be used, as can brewing sugars and caramel coloring or simply black malt.

Single-infusion mashes can be conducted in the higher range (154–156 °F/68–69 °C) to produce a more dextrinous beer with a fuller finish. Top-fermenting English ale yeast favoring fruity-malty flavors and not being overly attenuative will work. Water treatments that favor chloride will give a softer finish. English variety hops are common, and the beer may be lightly dry hopped.

The beer can be blended, using a mix of old and new batches, or including batches that have some wood aging. I personally think this is difficult to control, and have had better results from simply designing beers to be aged. I prefer to bottle condition the beers with minimal oxygen uptake and allow natural cellar aging to produce interesting flavors.

Another technique I have used is to develop recipes that have an aged flavor profile when young. Increasing caramel and dark fruit flavors with darker crystal malts or darker invert sugars, while striving for a more balanced finish, will make your beer seem aged. If I expect to drink the beer relatively young, I can take this approach (which is actually how some modern English examples are made). You won't get as complex a final product, but you will get it in a much more reasonable timeframe.

HOMEBREW EXAMPLE

My example is inspired by Harvey's Elizabethan Ale, which I offer in tribute to the late Queen. It is a stronger, darker, malty beer that has aging potential. I'll be using mostly English ingredients but constructing the recipe around the flavor components I want present in the finished beer.

A base of Maris Otter seems natural, but I'll crank up the maltiness and flavor with the completely untraditional use of dark Munich malt. Purists may wish to use brown malt instead, but it will have a different flavor and may remind some of a porter. CaraPils® malt will provide some dextrins, but the color and flavor are from brewing sugars – Invert #3, if you can find it — but a similar Belgian candi sugar if you want. (Note: Invert sugar is a liquid syrup made by hydrolyzing glucose and fructose. It comes in various grades or colors, with #3 being relatively dark and having dark, fruity, caramelized flavors. Becker's is one available brand.) A touch of chocolate malt adds color and nuttiness but shouldn't contribute chocolate flavors.

I'm a fan of Styrian Golding hops, even though they are from Slovenia, not Kent. First Gold is a classic hop that I'm using for a retro feel. Other English-style hops would work too, like Fuggle, Willamette, or Goldings. I'm using a Yorkshire ale yeast, but other malty or fruity strains can be used as substitutes.

When brewing beers of this strength, I normally judge them ready to serve when the alcohol heat is not forward. Typically, this means they can be served young when the residual sweetness is higher, and then aged to develop more complexity over time.

Avoid getting dragged into debates about this style — almost any position you take will have obvious counter-examples. I prefer to focus on modern interpretations and the more common range of examples. Understand that there is a much broader range to this style, and that while it is historical, it never had a good definition. If you are a brewer, you can brew whatever version you enjoy drinking, but if you enter it in a competition, realize that some judges will have a narrower view of this style. Judges should keep an open mind and reward well-made beers that are stronger English ales with some positive age character. BYO

Photo by Charles A. Parker/Images Plus

OAK IT UP

Pros share barrel-aging advice and recipes

by Dawson Raspuzzi

Barrel-aged beers are some of the finest, most complex, and sought-after beers produced. Often imitated, though never truly replicated, oak barrels provide characteristics that are otherwise unobtainable. These come from a slow ingress of oxygen to the aging beer, flavors and tannins from toasted oak, as well as character from the spirit or other beverage that was previously aged in the barrel.

Often requiring a minimum of a year in the barrel — and sometimes much more — the resulting beers undergo a loss of water through evaporation and gain additional alcohol and flavor from the spirit previously aged in the barrel. They regularly push double-digit alcohol levels and are bursting in flavors; perfect for slow sipping and deep contemplation.

With the required investment in time, it's important to get barrel aging right. So, with the help of four professionals who regularly release some of the best wood-aged examples around, we explore the technique of barrel aging.

COREY ARTANIS

Co-Founder and Director of Brewing and Blending
3 Sons Brewing Co.
(Dania Beach, Florida).

SEAN BUCHAN

Co-Founder and CEO
Cerebral Brewing
(Denver, Colorado).

PAUL GRENIER

Co-Owner and CEO
Mortalis Brewing Co.
(Avon, New York).

JORDAN ZIEGLER

Vintage Barrel Master
Firestone Walker Brewing Co.
(Paso Robles, California).

How big is your barrel program and what styles have you barrel-aged?

Corey: We average an annual production of 150 barrels. We generally barrel-age stouts and barleywines, but have aged a Baltic porter, strong ale, imperial sour, and we currently have a wild ale in wine barrels.

Sean: We have 130 barrels in our clean program and 35 in our wild program, along with two 15-bbl mixed-culture foeders. The bulk of our barrel aging program is focused on barrel-aged imperial stouts, but we also dabble in barrel-aged barleywines as well as saison and other wild ales. Recently we've been enjoying working with barrel-aged lagers. In 2022, we took home a gold medal at the Festival of Barrel Aged Beers for a Chardonnay barrel-aged helles (check out a clone recipe for this beer on page 31). As one of our favorite adjuncts, we're always experimenting with new and unique barrel blends.

Paul: We have around 50 barrels right now and we are aging everything from imperial stouts to barleywines and even some fruited sours.

Jordan: We currently have a little over 1,000 casks filled in our program, which is roughly about 1,650 barrels in liquid. Over the years the styles that we have aged in barrels range from imperial stouts, milk stouts, imperial brown ale, smoked porter, blonde barleywine, imperial extra special bitter, browniewine, Munichwine, wheatwine, Baltic porter, Belgian quadrupel, and even Oktoberfest that is aged in wine barrels (*BYO* ran a clone recipe for Oaktoberfest in the March-April 2023 issue, online at: www.byo.com/recipe/firestone-walker-brewing-co-s-oaktoberfest-clone).

What attributes does barrel-aging add to a beer?

Corey: So many! Each depending on what previously aged in the barrel and for how long, the type of wood the barrels are made of, barrel size, char level, and how long you rest the beer in the barrel. All of these variables will enhance the flavor pro-

file, aroma, and texture of the beer in different ways.

Sean: When we choose to age a beer in a barrel we're typically looking for three things — spirit character (assuming it's a freshly dumped barrel), oak, and micro-oxidation. All three of these elements take time to develop, so it's important to taste along the way in order to track them. Barrel age statements will have significant impacts on both spirit and oak, so it's important to know what was aging in the barrel beforehand and for how long. Micro-oxidation is our tool to round out the sharp edges on our beer and develop deep, complex flavors, but if left for too long this can become a detriment.

Paul: That really depends on the barrel. You can get everything from cherry, oak, extreme tannins, vanilla, and so on. I think the better question is what attributes you are looking for, because I bet you could find a barrel to add those flavors!

Jordan: Oh, man. Where to start, ha! The beers that we design for barrel aging come out of the fermenter a bit blocky and rough around the edges but end up rounded out and balanced after resting in barrels for 12 months or longer. The char from the barrel offers carbon filtration of the beer as it rests over time. After 2–4 months you can notice a significant ABV increase from the booze inside the barrel, usually around 2–5% by volume depending on how freshly dumped the barrel was by the distillery. Around the 6–12 month mark you start to see the compounds from the oak start to shine: Vanillin provides notes of natural vanilla, lactones (trans and cis) give us notes of coconut. Furfurals (5-methyl and 5-hydroxymethyl) give off notes of toasted bread, butterscotch, and caramel. Finally, eugenols (trans and cis) give off hints of spice and clove.

What checks and preparation do you put barrels through prior to filling them with beer?

Corey: We buy our barrels from reputable brokers who put the barrels through a series of tests and fortunately we don't have many issues with them. When we receive our barrels, we make sure the bungs haven't been knocked out and there's no serious physical damage. If the barrels have to sit for several weeks, we will rehydrate them by standing them up on their head, soak with hot water for 10–15 minutes, flip over and repeat to the other end. The biggest issue we've had with barrels are the ones with head bungs (rum and brandy barrels). It's always good to add some barrel wax around a head bung before you fill them as a precaution.

Sean: We typically receive freshly dumped barrels and aim to fill them as quickly as possible. Before filling, we give each barrel a once-over to ensure there is no structural damage that could cause problems for us later and a quick sensory evaluation after we take the bung out. After that we're good to purge them with CO_2 and fill with beer.

Paul: Getting them fresh is super important. After you work with a trusted broker for some time you can eliminate some variables like if the broker does pressure testing, but we always test the barrel heads for a while to make sure they can hold liquid on top of the barrel and it's not soaking into the barrel.

Jordan: I usually start with a visual inspection on the outside of the barrel for cracks in the staves or gaps in the heads where the chime and croze meet. If I find anything that I suspect will leak liquid I can use wax or putty to seal it up. A hot rinse goes a long way to not only swell the barrel staves, but to get rid of any mold and grime that's on the outside of the barrel during aging at the distillery. After the hot rinse I take a pitcher mixed with iodine and water and scrub the area surrounding the wooden bung, followed by a few heavy sprays of 70% isopropyl. This allows me to sanitarily remove the wooden bung to inspect the inside of the barrel and insert a new rubber bung before filling with beer.

Photo by Christian Lavender

When buying a used barrel, the more recently it was emptied, the better. Give it a visual inspection, smell the inside, and give it a hot rinse to swell the barrel and check for leaks prior to filling.

What's the typical lifespan of a barrel that arrives at your brewery look like?

Corey: We only use them once here. Not to say you can't use them more than once, but that's our practice.

Sean: Most barrels are only used once in our clean barrel program. American oak whiskey/Bourbon barrels are much more porous and thus, allow more oxygen ingress than French oak wine barrels. That extra oxygen can lead to off-flavors like acetic acid in mixed-culture beers, so we typically don't move them to our wild program after they've finished aging a barrel-aged stout or barleywine. Wine barrels in our wild program, on the other hand, will get used until we're not happy with the character of the culture within it — often seeing 4–6 uses before they're retired. We could easily go beyond that in many cases, but we're constrained on space, so we'll often retire barrels to allow us to bring in fresh barrels with more wine character.

Paul: The vast majority of our barrels are single use and don't get reused in the aging process. However, if we find something special or are looking for a special flavor, we have been known to double barrel a beer or swap barrels in the process.

Jordan: Spirit barrels are only filled once with beer. We usually sell our spent spirit barrels to a cooperage or a broker once emptied, or we give them away to fellow employees for miscellaneous projects. We also use medium-toast American oak barrels to ferment our Unfiltered Double Barrel Ale in the Firestone Walker Union system, and each barrel can be filled up to 32x times before being retired and considered "neutral." Once the Union barrels are considered neutral, we ship them down to our sour facility (Firestone Walker Barrelworks) for sour beer production.

When in the process do you add the beer to barrel?

Corey: We transfer our stouts and barleywines to the barrels after the beer has reached terminal gravity and post centrifuge.

Sean: On our clean side, we go through primary fermentation then transfer to a brite tank for conditioning for an additional week or so. At that point we begin to check cell counts and when we're below 5–10 million cells/mL we're ready to fill.

The process is quite different for our wild beers. We have some that are barrel-fermented and others that see a primary fermentation in stainless with *Saccharomyces*, then see the addition of one of our mixed-cultures at the point of filling. It's one of the reasons we love our wild program so much — there are so many individual variables you can change to achieve different results.

Paul: After we have checked the barrel and it meets our standards, the beer can be added. This happens after final fermentation is completed. We typically do not ferment in barrels.

Jordan: Cold side. I like to crash cool/condition the beer for at least five days before sending it to barrel. Crashing the beer will allow yeast and trub to settle out, and I like to dump that stuff out of the tank the day before filling barrels to avoid developing off-flavors or autolysis during the aging process.

What is the range of time you've aged beer in barrel, and what factors impact that time?

Corey: We typically age our stouts and barleywines 18–28 months. The biggest factor is flavor pickup. The beer is ready when it tastes ready.

Sean: We currently have one Bourbon barrel that's been home to an imperial stout for nearly 60 months. While it's certainly an outlier, we do tend to target longer aged barrels for our imperial stout program. Our average age is around 24–28 months for most releases while our Endeavor bottle members are likely to see 30+ month age statements fairly frequently.

We live in a very dry climate so aging beer this long often leads to pretty significant loss. When we empty a 53-gallon (200-L) barrel after 2–3 years of aging we're typically losing about 25% of the product that we put in.

Paul: We have learned so much over the years in this process. Especially when you consider so many variables

Photo Christian Lavender

A stainless steel nail that can be removed and reinserted in the head of the barrel is a great way to draw samples of the aging beer inside. Frequent sampling is critical for smaller barrels that will draw out the flavor of the oak much more quickly than a full-size barrel.

like climate control, temperature change, age of the barrel, what's going inside, what flavors are you looking for, who your barrel broker is, how fresh the barrel was. I could talk for hours on this because of the significant impact of these variables. For an imperial stout, we start looking at it after 14–18 months and see how it evolved over time and then try to plan a course after that.

