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Brew Your Own

THE HOW-TO HOMEBREW BEER MAGAZINE

DECEMBER 2013, VOL.19, NO.8

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BYO RECIPE STANDARDIZATION

Extract efficiency: *65%*
(i.e. — 1 pound of 2-row malt, which has a potential extract value of 1.037 in one 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.

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what's happening at BYO.COM

Mumme's the Word: Style Profile

Sure, porter has a long history. But it is just a teen compared to mumme, which dates back to the Middle Ages. Learn to brew this thick, malty ale.
http://byo.com/story1170

Thirsty Dog's Old Leghumper: The Replicator

Still thirsty for more porter recipes? Check out this Replicator column from 2001 with a clone recipe for Thirsty Dog Brewing Company's Old Leghumper, with a grain bill made of more than 50 percent specialty malts!
http://byo.com/story1511

Enjoy the Real Thing: Cask-Conditioned Ale

Everything you ever wanted to know about cask-conditioned ale: from its history and use, to (more importantly) how to brew and serve it at home!
http://byo.com/story594

Aerating Wort: Techniques

In this issue, Mr. Wizard tackles an aeration question on page 15. Want more details on how to deliver oxygen to keep the yeast in your cooled wort healthy? Then this article is for you.
http://byo.com/story1894

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Volume 19, Number 8: December 2013

contributors

Gordon Strong is the President of the Beer Judge Certification Program (BJCP), the organization that certifies beer judges for homebrew competitions and also registers qualifying homebrew competitions. As a three-time winner of the Ninkasi award, which is given to the brewer having the most wins in the Final Round of the National Homebrew Competition, he knows plenty about entering homebrew contests. And, as a Grand Master Level V judge in the BJCP, he has also tasted quite a bit of homebrew. On page 52 of this issue, Gordon explores the mysteries of porter and how its style definition has evolved since it was first brewed. He also shares five recipes for brewing porter, which have each won awards in US homebrew competitions.

Terry Foster was born in London, England and holds a PhD in chemistry from the University of London. He now lives part of every year near New Haven, Connecticut, where he often brews commercially with the brewers at BruRoom@BAR — New Haven's first brewpub. Terry is known to many homebrewers as the author of the *Pale Ale* and *Porter* books in the Classic Beer Style Series (Brewers Publications) as well as many articles in *Brew Your Own*.

In this issue, on page 42, he takes us back in time to recreate an 18th century porter. Terry also tackles the subject of brewing with black malt in his "Techniques" column on page 85.

Glenn BurnSilver is a freelance writer who enjoys outdoor activities such as hiking and camping in the backwoods. He has lived in Colorado and Alaska and now resides in Scottsdale, Arizona. BurnSilver is also an avid record collector and travels to record conventions across the country. He also maintains a music review blog, *Liner Notes*, which can be found at www.burnsilver.com.

Glenn is a frequent contributor to *Brew Your Own*, including his most recent story about making hopped hard cider in the October 2013 issue. In this issue, on page 34, Glenn shares some advice for planning your next commercial brewery visit, and what you should ask as a homebrewer to get the most from your trip.

mail

Sam Adams seasonal

I loved the Sam Adams article in the November 2013 issue of *BYO*. I am really looking forward to brewing the Holiday Porter recipe. It's one of my favorite beers. Which reminded me that I've never seen a clone recipe for an even better seasonal, Old Fezziwig. Could you put one in a future issue, maybe in The Replicator section?

Kevin Fox,
Goffstown, New Hampshire

Brew Your Own *Editor Betsy Parks responds: Kevin, glad you enjoyed the Sam Adams story. I certainly enjoyed my visit to the brewery in Boston to write the story. Before I left, I and the rest of the edit staff really debated about which clone recipes to ask for from the Sam Adams brewers, and Old Fezziwig was the first runner up, unfortunately. But I agree — it's a great seasonal beer! You sent your letter to the right place (edit@byo.com), however, and I did forward your request along to our "Replicator" columnist, Marc Martin, who hopefully might be able to include Old Fezziwig in a future issue. In the meantime, though, I found the Samuel Adams staff to be extremely accommodating to homebrewers during my interviews, so perhaps you might contact the brewery directly and see if they can point you in the right direction for ingredients and techniques for making your own Fezziwig. To help you out on my end, check out this link for a story in* BYO *about making your own clones: http://byo.com/story886. I hope that helps a bit — happy holiday brewing!*

Gluten-free grains

Just wanted to let you know about an inaccuracy in the November 2013 *BYO*. The article "Rethinking Gluten-Free Homebrewing" states, ". . . there are essentially no pre-malted/kilned gluten-free grains available in small quantities for the homebrew market."

We are Colorado Malting Company, and have been malting gluten-free (GF) grains since 2011. We have malted and shipped millet, buckwheat, milo, quinoa, teff, ama-

ranth, sunflowers and rice to homebrewers and breweries all over the USA and Canada. The malted millet and quinoa Ryan Bove mentioned in "Tips from the Pros," (same edition of the magazine, page 13) were supplied to Ryan by Colorado Malting Co.

Malted GF grains are made available to homebrewers on our website: ColoradoMaltingCompany.com with a minimum five (5) pound order per grain.

Thank you for your time and your wonderful, insightful magazine!

Tim Cody
Home Brewer Product Advocate
Colorado Malting Company

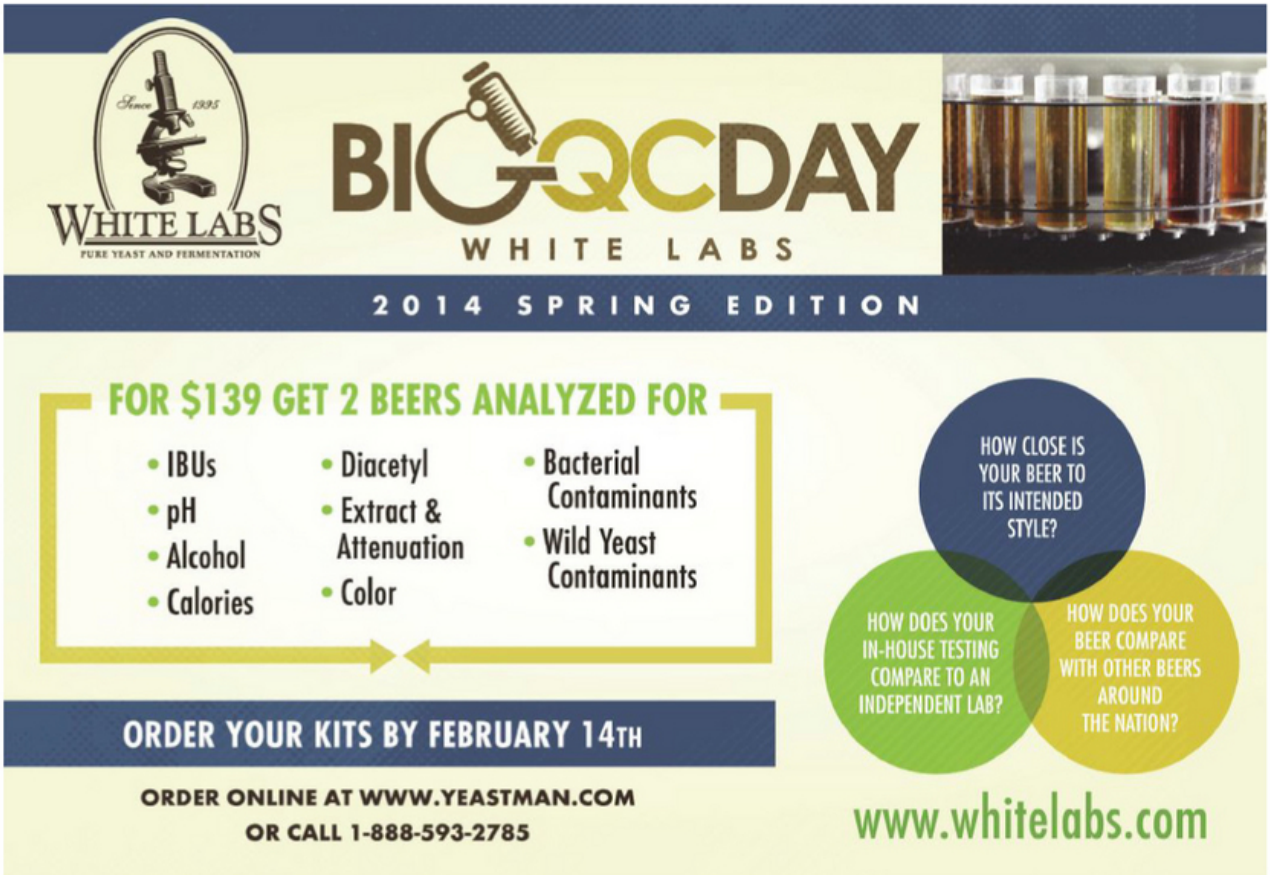
Brew Your Own *Editor Betsy Parks responds: Tim, thanks for writing in and letting us know about Colorado Malting Company's products. I have to admit, not being gluten-free myself I've been guilty of not being able to keep up with all of the advances and gluten-free products that are out there now for homebrewers who are also Celiac sufferers. Heck, I didn't even know about Omission beers from Widmer until I read the story in the November issue! My apologies for the oversight. If we run anything in the future about brewing with gluten-free grains, we'll be sure to mention you guys.*

Smoked malt question

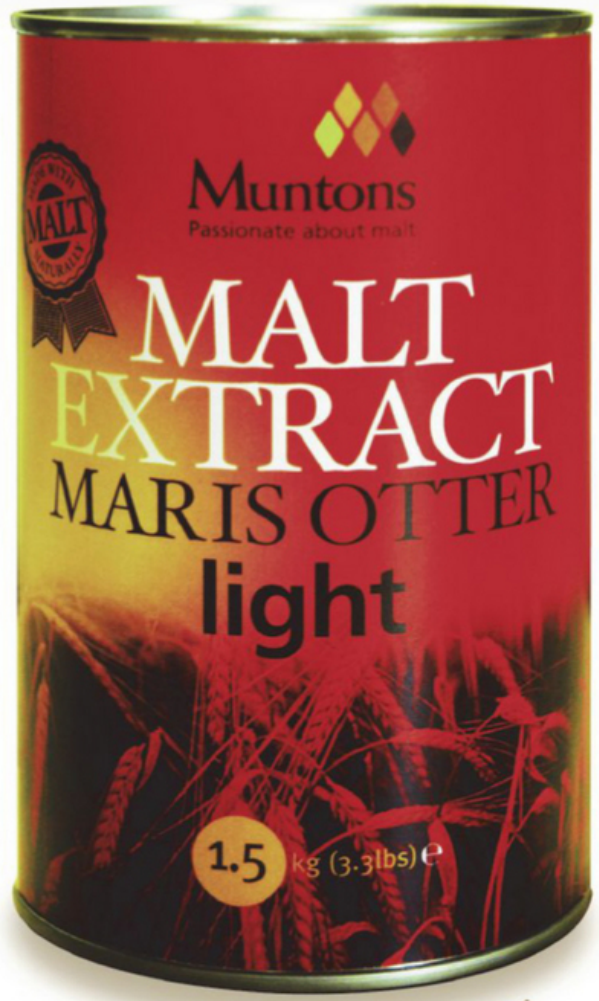
I just finished reading through my November 2013 issue of *BYO* and noticed a conundrum when reading about using smoked malts. In The Replicator's recipe for Big Al Brewing Company's smoked porter, it states to use 5 oz. of peat-smoked malt. Yet, in "Style Profile" we're told by Jamil Zainasheff, "You might come across peat-smoked malt. Do not use it. Peat-smoked malt imparts a horrible character to beer." So what should we do? Obviously Big Al's Smoked Porter is an awesome beer, but I don't want to add horrible character to it by using peat-smoked malt in the mash as the clone recipe calls for. Thanks for any suggestions or clarifications you can offer!

Nate Sanders
via email

Brew Your Own *Recipe Editor Dave Green responds: Nate, I recommend simply that restraint is required with peat smoked malt. A little goes a LONG way. Five ounces is definitely starting to get over that borderline "nasty" description that Jamil speaks of. But if used very judiciously given the nature of the recipe, then there should be somewhat of a "safe" zone where it is perceptible but not off-putting to your senses.* BYO



CAN DO!



Developed by Dr G.D.H Bell and his team at Cambridge, England in the 1960s, *Maris Otter* is a two-row barley with unrivalled heritage in the UK brewing industry.

Dr Bell bred *Maris Otter* barley from a cross of *Proctor* and *Pioneer* - two top quality traditional malting barley varieties. To this day, *Maris Otter* seed is only sold to a select group of farmers who are specially chosen to grow the variety.

Soon after its introduction, *Maris Otter* barley malt became a favourite with brewers due to its excellent malting characteristics, low nitrogen content and forgiving brew-house performance.

Maris Otter is still highly prized in today's craft brewing industry providing independent brewers with a rare opportunity to create beers of unparalleled individuality and quality.

And now you can benefit from the unique characteristics of *Maris Otter* in your home brewed beers. Muntons *Maris Otter* liquid Malt Extract is a new addition to the Muntons Malt Extract range available in both 3.3lb cans and bulk malt.

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homebrew nation

READER PROFILE:

Brewer: Mike Prosser

Hometown: Burien, Washington

Years Brewing: 10

Type of brewer: All-grain, some extract with grains

Homebrew Setup (volume, style, efficiency): 10-gallon (38-L) single-tier natural gas/three 110 BTU burners, Chugger pump, 30 plate chiller, 14.5-gallon (55-L) stainless steel conical fermenter

Currently fermenting: Calypso Ale (Recipe from the July-August 2013 *Brew Your Own*)

What's on tap/in the fridge: Imperial IPA, red ale (Kilt Lifter clone), Vertigo IPA

How I started brewing: I was introduced to homebrewing by my brother-in-law more than 15 years ago. I bought one of those Mr. Beer setups and brewed one gallon (3.8 L) at a time. Although all I had to do was add the packaged ingredients, water and yeast, I really didn't know what to do or expect. My wife eventually bought me a 5-gallon (19-L) brew setup and Charlie Papazian's *The Complete Joy of Homebrewing* from Larry's Brewing Supply in Kent, Washington.

My first batch was the Rocky Raccoon recipe from this book. Since then, I have been growing three different types of hops and washing/cultivating different strains of yeast. I have become a hop head and have been experimenting through BeerSmith designing my own IPAs and stouts. I built a 3-tier gravity stand three years ago but after reading about the Brutus-style system I built one of those to replace it (see picture). This new stand is framed with 2-inch by 2-inch square steel and houses three 110 BTU natural gas burners, 30 plate Duda Diesel chiller and a Chugger pump. This stand weighs over 300 pounds and sits on eight swivel casters. It took about two weeks to weld and plumb.

I'm currently the Vice President of Rat City Homebrewers in White Center, Washington. We have 25 members and participate in various brew events in Seattle. Our website is www.ratcityhomebrewers.com

reader recipe

Hoppy Days IPAyyyeee

(5 gallons/19 L, all-grain)

OG = 1.075 FG = 1.020
IBU = 100+ SRM = 6 ABV = 7.1%

Ingredients

14.4 lbs. (6.5 kg) 2-row pale malt (1.8 °L)
1 lb. (0.45 kg) dextrine malt (2 °L)
6 oz. (0.17 kg) caramel malt (10 °L)
28 AAU Columbus hops (60 min.) (2 oz./57 g at 14% alpha acids)
28 AAU Columbus hops (20 min.) (2 oz./57 g at 14% alpha acids)
11 AAU Cascade hops (15 min.) (2 oz./57 g at 5.5% alpha acids)
10.8 AAU Hallertauer hops (10 min.) (2 oz./57 g at 5.4% alpha acids)
10.8 AAU Hallertauer hops (5 min.) (2 oz./57 g at 5.4% alpha acids)
2 oz. (57 g) Cascade hops (dry hop)
Wyeast 1056 (American Ale) or White Labs WLP001 (American Ale) or Safale US-05 (American Ale) yeast
Priming sugar (if bottling)

Step by Step

Heat 18.4 quarts (17.5 L) strike water to 161 °F (72 °C) degrees in order to stabilize the mash at 152 °F (67 °C). Hold at this temperature for 60 minutes. Raise mash to 168 °F (76 °C) and begin to lauter. Bring wort to a boil, adding hops at times indicated. After 60 minutes of boil, cool the wort to 68 °F (20 °C) and pitch yeast. Ferment at 68 °F (20 °C) for 14 days. Dry hop the beer after the first seven days and let rest another seven days before bottling or kegging.

byo.com brew polls

What do you enjoy most about brewery visits?

Sampling the beers 39%
Speaking with the brewers 32%
Learning about the brewery 16%
Seeing the brewing equipment 13%

social homebrews

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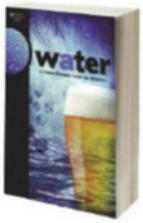
what's new?

Water: A Comprehensive Guide for Brewers



Ingredients like hops, barley and yeast are widely understood by brewers, but the fourth primary ingredient in beer, water, is often overlooked. Beer experts (and *BYO* contributors) John Palmer and Colin Kaminski penned *Water: A Comprehensive Guide for Brewers* with the intent to change that and help brewers who have long been flummoxed by the liquid's complex chemistry. The third book in Brewers Publications' Brewing Elements series, this detailed guide is the first book solely devoted to the use and treatment of water throughout the brewing process.
Visit www.brewerspublications.com for more info.

Beer Squared

A great beer will stay in the cooler if the packaging looks like an afterthought. Beer Squared helps brewers of all levels with labels, packaging, web design and print media design. They can give a new brewery an identity from the logo up or help an old brewery reinvent itself. Once the logo is designed, Beer Squared can create a website, carriers, labels and advertising that can turn a hometown brew into a sensation. Shouldn't your beer look as good as it tastes? Learn more at www.beersquared.com or give them a call: 888.596.6636

Craft Beer Cookbook

In his newest book, *The American Craft Beer Cookbook*, beer-writer John Holl profiles some of his favorite craft breweries and shares 150 of their beloved food recipes that taste amazing with beer. Recipes range from simple sandwiches and burgers to loftier dishes such as saison and clementine Cornish game hens with roasted vegetables. Available at major booksellers.

calendar

December 7
Monk Melee III
Hulmeville, Pennsylvania
The ALEiens Homebrew Club will hold their Monk Melee III homebrew competition at the Hulmeville Inn in Hulmeville, Pennsylvania. It is a BJCP sanctioned homebrew competition accepting entries in BJCP style categories 16 (French and Belgian Ales), 17 (Sour Ales), and 18 (Belgian Strong Ales). The entry deadline for the event is December 4
Entry Fee: $6 first entry/other entries $5
Web: www.aleiens.com

December 7
Entry deadline for Big Beers, Belgians, & Barleywines Homebrew Competition
Vail, Colorado
This is an AHA sanctioned event accepting entries in various BJCP categories. The entry deadline is December 7 and judging of the 14th annual event will take place January 10, 2014. The Grand Prize winner will have a commercial batch of their recipe brewed and served at The Falling Rock Taphouse in Denver and Dry Dock Brewing in Aurora. Dry Dock will also partner with the Grand Prize winner and submit the winning recipe as a collaboration entry into the 2014 Great American Beer Festival.
Entry Fee: $5 per entry
Web: www.bigbeersfestival.com

December 11, 13, 14
Happy Holidays Homebrew Competition
Webster Groves, Missouri
The 23rd Annual Happy Holidays Homebrew Competition, the last qualifying event for the Annual Masters Championship of Amateur Brewing, is an AHA/BJCP sanctioned event hosted annually by the St. Louis Brews. The main judging will occur on Saturday at Annunciation Church Cafeteria. The competition uses the 2008 BJCP style guidelines. Registration is open from November 4 to December 6.
Entry Fee: $6
Web: www.stlbrews.org

homebrew drool systems

"Gnarly" Brewstand

Sal Mortillaro II • Mandeville, Louisiana

I am the Vice President of The Mystic Krewe of Brew club in Covington, Louisiana and am also a BJCP-certified judge. I'm known in our club for specializing in "weird" beers and enjoy pushing the boundaries of beer. I have been brewing for 3.5 years and wanted to step up my all-grain game. My good friend Zac Caramonta of Gnarly Barley Brewing built a similar system for himself and wanted to build another one to implement some "lessons learned" from his system. This system was a labor of love for Zac and I. We worked on it over the course of several weekends from January-April 2012.

We purchased 90-degree angle iron for the frame, steel plate metal for the burner stands, and aluminum diamond plate for the floor. We welded the frame along with several support braces throughout for structural integrity. We then applied a cold galvanization product to the frame to prevent rust, painted the frame, laid down the diamond plate, & drilled holes for drainage.

Next, we built the burner assemblies. To save time and money, we bought tool stands and cut and welded the steel plates to sit over the stands. We used two Bayou Classic burners for our application by cutting the legs off of them, welding brackets, and dropping the burner down 1 inch (2.5 cm) for airflow. The burners were finished off and bolted onto the frame.

Our last step was to modify two 15.5-gallon (59-L) decommissioned kegs for a HLT and boil kettle. We cut off the tops and added the appropriate internal parts for each one. We used cam-lock fittings with food-grade silicone hose throughout. We finished it off with a March pump and Blichmann Therminator. An upgrade in the works is a Blichmann Tower of Power.

beginner's block

STAINLESS STEEL CARE

by dawson raspuzzi

With qualities that prevent it from rusting, stainless steel is highly regarded and often used in every facet of homebrewing — from stainless kettles with stainless immersion coolers, to hot liquor tanks, mash tuns and conical fermenters. While it is durable and rust-resistant thanks to a shield of chromium oxide, that doesn't mean caring for your stainless steel equipment should be overlooked. Proper cleaning and care for your equipment will ensure these products last a long time, protecting what can be a hefty investment in homebrewing equipment and preventing contamination. While a long brew day can sometimes leave you short on motivation to clean up, do not put it off!

Corrosion, particularly around scratches, can occur below stuck-on grime when there is no free oxygen to maintain the passive chromium layer. If those brownish or whitish spots on the bottom of your brew kettle aren't removed they may cause pitting underneath them. Stainless steel can be cleaned using most household cleaning items, with one major exception: chlorine bleach. Chloride ions present in bleach attack stainless steel and have the strength to break down the invisible chromium surface on your stainless steel. Bleach is incorporated into many common household cleaners, so be sure to read what is in the cleaning products you use before you begin cleaning your stainless.

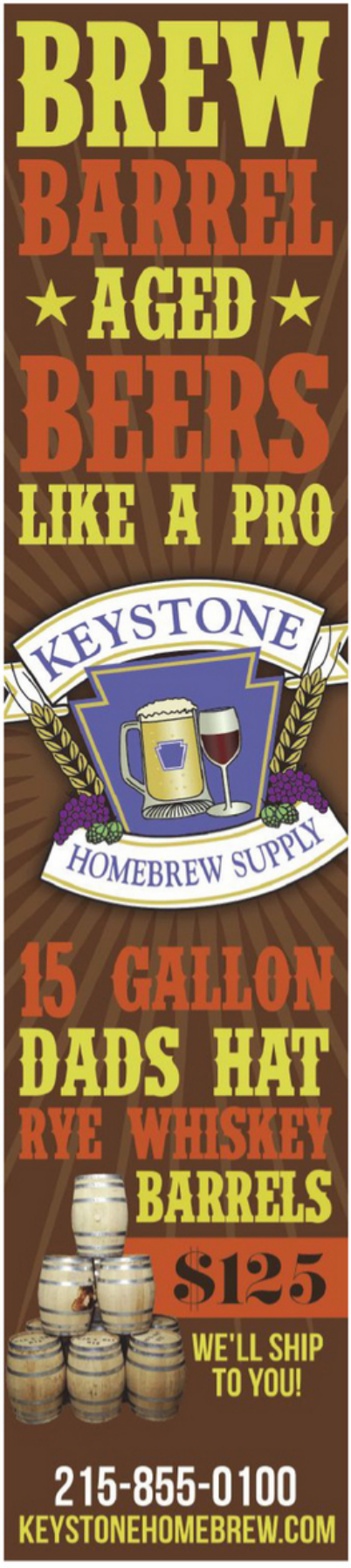
Ordinary household soaps and detergents work great for cleaning stainless, but if there is a heavy-duty scrubbing that needs to be done (ever burn extract to the bottom of your kettle?), common cleaners like Bar Keeper's Friend and Powder Brewery Wash (PBW) can remove most grime with the assistance of a woven nylon scrubber or dish brush. Do not use steel wool, as it will leave tiny steel particles embedded in the surface and, over time, those pieces will rust! Once surface rust has breached the protective chromium layer, the iron in your stainless product will begin to rust as well. If this happens, rust stains can be removed with Bar Keeper's Friend or using a solution of nitric acid and water (about 1 part nitric acid to 10 parts water), letting it sit for up to an hour and then washing it off. After cleaning, always make sure to carefully rinse your stainless to ensure no cleaning products dry on the surface.

Stainless steel is not scratch proof. While light surface scratches should not be a problem, deeper scratches (ones you can feel) should be buffed or grinded out because they can lead to crevice corrosion. Again, the rust that may form in these scratches will spread due to the iron in the stainless steel. You can buy an abrasive intended for use on stainless steel from welding supply stores to smooth out scratches. After smoothing, clean the area well with kitchen cleaner to give it a good polish. Air contact will naturally strengthen the chromium over the buffed area so your equipment will remain rust-resistant. For more information about taking care of stainless steel equipment, visit http://byo.com/story1516

hop profile

GALENA

Galena emerged from an open pollination of Brewer's Gold in Idaho in 1968. Its name comes from galenite, a mineral found in the soil of Oregon where Galena is often grown. It has a relatively high content of both alpha and beta acids, with alphas ranging around 11.5-13.5%. Its aroma contains mild citrus notes, and the hop can be used in most English- and American-style ales. Possible substitutions include Brewer's Gold, Columbus, and Nugget.



by marc martin

DEAR REPLICATOR,

MY WIFE AND I RECENTLY TREATED OURSELVES TO A VACATION TRIP TO PORTLAND, OREGON AND IT WAS THERE THAT MY BRIDE ACTUALLY LOVED A BEER: TERMINATOR STOUT FROM MCMENAMINS. AS MCMENAMINS IS NOT AVAILABLE IN WISCONSIN, I WAS HOPING TO GET HOPPING ON MAKING IT FOR HER.

MICHAEL PEUSE
ROSHOLT, WISCONSIN

A trip to Portland would not be complete without visiting one or more of the McMenamins establishments.

Brothers Mike and Brian McMenamin have successfully created a pub empire that is unmatched anywhere else in the country, the beginnings of which can be traced back to the opening of the Produce Row Café in 1974. Here they began to serve tap beers that were outside the normal industrial yellow lagers. While driving through his native Portland in 1983, Mike, an out of work beverage wholesaler, noticed a recently closed old tavern that he had frequented. He stopped to talk to the landlord and by the time Mark left he had leased the building; and thus their first real neighborhood pub, The Barley Mill Pub, was created.

Mike saw great potential in the newly emerging craft beer market and wanted to try making his own beer to sell in the pub. Both brothers lobbied hard at the state capitol and in 1985 the Oregon legislature nixed a law forbidding bars to brew their own beer. This not only launched their road to success, but became the beginnings of the Oregon brewpub revolution.

Soon after the law change they opened the Hillsdale Brewery and Public House in Portland, which became the first post-Prohibition brewpub in Oregon. They also became the first brewery in the U.S. to legally include fruit in their brew with their Ruby Ale made with fresh raspberries. This beer continues to be part of their list of "standard ales."

In 1987 they purchased a 75-year-old church just west of the downtown core. With extensive renovation, it became The Mission Theatre Pub, a place where you can watch a movie while enjoying a pint. That was the first of the brothers' acquisitions of old, historic buildings. They have become famous for restoring classic properties that would otherwise be lost and converting them into brewpubs. Today, Mike focuses on the creative side while Brian handles operations. The empire totals well over 50 locations with about half of those brewing beer on premises. Many homebrewers start their professional brewing careers by apprenticing with one of their experienced brewers.

The Terminator Stout is one of their top year-round sellers. This classic stout doesn't try to emulate any particular style guideline, instead choosing to stand on its own. Black as night and topped by a firm, tan head, this beer is what craft beer fans expect for stout appearance. A hefty malt backbone exhibits notes of fresh roast coffee and chocolate. Chinook hops provide just enough bitterness to offset the residual sweetness. It is truly a great beer for the dark of winter but enjoyable anytime.