Jordan: 12-24 months is our sweet spot for most of our barrel-aged beers, although we have gone longer. Since the Bourbon barrels allow micro-oxygenation into the beer, the more time in the barrel means more dissolved oxygen getting into the beer. At some point the compounds from the oak become saturated. In our experience, we seem to achieve our desired extraction from the barrel sometime in that second year in barrel.

Is your barrel room temperature-controlled? What temperature range/humidity/etc. should a homebrewer try to achieve for barrel-aged beers?

Corey: Our barrel room temperature fluctuates between 75-85 °F (24–29 °C). No humidity control. When I used to barrel age my homebrew I really didn't worry about temperature range/humidity/etc., mostly because the barrels I used were 5- to 15-gallons (19- to 57-L), so the time in barrel was quite short and those things didn't affect the beer as much. I would definitely suggest aging at warmer temperatures vs. colder, if it's an option. Also, if there's somewhere you can age that has big swings in temperature from night-to-day, this will help expand and contract the beer inside the barrel, thus giving you more flavor pickup.

Sean: Our barrel rooms are temperature controlled between 65–75 °F (18–24 °C), but that's mostly due to the fact that they're located in the same buildings as our taprooms. The temperature and humidity levels you target should be dictated by your goals for the beer. Larger temperature and humidity swings will cause the beer to pull into and out of the oak and often speeds up the development of barrel character. Smaller swings in those variables are going to keep the beer on a more consistent, but possibly slower, path to developing the flavor profiles you're after.

Paul: Our barrel aging facility is not really temperature controlled. We really love it when the warmer months expand the oak staves to absorb more beer and when the colder months contract to push that beer back into the barrel carrying with it some of those amazing flavors in that oak.

Jordan: We keep our barrel room at 50 °F (10 °C) all year round. Keeping our barrel room at a constant temperature eliminates temperature fluctuations and contracts the barrel, allowing the beer to penetrate deeper into the staves for a cleaner extraction. As a homebrewer I would just try to keep it in a cool, dark place that has the least amount of temperature fluctuations.

Have you used oak spirals/cubes/other barrel alternatives to amplify the oak character when barrels go neutral (or for other reasons)?

Corey: Negative. I have used some spent Black Swan honeycomb barrels for aging and they were quite nice. Black Swan mills a honeycomb-like pattern in the barrel staves to increase the internal surface area, thus speeding up the aging process.

Sean: We've used amburana (a Brazilian hardwood) spirals with great success several times. These were added to the brite tank after barrel aging to add additional character. While we could source amburana barrels, they're extremely expensive and it's much easier to dial in the desired flavor profile on an intense wood type like amburana using something like spirals.

Paul: Our current process really doesn't utilize cubes or spirals. We have found the best results come with time and fresh barrel selection.

Jordan: We use a lot of different oak spirals, staves, and barrel bung inserts to amplify our beers. I just made a beer called ParAmburana that I infused with amburana oak from Brazil, which gave off a lot of confectionary notes like gingerbread, snickerdoodle cookies, and autumn spices to the beer. I am also working on a triple-oaked barleywine that has been aged in rye whiskey barrels with single-forest French oak barrel bung inserts added, and then finished in red wine French oak barrels. The possibilities are endless with wood products.

What should homebrewers keep in mind when working with smaller (5-15 gallon/19–57 L) barrels?

Corey: On 5-gallon (19-L) barrels I would taste a sample two weeks in and continue to taste every 4–5 days thereafter until you're happy. With 10- to 15-gallon (38- to 57-L) barrels I would usually taste a month in and every week thereafter. Lastly, source local/fresh barrels whenever possible!

Sean: The most important thing to consider with barrel sizes is that the smaller you go, the larger the surface area-to-beer ratio. This means you'll have a much more significant flavor impact on a beer aged in smaller barrels than you will one aged in a larger one. Sometimes this can give you your desired flavor profile faster, but it can also lead to over-extraction and ruin the balance of your beer if you aren't careful.

Paul: We still use some smaller format barrel today! Those 5- to 15-gallon (19- to 57-L) barrels are awesome; the best advice I could give is that they take less time and to taste them often. Usually, you get a lot of spirit flavors from them depending on the previous occupant, so it's important to understand that when crafting those liquids going inside.

Jordan: Unfortunately, I do not have any experience aging beer in 5-15 gallon barrels. I, personally, would use oak staves to infuse my homebrew at that scale. You can get some decent oak character after aging on staves for 6–8 weeks.

Other than stouts in Bourbon barrels, are there other beer style/barrel combinations that you're particularly fond of?

Corey: Barleywine in Bourbon barrels!

Sean: We love playing with specialty barrels for our imperial stouts — some of our favorites include rum, apple brandy, BLiS Maple Syrup Bourbon, and XO Cognac. On the mixed-culture side, we've really enjoyed the interplay of saison with the herbal elements of spirits like Rhum Agricole and Tomcat Gin.

Paul: We love our rum barrels at Mortalis. Nothing gets me going quite like designing a new Tiki cocktail in beer format with a Hydra base. We have also been known to dabble with pear brandy from time to time as well.

Jordan: Barleywines aged in rye whiskey barrels have really caught my attention lately. I like to work with barleywines because they tend to have varying levels of sweetness and malt depth, which makes them a great candidate for blending. You can blend in a sweeter beer to amplify another beer that seems too dry or lacking definition on the finish.

What qualities in a beer make it a good candidate for barrel aging?

Corey: I like a lower roast stout with higher final gravity (FG). I feel the lower level of roast is more approachable/palatable and the higher FG will help balance the alcohol pickup from the barrel. So, use debittered roasted malts as a substitute for black malt and roasted barley. You also want to keep your IBUs on the lower side for balance; 40–45, sometimes lower. Play around with it.

Sean: The key to designing beers for successful barrel aging is planning for the future. Our barrel-aged stouts, for example, are designed with more hop bitterness and roasted black or chocolate malts knowing that the bitterness will fade over time and the roasted flavors will mellow out and become more complex. We purposefully design our clean barrel-aged beers to have harder edges at first, so don't be discouraged if you don't love how your beer tastes going into barrel. Off-flavors do not, however, diminish with age — so make sure your fermentation is healthy and complete.

Paul: Gravity is super important in this process. Understand that barrel aging can thin a beer out and that it might not have quite the viscosity it had going into the barrel as coming out of the barrel so plan accordingly and brew a thick beer to help it survive the long slumber.

Jordan: I aim to have the finishing gravity on my barrel beers to stall out significantly higher than a normal beer, usually around the 8–14 degrees Plato (1.032-1.056 specific gravity). I feel it's important to have some sweetness and malt depth to balance

out the flavors imparted from the barrel. You also want to have a higher ABV going into the barrel compared to most normal homebrews. Alcohol is one of the main drivers behind the extraction of the compounds from the oak, the more ABV going in means more extraction.

When do you make adjunct additions (whether it's coffee, fruit, or a full-on pastry stout) in barrel-aged beers?

Corey: For adjunct beers we add everything post barrel aging. I feel tasting a beer after aging gives me a clearer picture of what adjuncts will pair best with the final blend, or unblended flavor profile of the beer. Viscosity, oak, roast, alcohol, and sweetness all play big rolls when deciding adjuncts.

Sean: Nearly all of our adjunct additions are post barrel aging, with the exception of vanilla. Vanilla beans are hand-processed and dosed in the barrel, typically at a rate of 0.5–1 lb. (220–450 g) per oak barrel. This allows for greater exposure time and, ultimately, a more nuanced and complex vanilla character. Adjuncts like coconut, cacao nibs, nuts (almond, macadamia, pecans, etc.) are all added post barrel aging in our adjunct dosing vessel. This tank is essentially a mobile brite tank with a false bottom that allows us to steep or recirculate on ingredients without clogging our pump. Coffee gets the same treatment but we get the beer as cold as we can in order to limit oxidation-derived off-flavors (think green pepper/jalapeño).

Adding ingredients post barrel aging allows us to maximize their impact and achieve a much fresher flavor profile of your targeted adjuncts.

Paul: 95% of those additions are done after the barrel aging process is complete for us. This really allows you more control of flavors you want to bring to the beer without going too far in one direction and not being able to come back.

Jordan: We add our adjuncts post barrel aging. A lot of the aromas from the adjuncts are very volatile and are usually the first to fade over time. I want to add them on the back end so I can allow them as much opportunity to be bright and aromatic. I feel like if you were to add adjuncts prior to aging they can become over extracted or even muted. Our preferred method is steeping/recirculating the adjuncts, which allows us to monitor the progress and taste each addition along the way.

ON TO THE RECIPES

We've soaked up a lot of advice from our pros, and now it's time to put it to use. Following are clone recipes graciously provided to us by each of these brewers. While each is aged in barrel at the commercial level, and intended as such even for smaller batches, homebrewers have the option of going the easier route of using oak alternatives.

3 SONS BREWING CO.
DANIA BEACH, FL

3 SONS BREWING CO.'S SUMMATION CLONE

(5 gallons/19 L, all-grain)
OG = 1.154 FG = 1.074
IBU = 40 SRM = 60 ABV = 10.5%*

The easiest way to replicate this huge beer on a homebrew scale is with an extended boil and the addition of malt extract to assist in hitting the high gravity. As you can see in the recipe, Director of Brewing Operations Corey Artanis loves to layer lots of different malts in imperial stouts for added complexity. This is the base recipe for Summation, which 3 Sons often brews variations of with added flavors like coffee, vanilla, and more. If you wish to create a variation with adjuncts, add after barrel aging.

**ABV calculated prior to barrel aging. At 3 Sons, this beer usually finishes close to 13% after 18–28 months in barrel.*

INGREDIENTS

6 lbs. (2.7 kg) dark dried malt extract
4.4 lbs. (2 kg) 2-row pale malt
4.4 lbs. (2 kg) Maris Otter malt
4.4 lbs. (2 kg) Golden Promise malt
1.9 lbs. (0.9 kg) flaked oats
1 lb. (0.45 kg) chocolate malt
14 oz. (400 g) caramel Munich malt (60 °L)
14 oz. (400 g) crystal malt (40 °L)
14 oz. (400 g) crystal malt (80 °L)
8 oz. (225 g) wheat malt
5 oz. (140 g) Weyermann Carafa® Special III malt
5 oz. (140 g) Briess Blackprinz® malt
5 oz. (140 g) Briess Midnight Wheat malt
12.6 AAU Columbus hops (120 min.)
(0.9 oz./26 g at 14% alpha acids)
Yeast nutrient
Wyeast 1318 (London Ale III), Omega OYL-011 (British Ale V), or LalBrew Verdant IPA yeast
LalBrew CBC-1 (if priming)
¾ cup corn sugar (if priming)

STEP BY STEP

It is recommended that you repitch yeast from a previous batch of beer for adequate pitch rates. If that is not easily attainable, a large yeast starter made up in advance (if using a liquid yeast strain) or pitching 3 sachets of dried yeast is recommended.

Mash the grains with a liquor-to-grist ratio of 1.15–1.25 qts. per lb. (2.4–2.6 L/kg) at 158 °F (70 °C) for 60 minutes. Vorlauf until the runnings are clear of particles then start the burner and run off into kettle. Sparge to collect 8 gallons (30 L). Boil for 2 hours, adding hops at the start of the boil. Add the dried malt extract in the last 10 minutes of the boil. Check the gravity and, if needed, add additional extract to bring it up to 1.154.

Chill to 65 °F (18 °L) and add yeast nutrient according to manufacturer's instructions. If using a liquid yeast, you will need to aerate extremely well and pitch plenty of healthy yeast. Ferment at 68–70 °F (20–21 °C).

When fermentation is complete and gravity has stabilized for 3–4 days, drop temperature to 52 °F (11 °C). Drop yeast or rack beer off of it into a secondary vessel purged with CO_2. Hold for an additional 5–6 days in secondary and allow to rise to ambient temperature. Rack into a 5-gallon (19-L) Bourbon barrel purged with CO_2, leaving just a little head space. Allow your taste to guide you in how long to keep the beer in the barrel, first tasting after a week or two. When ready, rack to a keg and force carbonate or bottle. If bottling, pitch a cask-conditioning yeast such as LalBrew CBC-1.

3 SONS BREWING CO.'S SUMMATION CLONE

(5 gallons/19 L, extract with grains)
OG = 1.154 FG = 1.074
IBU = 40 SRM = 60 ABV = 10.5%*

INGREDIENTS

6 lbs. (2.7 kg) dark dried malt extract
6 lbs. (2.7 kg) Maris Otter liquid malt extract
3 lbs. (1.4 kg) light dried malt extract
1.5 lbs. (0.68 kg) wheat liquid malt extract
1 lb. (0.45 kg) chocolate malt
14 oz. (400 g) caramel Munich malt (60 °L)
14 oz. (400 g) crystal malt (40 °L)
14 oz. (400 g) crystal malt (80 °L)
5 oz. (140 g) Weyermann Carafa® Special III
5 oz. (140 g) Briess Blackprinz® malt
5 oz. (140 g) Briess Midnight Wheat malt
12.6 AAU Columbus hops (120 min.)
(0.9 oz./26 g at 14% alpha acids)
Yeast nutrient
Wyeast 1318 (London Ale III), Omega OYL-011 (British Ale V), or LalBrew Verdant IPA yeast
LalBrew CBC-1 (if priming)
¾ cup corn sugar (if priming)

STEP BY STEP

Place the crushed grains in a muslin bag (or two muslin bags so they are not packed in tightly) and submerge in 6.5 gallons (25 L) water as it heats up to 170 °F (77 °C). When that temperature is achieved, remove grain bag, allowing to drip into the kettle. With the heat turned off, stir in the malt extract until dissolved. Return to heat and bring wort to a boil. Boil for 60 minutes, adding hops at the start of the boil. Follow cooling, fermenting, aging, and packaging instructions in the all-grain recipe.

Tips for Success: To time your barrel aging correctly with smaller barrels you'll need to sample regularly after the first couple weeks in the barrel. Artanis recommends buying 2-inch (5-cm) stainless finishing nails and drilling a hole into the center of the head of the barrel BEFORE you fill it for easy access to pulling samples. Hammer a sanitized, stainless steel finishing nail in the hole and fill the barrel. After pulling samples, spray the nail with some isopropyl to sanitize before re-inserting it.

Oak chips soaked in Bourbon can be used to finish the beer on the homebrew scale if you do not have a barrel. Age the chips in just enough Bourbon to cover them for a week, and then add the chips to the beer for another week or more. Consider adding the Bourbon too.

CEREBRAL BREWING CO.'S STANDARD PRACTICE CLONE

(5 gallons/19 L, all-grain)
OG = 1.045 FG = 1.007
IBU = 19 SRM = 5 ABV = 5%

Stouts and barleywines aren't the only styles you should consider aging in barrels. This helles lands on the other end of the flavor intensity threshold and is perfect for any occasion. This beer received a gold medal in 2022 at the Festival of Barrel Aged Beers.

INGREDIENTS

7.5 lbs. (3.4 kg) Weyermann Barke® Pilsner malt
1.5 lbs. (0.68 kg) Weyermann Barke® Munich malt
5.5 oz. (155 g) Weyermann Carafoam® malt
2 oz. (56 g) rice hulls
2.5 AAU Hallertau Hersbrucker hops (90 min.)
(1.5 oz./42 g at 1.7% alpha acids)
1.7 AAU Hallertau Hersbrucker hops (30 min.)
(1 oz./28 g at 1.7% alpha acids)
SafLager W-34/70, Wyeast 2124 (Bohemian Lager),
or White Labs WLP830 (German Lager) yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Use enough water to have a moderately thick mash at 1.4 qts./lb. (2.9 L/kg). Cerebral uses rice hulls to help the lauter, though depending on your system this may not be necessary. If using, a small amount should do. Mash your grains at 149 °F (65 °C) for 60 minutes. Sparge slowly and collect enough wort to result in 5.5 gallons (21 L) after a 90-minute boil. Boil wort 90 minutes, adding hops at the times indicated in the recipe.

When the boil is complete, chill wort to 50 °F (10 °C) and pitch yeast. Ferment at this temperature. When fermentation is complete, lager at as close to freezing temperature as possible for four weeks and then rack to a freshly emptied Chardonnay barrel. Lager further, in the barrel, for an additional six weeks.

Rack the beer, prime and bottle condition, or keg and force carbonate as usual.

CEREBRAL BREWING CO.'S STANDARD PRACTICE CLONE

(5 gallons/19 L, extract with grains)
OG = 1.045 FG = 1.007
IBU = 19 SRM = 5 ABV = 5%

INGREDIENTS

4.8 lbs. (2.2 kg) Pilsner liquid malt extract
1 lb. (0.45 kg) Munich dried malt extract
5.5 oz. (155 g) Weyermann Carafoam® malt
2 oz. (56 g) rice hulls
2.5 AAU Hallertau Hersbrucker hops (90 min.)
(1.5 oz./42 g at 1.7% alpha acids)
1.7 AAU Hallertau Hersbrucker hops (30 min.)
(1 oz./28 g at 1.7% alpha acids)
SafLager W-34/70, Wyeast 2124 (Bohemian Lager),
or White Labs WLP830 (German Lager) yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Add the crushed Carafoam® to a steeping bag put it in 6.5 gallons (24.5 L) of water in the brew kettle. Heat to 170 °F (77 °C). When temperature is achieved, pull the grains, allowing them to drip back into the kettle, and continue heating up to a boil. Turn off the heat. Add the malt extract and stir thoroughly to dissolve completely. You do not want to feel liquid extract at the bottom of the kettle when stirring with your spoon. Turn the heat back on and bring to a boil.

Boil the wort for 60 minutes, adding hops at the times indicated. When the boil is complete, chill wort to 50 °F (10 °C) and pitch yeast. Ferment at this temperature. When fermentation is complete, lager at as close to freezing temperature as possible for four weeks and then rack to a freshly emptied Chardonnay barrel. Lager further, in the barrel, for an additional six weeks.

Rack the beer, prime and bottle condition, or keg and force carbonate as usual.

Tips for Success: If you can't get your hands on a freshly emptied Chardonnay barrel, soak oak chips, cubes, or other barrel alternative in enough Chardonnay to cover for a few days. Add the oak to your lagering vessel and continue lagering six weeks prior to racking off the oak.

MORTALIS BREWING COMPANY
ESTD. MMXVII

MORTALIS BREWING CO.'S OPHION CLONE

(5 gallons/19 L, all-grain)
OG = 1.160 FG = 1.068
IBU = 25 SRM = 85 ABV = 12%*

This is a huge beer that requires a huge amount of fermentables and an extended boil to hit the target gravity. An oversized mash tun that can handle 23 lbs. (10 kg) of grain will be required to brew a 5-gallon (19-L) batch. An alternative is to sub out some or all of the base grain with malt extract. This is the base recipe for Ophion, which Mortalis has released numerous variants of over the years with differing aging times and occasional adjunct additions like vanilla beans, coconut, and more.

**ABV is calculated prior to barrel aging.*

INGREDIENTS

10 lbs. (4.5 kg) Briess 2-row pale malt
2.75 lbs. (1.2 kg) Crisp Maris Otter malt
2.5 lbs. (1.1 kg) maltodextrin
2.5 lbs. (1.1 kg) black patent malt
1.75 lbs. (0.8 kg) caramel malt (60 °L)
1.25 lbs. (0.6 kg) Weyermann Carafoam®
1.25 lbs. (0.6 kg) flaked barley
1.25 lbs. (0.6 kg) flaked oats
12 oz. (340 g) Briess chocolate malt
12 oz. (340 g) Crisp brown malt
4 oz. (110 g) roasted barley
8 oz. (230 g) rice hulls
Dextrose (if needed to boost gravity)
7.5 AAU Warrior hops (60 min.)
(0.5 oz./14 g at 15% alpha acids)
2.5 AAU Willamette hops (30 min.)
(0.5 oz./14 g at 5% alpha acids)
Yeast nutrient
SafAle US-05, Wyeast 1056 (American Ale),
or White Labs WLP001 (California Ale) yeast
LalBrew CBC-1 (if priming)
¾ cup corn sugar (if priming)

STEP BY STEP

It is recommended that you repitch yeast from a previous batch of beer for adequate pitch rates. If that is not easily attainable, a large yeast starter made in advance (if using a liquid yeast strain) or pitching 3 sachets of dried yeast is recommended.

Mill in the grains and add rice hulls to avoid a stuck mash. Mash the grains at 158 °F (70 °C) for 60 minutes. Adjust mash PH 5.3 if necessary. Vorlauf until the runnings are clear of particles, then start the burner and run off into kettle. Sparge to collect 10 gallons (38 L). Boil for 4–5 hours, depending on evaporation rate, with the intent of transferring about 5.5 (21 L) gallons into the fermenter. Add hops at times indicated and the maltodextrin near the end of the boil. Take a gravity reading near the end of the boil, and if gravity is low add dextrose as needed to achieve the 1.160 gravity before the end of the boil.

Chill to 65 °F (18 °L) and add yeast nutrient according to the manufacturer's instructions. If using a liquid yeast, you will need to aerate extremely well and pitch plenty of healthy yeast. Ferment at 68–70 °F (20–21 °C).

When fermentation is complete and gravity has stabilized for 3–4 days, drop temperature to 52 °F (11 °C). Drop yeast and rack into a secondary vessel purged with CO_2. Hold for an additional 5–6 days in secondary and allow to rise to ambient temperature. Rack into a 5-gallon (19-L) Bourbon barrel purged with CO_2, leaving just a little head space. Allow your taste to guide you in how long to keep the beer in the barrel, first tasting after a week or two. When ready, rack to a keg and force carbonate or bottle. If bottling, pitch a cask-conditioning yeast such as LalBrew CBC-1.

MORTALIS BREWING CO.'S OPHION CLONE

(5 gallons/19 L, extract with grains)
OG = 1.160 FG = 1.068
IBU = 25 SRM = 85 ABV = 12%*

INGREDIENTS

6.5 lbs. (2.9 kg) light liquid malt extract
2 lbs. (0.9 kg) Maris Otter liquid malt extract
1.5 lbs. (0.68 kg) Munich dried malt extract
2.5 lbs. (1.1 kg) maltodextrin
2.5 lbs. (1.1 kg) black patent malt
1.75 lbs. (0.8 kg) caramel malt (60 °L)
1.75 lbs. (0.8 kg) Weyermann Carafoam®
12 oz. (340 g) Briess chocolate malt
4 oz. (110 g) roasted barley
Dextrose (if needed to boost gravity)
7.5 AAU Warrior hops (60 min.)
(0.5 oz./14 g at 15% alpha acids)
2.5 AAU Willamette hops (30 min.)
(0.5 oz./14 g at 5% alpha acids)
Yeast nutrient
SafAle US-05, Wyeast 1056 (American Ale),
or White Labs WLP001 (California Ale) yeast
LalBrew CBC-1 (if priming)
¾ cup corn sugar (if priming)

STEP BY STEP

Place the crushed grains in a muslin bag (or two muslin bags so they are not packed in tightly) and submerge in 6.5 gallons (25 L) water as it heats up to 170 °F (77 °C). When that temperature is achieved, remove grain bag, allowing to drip into the kettle. With the heat turned off, stir in the malt extract until dissolved. Return to heat and bring wort to a boil.

Boil for 60 minutes, adding hops at the start of the boil and maltodextrin in the final 10 minutes. Take a gravity reading near the end of the boil, and if gravity is low add dextrose as needed to achieve the 1.160 gravity before the end of the boil time.

Follow cooling, fermenting, aging, and packaging instructions in the all-grain recipe.

FIRESTONE WALKER BREWING CO.'S PARABOLA CLONE

(5-gallons/19 L, all-grain)
OG = 1.106 FG = 1.032
IBU = 45 SRM = 70 ABV = 10%*

Parabola is arguably Firestone Walker's most notorious barrel-aged beer and is released as a vintage beer each year. This imperial stout is thick with bold yet balanced flavors of chocolate, charred oak, vanilla, black cherry, and coffee.

**ABV calculated prior to barrel aging.*

INGREDIENTS

15 lbs. (6.8 kg) Golden Promise pale malt
2.6 lbs. (1.2 kg) crystal malt (20 °L)
1.8 lbs. (0.8 kg) Briess roasted barley
1.1 lbs. (0.5 kg) crystal malt (80 °L)
14.4 oz. (410 g) Simpsons Crystal Dark malt
11.3 oz. (320 g) oat malt (with husk)
8.8 oz. (250 g) Chocolate malt
8.8 oz. (250 g) Weyermann Carafa® III malt
Malt extract or brewers crystals (if needed to boost gravity)
8.3 AAU Hallertau Tradition hops (60 min.)
(1.5 oz./42 g at 5.5% alpha acids)
8.3 AAU Hallertau Tradition hops (30 min.)
(1.5 oz./42 g at 5.5% alpha acids)
1.5 oz. Hallertau Tradition hops (0 min.)
White Labs WLP007 (Dry English Ale), Wyeast 1098
(British Ale Yeast), Imperial A01 (House), or SafAle S-04 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Mash the grains at 145 °F (63 °C) for 30 minutes and then ramp to 151 °F (66 °C) until conversion is complete. A single-infusion mash could also be done at 149 °F (65 °C). Vorlauf until your runnings are clear, then run off into the kettle. Sparge the grains and top up as necessary to obtain approximately 6.5 gallons (25 L) of wort (depending on evaporation rate, this may be higher or lower for your system).