Michael, a trip to Portland won't be needed to get your wife's new favorite beer because now you can "Brew Your Own." For more on McMenamins, visit www.mcmenamins.com. BYO

McMenamins Breweries' Terminator Stout Clone

(5 gallons/19 L, extract with grains)

OG = 1.065 FG = 1.016 IBU = 27 SRM = 42 ABV = 6.3%

Ingredients

3.3 lbs. (1.5 kg) Briess, light, unhopped, liquid malt extract
2.6 lbs. (1.2 kg) dried malt extract
2.25 lbs. (1.0 kg) Munich malt
1 lb. (0.45 kg) crystal malt (40 °L)
1 lb. (0.45 kg) black barley malt (530 °L)
6.5 AAU Chinook hop pellets (60 min.) (0.5 oz./14 g at 13% alpha acids)
1.65 AAU Cascade hop pellets (30 min.) (0.3 oz./9 g at 5.5% alpha acids)
½ tsp. Irish moss (30 min.)
½ tsp. yeast nutrient (15 min.)
White Labs WLP001 (American Ale), Wyeast 1056 (American Ale), Safale US-05 (American Ale) yeast
Corn sugar for priming (if bottling)

Step by Step

Steep the grains in 2.25 gallons (8.5 L) of water at 156 °F (69 °C) for 30 minutes. Then rinse the grains with 2 quarts (1.9 L) of hot water. Add the extracts and boil 60 minutes. While boiling, add other ingredients as per the schedule. When finished, add the wort to 2 gallons (7.6 L) of cold water in a sanitized fermenter and top off with cold water up to 5 gallons (19 L).

Cool the wort to 75 °F (24 °C). Pitch your yeast and aerate the wort heavily. Allow the beer to cool to 68 °F (20 °C). Hold at that temperature until fermentation is complete. Transfer to a carboy and allow the beer to condition for 1 week and then bottle or keg.

All-grain option:

This is a single-step infusion mash using 10 lbs. (4.5 kg) of 2-row pale malt to replace the liquid and dried malt extracts. Mix all of the crushed grains with 4.75 gallons (18 L) of 173 °F (78 °C) water to stabilize at 156 °F (69 °C) for 60 minutes. Slowly sparge with 175 °F (79 °C) water. Collect approximately 6 gallons (23 L) of wort runoff to boil for 60 minutes. Reduce the 60-minute Chinook hop addition to 5.2 AAU (0.4 oz./11 g) and the Cascade hop addition to 1.4 AAU (0.25 oz./7 g) to allow for the higher utilization factor of a full wort boil. The remainder of this recipe and procedures are the same as the extract with grains recipe.

Cask Ale

tips from the pros
by Dawson Raspuzzi

"An art form as much as a science"

CASK ALE, ALSO CALLED "REAL ALE," IS NATURALLY CARBONATED THROUGH A SECONDARY FERMENT IN THE BARREL. THE BEER IS NOT FILTERED OR PASTEURIZED AND IS DISPENSED WITHOUT THE USE OF GAS. WE'VE PULLED TOGETHER TWO PROS WITH YEARS OF CASKING EXPERIENCE TO HELP GET YOU ON YOUR WAY TO BREWING GREAT CASK-CONDITIONED BEER.

Cask beer is the first beer that I fell in love with, so it remains at the root of my fascination with brewing. Cask beer is a slow drink in an age that too often demands speed over quality. It's an art form as much as a science, and that's a beautiful thing. We produce cask beer every week, some of which we'll age for a year or more. Casking is something we do entirely by hand, and for New York City it's a pretty Zen activity. And that's a good thing unto itself.

When done properly, cask beer is more nuanced, layered and subtle than the vast majority of kegged beer. This is especially true of low-gravity ales, which can transform into elegant and revelatory beers, even at 3.5% ABV. There's a creamy softness to the texture, yeast-driven fruit flavors come forward, and the whole mouthfeel is different and better married.

At Brooklyn Brewery, we cask condition any beer we make that has a British-style background, including some of our Brewmaster's Reserve specials. I've recently had a number of Belgian-style cask beers in the UK, and although they were interesting and adventurous, I've yet to find one convincing. That said, some German lager styles do well, primed a bit more heavily to give an "*Ungespundet*" (mild effervescent) character. Those are often served a bit hazy.

Cask conditioning and service produces a beer that is less carbonated and served cool rather than cold. As a result of this and the churning caused by the beer engine, hop bitterness seems much lower in cask versions of any given beer. The beer's sweet and fruity elements also come forward. So when we brew a beer specifically for cask, we'll adjust the bitterness upwards to provide a better balance.

We use steel casks. Wood casks are cool looking, but they confer no real advantages as you do not want to impart wood flavors from the cask. Plus, steel can be sterilized, which is also important. When we want to impart wood flavors, we barrel-age, usually in bourbon oak, but that's very different than casking.

Consistency is, in a way, the issue in cask beer. One thing that many American brewers don't understand is that traditional British cask beer is supposed to be absolutely, utterly bright. No haze whatsoever. Cask beer should also be frisky (not fizzy) and cool, not warm and flat. We're Americans and we can do as we please, but if your beer is flat or hazy, it's definitely not traditional cask beer. We ferment our cask beer out to the end of fermentation and then prime the beer with sugar, finings and new yeast for conditioning. This, with proper cellarmanship, produces a consistent result.

We usually give our beers at least a week in cask to finish the secondary fermentation. Our Best Bitter prefers about 10 days for the malt flavors and fruity yeast flavors to deepen. IPA, on the other hand, likes to get out there fast; five days is fine. This gives the best and brightest hop flavors.

At home, unless you have a cask breather system, you really should drink the cask in a single evening. So you might want to have a party! A breached cask can sometimes last another day, but not more than that. And give it time on the stillage to drop bright — 24 hours is usually not enough. It's a hobby and you're not under commercial pressure, so why not take your time? Three days in place, and you'll have far nicer pints.

Garrett Oliver is the Brewmaster of Brooklyn Brewery, Editor-in-Chief of *The Oxford Companion to Beer* and author of *The Brewmaster's Table*. He began brewing professionally at Manhattan Brewing Co. in 1989 and became Brewmaster there in 1993. A year later he came to Brooklyn Brewery, where his beers have won numerous national and international awards.

Hugh Sisson is a pioneer in Maryland's craft beer movement. He lobbied to legalize brewpubs in Maryland in 1987 and opened the state's first brewpub, Sisson's, in 1989. He is also a founding member and past president of the Brewer's Association of Maryland and founded Baltimore's first homebrewing club, the Cross Street Irregulars. In 1994 he founded Clipper City Brewing Co. and in 2003 he created the brand Heavy Seas (one of the largest producers of cask ale in the US).

Cask beer is draft beer at its highest expression. Unfiltered, softly carbonated, rounded and complex. It is naturally and gently carbonated in the cask — much like Champagne is carbonated in the bottle. It is a very artisanal approach that we just plain like.

We use the same base beer for our cask-conditioned beers as we do for our "regular" beers, we just pull it before it is filtered. Oftentimes we may give it extra hops or wood chips depending on if we believe the style will support it.

We have both wood and stainless steel casks, but they are mostly stainless steel. The wooden casks are expensive and really fragile — so they are a challenge — but they do add an additional flavor nuance. I think we own eight wooden casks and around 600 stainless ones.

In the cask, it usually takes about five days until the beer is carbonated through secondary fermentation. It may require a bit more time for some of the bigger beers, or if we are dry hopping it is better to give it a few more days.

One tricky thing with cask conditioning is that it is more difficult to reproduce the same exact beer every time. Certainly, cask conditioning is not an exact science. We are pretty consistent, but there are definitely small variances between casks. It is "live" beer after all.

When it comes to advice for homebrewers exploring cask conditioned beer, the fact is that most homebrewers are already bottle conditioning so they already are experiencing "real" ale.

The most difficult part of conditioned beer for homebrewers probably is getting the carbonation level right. You can over-carbonate and blow out the bung (which is messy as hell) or you can under-carbonate, which will result in a beer that is dull. BYO

Aeration

Benefits of mash hopping

help me
mr. wizard
by Ashton Lewis

Q I HAVE BEEN TRYING TO COME UP WITH AN EASY AND COST-EFFECTIVE WAY TO GET GOOD AERATION IN MY FERMENTATIONS. I RECENTLY CAME ACROSS A DEVICE CALLED AN OXYGEN CONCENTRATOR, WHICH TAKES REGULAR AIR AND CONCENTRATES THE OXYGEN FOR USE IN THE MEDICAL INDUSTRY. THERE ARE MODELS FOR HOME USE PRICED IN THE $500-$1,200 RANGE. COULD THESE DEVICES BE USED FOR WORT AERATION IN PLACE OF BUYING THE RED WELDING BOTTLES AT HOME IMPROVEMENT STORES OR THE MEDICAL GRADE BOTTLES?

DARIN EBBERSON
PASCO, WASHINGTON

A The imagination of the homebrewer never ceases to amaze me. Using an oxygen concentrator to produce oxygen for wort aeration certainly is a creative way to tackle this particular brewing process. I must admit that I was not sure how these devices function. My guess was that the oxygen concentrator uses a membrane filter to separate nitrogen from oxygen, basically the opposite of how nitrogen generators operate, and did some reading to check my guess.

It turns out these devices use a zeolite medium as a molecular sieve to separate nitrogen from oxygen. The resultant oxygen is blended with air to control the oxygen content of the gas delivered from these units. One major benefit is that they replace bottles of pure oxygen, which are heavy, have to be re-filled and are potentially dangerous since oxygen is just a wee-bit combustible. So far, this device is looking like something that a brewery may find useful.

You state in your question that you are looking for an easy and cost-effective method to oxygenate wort. While this device may be an easy source of oxygen, plug it in, turn it on and out flows oxygen, I am having a hard time considering a $500 investment (minimum) in this device cost-effective. If this seems like a reasonable investment, go for it and let us know how it worked. But if you really would rather spend $495 on ingredients and $5 on a wort aerator, keep reading.

In the old days before high-gravity brewing (strong beer diluted with water prior to packaging) and commonplace double IPAs, brewers would aerate wort with air. Indeed, a significant volume of the world production of beer relies upon air for aeration, not bottled oxygen. The solubility of oxygen in wort decreases as wort strength increases, and it also decreases when air is used instead of oxygen. The use of oxygen for aeration makes sense for stronger beers. But even for high-gravity worts aerated using air, there is sufficient oxygen for yeast to produce the sterols and unsaturated fatty acids needed for cell wall synthesis. Yeast biochemists and practical brewers know that increasing the oxygen concentration in high-gravity worts can improve fermentation rate and the health of yeast cropped from these fermentations, but very few will argue that wort must be oxygenated. At Springfield Brewing Company we use air for all of our wort aeration needs, independent of wort strength, and we brew beers ranging from 11-24 °Plato (1.044 – 1.100 SG).

> "A significant volume of the world production of beer relies upon air for aeration, not bottled oxygen."

If you do choose to add oxygen to

Photo by Les Jörgensen

> "The cheapest way to filter gas is by using a cotton plug jammed in the open end of the injection tee."

wort, you do need to be aware that excessive oxygen can cause stress to yeast cells, increase the concentration of some fermentation products such as acetaldehyde and sulfur, and can also cause fermentations to become stuck. Commercial brewers who add oxygen to wort often measure the dissolved oxygen to prevent adding too much. A common target level is 15 mg of oxygen/liter.

The type of aeration device used in most modern breweries utilizes a Venturi nozzle to aid in gas transfer. These devices rely on the reduction in pressure that occurs when liquid flow is accelerated through a restriction in a pipe to bring gas into the wort stream. In a commercial brewery these devices are supplied with dry, compressed air or oxygen that is pushed through a sterile filter en route to the Venturi nozzle and they work extremely well.

You can build your own Venturi aeration device by purchasing a hose-barb tee. Hook one end of the tee to the outlet of your wort cooler, one end to a cane extending to the bottom of your carboy and leaving the other end (pointing upward) open to the atmosphere. The open end is your gas inlet and what happens when wort flows through this contraption is that air is sucked into the open end as the pressure of the liquid is reduced as it flows through the tee. Of course, atmospheric air is not really what most brewers want in their wort. The cheapest way to filter gas is by using a cotton plug jammed in the open end of the injection tee. This whole thing can be made for $5 or less. I will leave the remainder of this project to our DIY desk, but suffice to say, this baby works. I built something like this while I was a graduate student in the brewing program at UC-Davis and never had any problems with contaminated beer (I am assuming some readers may be wondering if the cotton plug actually works).

I do like your creative solution to wort aeration and see nothing at all wrong with the idea of bringing in an oxygen contractor to supply your oxygen. You could even hook the concentrator into the tee I describe, but I honestly do not think you will see marked improvements in your beer. And this advice is coming from a brewer who has been preaching the benefits of proper wort aeration in the pages of *BYO* for the last 18 years. If it were my money, I would build Ashton's cheapo aerator and invest the remainder into ingredients or other brewing tools.

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Q I HAVE ENCOUNTERED SOME DEBATE ON A BEER SCIENCE/HOMEBREWING QUESTION THAT HAS A COUPLE OF US SPLIT. I HARVESTED SOME HOMEGROWN COLUMBUS HOPS THIS YEAR AND WAS THINKING ABOUT USING THEM IN A MASH HOP TO HELP BRING A LOT OF HOP AROMA AND FLAVOR WITHOUT HAVING A SIGNIFICANT AMOUNT OF TRUB AND WORT LOSS IN THE BOIL. I GOT THIS IDEA FROM READING MITCH STEELE'S BOOK ON IPAS. HOWEVER, ONE OF THE PEOPLE I BROUGHT THIS UP TO SAID IT WOULD BE A WASTE OF MY HOPS BECAUSE ALL OF THE AROMA/FLAVOR COMPONENTS IN THE HOPS WILL JUST BE BOILED OFF.

DO YOU HAVE ANY EXPERIENCE WITH MASH HOPPING BEERS? WHAT WOULD THE SCIENCE SUGGEST ABOUT USING HOPS IN THE MASH? THANKS FOR YOUR INSIGHT!

KEITH BACHMAN
OZARK, MISSOURI

A Thanks for the good question, Keith. I have always thought that the notion of adding hops early in the process, either as mash additions or pre-boil additions to the kettle, in an attempt to improve aroma retention is completely counter-intuitive and inherently illogical. Increased exposure to high temperature will simply lengthen the time for precious hop oils to volatilize and serve as aromatherapy for those around the brewhouse during wort production, so the argument against this method goes. I have never added hops to a mash, and don't have any first-hand experience with this method. Nothing I have read about this technique has persuaded me to want to experiment with mash hopping because the purported benefits seem pretty marginal.

The basic argument in favor of mash hopping is that flavor components from hops are extracted during mashing that are not extracted in the kettle because of pH differences between the mash and wort.

> "Looks like you need to conduct an experiment and develop your own opinion about this technique!"

According to this argument the flavor of beers that have been mash hopped are indeed different from those that have not been mash hopped, ergo the method adds something to beer flavor not achievable without the method. Another argument in favor of the method is that hop oils oxidize, become less volatile in the boil and remain in the beer to contribute to beer flavor. I think these arguments are interesting enough that, if you would like to see for yourself, you should brew two batches of the same basic beer with the only difference being the use of mash hopping. You can conduct this experiment, host a blind tasting somewhere large enough for the members of your club … I am thinking that Springfield Brewing Company may want to host your tasting … and determine what it did to your beer.

Many brewing techniques address issues related to process efficiency. Let's consider a brewery that uses a lot of cone hops and a hop back for hop removal. If the hop cones are not sparged following separation, wort is lost when the hops are discharged from the hop back. When the hops are discharged from the hop back, they need to be somehow removed from the brewery. One way to deal with both of these issues is to move the hops contained in the hop back into the next mash of the day. This addresses the concern over wort loss and allows the hops to be removed with the spent grain. Voila, problem solved.

Do these methods make any sense and are there similar processes used by brewers? The answer to both questions is yes; it is common practice in many breweries to transfer trub removed from the whirlpool after use to the lauter tun. This reduces wort loss associated with trub and reduces the volume of effluent sent down the drain.

My conclusion on this topic is that mash hopping may have historical ties to attempting to deal with a waste stream. There is a huge amount of anecdotal information on brewing forums about this technique. Some brewers who have used the method believe it is beneficial and others believe it does not do anything other than use expensive hops to contribute nothing identifiable. Looks like you need to conduct an experiment and develop your own opinion about this technique! BYO

Strong Scotch Ale

Wee heavy is a sweet, malty beer

style profile
by Jamil Zainasheff

Many brewers, after having brewed a variety of beer styles, eventually seem to focus their efforts toward either the hoppy or the malty side. Perhaps they enjoy drinking one type of beer more than the other or perhaps it is because they are having more success brewing one style versus another. It also seems to be true with darker versus lighter beers. Perhaps their preference can be attributed to their water source, which can favor hoppy over malty or dark over light. Malty beers certainly tend to do a little bit better with softer water.

Those that go toward the malty side eventually want to brew strong Scotch ale. It is kind of like the IPA of the malty world. Also known as wee heavy, it is a rich, malty beer. Do not confuse strong Scotch ale with the much lower alcohol Scottish strong ale. To avoid confusion, I think it is better to refer to strong Scotch ale as wee heavy. While wee heavy is related to the lower-alcohol Scottish ales, and could be considered a higher shilling version of them, wee heavy's higher starting gravity results in a different beer.

A good wee heavy is sweet, but not cloying, has a complex malt character, and has a warming, yet not harsh, alcohol presence. Enhancing the perception of sweetness is a low level of hop bitterness and considerable melanoidin character either from long boil times or specialty malt additions. Fermenting higher gravity wort not only results in higher alcohol beer, but also some additional ester formation. A good example of this beer will not be as clean and low-ester as Scottish ale. The color should range from light copper to dark brown, often with deep ruby highlights.

Unfortunately, quite a large number of judges still seem to reward only sweet, full, and boozy examples of the style. If you want to win at competition, you need to focus on bigger beers for this category. They expect a beer with warming alcohol, sweet malt complexity, and caramel notes. As for appearance, lean toward darker beers, but avoid roasted character. Hop bitterness should just barely balance the malt sweetness and late hop character should be minimal or non-existent.

Much of the rich malty flavors in wee heavy come from selecting a proper base malt. To brew an award-winning example of this style, start with British pale ale malt as the base.

> "The color should range from light copper to dark brown, often with deep ruby highlights."

It provides that background biscuit-like malt character that is a key component in fine British beers. British pale ale malt is kilned a bit darker (2.5 to 3.5 °L) than the average American 2-row or pale malt (1.5 to 2.5 °L) and this higher level of kilning brings out the malt's biscuity flavors. Some brewers use North American pale ale malt or North American 2-row with the addition of 5–10% Munich malt when they cannot source British pale ale malt. This will not produce the same beer as using British pale ale malt, but will produce a pleasant malt background.

Extract brewers should make the effort to source an extract made from British pale ale malt. If you end up using North American 2-row malt extract, you will need to compensate by partial mashing some additional specialty malts such as Munich or biscuit. For a 5-gallon (19-liter) batch, use about 5–10% of the total base malt.

All-grain brewers should use

Continued on page 21

STRONG SCOTCH ALE
by the numbers

OG:	1.070–1.130 (17.1–30.2 °P)
FG:	1.018–1.030 (4.6–7.6 °P)
SRM:	14–25
IBU:	17–35
ABV:	6.5–10.0%

McZainasheff's Wee
(5 gallons/19 L, all-grain)

OG = 1.099 FG = 1.026
IBU = 28 SRM = 20 ABV = 9.7%

Ingredients

17.8 lbs. (8.1 kg) British pale ale malt
17.6 oz. (0.5 kg) crystal malt (45 °L)
14.1 oz. (0.4 kg) Munich malt (8 °L)
7 oz. (0.2 kg) crystal malt (120°L)
1.8 oz. (50 g) roasted barley (500 °L)
6.5 AAU Kent Goldings hops (60 min.)
(1.3 oz./37 g at 5% alpha acids)
2 AAU Kent Goldings hops (10 min.)
(0.4 oz./11 g at 5% alpha acids)
1 tsp Irish moss (optional)
White Labs WLP028 (Edinburgh Ale) or
Wyeast 1728 (Scottish Ale) yeast

Step by Step

When I homebrew, I use Crisp Malting's British Pale Ale malt (made from Maris Otter) as my base grain, but other malts of a similar nature should work well. Remember, the bulk of the flavor comes from the base grain, so try to get British pale ale malt.

Currently I use the Thomas Fawcett crystal and pale chocolate malts, as they have a great flavor that is very British. For Munich malt we're currently using Best Malz. For any of these malts, feel free to substitute any high quality malt of a similar flavor and color from a different supplier. My hops are in pellet form and come from Hop Union, Willamette Valley, or Hopsteiner depending on the variety.

Mill the grains and dough-in targeting a mash of around 1.5 qts. (1.4 L) of water to 1 pound (0.45 kg) of grain (a liquor-to-grist ratio of about 3:1 by weight) and a temperature of 154 °F (68 °C). Hold the mash at 154 °F (68 °C) until enzymatic conversion is complete. Infuse the mash with near-boiling water while stirring or with a recirculating mash system raise the temperature to mash out at 168 °F (76 °C). Sparge slowly with 170 °F (77 °C) water, collecting wort until the pre-boil kettle volume is around 6.5 gallons (25 L) and the gravity is 1.076. If you should come up short on the pre-boil gravity, top it off with some dried malt extract (DME).

The total wort boil time is 90 minutes. This helps concentrate the wort and aids in the development of flavor compounds. You should check the gravity of your wort before you add your first hop addition. If the boil is not tracking according to plan, keep boiling until you are at the right gravity, and then add your first hop addition. The first hop addition comes with 60 minutes remaining in the boil. If you wish, add Irish moss or other kettle finings with 15 minutes left in the boil and the final hop addition with 10 minutes left.

Chill the wort to 65 °F (18 °C) and aerate thoroughly. The proper pitch rate is 3 packages of liquid yeast, or 1 package of liquid yeast in a 1.5-gallon (6 L) starter. Ferment at 65 °F (18 °C) to start, raising the temperature gradually to 70 °F (21 °C) for the last ⅓ of fermentation. When finished, carbonate the beer to approximately 2 volumes CO_2. Use the *BYO* priming chart if bottling at http://byo.com/resources/carbonation

McZainasheff's Wee
(5 gallons/19 L, extract with grains)

OG = 1.099 FG = 1.026
IBU = 28 SRM = 20 ABV = 9.7%

Ingredients

11.8 lbs. (5.4 kg) British pale liquid malt extract (LME)
17.6 oz. (0.5 kg) crystal malt (45 °L)
14.1 oz. (0.4 kg) Munich malt (8 °L)
7 oz. (0.2 kg) crystal malt (120°L)
1.8 oz. (50 g) roasted barley (500 °L)
6.5 AAU Kent Goldings hops (60 min.)
(1.3 oz./37 g at 5% alpha acids)
2 AAU Kent Goldings hops (10 min.)
(0.4 oz./11 g at 5% alpha acids)
1 tsp Irish moss (optional)
White Labs WLP028 (Edinburgh Ale) or
Wyeast 1728 (Scottish Ale) yeast

Step by Step

Ask your local homebrew shop for an English-style liquid malt extract. If they do not have any, many online suppliers sell an English-style extract made from 100% Maris Otter malt. Always choose the freshest extract that fits the beer style. If you cannot get fresh liquid malt extract, it is better to use an appropriate amount of dried malt extract (DME) instead.

Currently I use the Thomas Fawcett crystal and pale chocolate malts, as they have a great flavor that is very British. For Munich malt we're currently using Best Malz. For any of these malts, feel free to substitute any high quality malt of a similar flavor and color from a different supplier. My hops are in pellet form and come from Hop Union, Willamette Valley, or Hopsteiner depending on the variety.

Mill or coarsely crack the specialty malt and place loosely in a grain bag. Avoid packing the grains too tightly in the bag, using more bags if needed. Steep the bag in about 1 gallon (~4 L) of water at roughly 170 °F (77 °C) for about 30 minutes. Lift the grain bag out of the steeping liquid and rinse with warm water. Allow the bags to drip into the kettle for a few minutes while you add the malt extract. Do not squeeze the bags. Add enough water to the steeping liquor and malt extract to make a pre-boil volume of 6.5 gallons (25 L) and a gravity of 1.076. Stir thoroughly to help dissolve the extract and bring to a boil.

The total wort boil time is 90 minutes. This helps concentrate the wort and aids in the development of flavor compounds. You should check the gravity of your wort before you add your first hop addition. If the boil is not tracking according to plan, keep boiling until you are at the right gravity, and then add your first hop addition. The first hop addition comes with 60 minutes remaining in the boil. If you wish, add the Irish moss or other kettle finings with 15 minutes left in the boil. Then add the final hop addition with 10 minutes left. Chill the wort to 65 °F (18 °C) and aerate thoroughly. The proper pitch rate is 3 packages of liquid yeast, or 1 package of liquid yeast in a 1.5-gallon (6 L) starter. Ferment at 65 °F (18 °C) to start, raising the temperature gradually to 70 °F (21 °C) for the last ⅓ of fermentation. When finished, carbonate the beer to approximately 2 volumes CO_2. Use the *BYO* priming chart if bottling at http://byo.com/resources/carbonation

Strong Scotch Ale Commercial Examples

AleSmith Wee Heavy
AleSmith Brewing Co.
San Diego, California
www.alesmith.com

Big Sound Scotch Ale
Cigar City Brewing
Tampa, Florida
www.cigarcitybrewing.com

Founders Backwoods Bastard
Founders Brewing Co.
Grand Rapids, Michigan
www.foundersbrewing.com

Heritage Ale
Bear Republic Brewing Co.
Healdsburg, California
www.bearrepublic.com

McEwan's Scotch Ale
The Caledonian Brewing Co.
Edinburgh, Scotland
www.livecanny.com

Skull Splitter
Orkney Brewery
Orkney, Scotland
www.sinclairbreweries.co.uk

Smuttynose Scotch Style Ale
Smuttynose Brewing Co.
Portsmouth, New Hampshire
www.smuttynose.com

Wachusett Winter Ale
Wachusett Brewing Co.
Westminster, Massachusetts
www.wachusettbrew.com

Wee Heavy
Dry Dock Brewing Co.
Aurora, Colorado
www.drydockbrewing.com

XS McRogue Scotch Ale
Rogue Ales
Newport, Oregon
www.rogue.com

Ye Olde Kilt Tilter
Middle Ages Brewing Co.
Syracuse, New York
www.middleagesbrewing.com

an infusion mash. You will find a temperature in the range of 152–158 °F (67–70 °C) works well. Use a lower temperature when using lower attenuating yeasts or higher starting gravities. Use a higher mash temperature when using the higher attenuating yeasts or lower starting gravity beers. If you are unsure, a great starting point is 154 °F (68 °C).

In theory, you can brew a great example of the style by using only base malt, some roasted barley for color (less than 3%), and an extensive boil. The extensive boil is to develop malt flavors that are a key component to the style. Judges will expect some caramel flavors and aromas in wee heavy and you can develop them through extended boiling. The best way, if you want to try it, is to boil down one gallon (4 L) of first runnings

until it is thick and syrupy. While you will develop some caramel flavors by boiling for an extended time, it can be hit or miss. Often there is not enough caramel flavor or the flavor that develops is more toffee-like and judges think the beer has a diacetyl problem.

So, the easiest and most consistent way to get the proper caramel character is the use of crystal malt. Allocating 5-10% of the grist for crystal malt should add the right character. I prefer to split the crystal malts into a couple different color ranges. Lighter color crystal malts add sweeter caramel notes, mid-color crystal adds more caramel flavor, and dark crystal adds some raisin notes. The beer should have a rich color, so a touch of highly kilned malts, such as roasted barley can add a hint of balancing dryness and the depth of color that judges are looking for.

If you are looking for more complexity, you can add other specialty malts. Wheat malt, Victory®, biscuit, and others are common additions in many recipes, but restraint is important so that the beer does not become saturated with non-fermentable dextrins and cloying flavors. In general, keep the total of all specialty grain additions to less than 20% of an all-grain grist. Keep highly kilned malt additions small (less than 3%), as bold roasted flavors are not appropriate.

If you want to develop more color and more melanoidin-based flavors and aromas, start with a larger pre-boil volume so you can boil the wort for two hours or more. This develops a unique character that is not possible by grain additions alone. Regardless of what you might read on the Internet, do not add peat smoked malt to your wee heavy. It is not appropriate. Any suggestion of smoke character is possibly from the use of roasted barley and long boil times. It is not from the water and it is not from peat smoke.

> "If you are looking for more complexity, you can add other specialty malts. Wheat malt, Victory®, biscuit, and others are common additions in many recipes, but restraint is important."