Boil for 90 minutes, adding hops as per the schedule. With 10 minutes remaining in the boil, take a gravity reading. If short, add malt extract or brewers crystals to bring the gravity up to 1.106. This is a preferred method vs. extending the boil.

Chill to slightly below fermentation temperature, about 63 °F (17 °C). Aerate the wort if using liquid yeast and then pitch the yeast. Ferment at 66 °F (19 °C) and when complete perform a diacetyl rest at 70 °F (21 °C). Rack to a CO_2-purged spirit barrel and age until your desired taste is achieved. The larger the barrel, the longer the beer can be aged in it. Once flavor profile is achieved with a distinct wood and Bourbon character, it's time to package. Carbonate to 2.5 v/v or prime and bottle condition.

FIRESTONE WALKER BREWING CO.'S PARABOLA CLONE

(5-gallons/19 L, extract with grains)
OG = 1.106 FG = 1.032
IBU = 45 SRM = 70 ABV = 10%*

**ABV calculated prior to barrel aging.*

INGREDIENTS

10 lbs. (4.5 kg) pale liquid malt extract
2.6 lbs. (1.2 kg) crystal malt (20 °L)
1.8 lbs. (0.8 kg) Briess roasted barley
1.1 lbs. (0.5 kg) crystal malt (80 °L)
14.4 oz. (410 g) Simpsons Crystal Dark malt
11.3 oz. (320 g) flaked oats
8.8 oz. (250 g) Chocolate malt
8.8 oz. (250 g) Weyermann Carafa® III malt
Malt extract or brewers crystals (if needed to boost gravity)
8.3 AAU Hallertau Tradition hops (60 min.)
(1.5 oz./42 g at 5.5% alpha acids)
8.3 AAU Hallertau Tradition hops (30 min.)
(1.5 oz./42 g at 5.5% alpha acids)
1.5 oz. Hallertau Tradition hops (0 min.)
White Labs WLP007 (Dry English Ale), Wyeast 1098
(British Ale Yeast), Imperial A01 (House), or SafAle S-04 yeast
¾ cup corn sugar (if priming)

STEP BY STEP

Place the crushed grains in a muslin bag (or two muslin bags so they are not packed in tightly) and submerge in 6.5 gallons (25 L) water as it heats up to 170 °F (77 °C). When that temperature is achieved, remove grain bag, allowing to drip into the kettle. With the heat turned off, stir in the malt extract until dissolved. Return to heat and bring wort to a boil. Boil for 60 minutes, adding hops as directed. Follow cooling, fermenting, aging, and packaging instructions in the all-grain recipe.

Tips for Success: Regarding hops, Firestone Walker suggests any German noble-like variety will do, but recommended Hallertau Tradition or American Willamette as the first choices.

Parabola is a great base for coffee, vanilla, or other adjuncts. Feel free to play around with adjunct additions after barrel aging this beer.

Oak chips soaked in Bourbon can be used to finish the beer on the homebrew scale if you do not have a barrel. Age the chips in just enough Bourbon to cover them for a week, and then add the chips to the beer for another week or more. Consider adding the Bourbon too — Parabola picks up about 3% ABV during barrel aging, so a little extra Bourbon won't hurt.


BrewZilla
FRANÇOIS FRERES
TONNELLERIE
ST ROMAIN CÔTE D'OR
FRANCE
PATTON VALLEY VINEYARD
LOT 16 COPPER BRIDGE
CABERNET SAUVIGNON
Racked & Returned
5/24

Fauxlera
BARREL BLENDS

A HOMEBREW APPROACH TO SOLERA AGING

story and photos by Tobin Bottman

Do you seek a more complex character in the sours you brew? The solera process might be a path to that goal. The term *solera*, a noun, is defined as "a system for aging Sherry and other fortified wines, in which younger wines in upper rows of casks are used to top up casks of older wines stored below in order to produce a consistently aged blend." The literal translation is "on the ground" and is traditionally the lowest of three stacked barrels. The upper barrels, or *criaderas* (lit. "nursery," but also variously referred to as scales or *clases*), contain increasingly younger liquids the higher they are in the stack.

The concept, which likely originated within the Iberian Peninsula for consistency in vinegar, Sherry, and Madeira production, is that a portion of the solera will be emptied and packaged, often on an annual basis, then topped up with an equal portion of liquid via gravity transfer from the criadera above, and so on until the top-most criadera is topped off with freshly fermented liquid. This ensures a blend of fermented beverage with the youngest in the top criadera and the oldest in the solera at the bottom. Therefore, no container is ever drained completely and so portions of the original fill will always be present, though in diminishing volumes.

The solera process of aging and blending liquids in wood can also be applied successfully to beer making, but on a larger and small home scale.

TRADITIONAL SOLERA BLENDING

When considering the technique, the first question may be: Why barrel age beer? The reasons are numerous. The wood character derived from the barrel can beautifully complement the beer being stored in it — some styles even require this character. The barrel also acts as a great storage vessel that soon becomes host to plentiful yeasts like *Brettanomyces* and bacteria that create complex characteristics that otherwise are not found in beer fermented with *Saccharomyces cerevisiae* yeast alone.

Applying the solera process adds additional complexity to the finished beer, as it is a great way to age beer for long periods of time and be able to mitigate the sourness and/or acetic characteristics of the oldest beer with the fresher, younger beer from the criaderas above.

The solera method of barrel blending is distinct from traditional barrel blending as the solera method blends various vintages of the same barrel, resulting in a mixed-vintage blend that is continuously being added to. Combining multiple vintages of a single beer can result in a complex and nuanced blend. To as-

sist in calculating the combined age of your solera blend, Michael Tonsmeire, author of *American Sour Beers*, developed a spreadsheet that calculates the age of a solera that is available online at www.archive.org/details/SoleraAgingSpreadsheet.

Beer added to the uppermost barrel can be fully fermented or can be added as wort with primary fermentation occurring in the barrel, depending on the character of the beer one is seeking. Barrel aging beer allows fermenting agents other than standard brewer's yeast to affect the beers character. Adding beer that has already undergone primary fermentation plays differently with *Brettanomyces* and other alternative fermenters and, in my experience, creates a more complex final product than a 100% *Brett* fermentation. In addition, adding unfermented wort to a barrel can create a messy fermentation.

A HOMEBREW SOLERA (FAUXLERA)

Homebrewers, who likely do not have the space or need the volumes that would result from a multiple-large barrel system, can create a solera program using a single barrel (or other vessel), a process I like to call "fauxlera." In this system, the vessel is filled with the original brew. After some amount of time aging, a volume of aged beer is removed and topped off with a fresh portion, thereby leaving percentages, albeit ever diminishing, of each addition, in perpetuity. How often you draw off/replace an amount is up to you, and should be driven by taste, but once or twice a year seems like a reasonable goal.

Most homebrewers would likely find the volume of a standard wine barrel (59 gallons/225 L) too large — not only is it difficult to fill with most common homebrew equipment, but also difficult to consume! If you are part of a homebrew club; however, a group barrel could be a fantastic investment, as they are relatively common, generally affordable for a group-buy, and due to their size, have slow overall evaporation rates. The same cannot be said for smaller barrels, which are generally more difficult to come by (though you can buy them online, if you are willing to pay the shipping on top of the cost). Additionally, the rapid evaporation rate is a real concern, as a small barrel will lose a much higher percentage of its volume than a standard wine barrel. For me, this is a loss of about 13% of my volume per year, though the amount will depend in part on other factors like storage conditions.

The author's 15-gallon (57-L) French oak barrel was sourced from a local winery. In addition to online barrel brokers, homebrewers can check with local wineries, distilleries, and breweries when looking to source a barrel — though smaller sizes are more difficult to come by.

IT STARTS WITH A BARREL

The type of oak and toasting and what, if anything, was previously aged in it can make a big difference to the character a barrel will impart to your beer. While the brewer can be very creative with pairing a particular barrel to a beer, some styles work better with specific barrels than others. For example, I find saison ales to pair wonderfully with French oak barrels that once contained red or white wine. Bourbon barrels, on the other hand, are made of American oak with the Bourbon imparting a distinctly different character than a wine barrel and are much better suited to imperial stouts and other big, malty styles. Additionally, the wood character that is imparted diminishes relatively quickly each time it is used. Be creative and work with what you can source.

Once you find a barrel, it will need to be inspected and conditioned. Remove the bung and take a whiff before you buy a barrel. If it does not smell good, it likely won't make good tasting beer — certain types of molds and bacteria are very difficult, if not impossible, to eradicate. Also, the staves will have likely contracted and may not hold liquid if a barrel has sat empty for any appreciable amount of time. Some leakage usually isn't a concern. If they have not sat dry for too long, it is easy to rehydrate the staves by filling the barrel with chlorine-free water and topping up until it is watertight. Do this outside or in a large sink/tub, as a freshly filled dry barrel will leak like something out of a cartoon! If you find an empty barrel and need to store it for a period of time before you are ready to fill it, you can stabilize and store it by adding a solution of 1 tsp. citric acid and 1.5 tsp. potassium metabisulfite per gallon (3.8 L) of hot water added to the empty barrel. Rotate

the barrel occasionally and it can be stored this way indefinitely. But note that it will strip the wood character, so it is best to limit the amount of time it sits.

Once you have sourced and conditioned a barrel, long-term storage is the next consideration. This involves sourcing or constructing a cradle for your barrel to allow stable storage, ease of access, and potential mobility. Even smaller barrels are heavy when filled, so it will require a sturdy cradle. Casters are an option on cradles as long as they are adequately weight-rated. If you are going to be using more than one barrel, commercially available barrel stacking racks in metal or plastic are available. You may also need to utilize a pump to transfer pulls from the barrel.

Barrels of all sizes can be purchased online from brokers like Midwest Barrel Co., Northeast Barrel Co., and others that will come up in an Internet search. The other option is looking at local wineries, distilleries, or breweries who may have barrels they are willing to sell. I am fortunate to live in the "wine country" of Oregon's Willamette Valley. But even here, it took me a couple years of focused searching to find a smaller oak wine barrel, with a generous dash of wheeling and dealing with a winery to sell it to me. I was fortunate to end up sourcing a 15-gallon (57-L) French oak barrel from a local winery that had been used for a test batch of Cabernet Sauvignon for $100. I love my little barrel! However, as mentioned earlier, contents in smaller barrels do evaporate more quickly and I lose approximately 2 gallons (8 L) per year. I built a cradle out of pressure-treated stock and installed casters to allow the barrel to be moved as needed over short distances, as it weighs nearly 150 pounds (68 kg) when filled. Also, consider barrel placement as well for racking out of the barrel — as mine is on the floor, I needed to purchase a self-priming, anti-gravity transfer pump as a standard racking cane will not suffice.

A HOMEBREW FAUXLERA EXAMPLE

My dear friend and brewing buddy Tom Francque and I started our homebrewing adventures together in 2017. We have slowly built our experience and our brewing system together and share a passion for quality, consistency, and innovation. Together, we decided that our locally sourced French oak barrel would nicely complement a French saison. We started engineering our recipe and decided that we did not want to rely only upon wild fermentation agents to inoculate the initial barrel fill to limit unregulated variables with some yeast laboratory-grown critters. In an effort to create the most complex beer, we also decided not to limit any potential *Lactobacillus* production, which contributes a rounded sourness to the beer, so we limited IBUs in the brewed saison to around 10 (that said, if you want to limit lactic tartness in your beer, you can hop your beer more heavily). Other than limiting the IBU level, we brewed a standard saison recipe (details on page 39). We decided to conduct primary fermentation in our regular fermenters rather than the barrel as we didn't want to deal with the mess and loss from high kraüsen in the barrel.