Wee heavy is best brewed with English hops such as East Kent Goldings, Fuggles, Target, Northdown, or Challenger. As a general rule of thumb, you can skip any late hop additions. If you do add late hops,

make sure they do not overwhelm the malt character — a half-ounce (14 g) of a mild hop, such as Kent Goldings, would be about all you should add.

Bittering additions are similarly subtle. You want just enough hop bitterness to add a little balance to the malt sweetness. Target a bitterness to starting gravity ratio (IBU divided by OG) of 0.2 to 0.4. One thing to be aware of is the effect of highly kilned specialty malts on the perception of dryness and bittering. If you use more low color malts, such as crystal for color, the beer will have a sweeter overall impression than if you use just base malt and roasted barley for color. You would adjust your bittering slightly to account for this difference.

> "Fermentation for all of the Scottish ale styles requires a clean, neutral yeast character. The goal for wee heavy is a beer with relatively low esters. . . and lots of rich malt flavor."

Fermentation for all of the Scottish ale styles requires a clean, neutral yeast character. The goal for wee heavy is a beer with relatively low esters, as compared to British ales, and lots of rich malt flavor. While I prefer White Labs WLP001 (California Ale) or Wyeast 1056 (American Ale) for the lower gravity Scottish ales, I like yeast with a little more fermentation character and a richer maltiness for wee heavy. White Labs WLP028 (Edinburgh Ale) and Wyeast 1728 (Scottish Ale) are both excellent choices for this style as well. In a pinch, you could use other yeasts. The important thing is finding one that has a more malt forward character.

Cool fermentation, proper pitching rates, adequate yeast nutrition, and the proper addition of oxygen to the wort also factor into getting that rich malt character, gentle warming alcohol, and fully attenuated (not syrupy) beer. On bigger beers like this, I start fermentation at the lower end of their range and then let the temperature rise at least a few degrees over the course of a couple of days. This helps moderate the production of hot tasting alcohols, helps the yeast attenuate fully, and keeps the amount of diacetyl in the finished beer to a minimum. BYO

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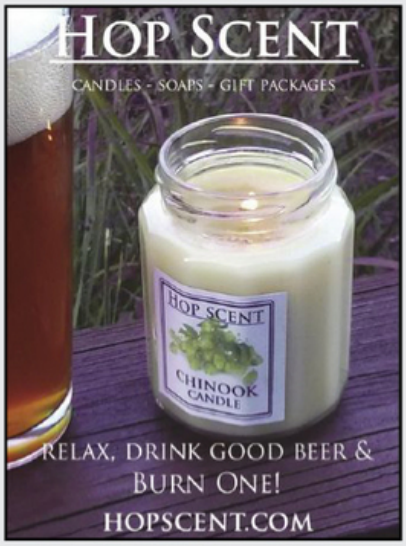

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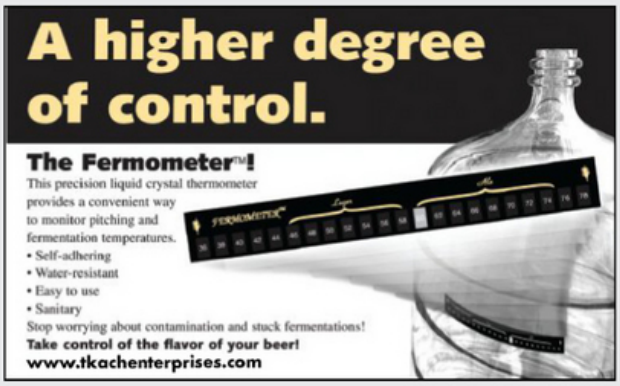

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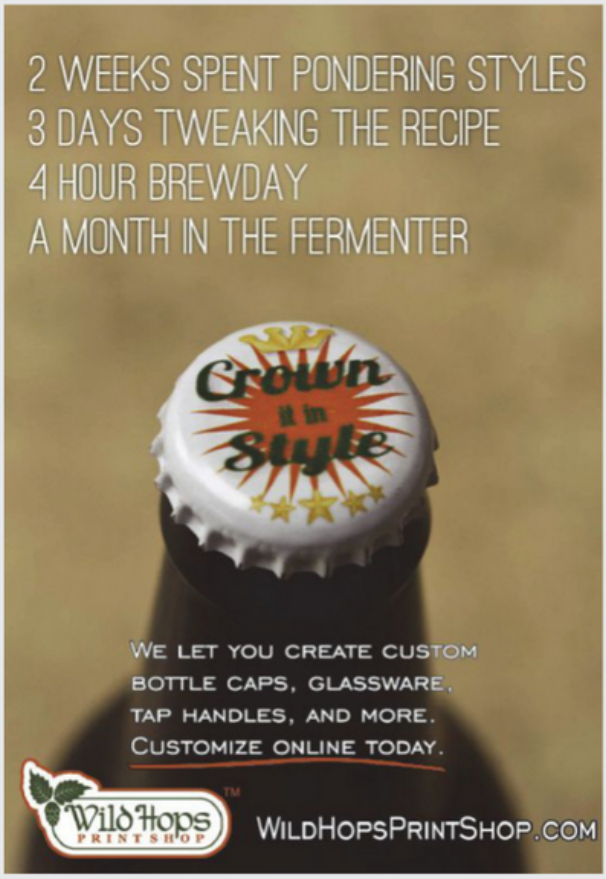
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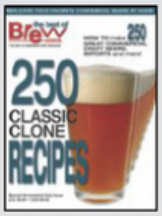

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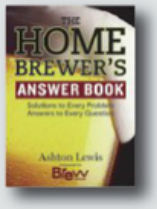

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by **Glenn BurnSilver**

Get the most from a BREW TOUR

For the average beer drinker, a commercial brewery is a mystery. It's the place glimpsed in glittery commercials where, through magic and science, the world's favorite fermented beverage is produced. For the homebrewer, however, the brewery is a place of reverence where people actually are paid to make beer for a living. It's also where brewing knowledge can be gathered and applied at home. The easiest way to do that is with a brewery tour.

Most commercial and craft brewers are happy to share from their experience, offering tidbits of wisdom, philosophy and insight that can shed light on the brewing process. However, before marching down to the local brewery and expecting to have a look around, soak in this pre-tour knowledge as dispensed by brewers and guides at several breweries. These tips will not only make any brewery tour more interesting and exciting, but could also make a difference in that next homebrew attempt.

Photo courtesy of New Belgium Brewing Co.

Pre-Planning

While it would be nice to head down to the local craft brewer's taproom, strike up some good-natured brewing debate with your friends, and then decide to seek the answers through an impromptu quickie tour, the odds of that happening are slim. Some breweries are able to give tours at random intervals if enough people happen to have an interest, but most operate on a set schedule with regular tours. The best place to get this information is on the brewery's website, or by calling ahead of your visit. This way you will find out tour length along with possible tour options (different brewery aspects, lengths, etc.) and any specific instructions (special closures) considered vital. Larger breweries are often also set up to book tours online, although making a phone call will give you a better chance of getting a tour with a brewer (we'll talk more about getting a brewer guide later).

Know Before You Go

If you haven't already, after booking your tour familiarize yourself with the brewery's products, history, philosophy, current workings, etc. Start with a beer while reading up online. Hopefully, this will spark some ideas as brewers and guides appreciate a well-informed tour group and are apt to

Photo courtesy of Stone Brewing Co.

Photo courtesy of New Belgium Brewing Co.

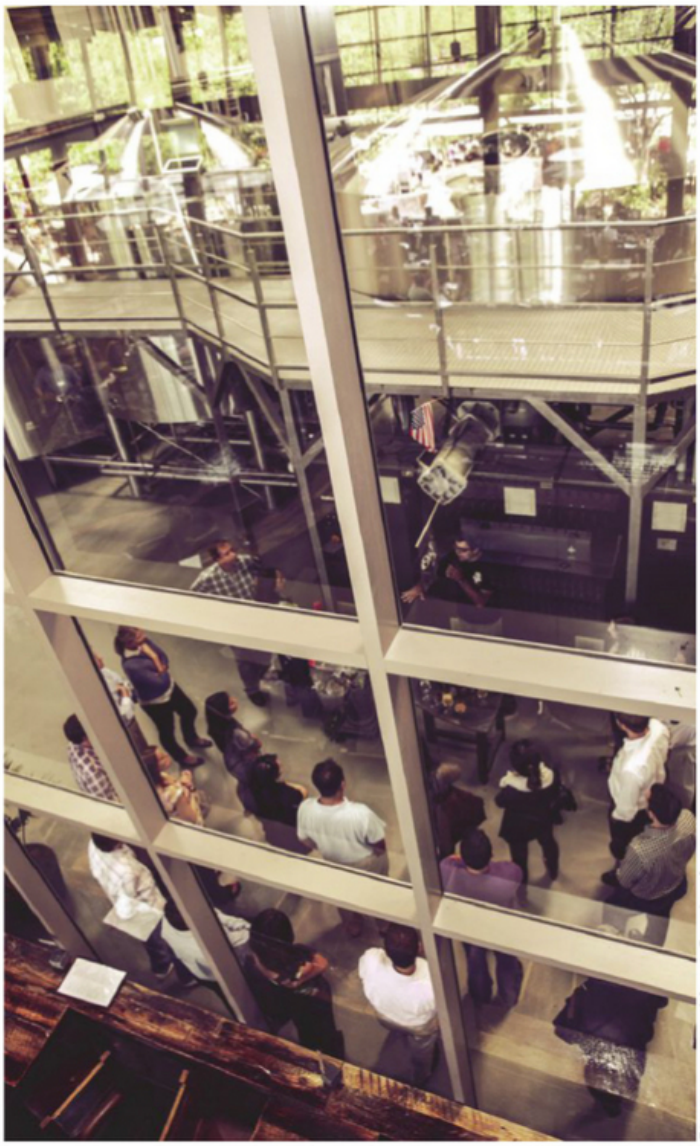

Photo courtesy of Stone Brewing Co.

Top left: A tour group at Stone Brewing Co. views the bottling line at the Escondido, California brewery.

Top right: Part of the tour at the New Belgium Brewing Company in Fort Collins, Colorado, includes a walk through the barrel aging room.

Bottom right: Another tour group at Stone Brewing Co. views the brewery's automated brew house.

Bottom left: A beer tasting in progress during one of New Belgium Brewing Co.'s tours.

Photo courtesy of New Belgium Brewing Co.

The culture room at New Belgium Brewing Company. If your next brewery tour brings you through their laboratory, ask if they might share a fresh, active yeast sample.

open up a little more when asked targeted questions.

If possible, try to determine whom — brewer or guide — will give that tour. If your plan is to plumb the depths of knowledge, a brewer would be the best person to give the tour. Many larger breweries have trained guides. These people are knowledgeable, and some may have actually brewed before, but can they answer your questions about adjusting pH balance and hop utilization ratios adequately? Call or email ahead and ask who is giving your tour. Don't be afraid to request that a brewer give the tour.

"I've been on plenty of tours myself, but obviously I don't ask the same kinds of questions a tour guide is prepared to answer," says Chandler, Arizona's SanTan Brewing Head Brewer Gabe Wilson. "A guide is taught to handle the (general) public, but when you start to get into more in-depth questions, they usually don't have the answer for that. It's better when a brewer gives the tour."

Who Are You?

There are two types of brewery tours. The first is where the guide leads a group around explaining the brewery's basic history and operation. It's all interesting, but it's what the brewery thinks you should hear. The second is an engaged tour where a homebrewer jumps in with both feet and fires off a salvo of questions that serve to increase everyone's brewing understanding — and make a tour more fun.

So, if your guide doesn't ask, be sure to mention that you're a homebrewer. You won't be the first or last, but that simple pronouncement can alter the direction of the tour. More detail could be spent on explaining recipe development, mashing systems or barrel aging instead of just running over the basics.

"When I give a tour, one of the first things I try to do is gain the knowledge and experience level of the group," Wilson says. "When you get homebrewers you can kind of gloss over the basic details and go for something a little more in-depth."

Ask and Ask Some More

The brewers and guides interviewed for this story relish engaged tourists. Such tours are more fun and create a sense of familiarity and ownership with the brewery. Brewers and guides love to share snippets of the brewery's history, philosophy, philanthropy and company direction, as well as the technical aspects of beer formulation, lagering techniques, yeast strain properties, hop selection and, well . . . it's all fair game.

"Most of all, don't be afraid to ask questions," New Belgium Brewing tour guide Sarah Van Vlerah recommends. "In an hour and a half tour you can only talk about so many things. I try to talk about the brewing process in the simplest ways, but (a homebrewer should) definitely start asking more specific questions. That's the way for the homebrewer to get the best experience."

While asking about grain storage, raw material supplies and wastewater management is somewhat "unexciting," Wilson says, technical questions, especially if a brewer is leading the tour, are more than welcome.

"Don't be afraid to come with technical questions," Wilson encourages, noting he'd rather talk about liquid-to-grist ratios and mash temperatures than removal of spent grains. "Obviously there are different levels of homebrewers (with) interests in different things, but the worst I can say is, 'I can't answer that.' I won't kick you off the tour for asking a (difficult) ques-

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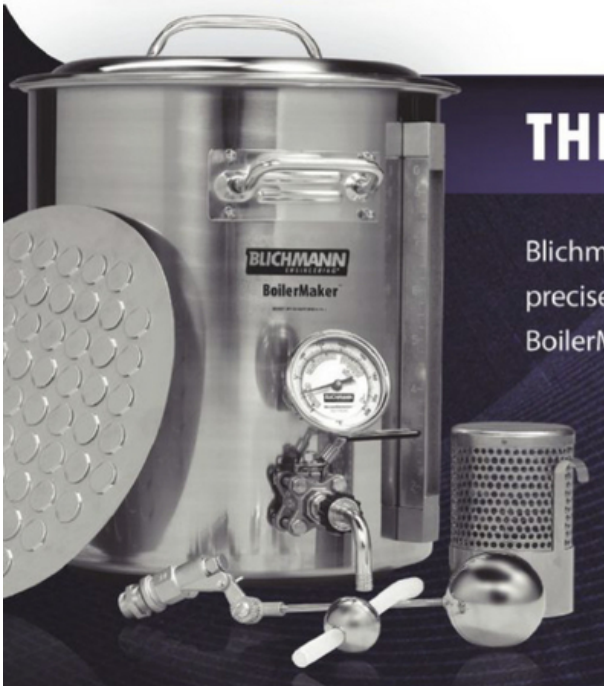

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tion. But you'll get more knowledge out of (asking)."

"You're going to be picking the brains of a brewer and brewers inherently like those challenging discussions," Ryan Arnold, Sierra Nevada Brewing Company's Communications Manager concurs. "Be curious, ask specific questions. Maybe you're having trouble with your homebrew set up. Maybe the brewery can help troubleshoot that."

Beer History and Development

Sometimes the best part of a tour is learning the secrets of how a beer came into existence. Ever wondered how that crazy imperial IPA with bitter orange and coriander was created? Or which lactose works best in a milk stout and why? A tour is the time to find out. Brewers love to talk about beer development — why they used certain grains, hops, yeast, spices, etc., and how ingredient amounts are formulated. It's a great way to gain insight to recipe formulation and scale, something that will come into play as your homebrewing skills evolve.

As homebrewers, most beers are created at a 5-gallon (19-L) level. Commercial brewers typically brew in 50-barrel batches or more. At that level, it's not feasible to chance it and expect that a new brew creation comes out perfectly. Instead, most breweries feature smaller pilot systems ranging from homebrew-style 5-gallon (19-L) carboys to Brew Magic systems to 5-barrel setups that benefit from the full brewery treatment. In asking about recipe development, find out if the tour includes a look at the brewery's the pilot system (if they have one). If not, request it.

Be sure to inquire about new brews in development. That question typically brings a wry look and smile from the guide — especially if it's the brewer. It's as if you're being let in on a special secret.

"There's always an opportunity for people to get excited about something we're working on," Wilson says. "It's always great to be able to share something with someone who's also excited about making beer."

Fun Disaster Stories

Every brewer has a disaster story. Mine is placing a just-filled carboy on a supposedly turned off hot electric burner. The breaking carboy sent five-gallons of beer flooding across the kitchen and into the living room — where it ruined the carpet. These things happen at commercial breweries too, but usually on a much larger scale. Plenty of beer has been poured down the drain, either on purpose or on accident. If you share your humorous brewing woes, perhaps your tour guides will share theirs. Again, if you don't ask, they won't tell.

"I've heard plenty of stories," Wilson says with a laugh. "Yes, we have some too."

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Wake Up and Smell the Hops

Every brewer knows the joy of opening a fresh package of hops and inhaling that exquisite earthy aroma. At that moment, nothing is better. Now imaging the overwhelming rush of entering a room with hundreds of pounds of whole cone hops! One of the best parts of a brewery tour is the rush of walking into the hop storage room.

Hops are an integral brew component and new varieties appear every year. The hop room is perfect for asking about specific hops, but also the methods a brewer uses in determining the right hops. Asking about the hops in a particular beer made at that brewery should generate a good response. Ask to smell and feel a particular hop variety. Ask for specific alpha acids, characteristics and uses. If you're lucky, you may get a handful to take home, but don't ask outright or everyone will want some too, and breweries are not in the business of giving away their raw products. However, if it's offered, consider it a bonus.

Bring Up Yeast

Yeast does two jobs: it ferments the beer turning sugars into alcohol, and in many cases, adds a flavor profile. Brewers can talk at length about yeast — it's sort of their geeky side. A great place to start is in the culture room. Many tours skip over this interesting backroom. Visitors probably won't get to go inside, but ask to see it. Often it looks like a scene from a sci-fi movie. If the brewery has a house yeast strain (and many do), ask how it's propagated, or what are the best methods to reclaim yeast from home carboys. Some breweries will share fresh, active yeast with homebrewers too, so it's worth asking. Save this question for the tasting room at the end. Have a sterile container on hand and a cooler waiting in the car for safe transport home just in case.

Ask a Brewer

It's important to remember that breweries are operational businesses and the people walking about are actually on the job. If your tour isn't being guided by a brewer and one is walking by, check with your guide before blurting out that deep burning question.

"I prefer to ask them," Van Vlerah says about approaching a brewer on the job. "Everyone loves to talk about what they do. They are passionate about what they do, but I wouldn't want a guest on my tour to stop a coworker. Sometimes they're really busy and it's easier for them to tell me if they can't talk."

"I think anyone walking through the halls is fair game," Arnold says. "If brewers are walking around (our guides) are going to say hello to them. Everyone knows everyone. Most of our team love to share what they do with people outside the brewery."

Play it safe, however, and check with the tour leader first before you approach anyone not on the tour.

Be Mindful of Others

Your mom used to say that, right? Well, she was right. While it's great to ask a lot of technical questions — and brewers love to get into this side of their craft — be mindful of others on the tour. If this is your homebrew club on tour, then the brewer is prepared and such questions are expected. If it's a general tour with a mixture of homebrewers and regular curious beer lovers, select your questions carefully so others won't be bored. It's OK to ask the brewer if you can ask him or her more specific questions after the tour, but remember, he or she has beer to make and may only have a limited amount of free time.

Don't Forget to Take Notes

If you want to learn from the pros, do as the pros do — write it all down. Professional brewers take copious notes, from pitching temperatures to flavor profiles at different aging points. It all goes into creating the best possible brew. Do the same with interesting tour facts. If you ask about a special lagering technique or hop usages, don't try to remember — put it to paper.

Photo Op

Taking photos is generally acceptable, and a great way to remember the trip. It's always best to ask first even though guides don't typically take visitors into sensitive areas. It's not exactly as if nuclear development is taking place either — though some brewers may act otherwise. This is often because they want to protect the proprietary nature of some of the things they do. For example, Sierra Nevada used to have their recipes hanging in the brewhouse. When they discovered that this information was stolen and used by a large brewer to create a copy of their pale ale, they discontinued the practice. Just be courteous and conscientious of where you're shooting.

"We had a homebrew rally and I saw people taking pictures of the brew sheets. It's kind of tacky," Wilson said. "We're happy to share information, but do you really think you can reproduce our beer by taking a picture of the brew sheet? Take pictures; have fun, but that kind of thing is annoying."

Tasting Room Etiquette

Typically, a brewery tour ends in the tasting room. Nevertheless, before rushing up to the tap, there are some things to bear in mind. First, think about what you're going to sample and how much (and who's driving home). For example, New Belgium Brewing has 26 beers available in its tasting room. Where to begin? If there was a beer that stood out on the tour, maybe try that one first, but if the desire is to try several, consider asking the guide what's the right order to sample for the greatest sensory input. Even though you are a brewer and have a level of beer knowledge, the guides and tasting room staff really know their beers, so don't hesitate to ask for advice — especially if there are special, non-

commercial brews on tap.

"I'd rather have people drink something they like than not enjoy our beers," Wilson says.

Wilson also points out that talking about the beer that is in front of you is a great way to learn more about its characteristics. Most guides are very knowledgeable in this area, but it's acceptable to ask them to join in and stoke the conversation. "If people are unsure about a beer we can pour a half a swig (for each) and sit there and talk about it," Van Vlerah says.

If you're just there just to drink, however, don't expect an open tap. Excessive sampling is typically discouraged. Be mindful that potentially thousands of people weekly are sampling these beers — free. Breweries are businesses too, and while giving away beer is the brewers' plight, in the end it can only affect the bottom line, and eventually the shelf price. So, if there's something you really like, buy some to take home. Most breweries have stores in house, some even offer growlers, which is a great way to take home something not available elsewhere.

To Tip, or Not?

In many cases, the tasting room is rather bar- or pub-like, and it's easy to forget you're still in the brewery. Breweries aim to put tourists in a place of comfort and relaxation, which makes for a more enjoyable tasting situation and memorable tour. Yet, it's important to note, this isn't a bar or pub and your pourer is not a bartender but your tour guide or even the very person who made the beer you are enjoying. While it's nice to offer the brewery staff a tip for a job well done, all the guides contacted for this article frowned on the practice.

Every brewery is different, and every tour follows different guidelines. Still, with some careful thought and planning, your tour can be more than just a stroll among giant tanks and clanking bottling lines. Think about what you, the homebrewer, want to learn and be ready to ask questions and soak up the answers. With a rewarding tour, that tasting room beer will taste that much better. BYO

PORTER BEGINNINGS

by Terry Foster

Photo courtesy of Wikipedia

A brief history of the style of London

If you have read any of my other articles in *Brew Your Own* you will know that I have a great interest in trying to reproduce historical beers. The beer that really sparked my interest was porter, perhaps because it was first brewed in the 18th century in London, the city where I was born. Or perhaps it was because porter played a big role in the growth of commercial brewing, yet had vanished from the English scene before I even started drinking beer. Or perhaps it was because the ingredients to brew it were just not available for much of my homebrewing career. Or perhaps it was because the brewing process used for brewing those early porters remained unclear to me, because for a long time I had little access to any original 18th century sources.

There was one source in particular I wanted to check for myself, and that was a volume that a noted brewing historian, H. S. Corran (Guinness archivist at one time) described as, "One of the most important brewing treatises ever written . . .". This book, *The London and Country Brewer* (LCB) was published anonymously in several editions from 1734 up to 1759. It did not mention porter in its early editions, but did so in the 1742 and 1744 versions. I finally managed to find some time to visit England's National Brewing Library (at Oxford Brooke's University, Oxford) and to read several of these editions. Note that the author is now known to be one William Ellis, a writer on brewing and agricultural methods.

Ellis, who claimed to have been a porter brewer in London, gave a relatively specific recipe for porter in the 1744 LCB. In short, he stated that 1 Quarter of brown malt gave one hogshead of porter, with the grain being mashed twice, the first wort boiled with 3 lbs. (1.4 kg) hops per barrel, and the second wort being boiled with the spent hops from the first wort. He implies that the worts were mixed (perhaps even with those from a third mash) before fermentation, and that this beer was sent out to the customer after about three days of fermentation.

There are a number of problems in trying to make sense of this recipe in order to construct a recreation of the beer. To begin with, all other available evidence suggests that porter was stored at the brewery for a good many months before being sold for drinking. Next, we do not know what hop varieties were used or their alpha-acid content. The earliest recorded variety with which we are familiar is the Golding hop, first discovered in 1785, some 40 years after this recipe was published. Finally, the measures he uses are all English, so 1 hogshead is 1.5 UK barrels, 54 UK gallons (65 US gallons, 2.1 US barrels). And the weight of a Quarter of brown malt is not certain, as the Quarter is a purely volume measure. Of course, too, we do not know the yield Ellis got from his grain — he didn't know his original gravity as the hydrometer as a brewer's tool would not arrive until much later in the 18th

"There are a number of problems in trying to make sense of this recipe in order to reconstruct a recreation of this beer."

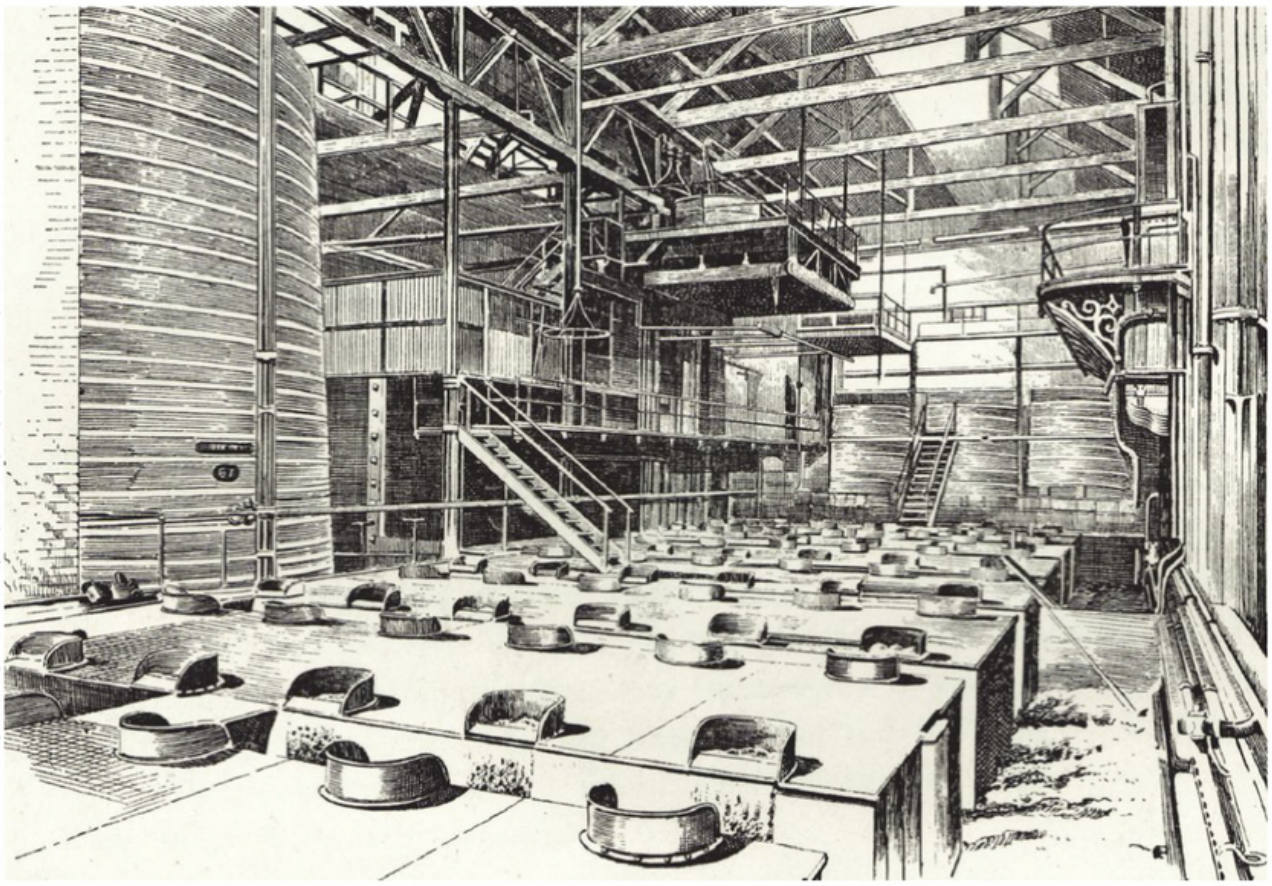


Illustration courtesy of Martyn Cornell's Zythophile - http://zythophile.wordpress.com

An illustration of the interior of a London brewery in 1889, showing pontos for brewing porter, with the troughs that carry the excess yeast away. To the rear, and at the side, can be seen huge vats for maturing porter and stout after it has been brewed.

century (read more about porter's role in the invention of the hydrometer in the sidebar on page 48).

So let's try and decipher all this information and turn it into a recognizable recipe (which I did with some help from Dr. John Harrison of *Old British Beers and How to Make Them* fame). I'll start with the malt, and the fact that a Quarter of pale malt weighed 336 lbs. (152 kg) (according to later information). Now there are a good many contemporary references stating that brown malt was up to 25% less dense than pale malt, which makes the Quarter of brown about 250 lbs. (113 kg). This malt was apparently high-dried on the kiln, and was often scorched, so it probably would have given a lower extract than pale malt. John Harrison suggested that brown malt would give 18 °SG/lb./UK gallon, while my own estimate was 25 °SG/lb./UK gallon. My estimate was based on figures from the early 19th century, when brewers were using the hydrometer. However, by that time malting techniques had probably improved so that my numbers were probably high for malt made in 1744, and indeed 25 °SG/lb./UK gallon would have given a much higher OG for this beer (1.116) than was indicated by John Richardson's work with the hydrometer in 1785. I therefore decided to go with John Harrison's number, so that (18 x 250)/54 = 83 gravity points, or OG = 1.083, which I rounded to 1.080.

Next let's look at the hop rates. Again I had to make an assumption that the first wort supplied half the final volume to the fermenter, and so was 27 UK gallons. The hop addition to that first wort was 3 lbs./UK barrel, so that the total addition was 3 x (27/36) = 2.25 lbs. (1 kg). But what was the alpha-acid content? Hops in those days were surely lower in alpha than present day hops, but we don't know how much lower. However, a well-respected figure in the UK hop industry told me they were likely to be around the same level as present day aroma hops, or about 2–4% alpha-acid, so I opted for 3% in my calculations. As to utilization (U), this was probably pretty high, since the spent hops from the first boil were used in the second. My estimate was that U would be about 30%, and I used this in the following calculation:

$$\text{IBU} = (\text{oz.} \times 28.35 \times \%\text{alpha} \times \text{U})/(\text{BV} \times 4.54)\ *$$

$$\text{IBU} = (2.25 \times 16 \times 28.35 \times 3 \times 30)/(10 \times 54 \times 4.54) = 41.6, \text{ say } 42$$

*This equation is discussed in a "Techniques" column in the Sept. 2011 issue of *Brew Your Own*; here I have slightly modified that to allow for the

Historical Porter Recipe

1744 Porter
(5 gallons/19 L, all-grain)
OG = 1.080 FG = 1.020
SRM = 57 IBU = 46 ABV = 7.9%

Since the hops were only used for bittering in the original, I opted for a high alpha-acid US hop, Columbus, and upped the IBU level a little just to give a round number for the weight of hops used.

Ingredients
12.25 lb. (5.6 kg) 2-row pale malt
2 lb. (0.91 kg) amber malt
2 lb. (0.91 kg) brown malt
0.8 lb. (0.36 kg) black malt
12 AAU Columbus hops (90 mins)
(1 oz./28 g at 12.4% alpha acid)
Wyeast 1098 (British Ale) yeast
(2 pkts in a 1 qt./1 L starter)
Priming sugar (if bottling)

Step by Step
Mash grains at 152–154 °F (67–68 °C) for 60 to 90 minutes. Sparge one hour, with water no hotter than 175 °F (79 °C) to collect about 6 gallons (23 L). Boil for 90 minutes, with bittering hops added at start. Cool as quickly as possible to 70–75 °F (21–24 °C). Pitch with yeast as a 1 qt. (1 L) starter prepared previously and allow to ferment for five to seven days. Rack to secondary for one to two weeks, then prime with sugar and bottle, or keg in the usual manner. If priming, refer to *BYO*'s priming chart at http://byo.com/resources/carbonation for guidance.

* Note that one thing I did not mention in the story was the yeast. We know nothing about the yeast used in Ellis' recipe, but Samuel Whitbread was brewing porter in 1744, so a Whitbread yeast strain is about as authentic as it is possible for us to get.

1744 Porter
(5 gallons/19 L, partial mash)
OG = 1.080 FG = 1.020
SRM = 57 IBU = 46 ABV = 7.9%

We must use brown malt in this so we shall have to do a partial mash along with the extract. You could use 6 lbs. (2.7 kg) light liquid malt extract (LME) in place of 9.25 lbs. (4.2 kg) pale malt, and do a partial mash with 3 lbs. (1.4 kg) pale malt and the amber, brown and black malts. But that means a partial mash of just less than 8 lbs. (3.6 kg) in weight, which I think most homebrewers would find a little too much to handle. I have therefore developed a more suitable recipe, based on an amber malt extract (preferably one made with crystal malt and Munich malt), eliminating the use of amber malt and reducing the amount of brown and black malts.

Ingredients
9.5 lb. (4.3 kg) amber liquid malt extract
1 lb. (0.45 kg) 2-row pale malt
1 lb. (0.45 kg) brown malt
0.5 lb. (0.23 kg) black malt
12 AAU Columbus hops (90 mins)
(1 oz./28 g at 12.4% alpha acid)
Wyeast 1098 (British Ale) yeast
(2 pkts in a 1 qt./1 L starter)
Priming sugar (if bottling)

Step by Step
Place the crushed grains in a muslin bag, add to 2 gallons (7.6 L) of water at 165 °F (74 °C), and keep at 150–155 °F (66–68 °C) for 30 to 60 minutes. Remove the bag, rinse with hot water two or three times, collecting the runnings in the brew pot. Do not squeeze the bag (see tips for success, below). Add the malt extract, stirring well to ensure it is properly dissolved, then bring to a boil and continue heat for 90 minutes, with bittering hops added at start. Cool as quickly as possible to 70–75 °F (21–24 °C). Pitch with yeast as a 1 qt. (1 L) starter prepared previously and allow to ferment for five to seven days. Rack to secondary for one to two weeks, then prime with sugar and bottle, or keg in the usual manner. If priming, refer to *BYO*'s priming chart at http://byo.com/resources/carbonation for guidance.

Tips for Success:
For partial mash brewers, resist squeezing the grain bag. *Brew Your Own*'s Mr. Wizard, Ashton Lewis, explains that when specialty malts are steeped in a grain bag the grains really do not behave as a filter and trub is not filtered from the wort, as is the case when a mash tun or lauter tun is used to separate spent grains from wort. Nonetheless, some of the trub is retained in the grain bag. By squeezing the grain bag more trub and cloudy wort is moved into the wort. This is why gently rinsing the bag with hot water is suggested instead of squeezing; it also extracts more of the good stuff from the grain bag. For more about this, visit http://byo.com/story1924

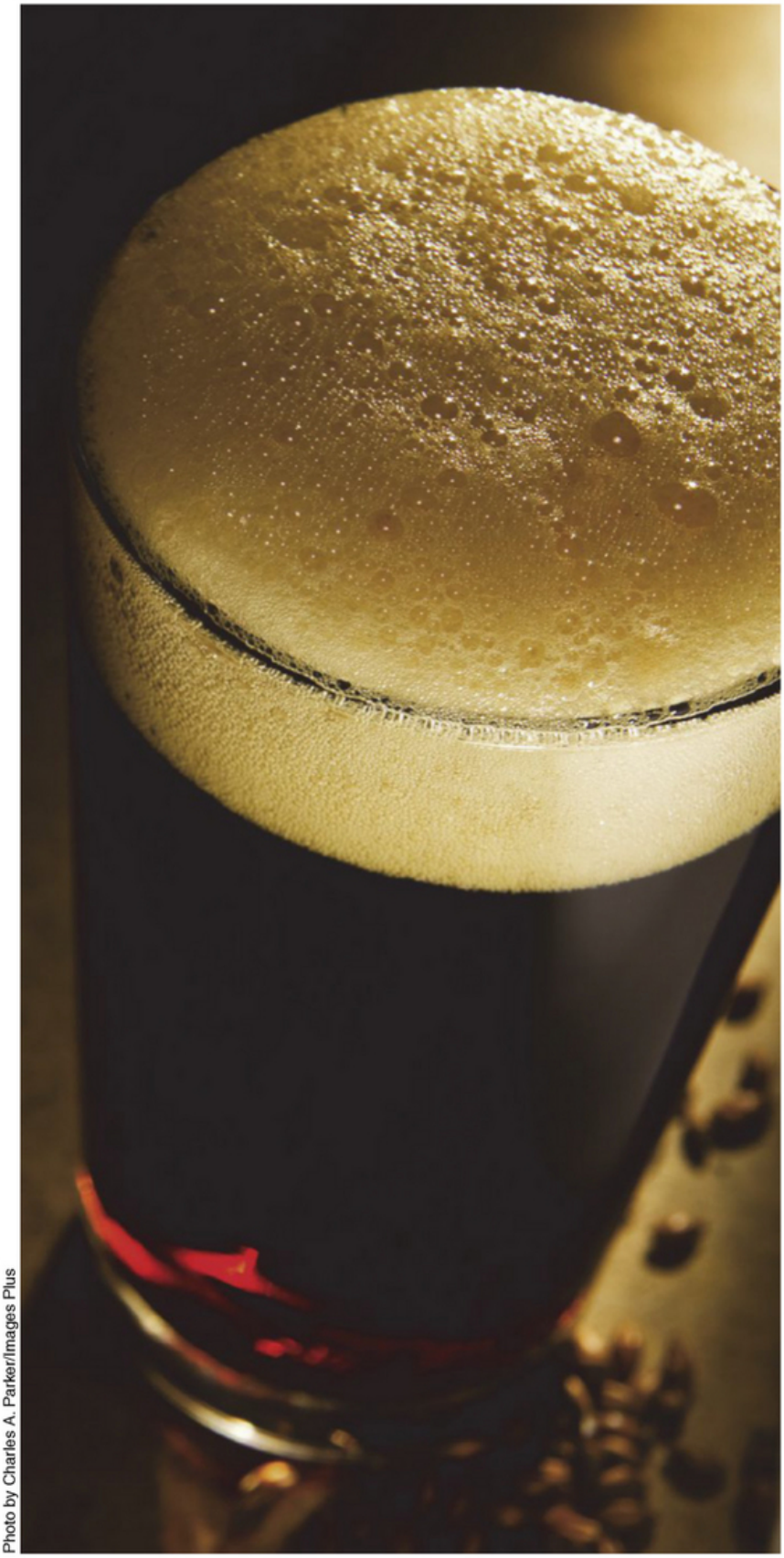


Photo by Charles A. Parker/Images Plus

fact that the volume is in UK gallons.

I did this calculation from scratch and 42 IBU was a surprise to me! When I made my first attempt at re-creating this beer some years ago I came up with a figure of 60 IBU. Checking back on my notes it seemed that my original calculation was based on the fact that I assumed 2% alpha-acid, and that the hops were added at 3 lbs./barrel based on the finished beer, that is 1 hogshead! So this emphasizes the difficulties waiting to catch you out when you try to interpret a historical recipe.

Now, to the malt. We know that only brown malt was used, but we need to convert Ellis' figures to something more sensible. He used a Quarter, or 250 lbs. (113 kg) to obtain a hogshead, 54 UK gallons, of porter. Therefore, for 5 US gallons (19 L) we have:

Weight of malt = (250 x 5)/(54 x 4.54/3.78) = 19.3 lbs.

This might appear to be a lot for a beer of 1.080 OG, but remember we ascribed a fairly low level of extract from this malt.

So let me summarize the above, bearing in mind that Richardson's 1785 analyses indicated about 75% attenuation during fermentation. Our recipe for 5 US gallons (19 L) is:

OG = 1.080; FG = 1.020; ABV = 7.9%; IBU = 42, and all from 19.3 lbs. (8.75 kg) brown malt.

Brown malt just was not available to me when I first became interested in brewing this beer. So imagine my excitement when I finally got my hands on some in the mid-1990s. But then reality returned and problems arose, because modern brown malt contains extract, but no enzymes, as they are killed off in the kilning process. So my first thought was that I might be able to steep out the extract from the grain and I ran a suitable experiment to see if that were the case. The result was a terrible mess as everything set to an unmanageable gel, which told me that the malt contained significant

Photo courtesy of Terry Foster

The 7-barrel brewery at BrüRm@BAR in New Haven, Connecticut where the author perfected his historical porter recipe, which was sold under the name "Presumptuous Porter."

amounts of starch.

Therefore, I could not follow the LCB recipe and use only brown malt, for I was going to have to use some pale malt in the mash in order to have enough enzymes to break down the starch in the brown. This suggested that maybe there were some problems inherent to Ellis' recipe, which I shall return to later. So I decided to use some 72% pale malt as a base and to add about 25% of an equal mix of brown and amber malts. Why did I suddenly introduce amber? First, I decided the remainder should be black malt (a bit under 5%), since using so much less brown malt than Ellis would make my version much paler in color than his. But that might give my version a rather harsher flavor than Ellis' if I used only pale, brown and black malts. So I opted for the brown/amber mix, so that the lighter and more nutty, amber malt might balance any harshness from the black malt and give me the kind of mellow flavor I was after.

The use of black malt is certainly not authentic to 1744, since it was not invented until 1817. It does have some credence in that black malt was (and is) widely used in porter as brown malt fell out of favor because of its low yield. Amber malt, on the other hand, was around in 1744 and was certainly in use in porter later in the 18th century, so my choice of it may not be so far out as it appears. As I have repeatedly said earlier in this story we'll return to this subject later, after the recipe — which I actually brewed. Jeff Browning and I liked this beer so much we brewed 7 US barrels of a closely similar version at BrüRm@BAR in New Haven, Connecticut, under the name of "Presumptuous Porter."

What's Wrong With This Picture?

By now you may well be wondering what sort of rubbish I am talking about in re-creating the original version of porter. I mean, I haven't stuck to the all-brown malt version, I've not only chucked in pale and amber malts, I've also used black malt which wasn't around in 1744. I may have come up with a good-tasting porter but does it really have any resemblance whatsoever to Mr. Ellis' version?

I said I would talk about this later, and now I shall, starting with taking a look at Ellis himself. Well, it turns out that on his own admission (in a later publication) that he was not a brewer in London, but went there merely as the executor to his uncle's will to dis-

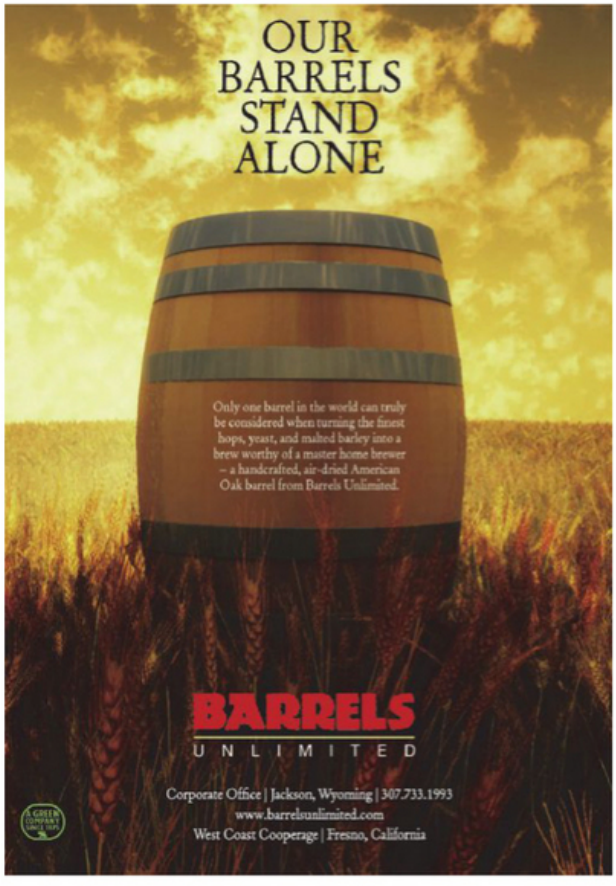
Richardson and the Hydrometer

In this article I have credited John Richardson with the honor of being the man who pioneered use of the hydrometer in brewing in 1784. He showed that porter original gravity at that time ran at around 1.070, with corresponding final gravity at around 1.018, which allows us today to deduce that those porters contained around 6.7% ABV. He also showed that these figures could be used to calculate the yield of different malts, and in particular that brown malt gave less extract yield than pale malt (on a volume, not weight basis). Michael Combrune introduced the thermometer to brewers some 20 years earlier, and this work coupled with that of Richardson forms the foundation of brewing science.

But Richardson was not the first to adapt the hydrometer for the brewer. The idea for doing so had been proposed in 1760 in a book by W. Reddington, but he did not actually bring his idea to fruition. The man who did so, in 1765, was John Baverstock, a brewer in Hampshire in southeast England. It was not easy for him, for his father (who founded the brewery) would not allow him to carry out such work, so that he was forced to do it clandestinely. He at first thought that the way to progress it after his initial studies would be to offer his method to one or more of the larger porter breweries in London.

Sadly, his first such approach was a failure. This was to Samuel Whitbread, founder of the eponymous brewery, then one of the top three porter brewers in London. Whitbread rebuffed young Baverstock entirely, basically saying that he saw no need for such gadgets, and that he, John, should return to his country brewery and get back to the real work of brewing. He did not, of course, but then in 1770 turned to Henry Thrale, owner of the Anchor Brewery in Southwark. Thrale proved receptive to Baverstock's ideas and conducted several tests with the hydrometer at his brewery. Some of these were carried out in the presence of Dr. Samuel Johnson, the great lexicographer, who was a close friend of Thrale and his wife. Thrale was impressed enough with the results that he presented Baverstock with a silver-encased hydrometer. However, nothing further seemed to come of this, and no other brewers took up the idea. That was when John Baverstock made a fatal mistake — he did not publish it. Why Baverstock did not do so we do not know, but we do know that John Richardson did so in 1784. Baverstock then responded with a book of his own in 1785, but it was too late for Richardson had already gathered the honors, and the system he introduced came into widespread use by brewers.

Baverstock did not entirely retire into obscurity, for he continued a successful career as a professional brewer, and did publish other tracts on various aspects of the brewing industry. In fairness, Baverstock's hydrometer work was neither as extensive nor as rigorous as that of Richardson. However, Richardson came up with a system for determining gravity based on "lb. per barrel." In other words he measured it as the extra weight of a barrel of wort or beer over that of the weight of a barrel of water. This unit became currency in British brewing right up to 1974, which to me is a very clumsy unit. Baverstock used specific gravity in his work, which is a much more sensible measurement, and indeed was the system adopted in Britain when lb. per barrel finally went out of use.



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New Instructor at The American Brewers Guild...

We're excited to announce the addition of Ron Cotti as a new American Brewers Guild instructor! Ron began home-brewing in the '90s and couldn't stop. After what seemed like forever, he ran kicking and screaming from the corporate world. He decided on a career change, to involve either cooking or brewing, and completed studies with The American Brewers Guild in mid-2004. After a four-plus year stint at the Bobcat Café in Bristol, Vermont he went back to Otter Creek Brewing where he had originally apprenticed after his ABG course. In 2011 he had a stint running a brewery on Cape Cod, but the pull from Vermont was too strong and now he's returned to work for The American Brewers Guild! The addition of Ron's expertise, to the ABG staff, will allow for new professional and home brewing courses to be added to the ABG curriculum. Look for many new course offerings in 2014.

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pose of the latter's brewery. He was a farmer in a county north of London, and by all accounts not a very competent one. Yet he wrote several other books on agricultural matters, in which he offered various farming gadgets for sale, none of which appeared to work very well. A careful examination of his brewing writings in the LCB, and elsewhere show that much of his material is simply a collection of recipes given to him by others. In short little or none of his material is original to him and does not come out of his own knowledge. In which case, with all due respect to H. S. Corran, can we really trust Ellis' 1744 account of porter brewing?

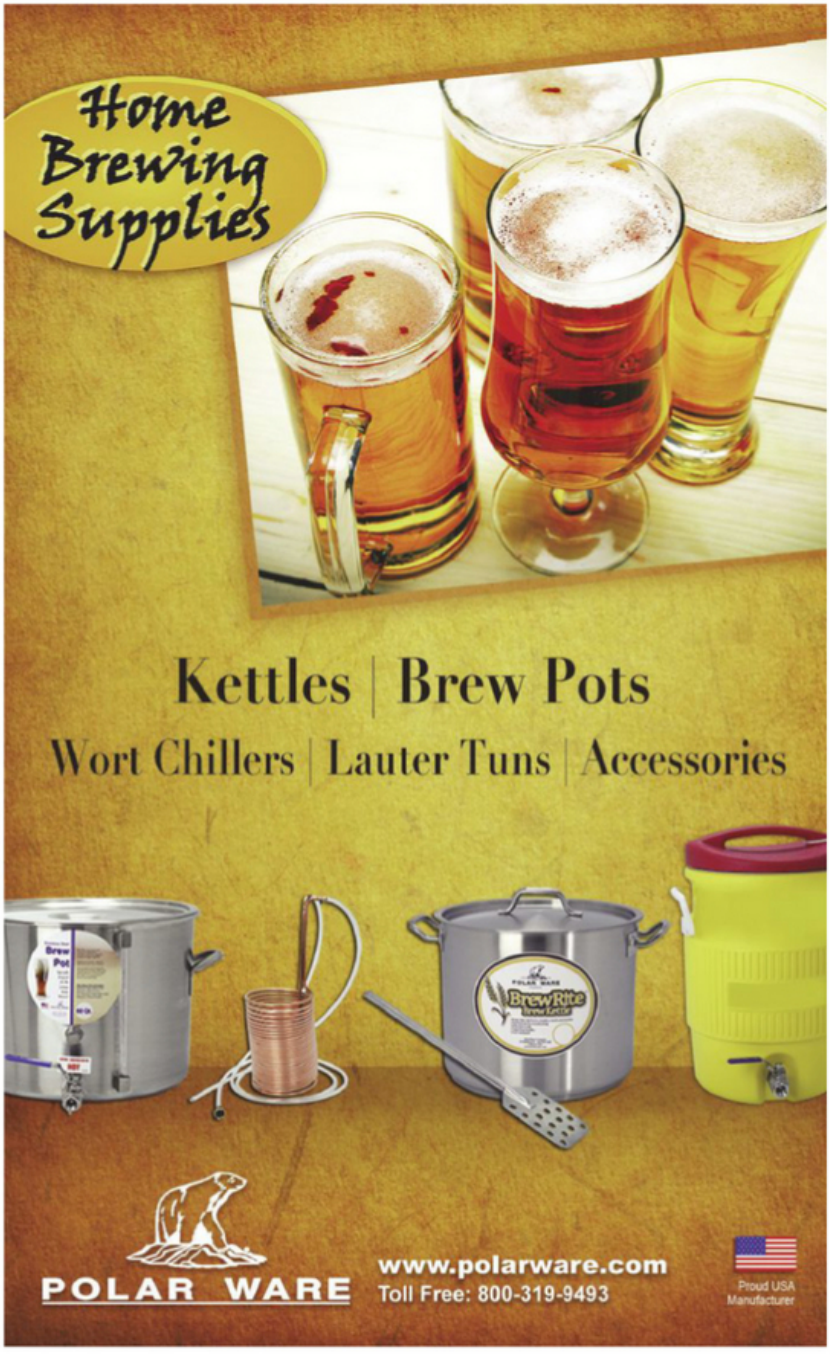
> "Ellis gives the method for preparing brown malt, which entails taking the partially dried green malt to a very high temperature quickly, by suddenly ramping up the fire."

Next, we need to consider brown malt from the perspective of a brewer. Ellis gives the method for preparing brown malt, which entails taking the partially dried green malt to a very high temperature very quickly, by suddenly ramping up the fire (confirmed by later writers). So quickly was this done in fact that the malt would "snap" or "blow," with the moisture inside the grains boiling and expanding the grain, which is why it was 20–25% less dense than pale malt, and therefore cheaper to produce on a volume basis.

By my reckoning that means that all of the starch-converting enzymes in the malt would have been destroyed. But also, heating the malt so quickly would surely not have permitted the conversion of starch to fermentable sugars. So with no enzymes present it was impossible to mash the grain to convert the starch, and the presence of the latter would have made it impossible to simply steep out any sugars that were formed in the drying process. Remember me producing a mess of jelly when I tried to mash modern brown malt on its own?

We know from Richardson's hydrometer work in 1785 that porter brewers were able to produce a reasonably balanced wort that would ferment in the normal manner, with decent attenuation (see more on Richardson and hydrometers in the sidebar on page 48). So if it was impossible to prepare a normal wort from brown malt they could only have done so by adding another malt to the grist that did contain sufficient enzymes to convert the starch in the brown malt. That, of course, would have had to have been pale malt.

Many writers (including myself at one time) have held that Richardson's



work showed that brown malt, although cheaper in terms of the volume price, was actually more expensive than pale malt in terms of extract yield. The theory was that this was the turning point when porter brewers stopped using only brown malt and replaced it first with pale and brown mixtures, and then for a period using various additives (some of them toxic) to recover the "true porter flavor," and finally to resort to using mixtures of brown, pale and black malts. My reasoning earlier suggests that any such turning point was due to other factors,

> "In fact, there is no evidence that Harwood did, in fact, invent porter, and it is likely that it simply evolved from a move by London brewers to accommodate public taste."

since brewers must already have been using pale malt along with the brown. In other words, I am proposing that Ellis' statement that porter was brewed solely from brown malt is likely a myth. After all, we already have one great and enduring myth about porter, and this is that the beer was first brewed about 1722 by Ralph Harwood, and that he called the beer "Entire" because he combined all the worts to make one beer. This was all based on a magazine account that appeared some 40 years after this supposed event and has been repeated by a host of writers, often verbatim, through the years right up to the present. In fact, there is no evidence that Harwood did, in fact, invent porter, and it is likely that it simply evolved from a move by London brewers to accommodate public taste. Whether early porter brewers used an inhomogeneous malt or a genuine mix of pale (coke- or air-dried) malt plus brown and

somehow roasted malt, it's hard to know for sure . . . and probably nobody does. Nonetheless, inhomogeneity could have been part of the explanation for those early brown-malt-only descriptions of porter mashes.

One thing to also consider is that the old malts in those porter mashes were almost certainly floor-malted. They may have also been somewhat smoky, because the indirect-fired roasting drum was not invented until 1817 (in England, by Daniel Wheeler) and indirect-fired, steam-heated, "pneumatic" malting (for pale malts) was not invented until 1842 (also in England, by Patrick Stead).

Make Your Own Historical Porter

You may well have spotted how I am going to finish this story, but I am going to say it anyway. If my hypothesis is correct, then my re-constructed recipe (on page 45) may in fact be closer to authenticity than at first appears to be the case. In any event, if you try it out I am sure you will find that the result is a very tasty and drinkable beer. If you do give it a try, be sure to let *Brew Your Own* know how it went by emailing the editors at edit@byo.com. We'd love to hear how things turn out! BYO

Related Links:

If you like recreating historical beers, why stop at porter? Try some of these recreation recipes:

• Find out what beer was like in the time of Al Capone. We've got the recipe for his once-illegal brew: http://byo.com/story1275

• Using a handwritten recipe unearthed at an eighteenth-century Virginia plantation, a homebrewer and archaeologist recreated Mrs. Cary's Good Ale, a homemade, all-malt beer from a colonial kitchen: http://byo.com/story479

• Historical "India" Pale Ale: What did this beer taste like when it arrived from the ocean voyage from England to India? http://byo.com/story759

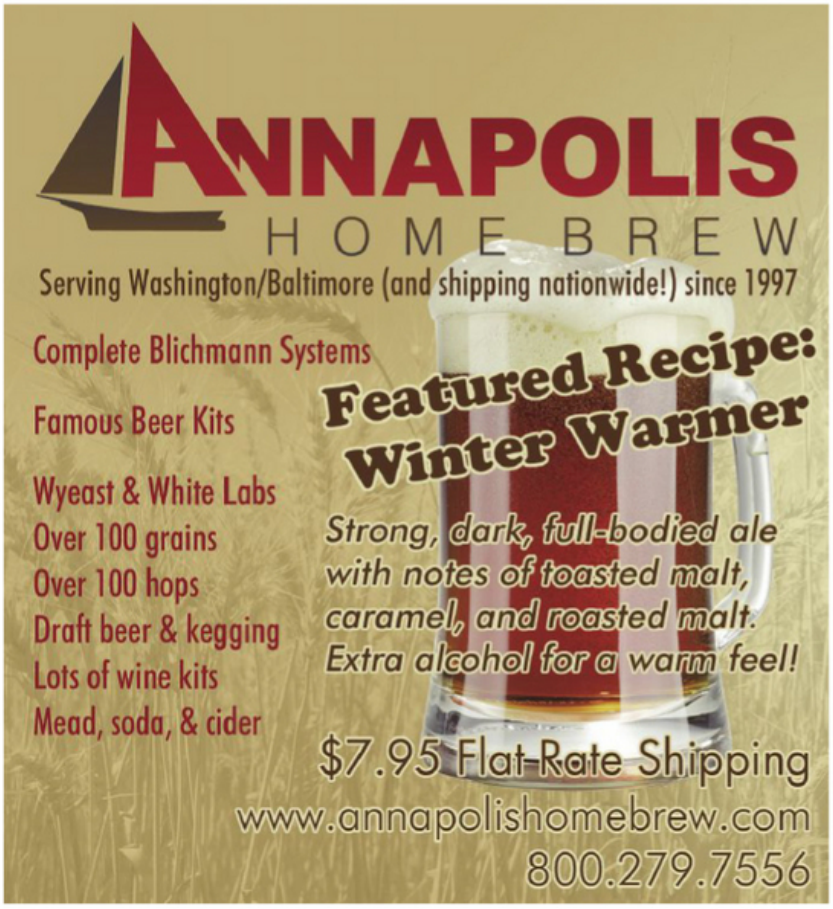


Photo by Charles A. Parker/Images Plus

AWARD-WINNING PORTER: Tips & Recipes

"It is a riddle, wrapped in a mystery, inside an enigma."
– Winston Churchill, 1939

by **Gordon Strong**

Sir Winston was referring to Russia, but the same quote could as easily apply to porter, the brownish beer originating in London about 300 years ago. There are few writings describing the origin of the style written anytime near when it was assumed to have been developed, and much later stories often quoted in beer books (including those talking about Ralph Harwood and the blending of "three threads") have been seriously challenged by modern historians. Beer enthusiasts have endless arguments about the nature of the style, its origin, and even its name. Most records do not even provide a decent description of what the beer actually tasted like, which is probably the most important detail omitted.