Since we did not yet have our current 15-gallon (57-L) brew system, we ended up brewing two initial batches to fill the barrel; one of 6 gallons (23 L) in the fermenter, the other of 11 gallons (42 L). This way we could stockpile a portion in a container like a growler or Corny keg to top off the barrel and offset the evaporation. I brewed the first 6-gallon (23-L) batch of French Saison in September 2020, and then Tom and I brewed the second batch on our larger shared system in October 2020 and pitched Imperial B64 (Napoleon) yeast for primary fermentation on both batches (we hit around 1.002 final gravity on both after primary fermentation, so keep this in mind when estimating gravity and ABV). We then reserved 64 ounces

Who says solera pulls have to be bottled straight from the barrel? Variations the author has created include racking the beer on fresh strawberries (shown here) and Concord grapes.

(1.9 L) from each brew session in growlers equipped with airlocks to use as top-off portions. After setting aside the two growlers, we transferred the remaining saison to the barrel and added a pitch of Omega *Brettanomyces claussenii* and another of Imperial W15 (Suburban Brett) to dose and funkify our new barrel.

We let the barrel sit for nine months with two 64-oz./1.9-L barrel top-offs in between — yeah, a small barrel really evaporates! — by which time our occasional tastings led us to conclude that it was time to pull our first 5 gallons (19 L) to bottle. Queue fantasy sequence! That batch, and we only have a couple of bottles left, is to this day one of the best beverages I have ever had a hand in creating. The oak character, coupled with the *Brett* and bugs we added, was amazing. And this was from a single barrel! As homebrewers, consistency matters less, so take advantage. Your first barrel pull is going to be the goods and you don't need a formal solera to accomplish it.

But have fun with subsequent barrel pulls! In addition to multiple straight pulls, we have now racked 5-gallon (19-L) batches into fermenters with Concord grapes (outstanding), local Mt. Hood strawberries (yum, yum, yum, yum!) and are aiming to dry hop our next pull onto New Zealand Wakatu™ hops. We like to rack these 5-gallon (19-L) "special project" fills to wide-mouthed fermenters to make adding fruit (and subsequently removing fruit after racking the finished beer) easier. The bit of oxygen in the headspace is not as big an issue as it would be for a delicate, hazy IPA. And it is very cool to be able to watch the pellicle develop in a clear fermenter. Don't fear the pellicle — it is nature's oxygen blocker.

But what to do after that? The beer in the barrel will collectively continue to become older, which will lead to increasing sourness and acidity. In our experience, it seems that one might have to start pulling portions in ever decreasing intervals. Certainly, our barrel became progressively more sour, with vinegary, acetic acid notes, so that in last year we drained and packaged the entire barrel and topped off with 15 gallons (57-L) of fresh saison. Since the barrel was now effectively inoculated with wild yeasts and bacteria, we did not add any additional yeast as we did when we started the barrel. The "fresh" saison has aged well and is tasting amazing, and we will be pulling five gallons (19 L) onto the aforementioned Wakatu™ hops soon.

Let's chat about packaging. When you add a beer like a saison to a barrel at an already very low terminal gravity, and then age on *Brett* and other bugs, you will end up with a beer at or below 1.000 — as dry as can be and void of most yeast that would consume bottle-priming sugar. Re-yeasting is key. It is best to condition with a strain known to tolerate higher alcohol and low pH, which makes Champagne yeast a good choice with a neutral profile. I have found that the commonly recommended LalBrew CBC-1 cask ale yeast does not stay in suspension and, at least for us, has resulted in a few batches of under-carbonated beer. Saison-style beers, especially if fermented on fruit, really take well to a Champagne-style yeast or even a wine yeast like Red Star Premier Cuvée, with a corresponding level of effervescence. For saisons, I like to target around 3.3 volumes CO_2, which should create an effervescent body with a rocky head. Use heavy Champagne-style or Belgian bottles if you are going to go this route! You could keg and force carbonate this type of beer, but bottle conditioning will allow the batches to age gracefully and be able to be tailored to the appropriate carbonation level.

The last point I want to touch on is specific to saison and other farmhouse-style beers. Be open to using the grains you have, but, as Gordon Strong so rightfully recommends, keep the original gravity low. These beers, with their diastatic-positive yeasts, create incredibly dry, low final gravity beers, and this is before they go into a barrel for aging. A 1.060 original gravity (OG) saison can turn into an 8%+ monster without batting a French eyelash. If you want to go the "super saison" route, by all means do, but know that you might be sacrificing the dry, subtle, nuanced beer that a barrel can produce.

The following recipe has been scaled to 6 gallons (23 L) into the fermenter to allow for setting aside a top-off portion to account for barrel evaporation. Adjust your recipe as needed based on your equipment profile and preferred ABV. Also, don't be hesitant to use other ingredients (rye, oats, etc.) as this is a farmhouse style ale and takes well to ingredient swapping. Have fun, be creative, and enjoy your own fauxlera-process beer!

A characteristic of wild fermentations is a thick pellicle. Don't worry, it's normal.

Solera Saison

(5.5 gallons/21 L, all-grain)
OG = 1.049 FG = 1.002
IBU = 9 SRM = 4 ABV = 6.1%

INGREDIENTS

6.8 lbs. (3 kg) Belgian Pilsner malt
1.5 lbs. (0.68 kg) white wheat malt
8 oz. (227 g) Munich malt
8 oz. (227 g) caravienne malt
8 oz. (227 g) acidulated malt
12 oz. (340 g) dextrose (10 min.)
2.75 AAU Willamette hops (60 min.) (0.53 oz./15 g at 5.5% alpha acids)
0.5 tsp. yeast nutrient (10 min.)
0.5 tsp. Irish moss (10 min.)
Imperial Yeast B64 (Napoleon), Wyeast 3711 (French Saison), LalBrew Belle Saison, or similar yeast

STEP BY STEP

This recipe uses acidulated malt to correct pH to approximately 5.5. If you use another method, just add an additional 8 oz. (227 g) base malt.

For infusion mash brewers, target a mash temperature of 147–148 °F (64 °C) for 90 minutes, followed by a 10-minute mash out rest at 168 °F (76 °). For those brewers who wish to utilize a step mash, I usually aim to mash in at 131 °F (55 °C) for 15 minutes, raise the temperature to 144 °F (62 °C) and hold for 60 minutes, raise temperature to 158 °F (70 °C) for 15, and then mash out at 168 °F (76 °C) for ten minutes.

Boil the wort for 60 minutes, adding hops at the start of boil, and finings and dextrose at 10 minutes remaining.

Chill the wort to around 65 °F (18 °C). Aerate the wort well if using liquid yeast and pitch yeast. Allow temperature to free rise up to 75 °F (24 °C). Some saison yeast strains are prone to stall and so I always allow the beer to ferment for a full two weeks. Since additional conditioning will occur in the barrel; however, the beer does not necessarily have to be fully fermented.

Once the beer has completed fermentation, you should have approximately 5 gallons (19 L) to add to the barrel and 2 quarts (2 L) to set aside (I use growlers with airlocks) to top off the barrel after a few months or as needed. A keg, purged of oxygen, could also function as an excellent long-term storage solution for the top-offs.

Extract with grains option:
Replace the Pilsner, wheat, and acidulated malts with 4 lbs. (1.8 kg) Pilsner dried malt extract and 12 oz. (340 g) wheat dried malt extract. Add 1 tsp. 88% lactic acid to 7 gallons (26.5 L) of water. Add crushed grains in a bag to the water and heat to ~170 °F (77 °C). Remove grains, allowing the bag to drip over the kettle, and then bring the wort to a boil. When a boil is reached, remove kettle from heat and stir in the dried malt extracts. Once fully dissolved, turn the heat back on and bring to a boil.

Follow the remainder of the all-grain recipe instructions.


YEAST 2112
CALIFORNIA LAG
7/2020

THE SECRETS TO Freezing Yeast

CREATE A FROZEN YEAST BANK AT HOME

story and photos
by Martin Keen

At the bottom of my freezer lies a homebrewer's treasure trove: Dozens of small vials containing frozen yeast. These vials are organized in groups of five or six, each cluster representing a different yeast strain. My collection includes popular varieties like Chico and seasonal favorites such as British Bedford Ale.

At any time, I can select a vial or two, revive the yeast in a starter, and have it ready to pitch into a fresh batch of wort. The best part? Some of these frozen vials are over five years old and still perform well when reactivated.

The secret lies in proper freezing techniques. When managed correctly, frozen yeast can maintain its viability for an impressively long time, offering homebrewers a convenient and cost-effective way to always have their favorite strains on hand.

UNDERSTANDING THE BASICS

Freezing yeast is a relatively straightforward way to keep various strains on hand without taking up much space. The basic process involves creating a protective solution called a cryopreservative using food-grade glycerin and water. When combined with yeast, this solution helps prevent ice crystals from damaging the yeast cells during freezing.

After sterilizing the solution, you mix it with a small amount of yeast (either fresh yeast or from a slurry) and store it in small vials in the freezer. This method slows down the yeast's biological activity, keeping it viable for years. With careful handling, you can easily revive the yeast by thawing out a couple of vials and adding them into a starter a day or so before brew day.

THE BENEFITS OF FROZEN YEAST

Purchasing fresh yeast for every batch can get expensive, and since the viability of yeast cells decreases over time, it requires careful planning to ensure you have fresh yeast just in time for brew day. For years, my favorite way to address these concerns was to overbuild starters.

Here's how overbuilding starters works:

1. A day or so before brew day, take a packet of fresh liquid yeast and pitch it into a yeast starter that's about 50% larger than needed for the intended batch.
2. After a day or two of spinning the starter on a stir plate, collect a third of the starter in a sanitized vessel — such as a pint-size Mason jar — and store it in the fridge.
3. The rest of the starter is pitched into your wort as usual.
4. When it's time to use that yeast again, take it out of the fridge a couple of days before your next brew day, overbuild another starter, and again split that starter between your new brew and another sanitized vessel.

This method allows a single packet of yeast to be used multiple times without the added steps of harvesting yeast from the bottom of your fermenter post-fermentation. However, freezing yeast overcomes several limitations of the overbuilt starter approach:

Extended Viability: A yeast slurry stored in the fridge can retain some viability for months, though it is often recommended to use it within a week or two. With each passing day, more yeast cells die, and after a few months, the slurry may contain very few viable yeast cells. By freezing yeast, the yeast cells' biological activity is significantly slowed down, preserving their viability, potentially for years.

Reduced Generational Mutation: Freezing yeast also reduces generational mutation. With the overbuilt starter approach, each use of the yeast slurry results in a new generation of yeast. Repeating this process more than a handful of times can lead to significant mutations not present in the fresh yeast received from the yeast lab. In contrast, freezing yeast allows you to split a single starter or packet of fresh yeast (let's call it generation 0) into 10 vials. When you have only a few vials left, you can build a starter with the remaining vials to create another 10 vials of what is now generation 1 yeast. This cycle means many more batches of yeast are available from each generation, resulting in fewer mutations over time.

STEP-BY-STEP GUIDE

The process to freeze yeast takes a bit of preparation but with some minimal equipment is easy enough to follow and is something I've repeated dozens of times.

STEP 1: PREPARE A CRYOPRESERVATIVE SOLUTION

Yeast cannot simply be stored in the freezer as ice crystals will form and rupture the cell walls, killing the majority of the yeast. A cryopreservative is needed to protect the yeast cells during freezing. Here is how to make the cryopreservative:

Required Equipment

- Pressure canner
- Food-grade glycerin
- Measuring cup
- Mason jar (preferably with a wide mouth)

Instructions

1. Measure out 2.5 fl. oz. (75 mL) of glycerin and 7.5 fl. oz. (225 mL) of water. I'll typically use filtered or bottled water. This creates a 25% glycerin, 75% water solution.
2. Combine the glycerin and water in the Mason jar.
3. Place the jar in a pressure canner and process for 10 minutes following your canner's instructions. This will sanitize the cryopreservative and make it shelf stable.
4. After processing, remove the canner from heat and allow it to depressurize naturally.
5. Once it's safe to open the canner, remove the jar and let it cool to room temperature. Do not rush this process by running it under cool water or placing it in a water bath, as rapid temperature changes could cause the jar to shatter.
6. Once cooled, your cryopreservative is ready for use. This solution can last for a good while — typically enough for six batches or about 60 15-mL tubes.

STEP 2: PREPARE YOUR YEAST

You have two options for preparing your yeast: Using a fresh packet or creating a yeast starter. Both methods are valid and have their own advantages.

Required Equipment

- Sanitizer spray bottle
- Wide-mouth Mason jar

Option A: Using a fresh yeast packet

1. Purchase a fresh pouch of your desired yeast strain. I've only ever used liquid yeast for this process, although dry yeast should work as well. Check the manufacture date on the yeast pouch — the fresher, the better to maximize viability.
2. Sanitize the outside of the pouch thoroughly using your sanitizer spray bottle.
3. Carefully open the packet and pitch the yeast into a sanitized Mason jar. This will make it easier to extract in the next step.

Option B: Creating a yeast starter

1. Alternatively, prepare a yeast

starter 24–48 hours before you plan to freeze your yeast, following your preferred starter recipe.
2. Once fermentation is complete (usually 24–36 hours), place the starter in the refrigerator for a few hours to cold crash. This helps the yeast settle to the bottom.
3. Carefully decant most of the liquid from your starter, leaving behind the yeast slurry at the bottom.
4. Transfer the remaining yeast slurry to a sanitized wide-mouth Mason jar.

Step 2: Transfer yeast from package or starter to a Mason jar and refrigerate to allow yeast to settle to bottom.

STEP 3: MIXING YEAST WITH CRYOPRESERVATIVE

Now we are ready to combine the yeast and cyropreservative into test tube vials. Each vial will contain approximately 5–20 billion yeast cells, depending upon the viability of the source yeast.

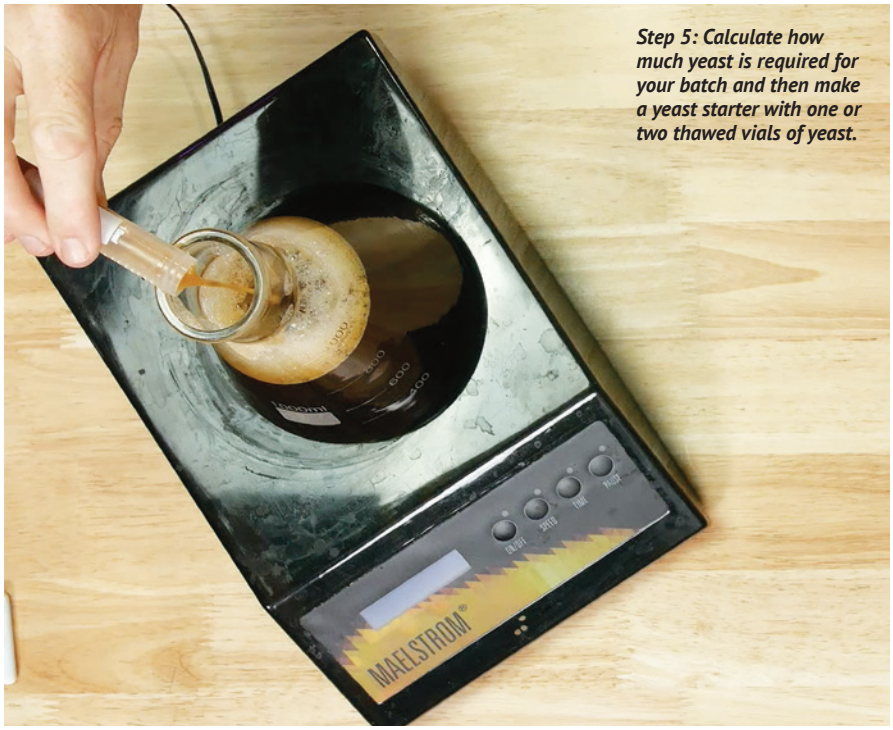
Required Equipment

- Sterile test tube vials (15-mL capacity, 10 per batch)
- Oral syringes (6-mL capacity)
- Sanitizer spray bottle

Instructions

1. Sanitize both the oral syringe and test tubes using a sanitizer spray bottle.
2. Using a sanitized 6-mL oral syringe, extract 5–6 mL of yeast and gently squirt the yeast into each test tube. One pouch of fresh yeast or a yeast slurry should easily be able to fill 10 vials.
3. Sanitize the syringe again and then extract an equal 5–6 mL of cryopreservative solution and add to each test tube.
4. Once all tubes have yeast and cryopreservative, close each tube and shake to mix the yeast and cryopreservative thoroughly.
5. Be sure to label the test tubes with the yeast strain added, the date, and the yeast generation.


Steps 3-4: After adding measured amounts of yeast and cryopreservative to vials, label each vial and place them all in a plastic bin with isopropyl alcohol before placing the bin in the freezer so the yeast freezes more slowly.



Step 5: Calculate how much yeast is required for your batch and then make a yeast starter with one or two thawed vials of yeast.

STEP 4: FREEZING THE YEAST SAMPLES

We are now ready to freeze the yeast vials, but rather than just tossing the samples into the freezer, we'll need to use an isopropyl alcohol bath. This

will slow down the freezing process, which helps prevent damage to the yeast cells from ice crystal formation.

Required Equipment

- Freezer-safe, leak-proof plastic bin
- High purity (>90%) isopropyl alcohol
- Freezer

Instructions:

1. Take a freezer-safe plastic bin and place all of your prepared yeast sample test tubes in it.
2. Pour high purity (>90%) isopropyl alcohol into the bin until the yeast samples are fully submerged.
3. Securely cover the bin with its lid.
4. Place the sealed bin containing the alcohol and yeast samples into your freezer. Leave the bin in the freezer for a minimum of 24 hours.
5. The yeast samples can be removed from the alcohol after this period and stored in the freezer in a container of your choosing.

STEP 5: USING YOUR FROZEN YEAST SAMPLES

When your next brew day arrives, the process of thawing and putting the yeast to work is straightforward.

Required Equipment

- Yeast starter calculator
- Yeast starter equipment (wort, flask, stir plate)

Instructions

1. Use a yeast starter calculator to determine your pitching needs. Enter your wort details (original gravity, volume, target pitch rate, and enter 20 billion as the starting yeast count for each tube you plan to use).
2. Once you've determined the correct number of tubes and starter specifications, remove the required number of yeast sample tubes from your freezer. I will typically only use one or two vials. Let them thaw slowly at room temperature.
3. Prepare your yeast starter following standard practices.
4. Use the thawed yeast samples as you would a commercial yeast packet when making your starter.

Once you are down to three tubes in the freezer of a given yeast strain, use them to make a new starter of this yeast to replenish your stock. Then follow the previously outlined steps again to create the next generation of your frozen yeast bank. I will typically go through three generations before purchasing new yeast, which is enough for dozens of batches of beer.

And that's all there is to establishing your own private yeast bank, allowing you to keep your favorite yeast strains viable and on-hand whenever you need them. (BYO)

Sources:

- www.homebrewnotes.com/making-a-frozen-stock-yeast-bank/
- www.homebrewtalk.com/threads/maintaining-a-healthy-yeast-bank-long-term.678997

BY DREW BEECHUM & DENNY CONN

REPORTING WATER

Understanding water reports to make simple water adjustments

We return to water this issue because as it turns out, the composition of your water, being more than 90 percent of your beer, is incredibly impactful on the final nature of your beer. Most brewers will forgo messing with their water early in the hobby — first out of not knowing that it's important and then believing the topic is too complicated for the impact it has — before finally trying to crack the H_2O molecule. We firmly believe that adjusting water to fit a certain profile to complement the beer style being brewed is worth the time it takes to understand this subject.

Manipulating your water profile is often the last piece that pushes someone's beer from "pretty good" to "hot damn." But we understand why people don't tackle it. Water chemistry is intense stuff. Unlike many other parts of brewing, the science is much harder to wave away behind a magical calculator because there are interactions upon interactions, upon interactions. And it all starts with reading a water report.

Fun fact: In the U.S., your water district is required to test and report on the quality of the water they feed into your local system. No matter how big or small, they are also required to make that reporting available to the public (though, as we'll discuss later, these reports aren't always as helpful as you'd assume as water sources may change throughout the year). Turns out that knowing what's in your water is important to more than just brewing. As brewers starting with the water available in your household, these water reports should be used to make decisions in how you treat your brewing water.

Manipulating your water profile is often the last piece that pushes someone's beer from 'pretty good' to 'hot damn.'

Photo courtesy of Shutterstock.com

WATER REMINDERS

Before we dig into the nature of water reports and how to use them to tell you something useful, here are some fundamental water rules that the two of us follow:

- Your brewing water should taste clean with no off-flavors, sulfur, metals, etc.
- If you do nothing else to your water, remove any chlorine or chloramine from it. (Unless you're on a well, odds are good your water has one of those compounds. Either slow carbon filter (under 1 gallon/4 L per minute) or a pinch of metabisulfite powder will do the trick.
- When choosing a water profile, we skip "city profiles" and prefer to go on profiles based on beer color (pale, amber, brown, black) and malt balance (dry, balanced, full). See Table 1 on the facing page for good starting points for different types of beers.
- Don't obsess over trying to dial in numbers to match a target water profile. No matter what your favorite water calculator tells you, your additions do not need to be that precise and perfect.
- Use your salts for flavor (and basic chemistry). 50 ppm of calcium and under 50 ppm of sodium are generally safe rules of thumbs. Don't try and dial in your pH with calcium additions!
- Don't go overboard with your salt additions. Keep additions simple and your numbers in reasonable ranges — you'll mostly just need small touches of gypsum and calcium chloride.
- Use lactic or phosphoric acid to adjust your mash pH.

ON TO THE WATER REPORT

As we said earlier, your water provider is required to publish reports on water

Table I: Sample Target Water Profiles

Profile Name	Calcium (ppm)	Magnesium (ppm)	Sodium (ppm)	Sulfate (ppm)	Chloride (ppm)	Bicarbonate (ppm)
Dublin	120	4	12	55	19	315
Pale Ale	113	20	25	300	55	35
Black, Full-bodied	50	5	33	35	45	140
Yellow, Dry	50	10	5	105	45	0
Amber, Balanced	50	10	15	75	63	40

quality and these days they're invariably online. Search for your water provider and "annual water reports." Odds are pretty good you'll get a clear result.

Example: Drew Googling "Pasadena DWP water report" returns: https://pwp.cityofpasadena.net/waterqualityreports/ where the Department of Water and Power has reports available going back to 2001.

Caveat: Be aware that these water reports are essentially averages of what's happening in your water area and not a guarantee that the water pouring out of your taps has the exact same profile. In fact, in a number of places, the water profiles will change over the year as water sources are added, removed, and blended. (The water profile in Los Angeles dances between soft Sierra snow melt and mineral-laden Colorado River water, amongst other sources.) In fact, some areas may have different water sources from one day to another, in which case relying entirely on a water report may be far off from your actual water at any given time. If you want something more precise, read on, but in most cases your water report averages will provide you a general starting ground.

Pull up your water report. Find the longest version they offer. Everything we care about as brewers is generally buried in tables called names like "Secondary Standards" and "Other Parameters." These are characters that aren't health and safety motivated (like lead, uranium, etc.), but instead taste, flavor, and odor motivated.

For most brewing applications, what we are trying to find is water pH, alkalinity, calcium, magnesium, sodium, chloride, sulfate, and perhaps total hardness and bicarbonate (these last two can be back calculated from other values). Total hardness is generally a measure of calcium and magnesium.

By the by, don't get fooled into thinking "hard water is bad for brewing." There are plenty of ways and styles to brew with hard water. What we mostly will care about is getting our mash pH into the right range and adjusting those salts to impact our flavors.

In those tables, many of the needed numbers are directly expressed in parts per million (ppm) or mg/L. Plug those straight into your favorite water calculator of choice. (We use Bru'n Water, plus the calculators in Brewfather and Grainfather — the later two are fairly straightforward but Bru'n Water is the most accurate and flexible once you're configured. Go listen to Episode 45 of the Brew Files if you want to hear a guided tour of setting it up, available at www.experimentalbrew.com/2018/09/19/brew-files-episode-45-water-water-everywhere.

It is critical you pay attention to the listed units on both your water report and your calculator. The numbers aren't always plug and play. In particular, pay attention to the units around total hardness, bicarbonate, and alkalinity as they get expressed in different ways by different reports. For instance, both hardness and alkalinity get reported as "mg/L (or ppm) as calcium carbonate $CaCO_3$," but not always. Sometimes sulfate gets reported as SO_4-S instead of just SO_4. Why this matters is Brewfather wants SO_4-S, where Bru'n Water wants SO_4.

The maddening part about water reports is they don't always have things listed as you need, but modern calculators can generally help you out. Alkalinity is one that used to be difficult to find, but in a recent survey appears to be more common now. With most of the facts in hand, your water calculator can help you reverse engineer and double check your values. The software should report a value of how closely the cations (calcium, magnesium, sodium, etc.) and anions (bicarbonate, carbonate, chloride, sulfate, etc.) balance chem-

“It is critical you pay attention to the listed units on both your water report and your calculator. The numbers aren't always plug and play.”