The Origin of Porter

Current thinking seems to have coalesced around porter developing as a more heavily hopped and aged version of the strong (in modern terms), sweetish brown ale popular in London through the 17th century. Sometime in the early 1700s, brewers began to age or mature their brown ales for several months at the brewery prior to release to pubs. Aging was done in large wooden casks, known as butts, which was also a term used to describe the beers aged this way. A modern equivalent term might be reserve, although that doesn't necessarily describe barrel-aging. For more about the early days of porter, see Terry Foster's story on page 42 of this issue.

English brewers typically mashed their grains multiple times, often splitting fermentation to produce several beers. However, when all the mashes were combined in one beer, the resulting brew was known as an entire. These two terms are why porter was often called entire butt, which described an aged beer made from all the runnings of one mash.

The nourishing beer is said to have been popular with the London working class, particularly the porters who performed many of the loading, unloading, carrying and delivery functions of the day. Later historical accounts (ironically, many of the same ones called into question as inaccurate) mention that this is where the beer got its name. Good thing this naming method isn't in practice today, or Pabst Blue Ribbon might be called "hipster."

If this account is to be believed, then where is the controversy today? Can't we all agree on what porter is? Well, there's the tricky bit. Beer styles aren't static, and technical innovations and market forces will always exert their influences. Project these changes across 300 years, and you can imagine the problems.

Most areas of confusion with porter today seem to be derived from a disagreement of a common time and place that is describing the style. To really discuss porter, you first have to answer the two questions: Where and when?

The Evolution of Porter

One of the first changes evidenced in porter brewing was how it was aged. Brewers learned that they could blend aged porter with fresh porter to produce the characteristic aged flavor. Different accounts mention between one-quarter to one-third aged blended with the remainder fresh (or mild) porter. Descriptions of the aged character often mention a vinous, or wine-like, character, which typically implies an increased acidity level. If the porter was aged in unlined oak casks, some *Brettanomyces* character might also be assumed to be present (since the word *Brettanomyces* literally means "British fungus").

> "Since porter was a widely exported beer in its heyday, many around the world developed a taste for the style."

Photo courtesy of New Belgium Brewery

As new malts were developed over time and new brewing instruments invented, the use of brown malt diminished. Grists might involve some combination of pale, amber and brown malts, for instance. The invention of black patent malt in 1817 also had an impact, allowing darker colors to be introduced while using larger percentages of pale malts. The color of porter could be imagined to have changed from dark brown to pale brown to nearly black, depending on the particular grist. Not all brewers in all locations made porter the same way; London brewers were said to prefer to maintain a percentage of brown malt to give a characteristic flavor, while country brewers were more likely to adapt black malt.

Porter became a very popular style, and is believed to be the first beer widely exported to Britain's colonial possessions (including American colonies) and global trading partners. The Industrial Revolution impacted porter brewing, allowing large-scale breweries to become feasible. Porter became the first industrial beer, and London breweries bragged about the sizes of their aging vats — until one burst in 1814 killing several people. Rodenbach in Belgium still uses similar (although much smaller) vats today.

Porter changed around the mid-1800s in Britain again, when consumer taste for aged beer waned. Porter became a mild or present-use (unaged) beer, although some unscrupulous breweries were known to add various (sometimes poisonous) additives to enhance the flavor or reduce costs. Whether this led to a decline in quality and reputation is subject to speculation, but public tastes were definitely changing. The strength of the beer

declined, although before World War I it was still a 1.050-ish beer. WWI lowered the strength further (as with most beers), and porter ceased to be a mainstream English style. It continued to decline and was nearly gone by the end of WWII. Fuller's is believed to have been the last brewer to make it in the 1950s prior to its reintroduction later in the century.

Porter Elsewhere

Since porter was a widely exported beer in its heyday, many around the world developed a taste for the style. It's interesting to see how the styles were adapted and changed to suit local production and tastes, and how economic conditions and consumer preferences affected the products when compared to the English experience.

The American colonists preference for porter is well known, and some of our founding fathers were said to be quite the enthusiasts (as well as brewers, if the stories are to be believed). Whether due to supply constraints, burgeoning nationalism, or simple frugality, porter began to be produced domestically, first appearing in Philadelphia and later spreading.

As with other American beer of the era, porter would be made as an ale with various adjuncts such as corn, molasses and sugars. Grists changed over time as in England, and contemporaneous brewing texts refer to high- and low-kilned malts, as well as porter malts being used. When much later German immigrants brought their lager tradition to the states, some breweries began making their porters as lagers to simplify their production techniques. Some porters were reported to simply be a standard lager with the addition of a dark brewing caramel syrup known as porterine.

Prohibition effectively killed most porter (and ale) brewing in America, with only a few Northeast and Mid-Atlantic regional breweries continuing to produce porter. While WWI in England caused gravities to be reduced in beer styles, in the United States Prohibition caused entire styles to be eliminated overnight. When Prohibition ended, significantly fewer breweries were in operation, and most focused on lager production. Some surviving producers are still making porter today, most notably the oldest operating brewery in the US, Yuengling, while others died out as the mass-marketed standard American lagers dominated the landscape through the 1970s.

When English porter was being exported widely, countries along the Baltic Sea were known to enjoy the drink. The export of dark, strong, and sweet beers to Russia is well known, alas with many somewhat dubious stories in modern beer books. In a manner similar to America, local countries along the Baltic eventually developed indigenous production of porter. Today, these beers are collectively called Baltic porters (a relatively modern term, but fitting the style of beer made in many countries). These beers are often made as strong dark lagers, perhaps reminiscent of the strength of original porters.

Photo by Charles A. Parker/Images Plus

Porters are darker than brown ales and, depending on the grains and style, can be darker and roastier than a stout.

Porter Reborn

The 1970s were a bleak time worldwide. Economic malaise in the western world, communism on the march, multiple oil embargoes and energy crises, the list goes on. Yet, there were glimmers of hope for porter. Michael Jackson's *World Guide to Beer* was published, homebrewing was legalized in the United States, and modern porter was reintroduced into England (1978) and America (1974). The craft beer renaissance that we are experiencing today was just getting started, and porter was one of the rediscovered (and reinvented) styles. Fuller's reintroduced their London Porter as an export product, before finally releasing it domestically in 2000.

As with many American craft beer styles, American porter blends classic character with modern preferences. Rather than many of the sweeter, more chocolate- and caramel-flavored modern English porters, American craft porters tend to be more bitter and roasted, with increased strength — demonstrating the bolder, more aggressive flavors more common in craft beer today. Modern English porter has a wide range, with historic versions being brewed with old recipes (such as Flag Porter), to malty-sweet versions, to the London-style classics featuring a brown malt flavor. Baltic porters continue to be produced in at least eight countries bordering the Baltic Sea, and can be found in better beer shops in the US.

Brewing Porter

Normally when I write a beer styles article, I spend much more space on how to brew the beers than on the his-

Continued on page 61

Award-Winning Porter Recipes

Gatekeeper Robust Porter
by Curt Stock, St. Paul, Minnesota (5 gallons/19 L, all-grain)

OG = 1.064 FG = 1.020
IBU = 34 SRM = 47 ABV = 5.9%

This recipe took first place at the Upper Mississippi Mash-out in 2013.

Ingredients
6.6 lbs. (3 kg) Maris Otter pale ale malt
2.2 lbs. (1 kg) UK mild ale malt
2.2 lbs. (1 kg) Golden Promise malt
1.1 lbs. (0.48 kg) UK chocolate malt
4.4 oz. (0.13 kg) Belgian aromatic malt
6.5 oz. (0.18 kg) UK medium crystal (55 °L)
3.3 oz. (94 g) UK dark crystal (105 °L)
3.3 oz. (94 g) Belgian Special B malt
2.2 oz. (62 g) Belgian biscuit malt
2.2 oz. (62 g) UK roasted barley
2.2 oz. (62 g) Belgian debittered black malt
2.2 oz. (62 g) Briess Special Roast malt
5 AAU East Kent Golding hops (60 mins.) (1 oz./28 g of 5% alpha acids)
4.2 AAU UK Fuggle hops (25 mins.) (1 oz./28 g of 4.2% alpha acids)
4.2 AAU UK Fuggle hops (5 mins.) (1 oz./28 g of 4.2% alpha acids)
Wyeast 1318 (London III) yeast (1 qt./1 L yeast starter)
¾ cup corn sugar (for priming)

Step by Step
Two or three days before brew day, make the yeast starter, aerating the wort thoroughly (preferably with oxygen) before pitching the yeast.
On brew day, mash in the malt at 154 °F (68 °C) in 17 qts. (16 L) of water. Hold at this temperature for 60 minutes. Raise the mash temperature to 170 °F (77 °C), hold for 5 minutes then recirculate. Run off the wort and sparge with water hot enough to keep the grain bed around 170 °F (77 °C). Collect 6.5 gallons (25 L) of wort. (Check that final runnings do not drop below SG 1.010.) Boil wort for 60 minutes, adding hops at times indicated in the ingredients list. Ferment at 72 °F (22 °C).

Gatekeeper Robust Porter
by Curt Stock, St. Paul, Minnesota (5 gallons/19 L, partial mash)

OG = 1.064 FG = 1.020
IBU = 34 SRM = 47 ABV = 5.9%

Ingredients
1.5 lbs. (0.68 kg) light dried malt extract
3.3 lbs. (1.5 kg) light liquid malt extract
1 lb. (0.45 kg) Maris Otter pale ale malt
1 lb. (0.45 kg) UK mild ale malt
1 lb. (0.45 kg) Golden Promise malt
1.1 lbs. (0.48 kg) UK chocolate malt
4.4 oz. (0.13 kg) Belgian aromatic malt
6.5 oz. (0.18 kg) UK medium crystal (55 °L)
3.3 oz. (94 g) UK dark crystal (105 °L)
3.3 oz. (94 g) Belgian Special B malt
2.2 oz. (62 g) Belgian biscuit malt
2.2 oz. (62 g) UK roasted barley
2.2 oz. (62 g) Belgian debittered black malt
2.2 oz. (62 g) Briess Special Roast malt
5 AAU East Kent Golding hops (60 mins.) (1 oz./28 g of 5% alpha acids)
4.2 AAU UK Fuggle hops (25 mins.) (1 oz./28 g of 4.2% alpha acids)
4.2 AAU UK Fuggle hops (5 mins.) (1 oz./28 g of 4.2% alpha acids)
Wyeast 1318 (London III) yeast (1 qt./1 L yeast starter)
¾ cup corn sugar (for priming)

Step by Step
Mash grains at 154 °F (68 °C) in 6 qts. (5.6 L) of water. Hold at this temperature for 60 minutes. Collect 2.25 gallons (8.5 L) of wort. Add water to make at least 3 gallons (11 L) of wort. Stir in the dried malt extract and boil the wort for 60 minutes, adding hops at times indicated in the ingredients list. Add the liquid malt extract in the final 15 minutes of the boil. Chill the wort, transfer to fermenter and top up to 5 gallons (19 L). Aerate the wort and pitch the yeast. Ferment at 72 °F (22 °C).

Gatekeeper Robust Porter
by Curt Stock, St. Paul, Minnesota (5 gallons/19 L, extract with grains)

OG = 1.064 FG = 1.020
IBU = 34 SRM = 47 ABV = 5.9%

Ingredients
6.6 lbs. (3 kg) light liquid malt extract
0.5 lb. (0.23 kg) light dried malt extract
1.1 lbs. (0.48 kg) UK chocolate malt
6.5 oz. (0.18 kg) UK medium crystal (55 °L)
3.3 oz. (94 g) UK dark crystal (105 °L)
3.3 oz. (94 g) Belgian Special B malt
2.2 oz. (62 g) Belgian biscuit malt
2.2 oz. (62 g) UK roasted barley
2.2 oz. (62 g) Belgian debittered black malt
2.2 oz. (62 g) Briess Special Roast malt
5 AAU East Kent Golding hops (60 mins.) (1 oz./28 g of 5% alpha acids)
4.2 AAU UK Fuggle hops (25 mins.) (1 oz./28 g of 4.2% alpha acids)
4.2 AAU UK Fuggle hops (5 mins.) (1 oz./28 g of 4.2% alpha acids)
Wyeast 1318 (London III) yeast (1 qt./1 L yeast starter)
¾ cup corn sugar (for priming)

Step by Step
Steep grains in 3 gallons (11 L) of 158 °F (70 °C) water for 30 minutes. Remove grain, add dried malt extract and enough water to make at least 3 gallons (11 L) of wort. Boil wort for 60 minutes, adding hops at times indicated. Keep some boiling water handy and do not let boil volume dip below 3 gallons (11 L). Add liquid malt extract in the final 15 minutes of the boil. Chill wort, transfer to fermenter and top up to 5 gallons (19 L). Aerate wort and pitch yeast. Ferment at 72 °F (22 °C).

Recipe photos by Istockphoto.com

Award-Winning Porter Recipes

London Porter
by Gordon Strong, Beavercreek, Ohio (5 gallons/19 L, all-grain)

OG = 1.054 FG = 1.016
IBU = 24 SRM = 33 ABV = 5.2%

This recipe took first place at the SODZ British Beer Festival in 2012, and is fairly straightforward. It is meant to be in the style of Fuller's London Porter (my personal favorite), with brown malt being the key flavor ingredient. It was entered in the Beer Judge Certification Program (BJCP) Brown Porter category.

Ingredients

7.4 lbs. (3.4 kg) Maris Otter pale ale malt
13 oz. (0.37 kg) German Munich malt
1.25 lbs. (0.57 kg) UK brown malt
1.4 lbs. (0.65 kg) UK crystal (65 °L)
10 oz. (0.28 kg) UK chocolate malt
5.6 AAU Fuggles hops (60 mins.) (1.4 oz./40 g of 4% alpha acids)
2.4 AAU Fuggles hops (10 mins.) (0.6 oz./17 g of 4% alpha acids)
Wyeast 1968 (London ESB Ale) (1 qt./1 L yeast starter)
¾ cup corn sugar (for priming)

Step by Step

Two or three days before brew day, make the yeast starter, aerating the wort thoroughly (preferably with oxygen) before pitching the yeast.

On brew day, mash in the malt at 153 °F (67 °C) in 17 qts. (16 L) of water. Hold at this temperature for 60 minutes. Raise mash temperature to 170 °F (77 °C), hold for 5 minutes then recirculate. Run off wort and sparge with water hot enough to keep the grain bed around 170 °F (77 °C). Collect 6.5 gallons (25 L) of wort. (Check that final runnings do not drop below SG 1.010.) Boil the wort for 60 minutes, adding hops at times indicated in the ingredients list. Ferment at 66 °F (19 °C).

London Porter
by Gordon Strong, Beavercreek, Ohio (5 gallons/19 L, partial mash)

OG = 1.054 FG = 1.016
IBU = 24 SRM = 33 ABV = 5.2%

Ingredients

3.3 lbs. (1.5 kg) light liquid malt extract
1 lb. (0.45 kg) light dried malt extract
1 lb. (0.45 kg) Maris Otter pale ale malt
4 oz. (0.11 kg) German Munich malt
1.25 lbs. (0.57 kg) UK brown malt
1.4 lbs. (0.65 kg) UK crystal (65 °L)
10 oz. (0.28 kg) UK chocolate malt
5.6 AAU Fuggles hops (60 mins.) (1.4 oz/40 g of 4% alpha acids)
2.4 AAU Fuggles hops (10 mins.) (0.6 oz/17 g of 4% alpha acids)
Wyeast 1968 (London ESB Ale) (1 qt./1 L yeast starter)
¾ cup corn sugar (for priming)

Step by Step

Mash the grains at 153 °F (67 °C) in 8 qts. (7.6 L) of water. Hold at this temperature for 60 minutes. Collect 2.25 gallons (8.5 L) of wort. Add water to make at least 3 gallons (11 L) of wort. Stir in the dried malt extract and boil the wort for 60 minutes, adding hops at times indicated in the ingredients list. Add the liquid malt extract in the final 15 minutes of the boil. Chill the wort, transfer to fermenter and top up to 5 gallons (19 L). Aerate the wort and pitch yeast. Ferment at 66 °F (19 °C).

London Porter
by Gordon Strong, Beavercreek, Ohio (5 gallons/19 L, extract with grains)

OG = 1.054 FG = 1.016
IBU = 24 SRM = 33 ABV = 5.2%

Ingredients

3.3 lbs. (1.5 kg) light liquid malt extract
1.6 lbs. (0.74 kg) light dried malt extract
1.25 lbs. (0.57 kg) UK brown malt
1.4 lbs. (0.65 kg) UK crystal (65 °L)
10 oz. (0.28 kg) UK chocolate malt
5.6 AAU Fuggles hops (60 mins.) (1.4 oz/40 g of 4% alpha acids)
2.4 AAU Fuggles hops (10 mins.) (0.6 oz/17 g of 4% alpha acids)
Wyeast 1968 (London ESB Ale) (1 qt./1 L yeast starter)
¾ cup corn sugar (for priming)

Step by Step

Steep the grains in 3 gallons (11 L) of 158 °F (70 °C) water for 30 minutes. Remove the grain, add the dried malt extract and enough water to make at least 3 gallons (11 L) of wort. Boil the wort for 60 minutes, adding hops at times indicated in the ingredients list. Keep some boiling water handy and do not let boil volume dip below 3 gallons (11 L). Add the liquid malt extract in the final 15 minutes of the boil. Chill the wort, transfer to fermenter and top up to 5 gallons (19 L). Aerate wort and pitch yeast. Ferment at 66 °F (19 °C).

Tips for Success:

One of the keys to brewing a good porter is paying attention to the brewing water. If you are interested in brewing better beers with dark grains, it's a good idea to get a water report from your municipal water source, or have a sample of your well or spring analyzed. Brewing with dark grains adds acidity. If your water contains a low level of carbonates, the pH of the wort and beer can drop when brewing a dark beer, making the beer taste thin and acidic. You can counteract this by adding calcium bicarbonate (chalk) or sodium bicarbonate (baking soda). In the "Practical Porter" story from *BYO* December 2007, Chris Colby explains how to choose between the two: "Adding chalk adds calcium along with the carbonate, and these two partially offset each other in terms of their effect on pH. If your brewing water is deficient in calcium or you only need to make a small adjustment in mash pH, chalk is a good choice. If you already have enough calcium in your water, or you need to make a relatively large change in pH, baking soda may be a better choice. (Note: do not use baking soda that has been used previously to absorb odors from your refrigerator.)"

Award-Winning Porter Recipes

American Robust Porter
by Gordon Strong, Beavercreek, Ohio (5 gallons/19 L, all-grain)

OG = 1.056 FG = 1.016
IBU = 31 SRM = 30 ABV = 5.2%

This is a more modern take on an American robust porter, although it probably falls in between the BJCP Brown Porter and Robust Porter categories. Note the general similarity with the second recipe in this collection. It also is a nice base beer for a smoked porter; add a half pound of German rauchmalz and lower the bitterness to about 25 IBUs. For a more 'robust' American version, double the black malt, add 2 more pounds (0.9 kg) of base malt, and increase the late hops.

Ingredients

3 lbs. (1.36 kg) US 2-row pale malt
3 lbs. (1.36 kg) Maris Otter pale ale malt
3 lbs. (1.36 kg) German Vienna malt
1 lb. (0.45 kg) German Munich malt
1 lb. (0.45 kg) UK crystal malt (60 °L)
8 oz. (0.23 kg) UK chocolate malt
8 oz. (0.23 kg) wheat malt
4 oz. (0.11 kg) UK black malt
6 AAU Northern Brewer hops (60 mins) (0.75 oz./21 g of 8% alpha acids)
6 AAU Northern Brewer hops (10 mins) (0.75 oz./21 g of 8% alpha acids)
4.5 AAU Cascade hops (2 mins) (0.75 oz./21 g of 6% alpha acids)
Wyeast 1272 (American Ale II™) (1 qt./1 L yeast starter)
¾ cup corn sugar (for priming)

Step by Step

Two or three days before brew day, make the yeast starter, aerating the wort thoroughly (preferably with oxygen) before pitching the yeast.
On brew day, mash in the malt at 154 °F (68 °C) in 17 qts. (16 L) of water. Hold at this temperature for 60 minutes. Raise the mash temperature to 170 °F (77 °C), hold for 5 minutes then recirculate. Run off wort and sparge with water hot enough to keep the grain bed around 170 °F (77 °C). Collect 6.5 gallons (25 L) of wort. Check that final runnings do not drop below SG 1.010. Boil the wort for 60 minutes, adding hops at times indicated in the ingredients list. Ferment at 64 °F (18 °C).

Variation: Add 0.5 lbs (0.23 kg) German rauchmalz to the mash and reduce bittering (60 mins.) hops to 0.5 oz. (14 g).

American Robust Porter
by Gordon Strong, Beavercreek, Ohio (5 gallons/19 L, partial mash)

OG = 1.056 FG = 1.016
IBU = 31 SRM = 30 ABV = 5.2%

Ingredients

3.3 lbs. (1.5 kg) light liquid malt extract
0.75 lb. (0.34 kg) light dried malt extract
3 lbs. (1.36 kg) German Vienna malt
8 oz. (0.23 kg) German Munich malt
1 lb. (0.45 kg) UK crystal malt (60 °L)
8 oz. (0.23 kg) UK chocolate malt
4 oz. (0.11 kg) UK black malt
6 AAU Northern Brewer hops (60 mins) (0.75 oz./21 g of 8% alpha acids)
6 AAU Northern Brewer hops (10 mins) (0.75 oz./21 g of 8% alpha acids)
4.5 AAU Cascade hops (2 mins.) (0.75 oz./21 g of 6% alpha acids)
Wyeast 1272 (American Ale II™) (1 qt./1 L yeast starter)
¾ cup corn sugar (for priming)

Step by Step

Mash grains at 154 °F (68 °C) in 8 qts. (7.6 L) of water. Hold at this temperature for 60 minutes. Collect 2.25 gallons (8.5 L) of wort. Add water to make at least 3 gallons (11 L) of wort. Stir in the dried malt extract and boil the wort for 60 minutes, adding hops at times indicated in the ingredients list. Add the liquid malt extract in the final 15 minutes of the boil. Chill the wort, transfer to a fermenter and top up to 5 gallons (19 L). Aerate the wort and pitch the yeast. Ferment at 64 °F (18 °C).

American Robust Porter
by Gordon Strong, Beavercreek, Ohio (5 gallons/19 L, extract with grains)

OG = 1.056 FG = 1.016
IBU = 31 SRM = 30 ABV = 5.2%

Ingredients

6.6 lbs. (3 kg) light liquid malt extract
3 oz. (85 g) light dried malt extract
1 lb. (0.45 kg) UK crystal malt (60 °L)
8 oz. (0.23 kg) UK chocolate malt
4 oz. (0.11 kg) UK black malt
6 AAU Northern Brewer hops (60 mins) (0.75 oz./21 g of 8% alpha acids)
6 AAU Northern Brewer hops (10 mins) (0.75 oz./21 g of 8% alpha acids)
4.5 AAU Cascade hops (2 mins.) (0.75 oz./21 g of 6% alpha acids)
Wyeast 1272 (American Ale II™) (1 qt./1 L yeast starter)
¾ cup corn sugar (for priming)

Step by Step

Steep the grains in 3 gallons (11 L) of 158 °F (70 °C) water for 30 minutes. Remove the grain, add the dried malt extract, half the liquid malt extract and enough water to make at least 3 gallons (11 L) of wort. Boil the wort for 60 minutes, adding the hops at times indicated in the ingredients list. Keep some boiling water handy and do not let the boil volume dip below 3 gallons (11 L). Add the remaining liquid malt extract in the final 15 minutes of the boil. Chill the wort, transfer to fermenter and top up to 5 gallons (19 L). Aerate the wort and pitch yeast. Ferment at 64 °F (18 °C).

Award-Winning Porter Recipes

Classic American Porter
by Gordon Strong, Beavercreek, Ohio (5 gallons/19 L, all-grain)

OG = 1.049 FG = 1.014
IBU = 23 SRM = 30 ABV = 4.7%

This is my take on the lagered porters of the Northeast, in the style of Yuengling. It's important to not have an overtly roasted flavor; licorice-type flavors are desirable, but not burnt. A less bitter version of this beer without the crystal malt will do nicely as a Dark American Lager. It might work in the Brown Porter category, but entering it as a Specialty Beer would work too.

Ingredients

6.5 lbs. (3 kg) US 2-row pale malt
1.5 lbs. (0.68 kg) US mild malt
1 lb. (0.45 kg) flaked maize
12 oz. (0.34 kg) crystal malt (50 °L)
12 oz. (0.34 kg) Weyermann Carafa® Special II
5 AAU Cluster hops (60 mins.) (0.66 oz./19 g of 7.5% alpha acids)
1.5 AAU Cascade hops (10 mins.) (0.25 oz./7 g of 6% alpha acids)
Wyeast 2206 (Bavarian Lager) yeast (1 qt./1 L yeast starter)
¾ cup corn sugar (for priming)

Step by Step

Two or three days before brew day, make the yeast starter, aerating the wort thoroughly (preferably with oxygen) before pitching the yeast.
On brew day, mash in the malt at 152 °F (67 °C) in 17 qts. (16 L) of water. Hold at this temperature for 60 minutes. Raise mash temperature to 170 °F (77 °C), hold for 5 minutes then recirculate. Run off wort and sparge with water hot enough to keep the grain bed around 170 °F (77 °C). Collect 6.5 gallons (25 L) of wort. (Check that final runnings do not drop below SG 1.010.) Boil wort for 60 minutes, adding hops at times indicated. Ferment at 50 °F (10 °C). Lager at 34 °F (1 °C) for 8 weeks.

Variation: Add some brewer's licorice or blackstrap molasses (very small amount, perhaps 1 Tb.)

Classic American Porter
by Gordon Strong, Beavercreek, Ohio (5 gallons/19 L, partial mash)

OG = 1.049 FG = 1.014
IBU = 23 SRM = 30 ABV = 4.7%

Ingredients

3.3 lbs. (1.5 kg) light liquid malt extract
10 oz. (0.28 kg) light dried malt extract
1 lb. (0.45 kg) US 2-row pale malt
1 lb. (0.45 kg) US mild malt
1 lb. (0.45 kg) flaked maize
12 oz. (0.34 kg) crystal malt (50 °L)
12 oz. (0.34 kg) Weyermann Carafa® Special II
5 AAU Cluster hops (60 mins.) (0.66 oz./19 g of 7.5% alpha acids)
1.5 AAU Cascade hops (10 mins.) (0.25 oz./7 g of 6% alpha acids)
Wyeast 2206 (Bavarian Lager) yeast (1 qt./1 L yeast starter)
¾ cup corn sugar (for priming)

Step by Step

Mash grains at 152 °F (67 °C) in 6 qts. (5.6 L) of water. Hold at this temperature for 60 minutes. Collect 2.25 gallons (8.5 L) of wort. Add water to make at least 3 gallons (11 L) of wort. Stir in dried malt extract and boil wort for 60 minutes, adding hops at times indicated. Add liquid malt extract in the final 15 minutes of the boil. Chill wort, transfer to fermenter and top up to 5 gallons (19 L). Aerate wort and pitch yeast. Ferment at 50 °F (10 °C). Lager at 34 °F (1 °C) for eight weeks.