Table 2: Drew's Municipal Water Report vs. Ward Labs

Profile	Calcium	Magnesium	Sodium	Sulfate	Chloride	Bicarbonate	Alkalinity	Total Hardness	pH
Pasadena DWP (Avg)	70	22	33	74	44	250 (calculated)	180	276	8
Ward Labs (2/24)	68	24	102	65	89	180	150	270	8.1

ically and warn you if you're too far afield.

Additionally, don't hesitate to reach out to your water company and ask them "can you give me a hand?" You may be surprised at how much information a polite request will garner you. Stuff that's not listed in the water report may actually be tracked.

But what if you're on a well, like Denny? At that point, you're going to need to generate your water profile. There are brewing oriented test kits like LaMotte's BrewLab or Sensafe's eXact iDip. You can feel like a kid with a chemistry set all over again! Or if you want something more precise (and this goes for those with water district reports as well), order a W-501 Brewers' Test from Ward Labs (www.wardlab.com/). It costs about the same as a batch of beer, but it tells you precisely what's coming out of your taps at the time.

One nice bit of handiness about that Ward report is that it's become such an industry standard that most water calculators directly tell you how to input the water report. If you're truly serious about adjusting your water, a lab report is well worth the investment. The precision in these reports is superior to the average rates reported by municipalities. See Table 2 above with some real numbers and see how far off some can be.

If you use reverse osmosis (RO) or distilled water, your water profile, assuming that the filtration systems are properly maintained and functional, is effectively zeros across the board. (You'll definitely want to confirm this with a total dissolved solids tester.) And if you're using "spring water" or "drinking water," check out the source company — they too might have a water report you can use as well.

If you really want to dig in deeper on water, but not as deep as *Water* by John Palmer and Colin Kaminski, we'd recommend reading the basic tutorials at brunwater.com and Kai Troester's water tutorial at braukaiser.com BYO

BY BILL JABLONSKI

BALANCING A DRAFT SYSTEM

The three-legged stool analysis

Today's technical discussion for homebrewers with a draft system is the ever popular and sometimes mysterious topic of system balance. Having seen dozens, if not hundreds, of YouTube videos and online discussions, I recognize that there is a tremendous amount of bad, confusing, or simply unhelpful information out there on the subject. It sometimes hurts my head because the *how* and the *why* is not really all that puzzling. Over three pages in this column, I will explain in simple language and dismantle some of the myths surrounding draft system design. You can trust me, I am a professional (draft system installer/servicer) who also maintains multiple kegerators at home.

A balanced draft system will pour a perfect pint, with the proper amount of foam, at the proper temperature. A perfect pint is that beautiful beer that has the desired foam collar and does not waste beer. We want to get that perfect pint every time we pour with little fuss. Serving your homebrew from a bottle is cool. Serving that homebrew in a perfect pint is outstanding.

If you have ever messed around with line diameter, line length, temperature, applied pressure, or felt like you needed to change equipment in pursuit of the perfect pour, this article is for you. Let's get to pouring the perfect pint and stop dumping foam. You worked hard for that homebrew — don't waste it. This summary of system balance will discuss the how and the why while simultaneously describing corrective measures. I have found that most discussions about system balance don't get into why, but are quick to tell you what you should be fixing to adjust your system. The truth is that system balance requires a simple understanding of temperature, pressure, and resistance, the rest is quite intuitive. With some patience, you can learn to identify and correct foaming issues with your draft system, starting with the most common problem.

There are only three variables in any draft beer system: Temperature, pressure, and resistance. In that order. That's it, and it means you only need to think about three possible issues to address when your pours aren't right. Your system might need corrections to one, two, or all three variables, but once you know how each variable affects your draft beer, the needed changes are not very difficult.

Think of system balance as a three-legged stool. Each leg is equally important, and if one leg is out of whack you do not have a solid seat. When all three legs are adjusted accurately, the stool is stable.

TEMPERATURE

Temperature problems make up the majority of draft-related headaches. Fortunately, it is also the easiest to diagnose and cure. First, the beer in the keg should be at 38 °F (3 °C) and the beer in your glass should be the same temperature. If you find that the beer in the glass has warmed by even one or two degrees, you will be pouring some foam. If you like your draft beer warmer than 38 °F (3 °C), well, things are going to get much more difficult. You want a perfect pour? Then 38 °F (3 °C) it is. A degree or two colder won't have a significant impact, but a few degrees warmer and things can get squirrelly. It is not impossible to get a good pour at 44 °F (7 °C) (with additional pressure and more line restriction to balance the system), but since you are presumably reading this because your system is not perfect, let's try to get a good design at 38 °F

There are only three variables in any draft beer system. Temperature, pressure, and resistance. In that order.

(3 °C) before we start experimenting.

Place a glass of water inside the kegerator and leave it alone until the temperature stabilizes. Use a quality thermometer and measure the temperature. Compare it to the temperature of the first 3 or 4 ounces of poured beer. If you are off by a few degrees, it indicates that the beer in the line is warming. We need to correct that problem and it might require a fair bit of homebrew ingenuity.

The colder the liquid, the more dissolved carbon dioxide (CO_2) the liquid can hold. That is dissolved CO_2 gas, before it has become foam. The dissolved gas will break out of solution in the beer line and then you'll have a slug of foam as you open the faucet and pour. The foam will rise to the highest point in the line. If you have a quick burst of foam followed by clear beer, your warm spot is near the faucet. If you have clear beer, a bit of foam and then clear beer, the foam is rising to a bend somewhere in the beer line. If you pour some foam and then consecutively pour perfect pints, surely it is a temperature problem occurring after the keg.

Identifying temperature-related foam is not hard, but correcting the problem can sometimes be a chore. As we have determined, we need to maintain a constant temperature from keg to glass. In practice this is not always possible to execute to perfection with a home draft system. But we can get very close to perfection. First thing is to be sure all gaps are sealed in the refrigeration unit. Place a bright light inside the kegerator, close the door and turn off the lights. Look for light leakage. Seal those however you can. Next, be certain your draft tower is sufficiently insulated. It is not uncommon, or even a problem, when the tower sweats. That is water vapor condensing on a cold surface. If you have a lot of sweat on your draft tower, it's because the metal tower is absorbing ambient heat. The line in the tower is likewise gaining some heat. Well-placed insulation can help. I caution, however, don't overdo it. Dumping a can of spray foam in the draft tower is not a solution because we are going to want to cool the tower, and that requires air flow.

Higher-end kegerators will always have a fan and tube assembly to get cold air into the draft tower, all the way up to the faucet. Be sure the fan is working and that the tube is extended all the way up into the draft tower (it is a costly service call to show a client where that dangling hose is supposed to live). If you don't have a fan, fear not because the fine folks at Amazon (and other retailers) have you covered. A small fan with 20 to 50 cfm is plenty. More than that, and you'll start to force air out of the gaps you carefully sealed. Place the fan near the cooling coil, if possible, and direct the tube all the way up to the shank. Now you have a top-of-the-line kegerator. Congratulations. Cooling the tower is not just important, it is required if you want that first pour to be as good as the second. The cold air from the kegerator is not going to rise up to the faucet and shank on its own, and you will have foam if you do not keep the beer within the tower cold. The tower fan can fix it.

Next thing to consider with temperature, though it is unlikely, is you may have a problem maintaining keg temperature. Cheap refrigeration units feature cheap parts and that includes the internal thermostat. If the factory set cut in/cut out temperature variable is too large, it is possible that the keg is not holding a consistent temperature. This is especially true when a keg gets to the last few pints. The liquid will gain heat faster than it will chill down. If your compressor is not cycling enough, the keg might be warming and releasing CO_2. An outboard thermostat will fix this. It might also burn out the compressor prematurely, but that is the nature of a cut rate appliance. If your keg is not maintaining temperature, surely your draft tower is not either.

So that's temperature. By far the most important variable but also the easiest to fix and diagnose. Before moving to any other corrections, be certain that beer temperature is sorted.

PRESSURE

Foam is not often caused by too much applied pressure; instead it is often a result of too little applied pressure. How is that possible? Relating that dissolved CO_2 is gas that remains within the liquid and foam is gas that has escaped from the liquid as it equilibrates with atmosphere, we want to be sure the dissolved CO_2 content is maintained from keg to faucet. If your keg of beer has 12 psi of pressure applied at 38 °F (3 °C) you will eventually achieve 2.6 volumes of carbonation. As you are now maintaining temperature, you should be maintaining applied pressure.

Here is the rub: It is tempting to adjust the applied pressure to fix foaming problems. There are two convenient knobs. One is the thermostat and the other is the regulator.

Hold on. Adjust the temperature and you are messing with one of the legs of the stool. We need to hold 38 °F (3 °C) first and foremost. Lower the applied pressure and now you have gas escaping from the beer in the keg, and also in the beer line. The keg doesn't end at the coupler or quick disconnect after all. The beer doesn't know it's all one big system until it is poured into your glass. Now you have foam.

The next thing is to overcorrect and dial it back. Then, when we still have foam, we overcorrect and apply additional pressure. There is no immediate effect, but eventually the beer absorbs too much gas and your resistance is out of balance.

One more reason to diagnose temperature first: I think homebrewers can really up their game by dialing in proper carbonation levels, so adjusting pressure outside of the ideal range shouldn't be the first solution. Along with malt, hops, yeast, and water, CO_2 gas is incredibly important but too often neglected. If you have not approached how to establish and vary the CO_2 volumes in your beer, I think you'll be very satisfied with the results once you do. And once you do, you know to maintain the volumes in your draft system. If you feel the need to nerd out about volumes and applied pressure, check out this previous "Advanced Brewing" column "Gas Dynamics" from the November 2023 issue dedicated to your regulator: www.byo.com/article/gas-dynamics

RESISTANCE

Resistance is one and done. When you have it right, you will not need to adjust resistance again. Resistance is simply the sum of friction from the keg to the glass. Here is a quick

> **If you pour some foam and then consecutively pour perfect pints, surely it is a temperature problem occurring after the keg.**

analogy to help us understand resistance. The spigot on the side of the house will blast water when fully open. Attach 100 feet (30 m) of garden hose to the fully opened spigot and you'll see that the flow rate at the hose end has been significantly reduced. That is because the friction in the hose slows the rate of discharge.

We want our draft system to have the appropriate resistance; neither too much nor too little. A balanced system is just that, meaning all three variables are working together and delivering the perfect pour. The thing with resistance is that we can't easily change it up like we can with pressure or temperature (but there is a hack only available to homebrewers, which is necessary when pouring beer styles at different carbonation levels, which I will get to later).

The usual draft system, a kegerator or keezer, requires a certain length of choker. Choker is an appropriate term, because it chokes the rate of flow from keg to glass. With no choker, the beer will spew out at a rate equivalent to the applied pressure. Beer that pours at 12 psi is coming out like a firehose and impossible to tame in the glass. Chokers in America are universally 3⁄16-inch inner diameter and usually 7⁄16-inch outer diameter (check out a deeper dive into tubing in my previous article "Choosing Tubes and Hoses" at www.byo.com/article/choosing-tubes-and-hoses). You'll need to know the specific resistance of your choker. It will be between 2.2 psi and 3 psi. This is important. If your supplier can't tell you the resistance per foot, keep looking because it is the most important and only important variable we are working with.

Let's assume we have the best available, thermo-plastic extrusion (TPE) choker. This is free of BPA and phthalate, and oxygen impermeable as well. It will have a resistance of 3 psi per foot. A keg with 12 psi of pressure will require 4 feet of this tubing to be balanced. But we also need to consider the shank, faucet, and coupler, so add around ½ psi of resistance. Therefore, our 12-psi keg needs 12.5 psi of resistance, or 4.2 feet of TPE tubing. Finally, gravity adds resistance. Precisely 0.45 psi per foot of lift. Round this up to 0.5 psi. Measure from the middle of the keg to the shank and add the appropriate resistance. We need about 13 psi of resistance in this theoretical set-up.

Now, here is where we can let loose a little bit. Because in theory, a balanced system is ideal. In practice, your home bar is not serving pint after pint all night long. We can relax a few extra seconds while the beer pours, and a few extra seconds makes a huge difference. You really don't need to pour a pint in eight seconds, but you really do want to take a moment to get a great head on that beer while not dumping any at all. So let's add a few pounds of resistance. I like to see eight- to ten-second pours on commercial systems. Eight seconds is beneficial at a busy sports bar, and dumping a little is sometimes OK in the name of speed. An evenly balanced system will pour a pint in about eight seconds. Ten seconds is more profitable for a craft bar when the kegs cost serious money and the customers expect a nice pour. A home bar can go to 15 psi of resistance without any problems, and allow for a much better controlled pour with a great presentation. The speed of the pour affects foaming in the glass. It is hard to tame the beer when it is flowing too quickly.