Classic American Porter
by Gordon Strong, Beavercreek, Ohio (5 gallons/19 L, extract with grains)

OG = 1.049 FG = 1.014
IBU = 23 SRM = 30 ABV = 4.7%

Ingredients

3.3 lbs. (1.5 kg) light liquid malt extract
1.4 lbs. (0.64 kg) light dried malt extract
1 lb. (0.45 kg) corn sugar
12 oz. (0.34 kg) crystal malt (50 °L)
12 oz. (0.34 kg) Weyermann Carafa® Special II
5 AAU Cluster hops (60 mins.) (0.66 oz./19 g of 7.5% alpha acids)
1.5 AAU Cascade hops (10 mins.) (0.25 oz./7 g of 6% alpha acids)
Wyeast 2206 (Bavarian Lager) yeast (1 qt./1 L yeast starter)
¾ cup corn sugar (for priming)

Step by Step

Steep grains in 3 gallons (11 L) of 158 °F (70 °C) water for 30 minutes. Remove grain, add dried malt extract and enough water to make at least 3 gallons (11 L) of wort. Boil wort for 60 minutes, adding hops at times indicated. Keep some boiling water handy and do not let boil volume dip below 3 gallons (11 L). Add liquid malt extract and sugar in the final 15 minutes of the boil. Chill wort, transfer to fermenter and top up to 5 gallons (19 L). Aerate wort and pitch yeast. Ferment at 50 °F (10 °C). Lager at 34 °F (1 °C) for eight weeks.

Tips for Success:

It is important to get good attenuation and a relatively clean profile so be sure to oxygenate the wort and pitch an appropriate amount of clean, healthy yeast. Also, be sure to control the fermentation temperature. Jamil Zainasheff advises that holding the temperature steady is important to getting a proper level of attenuation and avoiding off-flavors. Letting the beer go through large temperature swings can result in the yeast flocculating early or producing solventy and/or overly estery beers. If you experience a temperature swing or two, you can optionally try raising the temperature a few degrees near the end of primary fermentation to help the yeast clean up some of the intermediate compounds produced during fermentation.

Award-Winning Porter Recipes

Baltic Porter
by Gordon Strong, Beavercreek, Ohio (5 gallons/19 L, all-grain)

OG = 1.083 FG = 1.024
IBU = 30 SRM = 54 ABV = 7.8%

I used a variation of this recipe to win an NHC gold in 2009, blending it with a sweet blackberry mead to make a Blackberry Baltic Porter. The base beer is delicious on its own, and is a scaled up version of a Carnegie-style porter that won several medals on its own.

Ingredients

7 lbs. (3.2 kg) Maris Otter pale ale malt
3.5 lbs. (1.6 kg) German dark Munich malt
1.5 lbs. (0.68 kg) UK brown malt
1 lb. (0.45 kg) German wheat malt
1.75 lbs. (0.79 kg) Weyermann CaraMunich® II
1.25 lbs. (0.57 kg) UK crystal (90 °L)
8 oz. (0.23 kg) Belgian Special B
12 oz. (0.57 kg) UK chocolate malt
6 oz. (0.17 kg) Weyermann Carafa® special III
1 oz. (30 ml) Black treacle
9 AAU Fuggles hops (60 mins.) (2 oz./57 g of 4.5% alpha acids)
1.8 AAU Hallertauer hops (10 mins.) (0.5 oz./14 g of 3.5% alpha acids)
1.8 AAU Hallertauer hops (2 mins.) (0.5 oz./14 g of 3.5% alpha acids)
Wyeast 2112 (California Lager) yeast (2 qts./2 L yeast starter)
¾ cup corn sugar (for priming)

Step by Step

Two or three days before brew day, make the yeast starter, aerating the wort thoroughly (preferably with oxygen) before pitching the yeast.
On brew day, mash in the malt at 151 °F (66 °C) in 17 qts. (16 L) of water. Hold at this temperature for 60 minutes. Raise the mash temperature to 170 °F (77 °C), hold for 5 minutes then recirculate. Run off the wort and sparge with water hot enough to keep the grain bed around 170 °F (77 °C). Collect 6.5 gallons (25 L) of wort. (Check that the final runnings do not drop below SG 1.010.) Boil the wort for 60 minutes, adding hops at times indicated. Ferment at 62 °F (17 °C). Lager at 34 °F (1 °C) for 12 weeks.

Baltic Porter
by Gordon Strong, Beavercreek, Ohio (5 gallons/19 L, partial mash)

OG = 1.083 FG = 1.024
IBU = 30 SRM = 54 ABV = 7.8%

Ingredients

6.6 lbs. (3 kg) light liquid malt extract
5 oz. (0.14 kg) Maris Otter pale ale malt
1 lb. (0.45 kg) German dark Munich malt
1.5 lbs. (0.68 kg) UK brown malt
1.75 lbs. (0.79 kg) Weyermann CaraMunich® II
1.25 lbs. (0.57 kg) UK crystal (90 °L)
8 oz. (0.23 kg) Belgian Special B
12 oz. (0.57 kg) UK chocolate malt
6 oz. (0.17 kg) Weyermann Carafa® special III
1 oz. (30 ml) Black treacle
9 AAU Fuggles hops (60 mins.) (2 oz./57 g of 4.5% alpha acids)
1.8 AAU Hallertauer hops (10 mins.) (0.5 oz./14 g of 3.5% alpha acids)
1.8 AAU Hallertauer hops (2 mins.) (0.5 oz./14 g of 3.5% alpha acids
Wyeast 2112 (California Lager) yeast (2 qts./2 L yeast starter)
¾ cup corn sugar (for priming)

Step by Step

Mash grains at 151 °F (66 °C) in 9 qts. (8.5 L) of water. Hold at this temperature for 60 minutes. Collect 2.25 gallons (8.5 L) of wort. Add water to make at least 3 gallons (11 L) of wort. Stir in dried malt extract and boil wort for 60 minutes, adding hops at times indicated. Add liquid malt extract in the final 15 minutes of the boil. Chill wort, transfer to fermenter and top up to 5 gallons (19 L). Aerate wort and pitch yeast. Ferment at 62 °F (17 °C). Lager at 34 °F (1 °C) for 12 weeks.

Baltic Porter
by Gordon Strong, Beavercreek, Ohio (5 gallons/19 L, extract with grains)

OG = 1.083 FG = 1.024
IBU = 30 SRM = 54 ABV = 7.8%

Ingredients

6.6 lbs. (3 kg) light liquid malt extract
1 lb. (0.45 kg) light dried malt extract
1.5 lbs. (0.68 kg) UK brown malt
1.75 lbs. (0.79 kg) Weyermann CaraMunich® II
1.25 lbs. (0.57 kg) UK crystal (90 °L)
8 oz. (0.23 kg) Belgian Special B
12 oz. (0.57 kg) UK chocolate malt
6 oz. (0.17 kg) Weyermann Carafa® special III
1 oz. (30 ml) Black treacle
9 AAU Fuggles hops (60 mins.) (2 oz./57 g of 4.5% alpha acids)
1.8 AAU Hallertauer hops (10 mins.) (0.5 oz./14 g of 3.5% alpha acids)
1.8 AAU Hallertauer hops (2 mins.) (0.5 oz./14 g of 3.5% alpha acids
Wyeast 2112 (California Lager) yeast (2 qts./2 L yeast starter)
¾ cup corn sugar (for priming)

Step by Step

Steep grains in 3 gallons (11 L) of 158 °F (70 °C) water for 30 minutes. Remove grain, add dried malt extract and enough water to make at least 3 gallons (11 L) of wort. Boil wort for 60 minutes, adding hops at times indicated. Keep some boiling water handy and do not let boil volume dip below 3 gallons (11 L). Add liquid malt extract in the final 15 minutes of the boil. Chill wort, transfer to fermenter and top up to 5 gallons (19 L). Aerate wort and pitch yeast. Ferment at 62 °F (17 °C). Lager at 34 °F (1 °C) for 12 weeks.

tory. However, with such a broad family as porter, I thought it best to review how the style has changed over the years — remember, when you're making a porter, ask the "when?" and "where?" questions: Historical or modern? English, American or Baltic? What era? What region? Understanding all the variations will let you decide which you'd rather brew.

Modern porter recipes are usually built around a base of pale malt, with crystal and roasted malts supplying much of the character and color. Sweeter versions will have a higher proportion of crystal malts, and tend to emphasize chocolate malt. Roastier versions will often use more black malt, and can have grains with more biscuity flavors. There are many choices of individual grains that can be used within these families. Modern brown malt lends a distinctive flavor to London-style English porters (see a photo of brown malt on page 62 and 63).

Historical English versions tend to rely on pale, amber, brown and black malts. Older recipes infrequently mention chocolate or crystal malts. One issue with trying to recreate historical recipes is that the ingredients are different; modern brown malt is not the same as historical brown malt (read more about recreating historical porters in Terry Foster's story on page 42). How different is the taste? That's not clear, since little in the way of detailed descriptions of historical flavors exist. If using modern malts with historical recipes, be careful to get proper conversion — modern amber and brown malts have no enzymes. Did historical brown malts have a smoky character? Modern brown malt doesn't. Did vatted porters have a sour, *Brettanomyces* or oak character? How much? That's not really known either. If you're guessing, let your palate be your guide — don't make something that is undrinkable just because you think you're being authentic.

Brewing sugars are often used for color and flavor in both English and American recipes. Professional brewing products are often not available for homebrewers, but some can be approximated using Lyle's golden syrup with a bit of blackstrap molasses (maybe 1–2%) or treacle. Various unrefined brown sugars and light molasses can provide additional character, especially in historic American porters. Darker Belgian syrups often bring much more fruit than is desired (except perhaps in Baltic porters, where they might be very interesting), but might add an interesting accent if used in small amounts.

Hops and yeast tend to be fairly straightforward. Select hops based on the country of origin, and emphasize the bittering additions. Modern American versions might have more of a late hop character. The most important aspect of the bittering addition is to achieve the right balance and overall impression — are you looking for a malty beer, a balanced beer, or a

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bitter beer? Yeast selection is likewise country-based, typically a malty/fruity English strain or a clean American strain. Lager yeast strains are typically clean and straightforward for historical American porters, but can have an elevated fermentation temperature for the more fruity Baltic porters, if desired.

Modern porter (especially the more malt-balanced English version) is a very adaptable style, and lends itself well to being used with fruit, spice, nuts, smoke, coffee, oak, bourbon, rum, *Brettanomyces*, honey, chile peppers, and other unusual ingredients. You can play around with any of these recipes to turn them into specialty beers by adjusting the special ingredients. For more on the variations you can try in porter, read *BYO*'s December 2007 story "Practical Porter" on the Web at http://byo.com/story1260.

So perhaps porter has been an elusive style because it has been so flexible and adaptable over the years, changing with available ingredients and consumer tastes and being retooled for local production. It's a mistake to assume all porters will taste the same, a condition not helped by the fact that

Photo courtesy of Muntons

Porter was originally brewed with mostly brown malt (above). Modern brown malts, however, are very different than those brewers used in the 18th and 19th centuries.

most examples are simply labeled "porter." Understanding the wide range and historical changes of the style will better help you appreciate the beer, and to brew accurate recreations. BYO

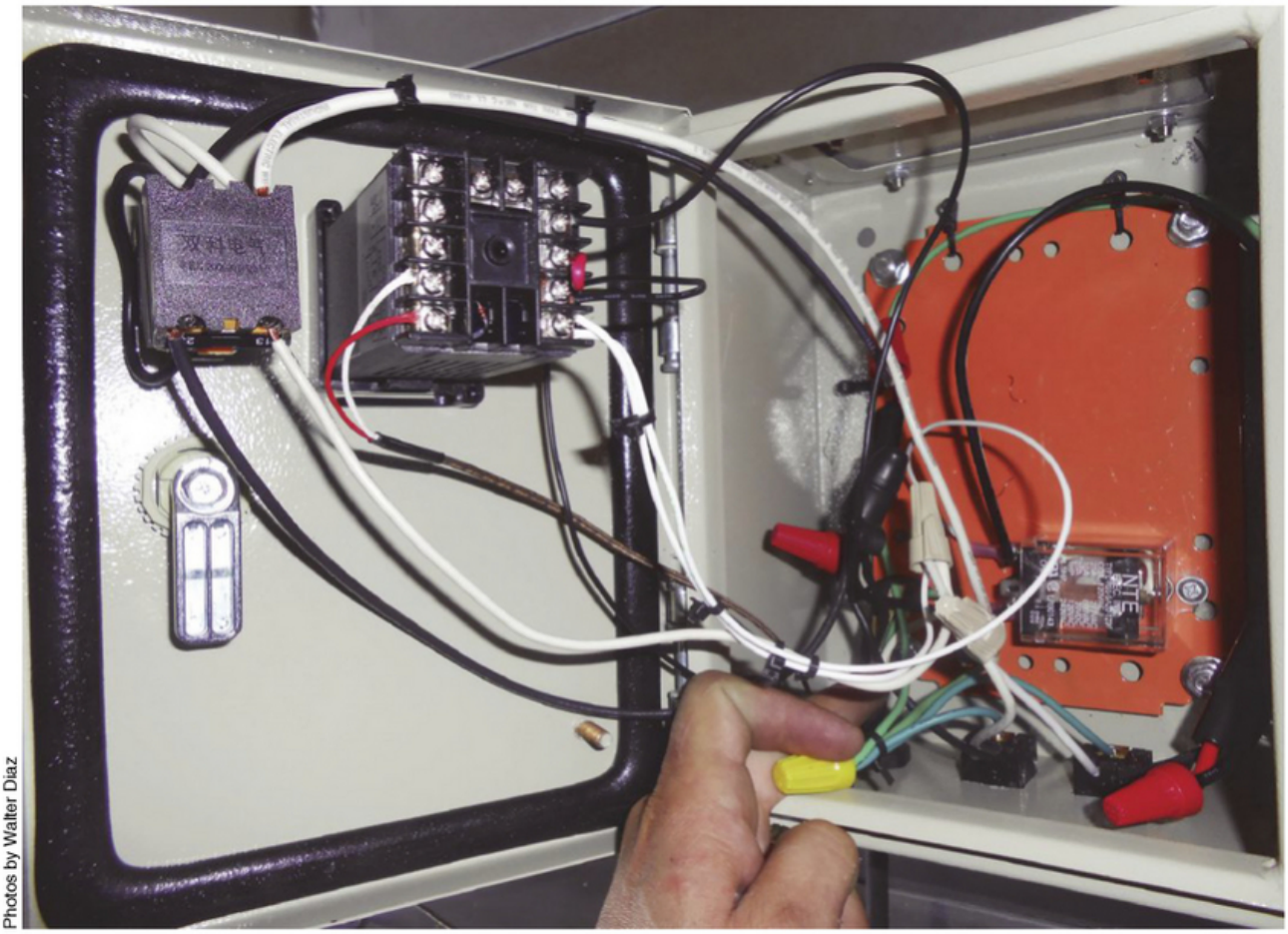
Related Links:

• Can't get enough porter recipes? Check out a few byo.com-exclusive porters to try in addition to the award winners in this story:
http://byo.com/story251

• Back when *BYO*'s Jamil Zainasheff was an extract brewer making the transition to all-grain, he brewed a robust porter. See his his recipe and read more about his robust technique:
http://byo.com/story2506

• Looking for something smokey? Try brewing a Greg Noonan/ Vermont Pub and Brewery-esque smoked porter at home:
http://byo.com/story1382

• Looking to brew a simple, basic porter? Try some simple recipes, including a Christmas porter:
http://byo.com/story514



Photos by Walter Diaz

Homebrewing Electrical Design 101: Build an Electrical Control Panel

by **Walter Diaz**

Homebrewing can be as simple or as complicated as you want it to be. Of course, the definition of simple or complicated all depends on the way you look at it. Like most of us, when I started homebrewing, my first batch was brewed all manually with a directly-fired mash tun, keeping an eye on the mash temperature and constantly tweaking the flame intensity for temperature control. Some say this is the simple way but I disagree. It was pretty hard to keep a constant mash temperature. In my case, I find that the use of some basic electrical-electronic tools really does make homebrewing simpler. This article reviews some basic considerations for building an electrical control panel and integration of electrical components.


18.4
76.0
MIXER
HEATER

Figure 1: Electrical Enclosure

Table 1: NEMA Enclosure Rating

Provides a Degree of Protection Against:	1	2	4	4X	5	6	6P
Access to hazardous parts	X	X	X	X	X	X	X
Ingress of solid foreign objects (falling dirt)	X	X	X	X	X	X	X
Ingress of water (dripping and splashing)		X	X	X	X	X	X
Ingress of solid foreign objects (circulating dust)			X	X		X	X
Ingress of solid foreign objects (settling airborne dust)			X	X	X	X	X
Ingress of water (hosedown and splashing water)			X	X		X	X
Corrosive Agents				X		X	X
Ingress of water (occasional temporary submersion)						X	X
Ingress of water (occasional prolonged submersion)							X

Illustrations by Chris Champine

Safety First

If you plan on simplifying your homebrewing methods using anything electrical, the first thing that should come to mind is your safety. If you are not experienced with electrical wiring, get a professional to help you with this project — do not attempt to do any electrical wiring yourself. Choosing a properly rated electrical enclosure to house/protect your electrical components is also very important — read on.

Choosing an Electrical Enclosure

Naturally, one of the first decisions to be made is choosing the physical size of the electrical enclosure that will contain all the electronics. To determine this, make a headcount of all the electrical components that your system currently uses and leave yourself some room for future expansion. There will always be one more thing to add on. I would suggest that a homebrewing system using a temperature-controlled hot liquor tank (HLT) and mash tun with electrical outlets for pumps fits inside of a 12-inch high x 12-inch wide x 6-inch deep enclosure (see Figure 1, left).

Once you have decided on a physical size, the next consideration will be the type of electrical enclosure. The National Electrical Manufacturers Association (NEMA) provides a rating system for electrical enclosures according to their degree of protection for different environments. Table 1 (left) shows the level of protectionof some electrical enclosures. I recommend using a NEMA type 4 enclosure because I don't find a significant difference in price going from NEMA 1 to NEMA 4, and the fact that this enclosure provides protection against the moisture hazard present in typical homebrewing environments. A NEMA 4-rated enclosure can be used either indoors or outdoors.

Once you have settled on an electrical enclosure, there is one accessory (normally not included with enclosure) that I strongly recommend you order from the same vendor: the sub-panel. The subpanel is a flat piece of sheet

metal (orange color inside of electrical enclosure shown in Figure 1) with predrilled mounting holes that are bolted inside of the enclosure. This provides a flat surface where miscellaneous components like electromechanical relays (described later) can be mounted on.

Now that you have a physical platform to centralize your system, it is time to decide what kind of electrical components are necessary to control your tools (pumps, heaters, etc.). In the following, the most commonly used electrical devices are discussed as it applies in a homebrewing context.

Figure 2: Symbol of an electrical switch used in wiring diagrams

Electrical Switches

A switch is an electrical device that can break an electrical circuit by interrupting current. In general, switches are classified according to the number and arrangement of their contacts. These contacts are said to be closed when current flows from one side of the switch to the other (electrical device ON), or open when no current can flow through it (electrical device OFF). See Figure 2, above. This is the simplest form of electrical switch, known as a toggle switch used to manually turn on/off electrical devices. There are normally closed and open switches. A switch that is equipped with a double electrical contact is known as a double pole switch. A double pole switch can be used to start two different electrical devices with the push of a single button. By application switches can also be classified by the type of process they help to control (i.e. flow switch, float switch, pressure switch, etc.). Some of these switches and their possible applications in homebrewing are described in more detail here:

Float Switch: This type of switch closes its contacts when the fluid level reaches a certain level in a tank. These switches are usually electrically wired

to a pump for level control, such as overflow protection when filling a tank, or preventing a tank from emptying below a certain level. In a homebrewing application, a float switch can be used to control the sweet wort level of a grant (a small buffer where wort drains by gravity out of the mash lauter tun — this prevents a pump from drawing vacuum by sucking directly from the grain bed).

Flow Switch: This type of switch is normally placed in-line to detect liquid flow. When liquid flow is detected, its contacts close, which can be used for energizing or de-energizing other devices. In homebrewing this type of switch can be used to improve the safety of a recirculated infusion mash system (RIMS). In a RIMS system, a recirculation pump is used to pump hot wort during the length of the mashing process. In the event that this pump overheats and stops pumping wort (or may be clogging with grain husk), and the temperature controller fails to turn off the electric heater, overheating can occur which can burn out the heater and possibly all the wiring back to the main electrical breaker. This would not happen if a flow switch is used to turn on the electric heater. Under this scenario, if the pump overheats and stops pumping, the flow switch opens the circuit which automatically turns off the electric heater. Another safety advantage of a flow switch is that it will prevent you from dry starting the heater.

Figure 3: Electrical symbol of electrical fuse

Electrical Fuse

Fuses are current limiting devices that are used to open a circuit and stop current flow to a system in the event that the current capacity of a system is exceeded for any reason.

Temperature Controllers

Due to the precision required in the brewing process (±1 degree Fahrenheit or less), electronic temperature controllers are most suitable. Figure 4, above, shows a proportional integral derivative (PID) controller. When choosing a temperature controller of this type, the following things need to be considered:

Figure 4: Proportional Integral Derivative controller (PID)

A. Power Supply: Normally these units will operate with anywhere from 120–240 VAC.

B. Input Type: This is the temperature sensor that will be feeding a signal to the temperature controller. The typical options are thermocouples and resistant temperature detectors (RTD) sensors. The thermocouple sensor consists of two dissimilar metal wires joined at one end. When the junction of the two metals is heated or cooled a voltage is produced that can be correlated back to the temperature. The RTD sensor consists of a resistor that changes its resistance value as its temperature changes. In comparison, RTD sensors produce much more stable and accurate signals (accurate within 0.3 degree Celsius vs 2.2 Celsius) than thermocouples but they are also more expensive. Still, thermocouple sensors may be used for accurate measurements in brewing because most commonly available electronic temperature controllers have signal conditioning circuitry to improve the stability and accuracy of thermocouple sensor outputs. Essentially this makes thermocouples nearly as accurate as RTD sensors. One example of a temperature controller with very good thermocouple signal conditioning is the Auber model# SYL-3242, which improves the quality of thermocouple signals up to 0.2% accuracy (that is within ±0.25 °C or ±0.5 °F).

C. Control Mode: With these temperature controllers at least three types of control options are available, PID, manual or on/off. P, I and D represents a parameter input into an algorithm that calculates and controls how the system should properly respond to disturbances that affect the variable being controlled. For example, mash temperature cools because of heat loss to the environment and this change results in the controller sending an output to a heater. The following is an analogy of what the PID parameters would do in practice for controlling mash temperature in a directly fired mash tun:

Pretend you are getting ready to begin mashing in with a directly-fired mash tun. Initially, you use the flame at full power to heat the strike water. When getting within a few degrees from the desired mash strike temperature, you either turn down the flame or cycle on/off to prevent overshooting this temperature. In PID control mode, this is known as the proportional band (P). After the controller enters into the proportional band, it will turn the heater on/off for periods of time that proportionally correlate (this is known as time proportioning method) to the amount of error (how far the measured temperature is from desired set point). For example, when mash temperature is 1 °F below set point, the controller will turn on the heater for 10 seconds; when mash temperature is 2 °F below set point the controller will turn on the heater for 20 seconds and so on. Another form of proportional control (P) is the analog 4–20 mA method. Using this type of proportional control, the degree of opening/closing of an electromechanical valve may be controlled in proportion to the amount of error. This would be used to modulate the intensity of a heating flame. However, because the proportional (P) control parameter relies on the amount of error to produce an output, it will never really reach the desired temperature, and that is when the integral (I) parameter kicks in. The integral (I) parameter summarizes the error, which is then subtracted in the algorithm. This brings the measured mash temperature much more closely to the desired set point. At this point, the amount of error (desired temperature vs measured temperature) is greatly reduced but there may be still some temperature overshoot. To prevent overshoot, the derivative (D) parameter keeps track of the rate of change in mash temperature and plugs this information into the algorithm. By knowing how fast the mash is heating up, the controller can then predict how far in advance to turn off the heater (or valve throttling when using analog 4–20 mA outputs) to prevent temperature overshoot. All these parameters are automatically calculated and adjusted (tuned) to fit your process. This works best in most circumstances but in certain cases, making adjustments to these parameters (P,I,D) to achieve the best control without overshoot, the controlled system may take too long to reach the desired set point.

If the heating times are not satisfactory to your mash process, you could then run the temperature controller in manual mode. This would allow you to manually modify (tune) the PID parameters as you see fit but this is no easy task. If you feel like going this route, it would then be a good idea to study the topic of PID tuning in depth and practice with online PID simulators before attempting anything. For more on tuning a PID controller,

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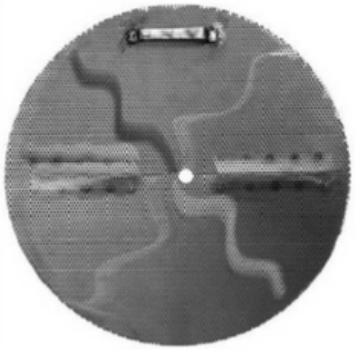
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Figure 5: SSR (left) vs. electromechanical relay (right)

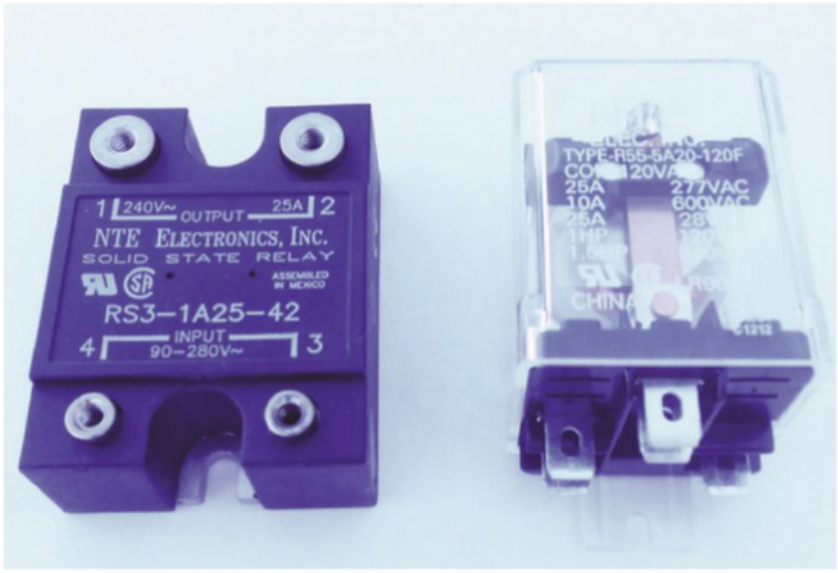
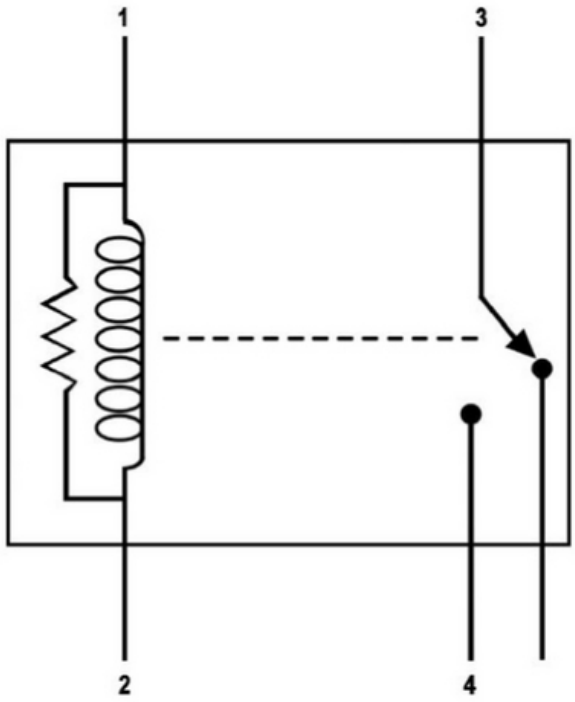


Figure 6: Wiring a basic type of an electromechanical relay



check out "Brewing on Autopilot" in the November 2003 *Brew Your Own*.

The last and simpler alternative is to run the controller in on/off mode. If your heater is sized correctly (it heats up the mash at a rate no higher than 2 °F per minute), this is the way to go. Under this scenario, even if the controller turns off the heater 15 seconds after the mash temperature reached the set point, this would only overshoot by 0.5 °F degrees, which is more than acceptable. Sometimes, simple is better.

D. Output Mode: This refers to the type of electrical output used by the controller to manipulate the controlled

variable (temperature). The options are SSR (solid state relay), electromagnetic relay and analog signal 4-20 mA (other forms of outputs are available such as DC pulse and 0-10V are available but they will not be discussed here.) When going with SSR output, the controller will not have any power to directly turn on/off any sizeable electrical devices. In this case, the controller only outputs an electrical signal to the SSR relay, which then turns on/off the electrical device. The SSR output mode option is used for high speed switching of loads, where a very high degree of accuracy is required. For example, when controlling an electrical heater, using a SSR relay the controller can order the on/off state of the heater up to hundreds of times per minute to prevent the smallest degree overshoot (this extreme case is really not necessary for beer brewing). The electromagnetic output mode option is used to control slower acting outputs. In some cases, the controller itself is able to run small electrical devices (typically less than 10 amps at 120 VAC) using an internal electromechanical relay. When electrical loads are bigger, this internal relay needs to be wired to an external electromechanical relay. One example of this is the same scenario of using the electric heater to control the temperature in a mash tun. As mentioned earlier, if the heater is adequately sized and its maximum potential to heat up the mash is 2 °F per minute, then the 'slow' acting electromechanical relay is appropriate for working with on/off control. The analog control output 4–20 mA signal is used in applications where proportional valves are being controlled to modulate the flow rate of fluids. For example, this could be used to regulate the flame intensity in a directly fired mash in response to measured temperature. Under this scenario 4 mA results in a closed valve and 20 mA results in a fully open valve. Anything in between results in a proportional degree of valve opening.

Relays

A relay is a load switching device used when the electrical load of a device being controlled exceeds the power rating of a controller. Relays can be very broadly classified as SSR or electromechanical relay. For illustration purposes, Figure 5 on the facing page shows a SSR vs electromechanical relay. The difference in operation was described earlier. The differences in installation will be described here. SSR relays produce a large amount of heat and this heat needs to be dissipated for its proper operation and lifetime. Every SSR relay should be mounted with a heat sink directly to the back side of it. The heat sink should also be properly sized and will usually be sold as a combo (SSR + heat sink).

Electrically both types of relays are wired very similarly. Figure 6 on the facing page shows the electrical diagram of an electromechanical relay. When coupled to a temperature con-

troller, terminals #1 and #2 of the relay are connected to the output of the temperature controller. The electrical controller outputs an AC (alternating current) or DC (direct current) signal that energizes this coil. In turn, this energized coil creates a magnetic field which causes terminals #3 and #4 of the relay to switch from open to closed position and turns ON an electrical device. When the electrical coil is de-energized, contacts #3 and #4 open and the electrical device turns OFF. SSR relays do not have an electrical coil (but a photo diode) but the wiring is still done basically in the same way.

Electrical Safety and Grounding

Electrical grounding is of extreme importance, not only for personal safety, but for proper functioning and protection of electrical and electronic systems. Effective grounding creates an electrical environment containing low levels of electrical noise and enhances the safety and performance of electrical and electronic equipment. The ground is the common potential point for all data and process control systems. It prevents interconnected systems from operating at different reference voltages. The following are three basic aspects of electrical safety:

> "A good ground is of extremely low resistance, that is, it is highly conductive."

1. Personal Safety

Extreme caution should be exercised when assembling and testing electrical and electronic systems because of the hazards of electrical shock. Major concerns are overloading and/or over-fusing of electrical circuits, and not having adequate circuit breaking systems in place while doing installations, repairs and testing. When dealing with moderate to high voltages and currents, it is highly recommended that gloves and other insulating gear be employed. It is improper to assemble, install and operate electrical and electronic systems in a wet environment since water can be a good conductor of electricity.

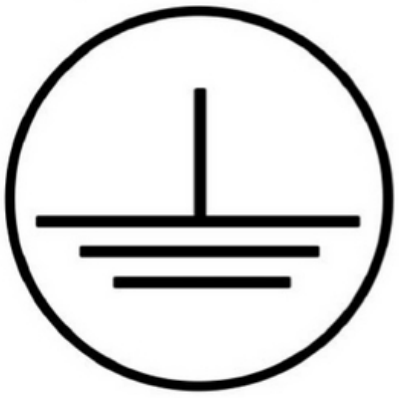
2. Grounding

Electrical and electronic systems grounding provides for proper protection and operation of all electrical and electronic systems. Electrical and electronic systems are generally divided into three major component systems: power, control and load. Each of these components must be grounded. Figure 7, right, shows the electrical symbol for ground.

Grounded systems are usually divided into two major types: electrical and electronic. Electrical grounding is a connection to a neutral point, generally the earth. The major purpose of such grounding is to provide a safe path for fault currents, static discharges and interference signals. A good ground is of extremely low resistance, that is, it is highly conductive. In the event that a high voltage wire came into contact with the metal housing of your electrical enclosure, the fault current would return to the ground via grounding wire of your electrical enclosure (instead of going back to the earth through you!). Because there is very little resistance for this current to flow back to the source, a very high amount of current begins to flow back to the source through this circuit, which quickly triggers the circuit breaker off. Electronic ground is to ensure that the circuits and systems within an enclosure are protected and operating properly, especially for signals and controls.

What makes electronic control systems different is their sensitivity to small transient voltages and currents and also static electricity. There are two types of grounding with these types of systems: a) safety grounding for fire and transient discharges b) performance grounding for protection of circuits and signals. These types of grounding do not have to involve an earth ground or grounding for the power system. Performance grounding usually employs an isolation transformer and proper shielding to achieve the needed protection.

Figure 7: Electrical symbol for ground



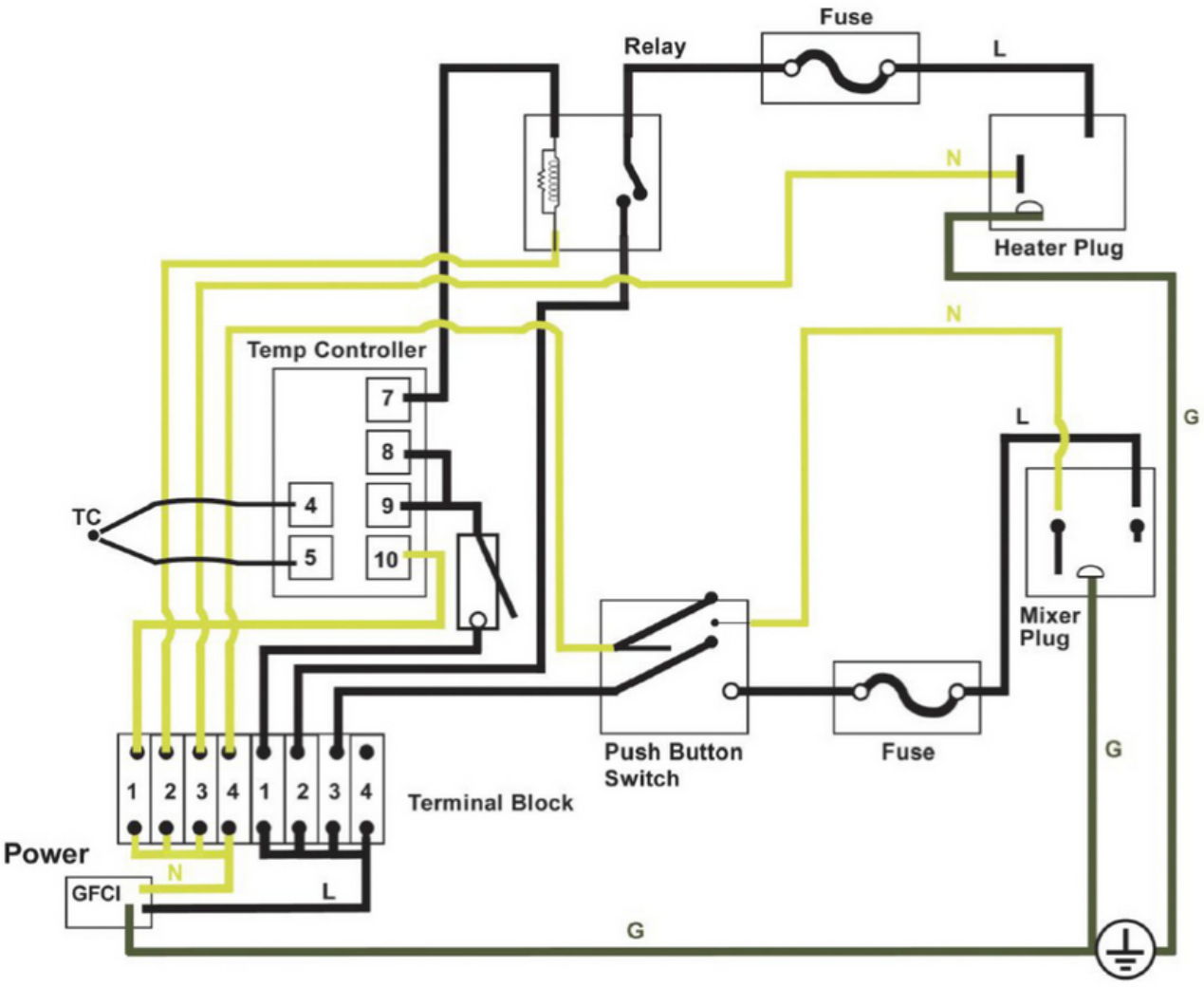
3. Ground Fault Circuit Interrupter (GFCI)

This is the second line of defense after grounding. A ground fault occurs when an unintentional path for current travels to ground other than the system ground path. In an ideal world with a perfect ground, this would never happen but the truth is some corrosion may develop in the ground circuit over time. If the ground fails to bring all the current back to the source, there is still some current that may leak out of the circuit. If this happened and you were touching the metal electrical enclosure, some of that current could travel back to ground through you (shocking you). What the GFCI does is to measure how much current is flowing through the hot line (L) and compares that to the neutral line (N). If these are not the same, it interprets that some of that current is available to electrocute someone, therefore, it shuts off the circuit instead. This is why GFCI's are an important safety line.

Basic Electrical Control Panel and Wiring

In Figure 8 on the next page, the electrical diagram of a simple electrical control panel is shown. Figure 9 on page 74 (and larger at the beginning of this story) shows a photo of the same electrical layout as built. Only two

Figure 8: Wiring diagram of the electrical control panel



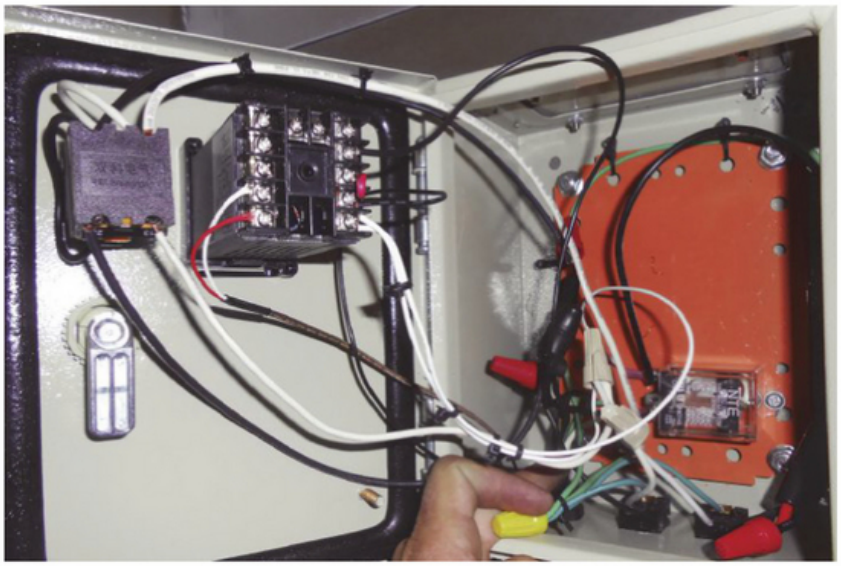
electrical circuits are integrated: a fused turn on/off switch for a mash mixer drive and an automatic mash temperature controlling circuit. The photo on page 65 shows the same electrical panel as seen from the outside. The brewing system controlled by this panel consists of a stainless steel mash tun wrapped by an electrically heated jacket. The mash is continually agitated by a top entry mash mixer to maintain a stable temperature. This would be the same circuitry necessary to run a RIMS system, where the temperature controller controls an in-line electric heater. Instead of the mash mixer, there would be a wort recirculation pump. A temperature controller with a type J thermocouple input is used to monitor the mash temperature and heat is added to the mash as needed to keep a set point temperature within a 0.5 °F margin. The electrical wiring diagram and mash temperature control logic is as follows:

1. Mash Mixer Circuit. The mash mixer is turned ON by pushing the Mixer Start button. This is a double pole switch. Both the neutral and hot wires run through it (the reason for using a double pole switch here is to operate a light indicator internally wired in this particular switch, which illuminates when the device in ON.) Pushing the start button closes the contact to the hot line (L) to the mash mixer circuit. This passes current through the inline fuse to the mixer. Once the current gets to the electrical motor in the mixer, it flows back to the power terminal block through N-line.

This current flow is what causes the mixer to turn ON. The green wire (ground) from the mixer is connected to the electrical enclosure frame.

2. Temperature Control Circuit. By pushing the controller start button (single pole switch — black button to the left of controller), the temperature controller is powered ON. Again this closes the contact in the hot line (L) to the electronic temperature controller,

Figure 9: Electrical control panel



allowing current to the controller, which then returns to the power electrical terminal through N-line. This current flow is what causes the controller to turn ON.

The temperature controller was turned ON so it can now read the thermocouple signal and compare to desired set point. If set point is lower than measured temperature it will output a signal on terminals #7 and #8 to turn ON the heater. The controller does this by closing internal contacts between terminals #7 and #8. This allows current from L-line to bypass from terminal #8 to #7 and then flow to the internal coil in the relay. This current then returns to the power terminal block by neutral (N) line. When current flows through this coil, it magnetically closes the internal contacts in the relay which bridge the hot line (L) power to the electrical heater (passing through electrical inline fuse first).This allows current flow to the heater, which returns to the power terminal block through the neutral line (N). When mash temperature is equal to set point, the contact in the terminals #7 and #8 inside the relay opens up, which stops current to the coil. This opens the hot line (L) to the heater and shuts it off. The green wire (ground) from the electric heater is connected to the electrical enclosure frame. BYO

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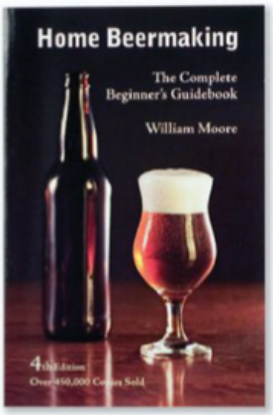

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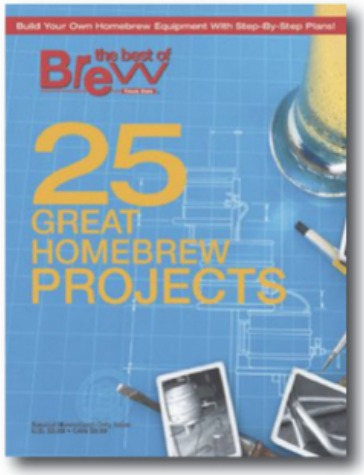

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Know Your Homebrew Metals

A Primer for the Do-It-Yourselfer.

I have to admit, I am a chronic DIY'er. Give me a nice and shiny off the shelf brewing system and I would probably try to take it apart and customize it — like, give it wheels and steering. For many of us, half the fun of brewing is getting to make the equipment we use. For some of us, it might be more. Regardless, making equipment is part of the fabric of homebrewing. (Except for brewpots, not many people have the ability to deep-draw metals at home.)

> "Each metal has its advantages and disadvantages . . ."

Every homebrewer is faced with equipment choices, whether they make it themselves or buy it from a shop. The decision to make or buy an item usually involves determining the best combination of material costs, performance, and degree of difficulty for making that item. There are brewers that live by the mantra, "simpler is better." There are other brewers that live by, "cheaper is better." And there are a few that unequivocally state that, "the best is better."

So, how do you decide? Each metal has its advantages and disadvantages depending on the product form and where you want to use it in the brewery. Aluminum and brass are often the most economical choices but require gentler handling and cleaning regimens than stainless steel. Copper has long been a favorite for do-it-yourselfers because it's easy to cut and solder, but the cost has now increased to the point where stainless steel is often more economical. Stainless steel has always been the gold standard for brewing equipment due to its excellent corrosion resistance and durability, but the cost of an all-stainless setup can still be prohibitive. The availability of less expensive stainless alloys for valves and fittings is helping

by **John Palmer**

Photo by Charles A. Parker/Images Plus

Photo by http://www.webstaurantstore.com

Aluminum is a very common metal used for brewing, often for making brewpots (above). Aluminum is easy to drill and accessorize, resists corrosion and is fairly inexpensive.

Copper has the highest heat conductivity of all brewing metals, which is why it is frequently used for making wort chillers, such as this immersion chiller, above.

to change that however. Weigh your wants and needs and use the information in this article to build a brewery that works best for you.

For example, what material characteristics should you look for in a brewing pot? Some of the considerations might be better heat conductivity, ease of cleaning, cost and customization. Some brewers might consider cost to be the biggest concern, but short-term cost may need to be weighed against long-term durability or adaptability. Each material choice should be considered to the application, and how that application may change over time.

The ultimate brewing setup for many people would be all stainless steel, and completely welded so it won't leak and can survive a magnitude 8 earthquake (or your kid's clumsy friends). Welding is fine and dandy but not many people have the equipment and expertise to produce clean welds. It is often easier to braze or solder using tin-silver plumbing solder to attach threaded nipples to pots. Brazing and soldering can be done by almost anyone with a little practice. Alternatively, weldless fittings are available for many applications and have the advantage of disassembly for cleaning.

Aluminum

Aluminum is a very good option, is low cost, has good conductivity, and good cleanability. The best thing about aluminum is that it's easy to drill and accessorize, using weldless fittings to add a ball valve, sight glass or thermometer. Be cautious if you are considering buying an aluminum turkey fryer pot and burner setup however. Those pots are often quite thin walled and more suitable for annual turkey boiling than for use as a brewpot. An 8- or 10-gallon (30- or 38-L) aluminum stockpot from a restaurant supply store makes a great brewpot and typically costs 70% of stainless steel.

The aluminum alloys most commonly used for cookware are alloys 3003 and 3004, which have very good corrosion resistance. Under normal brewing conditions, aluminum (by

itself) will not corrode and should not contribute any metallic flavor to your beer. The metal will season and turn dull with use. Do not clean the metal shiny bright between uses and you will minimize your chance of getting a metallic off-flavor.

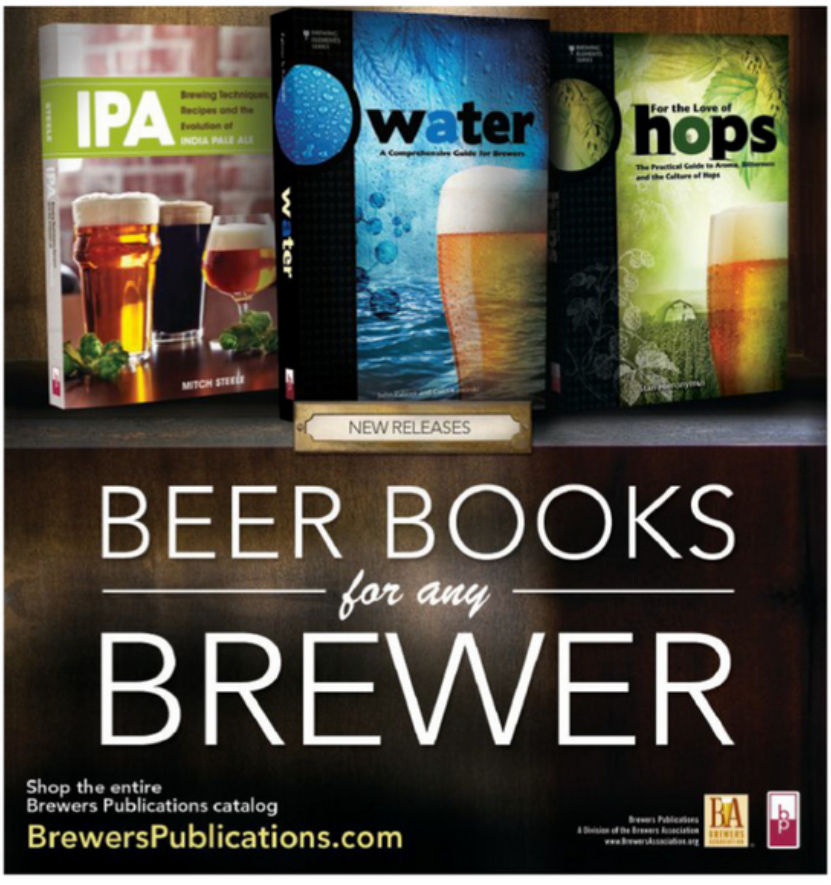
Aluminum will corrode if placed adjacent to another metal like copper in wort, but the short contact time during a typical brew day is not a problem. Do not use bleach or caustic, such as EZ Off, because these will cause pitting of the aluminum. Percarbonate-based cleaners like Straight A and PBW, or unscented dishwashing detergent, are recommended for general cleaning.

The role of aluminum in Alzheimer's Disease has been thoroughly discounted, but concerns still come up occasionally. A metallic off-flavor would be noticed long before a toxic level of aluminum could be ingested. Don't clean your aluminum shiny bright, let it turn dull, and you will not have any metallic off-flavors. There is more aluminum in a couple of Rolaids™ antacid tablets than in an entire batch of beer brewed in an aluminum brewpot.

Brass

Brass is a group of alloys made from copper and zinc with some lead thrown in for machinability. The lead percentage varies, but for the yellow brass alloys commonly used in plumbing fittings it is 3% or less. Lead does not alloy or mix with the copper and zinc in brass, but instead exists as tiny globules, like bananas in Jell-O. These globules act as a lubricant during machining and result in a micro-thin film of lead being smeared over the machined surface. It is this lead that can be dissolved off by the wort. While this teeny, tiny amount of lead is not a health concern, most people would be happier if wasn't there at all. Red brass does not contain lead and many states have legislated that plumbing alloys be lead-free. (See sidebar on the next page for a method to remove surface lead from brass.)

Brass can be readily soldered and brazed to copper and stainless steel. The thermal conductivity of brass is



De-leading Brass

The surface lead on brass is easily removed by soaking the parts in a solution of vinegar and hydrogen peroxide. You can get these at the grocery store or drug store. You can use white distilled vinegar or cider vinegar; just check the label to be sure it is 5% acid by volume. The hydrogen peroxide should be 3% by volume. To make the solution, mix them at a 2-to-1 volume ratio of vinegar to peroxide. Simply immerse the parts in the solution and watch for the color of the parts to change. The process takes just a couple minutes to clean and brighten the surface. The color of the brass will change to buttery yellow-gold when the lead is removed. The vinegar-peroxide solution should remain clear and colorless. If the solution starts to turn blue or green and/or the brass turns dark, it means that the parts have been soaking too long, the copper is dissolving and subsurface lead is being exposed. Make up a fresh solution and soak the parts again. This treatment only needs to be done once before the first use of the parts.

Photos courtesy of MoreBeer!

The thermal conductivity of brass is similar to aluminum but the corrosion resistance is similar to copper. Brass fittings, when well cared for, can give the same reliability as stainless steel fittings.

similar to aluminum, but the corrosion resistance of brass is more similar to copper. The reason that brass fittings are not commonly used in commercial breweries is that chemicals that are commonly used with stainless steel and clean-in-place (CIP) systems are too corrosive to copper and brass. As homebrewers, we don't have to use such strong chemicals, nor are the parts in service 24 hours a day/7 days a week, so mixing different alloys/components is not a problem.

Brass ball valves are very useful on large brewpots, allowing easy transfer of hot liquid to a chiller or another vessel. Ball valves are available in brass, nickel-plated brass and stainless steel. A plain brass valve will last a very long time with proper maintenance. Nickel-plated or stainless steel valves are more stain resistant, but cost more. Nickel-plated valves and fittings are about twice the cost of plain brass, but 304 stainless steel valves and fittings can be three times the cost of the plain brass. Stainless steel fittings may buy peace of mind, but honestly a little cleaning and wiping of brass will buy nearly the same performance.

Copper

Copper has the highest heat conductivity, is easy to form and was traditionally used for making the brewing kettles or "coppers." Copper can be readily soldered, brazed and welded with the proper equipment.

Copper is relatively inert to both wort and beer. With regular use, it will build up a stable oxide layer (dull copper color) that will protect it from any further interaction with the wort. Only minimal cleaning should be used to remove surface grime, hop bits and wort protein as necessary. There is no need to clean copper shiny-bright after every use or before contact with your wort. It is better if the copper is allowed to form a dull copper finish with use.

However, you need to be aware that copper can develop a toxic blue-green oxide called verdigris. Verdigris includes several chemical compounds — cupric acetate, copper sulfate, cupric chloride, etc. — and these blue-green compounds should not be allowed to contact your beer or any other food item because they are readily soluble in weakly acidic solutions (like beer), and can lead to copper poisoning (i.e., nausea, vomiting). To clean heavy oxidation (black), and verdigris, use vinegar, or oxalic acid-based cleansers like Revereware Copper and Stainless Steel cleanser. For regular cleaning of copper and brass, unscented dish detergent or sodium percarbonate-based cleaners are preferred. Cleaning and sanitizing copper wort chillers with bleach solutions is not recommended. Oxidizers like bleach and hydrogen peroxide quickly cause copper and brass to blacken; these oxides do not protect the surface from further corrosion, and quickly dissolve in the acidic wort. The trace metals like zinc are beneficial nutrients for yeast, but the amount of copper that can be dissolved from non-passive oxides can be detrimental to the batch.

While zinc is an important nutrient for yeast growth, it also can be too much of a good thing. Corrosion of brass can cause increased acetaldehyde and fusel alcohol production due to high yeast growth when zinc concentrations exceed 5 ppm. Excess zinc can also cause soapy or goaty flavors. But like copper, brass is usually stable in wort and will turn dull with regular use as it builds up a passive oxide layer. Brass should be treated like copper for normal cleaning.

Copper counterflow wort chillers should not be stored full of sanitizer or water. Any biological deposits can lead to corrosion in either water or sanitizer. Copper should be rinsed thoroughly

Why do Metals Corrode?

All corrosion is basically galvanic. The electrochemical difference between two adjacent metals in the presence of an electrolyte, creates a battery. An electrolyte can be any liquid such as tap water, salt water or beer. The more active of the two metals will ionize (or corrode). These metal ions will readily combine with oxygen to form oxides or other corrosion products. Corrosion can also occur between two adjacent areas on the same piece of metal, if the presence of dirt, a chemical, or a scratch can make the two areas seem electrically different from each other.

The relative surface area of the two metals also affects the corrosion rate. If the more passive metal has a larger surface area than the active metal, the corrosion of the active metal will be increased. If the active metal area is larger than the passive metal, the corrosion of the active metal will decrease significantly. In both cases, most of the corrosion will take place at the interface of the two metals.

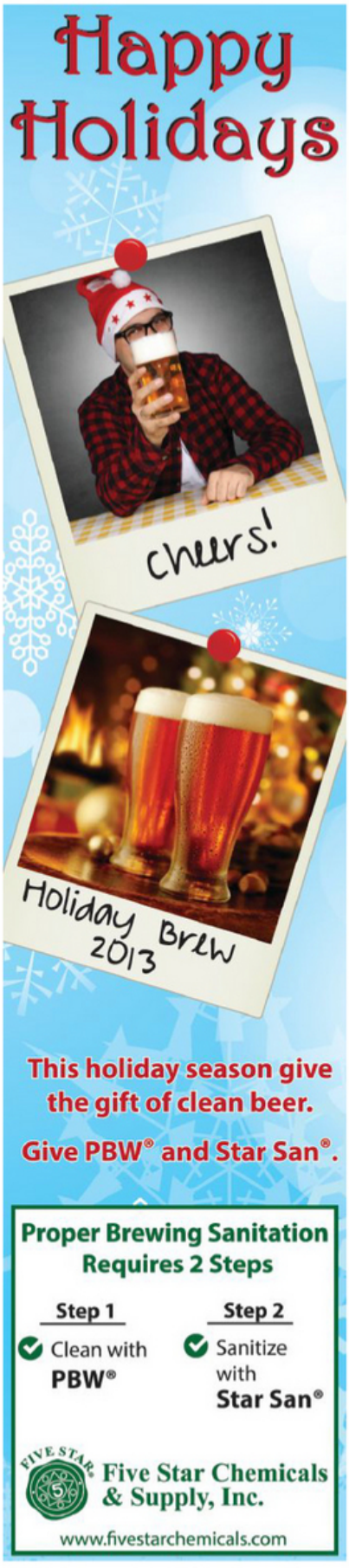
All metals are electrochemically different from one another, covering the spectrum from very active (e.g. magnesium, zinc, aluminum) to very passive (e.g. titanium, gold). The more active metal will corrode in preference to the more passive. This property is often used for corrosion protection. Anodic protection is where an active metal (e.g. zinc) is plated onto a more passive metal (e.g. steel) part to protect it. The zinc corrodes instead of the steel. The problem with anodic protection is that the active metal is released to the environment (i.e., the beer). Cathodic protection is where a more passive metal is plated onto a more active, such as gold plating onto a steel part. The problem with cathodic protection is that a breach in the plating will cause the more active metal underneath to corrode rapidly. Nickel and chromium platings are often used on brass to protect the brass from corrosion and provide a more aesthetic appearance. Brass, copper, stainless steel and silver solder are close enough together on the galvanic series that there is not much potential for corrosion between them.