Now, about that resistance hack for beers intended to be poured at different carbonation levels that I mentioned earlier. We can change our choker fairly quickly. Simply install a few John Guest quick disconnects at the coupler and before the shank. Fabricate a few different lengths and you can go from 12 psi of resistance to 18 psi of resistance quickly. Or any resistance. This is helpful when trying to pour beer styles that require high volumes, like a Belgian golden ale or a hefeweizen.

Before we move on, I know what some of you are asking. "What about flow control faucets?" Simple. If your system is out of balance, flow controls will pour foam slower. The CO_2 does not stay in solution because we installed flow control faucets. If your foaming is caused by velocity — that is the beer is hitting the glass too hard — correct your pouring technique. Flow controls can help in this situation, but you probably should first reconsider the amount of system restriction.

So those are the three variables, and you can see it is not all that difficult to get a balanced system. If you are ambitious and want to explore designing and installing a complex long-draw system, I covered that topic in the December 2022 issue, online at: www.byo.com/article/long-draw-draft-system. BYO

Photo by Bill Jablonski

Using John Guest quick disconnects, you can change the length of choker to pour beers at different carbonation levels.

BY JOHN BLICHMANN

INFRASTRUCTURE NEEDS FOR NANOS

I have had the pleasure of helping many new nanobreweries get started over the years, and in doing so I have gained a lot of knowledge that I enjoy sharing with new entrants into the nanobrewing world. In this article I'll cover some of the common infrastructure needs of a nanobrewery.

There are quite a few things to consider beyond the cost of the property, the location, and the zoning for your type of business when scouting locations and buildings for your new nanobrewery. Those are definitely vital considerations, but things that are often overlooked until too late in the game are the infrastructure needs for operating your business. These can result in costly oversights and unexpected expenses, to complete showstoppers. I highly recommend hiring a competent architect to help you through this process. While they are an added expense, the guidance can save you a ton in the long run.

UTILITY CONSIDERATIONS

Local building inspectors are your friend. They are there to help you understand the building code requirements of your community and make sure the contractors meet them. They are also a great source for reputable contractors and suppliers. By getting them involved early on, they will help you get on the right path and your startup will go along much more smoothly.

Since most nanobreweries are electric powered, it is very important to know what your electrical needs are for the entire facility. Work with your brewhouse supplier to see what options are available for the system size you're considering. Most will have single phase 240V options, which is a voltage available in nearly all commercial buildings.

However, single-phase power usually needs a lot of current to drive the heaters needed to boil adequately and heat at a reasonable speed, and many commercial locations won't have that amount of power readily available. Three-phase power is available typically in 208V and 480V, but it is more common in industrial locations since large machinery usually requires this type of power. A good rule of thumb is 6 KW of power per barrel of your brewhouse. For reference, 6 KW is 25A at 240V, or 28.8A at 208V. If you have 480V available, that drops the current to only 12.5A. An important thing to understand about heating elements is that they are built for a specific voltage. If you power the element with a different voltage the wattage will change significantly! Note that you may not be powering all tanks at the same time so factor that into your electrical power needs. Be prepared with a couple options from your supplier as you look for locations and buildings.

In addition to brewhouse power needs, glycol chillers also consume a lot of power. For instance, cold crashing one barrel requires 1500 BTU/hour, while maintaining that temperature in the brite tank requires 450 BTU/hour, or 175 BTU/hour in a conical fermenter (assuming the tanks are well insulated). Divide by 3.41 to convert BTU/hour to watts. Reach out to a reputable chiller company with local support and get power requirements from them as well. Smaller loads will be building air conditioning, lighting, grain mills, exhaust fans, and other small house loads. Making a chart with all the loads is helpful as you inspect different buildings. Be sure to ask the owner what power is available, (voltage, single- or three-phase, and amperage), and where the main panel is located. The further it is from your equipment, the more expensive it will be to install power to the equipment.

As you get closer to selecting a location, it is advisable to consult with a licensed electrician to confirm the power needs and the actual power available in the building. I would not recommend

. . . it is advisable to consult with a licensed electrician to confirm the power needs and the actual power available in the building.

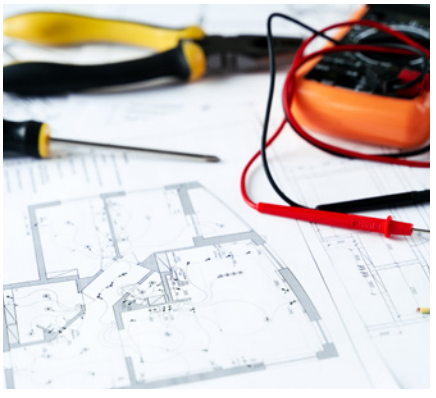


Photo courtesy of Shutterstock.com

asking the building owner or your buddy. An electrician can also give you an idea of what the cost will be to connect your equipment to the main power supply under the local code requirements. Be sure to confirm that your equipment supplier can provide UL listed panels and equipment since most insurers and buildings will require this.

If your needed power isn't currently available at this location, consult with the electric utility company for costs to upgrade to the power you need. Often there is little or no cost to upgrade as they do factor increased utility bills into their assessment. However, if the power isn't readily available at a nearby power pole, the costs can be a showstopper. Best to know this up front!

Lastly, make a plan for future growth at this location. Not only for electrical power, but additional cellar equipment and potentially a larger brewhouse. It is always cheaper in the long run to add it now than redo it later.

If your prospective locations simply don't have the power you need available, consider a natural gas-fired brewhouse. While installation costs are higher due to ventilation requirements and higher upfront equipment costs, it is a fast and efficient energy source. However, you will want to confirm with the gas company that they can provide gas at the necessary pressure and flow your burner will need. Your equipment supplier can let you know what those requirements are.

Water utilities are generally fine in most commercial locations for operating a nanobrewery. But do confirm the water pressure and incoming pipe size with the water company. The biggest flow need will likely be your wort chiller. Your supplier should be able to provide flow and temperature requirements. A quick way to measure flow rate available is a 5-gallon (19-L) bucket and a stopwatch. You will need to fill your tanks at a reasonable pace, but that won't be your bottleneck. In general, a 5-barrel system will need about a 1-inch (2.5-cm) water supply line diameter.

If you'll be treating your water with a reverse osmosis (RO) filter, the production rates are dependent on water pressure. If it is too low then you'll need to install a pressure boost pump so you can meet your brewing liquor needs. Your RO system supplier can likely provide a pump for the system.

Waste water is generally not an issue for nanobreweries, but it is wise to confirm with your water/sewer utility that your main brewing chemicals (acids and bases) are OK to run into the sewer, or if they need to be pre-treated prior to disposal.

OTHER INTERIOR INFRASTRUCTURE

Floors are the foundation of your brewery (pun intended). A concrete slab floor poured directly on the ground level will be adequate for supporting nano-sized equipment. If your floors are over a crawl space/basement or on the second floor, you will want to consult with a structural engineer to determine what will need to be done to safely support the load of full brewing vessels.

The only drawback of pre-existing concrete floors is that they are unlikely to be sloped to a drain. A sloped floor and central drain or a trench drain are highly desirable, but may be out of your budget. Most nanobreweries I've worked with do not have a sloped floor system and get by just fine. As long as you have a floor drain accessible you can squeegee wet floors to the drain.

Floor coatings are highly recommended, as brewing chemicals can quickly erode bare concrete. Epoxy paints are a very economical and reasonably durable solution. If you have the budget, there are other floor coatings that your local industrial floor coating suppliers can quote for you.

Wall and ceiling penetrations are another consideration for your ventilation system. Condensing steam in your brewhouse that isn't properly ventilated will lead to mold and mildew issues in your building. Not to mention aromas on brew day overwhelming your beer-consuming clients in your taproom. Be sure to locate your brewhouse where the boil kettle can be ventilated to the exterior of the building. Be sure to ask the building owner beforehand if they will allow roof/wall penetrations. Always install a condensate drain at the base of the ventilation piping so the Dimethyl Sulfide (DMS) and other undesirable condensate doesn't drain back into your brew kettle.

Another consideration is getting your equipment into the building. This can be through a door or the ceiling. If a large door isn't available, be sure the owner is OK with you widening it if needed. That will also make grain deliveries, spent grain disposal, and expansion easier in the future.

EXTERIOR INFRASTRUCTURE

Some key considerations for exterior needs include adequate parking, outdoor seating, truck deliveries, and spent grain storage and removal. Be sure to contact your architect or local building inspector to determine the parking space requirements for your business, and whether outdoor seating is allowed if that is something you are planning.

Considering food trucks? Make sure there is space for them and your customers to access it. Handicap access is most likely a requirement for your brewery, so be sure to get approval from the building inspector on your plans for that if it is not already up to code. Since you will be buying pallets of grain, having access for semi or box trucks is needed. For spent grains, note that they become quite ripe quickly in the summer so having a remote location for storing them until your local farmer can pick them up is a good idea.

BREWERY EXPANSION

It is always a good idea to have expansion plans ready to implement as your business needs grow or change. The Blichmann Pro Brewing page has a tank planner (found at www.blichmannengineering.com/tankplanner/index/index/) that is very helpful not only in planning your initial equipment, but to know how many tanks you'll need to meet increasing demand, and subsequently, how much additional space to allocate for that and when to do it. That said, oversizing your chiller may be recommended, or possibly adding a second chiller when the time comes.

Once you find your location, be sure to get all your infrastructure needs from your landlord in writing. That way, if there is confusion down the road you won't be left holding the bag. Starting your brewery is indeed an exciting and exhausting process, and knowing your needs and requirements is the best way to avoid any last-minute costly surprises! BYO

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BY GEORGE DOWNS

TRIP OF A LIFETIME

Visiting all 50 U.S. States & their breweries

Like many retired people, I created a bucket list of all the things I wanted to accomplish in my retirement. Most of my goals were the classic ones: Travel to new places, spend more time with my loved ones, and dive deeper into my hobbies (in particular, homebrewing). And as I completed these goals in my first few years of retirement, I had the idea of blending all of these goals into one trip of a lifetime: Visit all 50 U.S. states and drink local beer in each of them.

After a few months of discussing the idea with my wife and two of our friends, we eagerly planned the cross-country road trip. We ultimately decided the best way to reach this goal of mine was to tackle all 50 states in a few parts, and the first part would be traveling across all the Southern States during the springtime. Beginning from our hometown in Georgia, we would drive through as many states as we could until we reached the West Coast, visiting as many landmarks and our out-of-state families along the way. We kept the trip flexible, maintaining no more than 4½ hours in the car any day so we could explore the communities we were driving through. We also took our time in each city, sometimes spending multiple days in one place before visiting the next. The only timeline we followed was customized to specific events we did not want to miss (e.g., Chicago Cubs spring training).

In 40 days, we visited 15 states, 7 National Parks, 7 casinos, and 27 breweries where we sampled over 75 different local craft beers.

I used the Brewers Association's "Find a Brewer" webpage to find nearby breweries on our travel path. Whenever I arrived at a brewery, I would talk to staff and share that I was a homebrewer on a cross-country adventure. In doing so, I was able to meet and talk with production staff at several breweries and given tours of their breweries. Among the 27 breweries I visited, I was surprised to see how wide of a range of brewing equipment was used. Many had a large setup, which I typically see in my state's own local breweries; however, several setups were way more sophisticated, and others were as simple as my homebrew setup (just on a larger scale).

One of the best discussions I had was with a brewer in Amarillo, Texas. The brewer had just finished his day when we stopped by for a beer. We chatted for 90 minutes as he told me his homebrewer to brewmaster story. While talking, he kindly gave me a tour of the very unique brewery setup and shared a delightful imperial stout that he brews in small batches to share with other brewers and friends.

While I habitually purchased branded swag from breweries, the best thing I collected was the variety of invaluable information and pointers from the local brewers, painting a picture of the different patterns in the U.S. beer culture of today.

Several pieces of advice I was given stuck out to me — from the benefits of lab tests to the importance of water adjustments. After my travels were done and I settled back into normal life, I implemented much of the advice I received into my homebrew practices. I asked my local craft brewery if they would provide me with their filtered water with the needed minerals for a particular style of beer, with the promise of some my finished beer in return. They readily agreed, and in this process I noticed an immediate improvement in my homebrew.

I'm hoping in the next year to take a similar trip to the Northern States and get a bigger picture of the nation's beer culture. I look forward to sampling the local beers, collecting swag, and chatting with more brewers in each. BYO

While I habitually purchased branded swag from breweries, the best thing I collected was the variety of invaluable information and pointers from the local brewers . . .

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