Metals can also be protected from corrosion by building up a uniform oxide film, similar to how a sun tan can prevent sun burn. But just like a sun tan, the efficacy of the oxide film varies and may not be proof against all corrosion. Some oxides are very passive and inhibit almost all corrosion, such as the chromium oxides that protect stainless steel. Other oxides are more reactive, like red rust and heat tint on stainless steel, and do not inhibit further corrosion at all.

Stainless steel is referred to as being "passivated" when the protective chromium oxide surface layer is unbroken. If this oxide layer is breached by iron (from a wire brush or drill bit) or dissolved by chemical action (like bleach) or compositionally altered by heat (brazing or welding) it will rust. The problem with stainless steel corrosion is usually not an off-flavor, but more often a hole in a valuable piece of equipment.

Most other oxides are somewhere in between, and can be used to protect the metal from specific environments. The oxides of copper, brass, and aluminum fall in this category. Copper and brass will develop a dull stable oxide over time that is resistant to corrosion in wort, but scouring the metal shiny bright will remove the passive film. To encourage a passive film on aluminum, copper and brass — wash the item thoroughly, dry it thoroughly, and then put it in your oven (dry) at 350 °F (177 °C) for about 10 minutes. This will help the anhydrous oxide layer to thicken. The highly corrosion resistant, dark anodized finish that is common on aluminum cookware is produced by electrolysis in a chemical bath and can't be done at home.

Here is a good rule of thumb for preventing corrosion and metallic off-flavors: All metals should be dull-looking but still look like themselves. In other words, copper should look like dull copper. Aluminum should look like dull aluminum. They should not look black, or green or blue. Highly colored oxides are generally not passive oxides and will probably dissolve in wort and generate an off-flavor or promote staling.



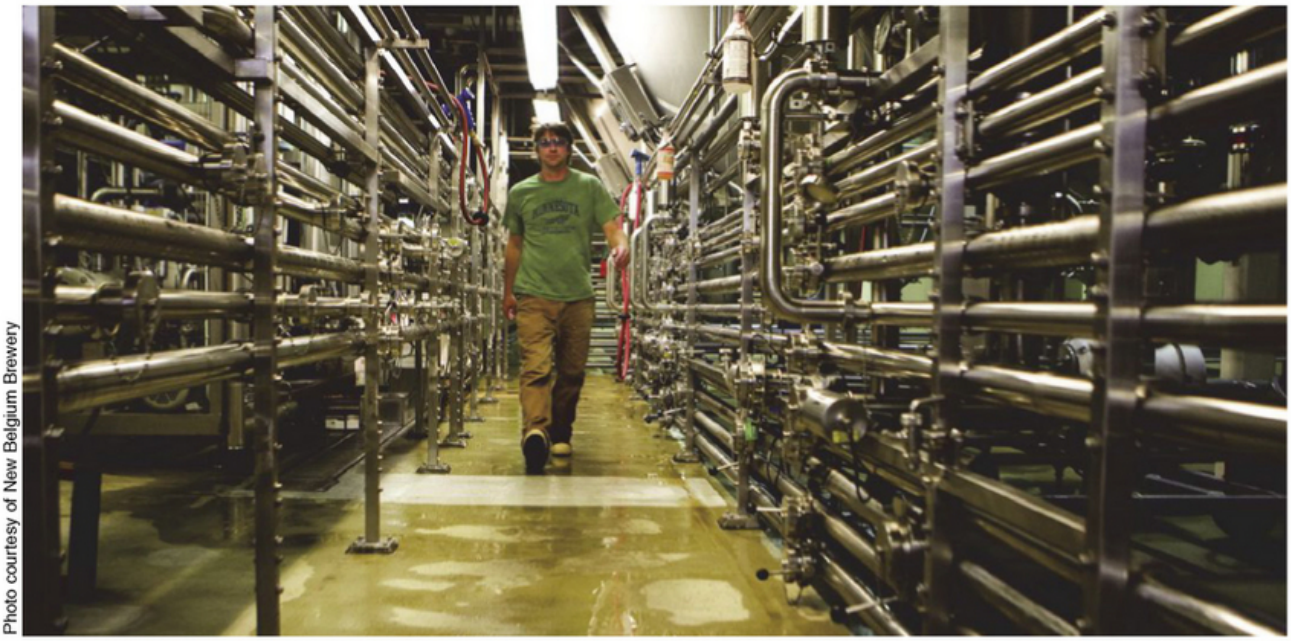


Photo courtesy of New Belgium Brewery

Metals and Stale Beer

Aluminum, copper and brass are fine when in contact with the wort before fermentation, but detrimental afterwards. In the case of copper, the ions react with the hydrogen sulfide produced during fermentation and reduce it to insoluble copper sulfide, which is left behind with the trub and yeast cake. Switching to all stainless steel brewing equipment can lead to noticeable quantities of hydrogen sulfide and sulfur off-flavors and aromas in the beer. The use of copper wort chillers will provide all the copper necessary, as will including a short piece (1 inch) of copper tubing in the boil. In fact, small amounts of most any metal (except iron) can be neutralized or removed from the wort by the yeast, assuming that the fermentation is strong.

Contact with aluminum, copper and steel after fermentation is a problem because it catalyzes staling reactions, including the production of hydrogen peroxide, the neutralization of hop aroma, and oxidize the alcohols to aldehydes. Finished beer should not be stored in contact with copper, and even the short contact time in a copper coil in a jockey box can oxidize the beer. Stainless steel tubing is better for beer quality, even though the thermal conductivity is much lower. This is why you will see most modern breweries awash in stainless steel.

with clean water and allowed to drain before storage.

Stainless Steel

Stainless steel does not have the thermal conductivity that copper or aluminum has, and scorching of wort can be a problem if the burner heating rate is too aggressive, but its cleanability is excellent. Large stainless steel pots can be quite expensive, especially if they have aluminum clad bottoms for better heat distribution. A good stainless steel brewing pot will last forever.

Stainless steels are iron alloys containing chromium and nickel. The types most commonly used in the food and beverage industry are the 200 and 300 series austenitic stainless steels. The 300 series typically contain 18% chromium and 8% nickel. The 200 series alloys use manganese instead of nickel and typically cost much less than the 300 series. They have similar corrosion resistance and machinability, and are weldable. The thermal conductivity of stainless steel is about 10 times less than aluminum.

The reason everyone likes stainless steel is the corrosion resistance and durability, but it's not perfect. The key to stainlessness is a passive oxide layer that protects the metal below from the environment. The key to creating this passive layer is getting the steel surface clean and free of contaminants. The easiest way to do this at home is to use a sponge or soft scrubby and kitchen cleanser made for cleaning stainless steel cookware. Three examples are Bar Keepers Friend, Kleen King, and Revereware Stainless Steel cleansers. The active ingredient in these cleansers is oxalic acid, and it serves the same cleaning purpose as nitric acid, which is commonly used in industry, but is too hazardous for home use. Once the surface has been cleaned to bare metal, the passive oxide layer will reform immediately. These cleansers are an effective method for repassivating stainless after cutting, grinding, soldering, or welding, and work great for cleaning copper as well.

Do not use steel wool or even a stainless steel scrubby to clean discoloration; they will cause rust. Stainless steel is not invulnerable; any breach in the oxide layer by another

Photo by Erica Michelsen

Stainless steel is very durable but not completely impervious to corrosion. Do not use steel wool or stainless steel scrubbies to clean your stainless steel as they can cause rust.

metal, or formation of non-passive oxides due to soldering or welding, can initiate corrosion, especially in the presence of chlorides.

Stainless steel plate chillers, like copper chillers, should not be stored full of water or sanitizer due to the risk of galvanic corrosion. Plate chillers should be rinsed thoroughly with clean water after cleaning and allowed to drain before storage. Blowing the chiller dry with compressed air will surely help prevent any chance of corrosion during storage.

Bio-fouling (trub deposits) and beerstone scale (calcium oxalate) can also cause corrosion. The metal underneath the deposit can become oxygen depleted via biological or chemical action and lose passivity, becoming pitted. A two-step procedure is most effective for removing beerstone. Beerstone is a combination of protein buildup and mineral deposit, so removal works best if the protein is broken up with a caustic, like sodium hydroxide or PBW™, and then the remaining lime can be dissolved by an acidic cleaner like CLR™. Do not use swimming pool (muriatic) acid to dissolve beerstone or clean stainless steel. The acid used for swimming pools is

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Comparing Homebrew Metals

Metal	Cost	Conductivity	Cleaning	Corrosion Resistance	Machining	Soldering	Welding
Aluminum	$$	good	good	good	good	poor	good
Brass	$$	good	good	good	good	good	poor
Copper	$$$$	excellent	fair	good	excellent	excellent	good
Stainless Steel	$$$	good	excellent	excellent	fair	fair	good

actually hydrochloric acid, which is very corrosive to stainless steel if left too long.

Choose Your Metals Wisely

Now that you have all the information you need, it's time to decide for yourself if you should go for the simplest choice, the cheapest choice or the "best" choice. To help you make that decision, check out the chart above for a quick side-by-side comparison of cost, conductivity, cleanability, corrosion resistance, machining, soldering and welding quality of each metal. If you are like most homebrewers, most likely you will use some combination of each of these metals in your homebrewery, depending on what will work best for your setup based on your homebrewing needs and metallurgy skills. BYO

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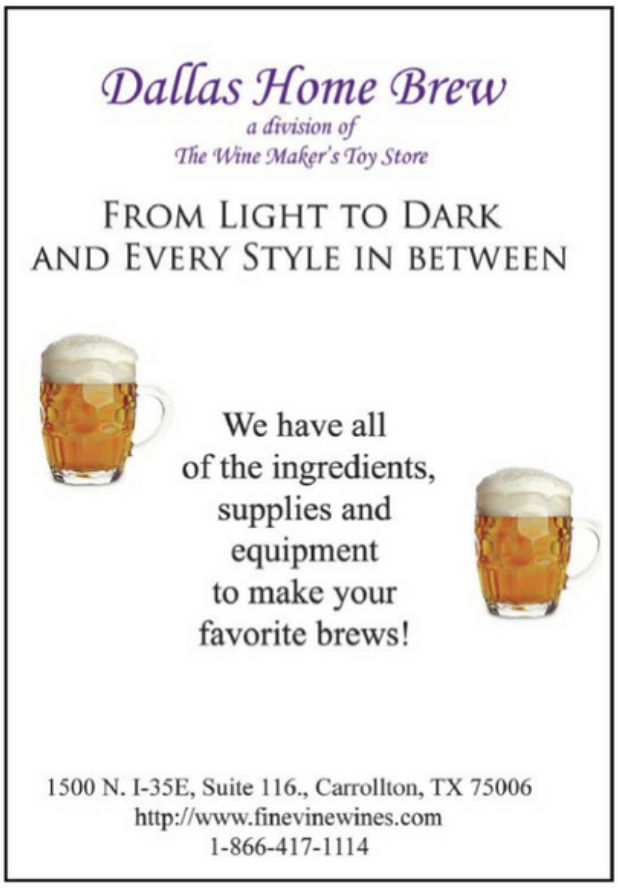


Black is Beautiful

"The daddy of all high-roast malts"

techniques
by Terry Foster

My mother's favorite phrase for a really dark place was "It's as black as Newgate's Knocker!" This derived from the infamous Newgate prison where public executions of criminals were carried out in the 18th and 19th centuries. I suppose the connection was that once you went through the door of Newgate you would soon be in eternal darkness. So what's my point you may be asking? Well, the prison sat in the City of London, which was where porter was first produced. And black malt has a close connection to porter brewing.

Black malt is in fact the daddy of all high-roast malts, being first produced in a coffee roaster by one Daniel Wheeler in 1817, and it soon found wide application as a replacement for brown malt in commercial porter and stout brewing. Wheeler actually patented the process and long after the patent expired, even into the 20th century, it was still often referred to as "patent malt." In the late 19th century, Wheeler's techniques were adapted first to produce crystal malt, and then high roasted malts of a lighter color than black, such as chocolate malt. Modern maltsters have developed the whole process still further, so that there is now a wide range of them running from a very pale color right up to deep black, but black malt itself still remains a powerful tool for the brewer.

Black malt does not always get the recognition from homebrewers that it deserves, which is a pity because it can add something to a wide range of beers; it isn't just for coloring and flavoring dry stout as many people seem to think. It is often thought that there is only one grade of black malt because in producing it the roasting temperature is taken to only just below the ignition point of the malt. And indeed, for many years it was common practice for the maltster to have a bucket of water close to hand in case things got out of hand and the malt ignited! Roasted malt production is still very much a craft, but modern maltsters are more sophisticated and knowledgeable than their predecessors and can control the process to produce a variety of black malts. Table 1, in which the information has been culled from the websites of the manufacturers, demonstrates this.

You can see that there is some variation in color of these, but not surprisingly they are all very black and will impart a black color to beer even in small amounts. Those made from de-husked barley are primarily intended for use as coloring agents, for they will give the beer a smooth roasted chocolate/coffee flavor without the astringency more common to the "regular" black malts. However, in some of these products not all the husk is removed before malting so they will still confer some astringency on beer, which is caused by roasting the husk. Briess claims that their BlackPrinz® is made from barley that bears a hull in the field but not

Table 1: A Survey of Available Black Malts

Manufacturer	Designation	Color °L
Baird	Black Malt	500-600
Crisp	Black Malt	580-630
Thomas Fawcett	Black Malt	410-500
Simpsons	Black Malt	500-600
Briess	Black Malt	500
Briess	2-Row Black Malt	500
Briess	Black Prinz®*	500
Briess	Midnight Wheat	550
Briess	Black Malted Barley Flour	500
Castle Malt	De-bittered Black*	500-600
Franco-Belges	Kiln Black	450-585
Dingemans	De-bittered Black Malt*	500-600
Paul's	Black	510-585
Muntons	Black	416-490
Weyermann	Carafa® III	488-563
Weyermann	Carafa® Special III*	488-563

* These malts are made from de-husked barley.

> "... black malts can be used in all sorts of beers, other than stouts and porters ..."

in the harvested grain, (in this respect it is similar to wheat) and will therefore offer the smoothest flavor of any black malt.

How much should you use?

As I have suggested, all these black malts can be used in all sorts of beers, other than stouts and porters, with the de-bittered types being particularly useful for more delicately flavored beers such as black lagers, mild and brown ales, and even bitter ales. The key to using black malt is the proportion used. Very small amounts, say 1 oz. (28 g) in 5 gallons (19 L), can add a background hint of roastiness without adding very much in the way of color, depending upon the base color of the beer in question. But this can work the other way too — you should not assume that you can just chuck large proportions of black malt into a beer or you will get something that tastes unpleasantly sharp and acrid.

Note that black malt yields some extract so its use will add to the beer's original gravity. The maximum yield is about 70%, or an original gravity (OG) of 1.033/lb./gallon. Using *BYO*'s usual 65% brewhouse efficiency, that equates to an OG of 1.021/lb./gallon. And, of course, black malt contains no starch, so its extract can be directly leached out with hot water and mashing is unnecessary. Therefore, it can easily be used in malt extract brewing, although remember to allow for any roasted malts that may have been used in the preparation of the extract you are using. If you are going to use a significant amount of black malt in an extract-based beer, it is generally safer to use a plain, pale extract as the base.

There are a few points I should make about Table 2. It is not meant to be exclusive and reflects my personal approach so it should not be regarded as limiting or prescriptive. Also, it may be misleading in the sense that in many cases black malt may not be used alone, but may be combined with other roast malts, such as chocolate. This is particularly true of the porters and stouts where black malt is often used in combination with brown and/or chocolate malts, or, in the case of dry stout roasted barley. In such cases you should use less black malt than I have suggested. Probably the best approach is to keep the total

weight of roasted malts at or below 10% of the total weight of grain malt. In the case of a malt extract brew the roasted malts should not exceed about 15% of the total weight of extract used. And remember that the amount of black malt you use depends upon the OG of the beer in question. Table 2 has allowed for this but if you want to depart from the standard OG for these styles you may have to decrease the amount of black malt used. The best approach in experimenting with black malt is to think small rather than big. If you don't you will produce a beer that apparently exhibits only one flavor and is very astringent!

How should black malt be used?

What I haven't discussed yet is at what stage in the brewing process black malt should be added. While this would seem to be straightforward, there are different schools of thought on this even among commercial brewers.

What is probably the most common practice for all-grain brewers is to add the black malt along with the other grains in the mash. Extract brewers would of course do a hot water steep and add the liquor from this to the rest of the water and the extract. In fact, I know of at least one English commercial brewer who practiced the steep approach, adding the liquor to the

Table 2: Suggested Black Malt Usage by Style

Beer Style	Malt	Ounces (grams) used for 5 gallons
Mild and brown ale	Black	1-4 (28–112)
Bitter ales	Black	1-2 (28-56)
Red ales	Black	2-3 (56-84)
Pale ales	De-bittered black	1-2 (28-56)
Pale lagers	De-bittered black	1-2 (28-56)
Schwarzbier	De-bittered black	2-4 (56-112)
Black IPA	De-bittered black	4-6 (112-168)
IPA	Black	2-4 (56-112)
Brown porter*	Black	3-6 (84-168)
Robust porter*	Black	5-13 (140-364)
Dry, foreign extra, American stouts*	Black	5-20 (140-560)
Russian imperial stout*	Black	15-20 (420-560)
Sweet stout	De-bittered black	3-5 (84-140)
Oatmeal stout	De-bittered black	4-8 (112-196)
Strong and old ales	Black	6-13 (168-364)
Barleywines	De-bittered black	6-19 (168-532)

* In the cases of porters and stouts these numbers assume that the only roasted grain used is black malt.

wort runoff from the mash. The idea behind this is that it results in less astringency in the final beer. Personally, I am not so sure that this is the case unless the steep temperature is lower than that of the mash, or the proportion of black malt being used is high, say 15% or more of the total malt. In any case, if you are worried about astringent flavors in the beer you can simply use one of the debittered black malts instead of the more usual type. A third approach is to add the black malt to the hot wort directly. Adding it before the boil is not recommended, simply because that may well extract astringent flavors as the boil is much hotter than the mash, or in a steep. So it is best done at the end of the boil, which requires a rest before cooling in order to extract both color and flavoring from the black malt. Optimum results are obtained if black malt flour is used; since this offers a much higher surface area per unit weight of black malt than do grains that have been merely crushed. Commercial brewers usually add this at knockout, before whirlpooling, so that the malt sits in the hot wort for at least half an hour before transfer of wort to the fermenter. They do not have to worry about carryover of this malt to the fermenter, since it will be largely contained in the dense trub formed by the action of the whirlpool. This might be a concern to the homebrewer who doesn't have a whirlpool, but I do not think it would be a problem; most of the malt will still stay with the trub, and what doesn't will have little or no effect on beer flavor and will settle out with the yeast at the end of fermentation.

My own approach is the simple one — in the mash for all-grain and steep separately for extract beers, and I do not normally find astringency noticeable in the resultant beer. Perhaps that is because I tend to work at the lower levels given in Table 2 in most cases. Even in brewing one of the stout family of beers I tend to use a mix of roast malts, such as black plus chocolate plus brown, especially in the bigger styles such as Imperial stout. Only in dry stout would I go for black malt alone, and then that's usually in combination with roasted barley.

Summary

Black malt is much more than a single product and can be used in a variety of ways and in a variety of beers. Think about using it in everything from Pilsners and bitters to black IPAs and imperial stouts, and let black malt help you produce your own brewing masterpiece. Now, I certainly hope that's the last time I use such an oxymoronic term as "black IPA."

Examples:

Here are the recipes for two stouts, both of historical significance, to emphasize for you the proportion of malts they use. The first is from the 18th century, the second is from the 19th century. Both were brewed commercially in London, but the second was obviously intended to match the product of a certain Irish brewer.

Bankside Brown Stout

(5 gallons/19 L, all-grain)

OG = 1.109 FG = 1.040
IBU = 100+ SRM = 87 ABV = 9.2%

Ingredients:

13 lbs. (5.9 kg) Briess 2-row pale malt (2 °L)
6.5 lbs. (3 kg) Crisp brown malt (65 °L)
3 lbs. (1.4 kg) Crisp amber malt (27 °L)
1 lb. (0.45 kg) Crisp black malt (600 °L)
36 AAU Columbus hops (90 min.) (3 oz./85 g at 12% alpha acids)
White Labs WLP007 (Dry English Ale) or Wyeast 1098 (British Ale) yeast (3 packs as 2 quart/1.9 L starter)

Step by Step

This is a single-infusion mash. Mix the crushed grains with 29 quarts (27 L) strike water to stabilize at 150 °F (66 °C). This is a 90-minute boil so be sure to collect at least 6.5 gallons (25 L) wort in your kettle to accommodate the extra evaporation. Add hops as the wort reaches a boil. After 90 minutes, cool wort to 68 °F (20 °C) and pitch yeast. Ferment at 68 °F (20 °C) and allow to condition for at least one month prior to bottling or kegging.

Dublin Stout

(5 gallons/19 L, extract with grains)

OG = 1.085 FG = 1.026
IBU = 83 SRM = 45 ABV = 7.6%

Ingredients

12 lbs. (5.4 kg) pale malt syrup (10 °L)
0.75 lb. (0.34 kg) black malt (550 °L)
23 AAU Target hops (90 mins.) (2.3 oz./65 g at 10% alpha acids)
White Labs WLP004 (Irish Ale) or Wyeast 1084 (Irish Ale) yeast (2 packs as 1.5 quart/1.4 L starter)

Step by Step

Steep the crushed black malt in 2 quarts (1.9 L) water at 150-160 °F (66-71 °C) for 20 minutes. Wash the grain bag with 2 quarts (1.9 L) hot water and top off kettle. This is a 90-minute boil so if you are doing a full wort boil, be sure to top off to at least 6.5 gallons (25 L) wort in your kettle to accommodate extra evaporation. Before reaching a boil, remove your kettle from heat and stir in the malt syrup. Be sure to stir until fully dissolved and return to heat. Add hops as the wort reaches a boil. After 90 minutes, cool wort to 68 °F (20 °C) and pitch yeast. Ferment at 68 °F (20 °C) and allow to condition for at least one month prior to bottling or kegging. BYO

Maillard Reactions

The origin of deliciousness

advanced brewing
by Chris Bible

Beer contains hundreds of different compounds that interact with our human senses to create the appearance, mouthfeel, aromas and flavors that we experience and enjoy. The compounds that are contained within beer are either derived directly from the raw materials used to produce the beer, or are the result of the malting and brewing process acting upon those raw materials (see Figure 1, below).

Many important compounds found in beer are produced only during the brewing process. Compounds in this category include everything from mashing-derived dextrins, to boiling-derived iso-acids, to fermentation-derived alcohols, esters and phenolic compounds. Other compounds in this category include chemical species that are derived only from the "hottest" activities associated with the malting and brewing process. At the higher temperatures experienced during malt-kilning and wort boiling, a specific group of chemical reactions known as the Maillard reactions can occur.

The Maillard reactions

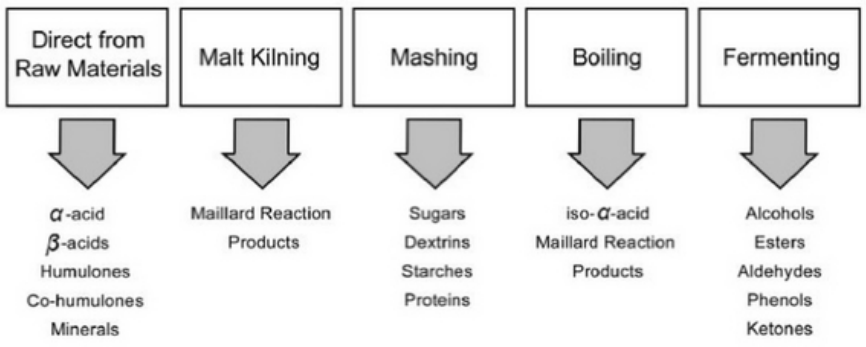
The Maillard reaction is named after the chemist Louis-Camille Maillard, who is credited as the first person to describe these kinds of chemical reactions. The Maillard reactions that occur within the malting and brewing process during malt-kilning and wort boiling are a type of non-enzymatic browning that results from a chemical reaction between a reducing sugar and an amino acid, protein, peptide or amine in the presence of an appropriate amount of heat. With appropriate temperature conditions, the reactive carbonyl groups (aldehyde or keto) within a sugar molecule can react with the nucleophilic groups (amine, sulfhydryl, hydroxyl or imidazole) within an amino acid molecule to form a complex mixture of reactant products. These products are comprised of the myriad molecules that are responsible for the colors, flavors and aromas associated with "browning." Additionally, many of these reaction products can undergo decomposition reactions to form still more flavor and aroma compounds, or polymerization reactions to form additional color-active compounds that are associated with "browning."

The details regarding the specific color, flavor and aroma compounds that are produced during a specific Maillard reaction depend upon the amino acid species, the sugar species, and the specific nature of their reaction. Since there are many different ways that a particular amino acid can react with a particular sugar via the Maillard reaction, there are many, many possible reaction products. Figure 2, on page 90, shows the carbonyl groups within sugars and the nucleophilic groups within amino acids that can be involved in the Maillard reactions. Figure 3 on page 91, provides an illustration of the major Maillard reaction pathways.

> "Many important compounds found in beer are produced only during the brewing process."

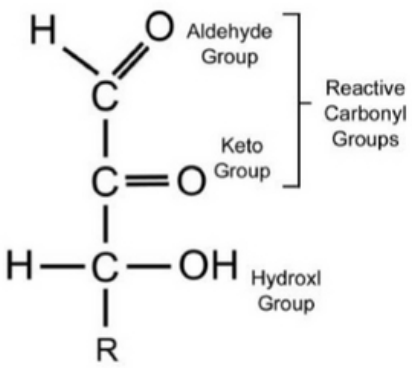
The rate and extent of the Maillard reactions is affected by temperature and pH. Increasing temperature increases the rate of the Maillard reactions. Temperature-time heating profiles also play a role in the extent

Figure 1: Origin of Some Important Flavor and Aroma Compounds

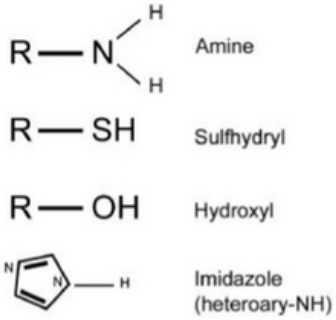


Illustrations by Chris Champine

Figure 2: Carbonyl Groups Within Sugars and Nucleophilic Groups Within Amino Acids



Sugar



Nucleophilic Groups in Amino Acids

to which higher molecular weight colorant compounds are produced via the Maillard reactions. Higher temperatures, to a point, favor the production of higher molecular weight species.

The Maillard reactions are also accelerated in an alkaline pH environment. This is because the nucleophilicity of the appropriate functional groups within an amino acid molecule is increased as the amino acid molecule becomes more and more deprotonated with increasing pH. Additionally, pH influences preferred reaction pathways is such a way that melanoidin production via Maillard reactions increases with increasing pH, up to a pH of about 9.

There is another distinct category of reactions that can cause browning and changes in flavor and aroma. Carmelization reactions can cause browning and flavor and aroma changes that are often perceived to be similar to the changes caused by Maillard reactions, but carmelization reactions are entirely different. Carmelization occurs when sugars undergo thermochemical decomposition (pyrolysis) at elevated temperature conditions. In contrast, the Maillard reactions always involve reactions between a sugar and an amino acid, protein, peptide or amine.

Maillard reactions associated with the malting and brewing process occur primarily during the kilning of malt and during the wort boiling process. Products of the

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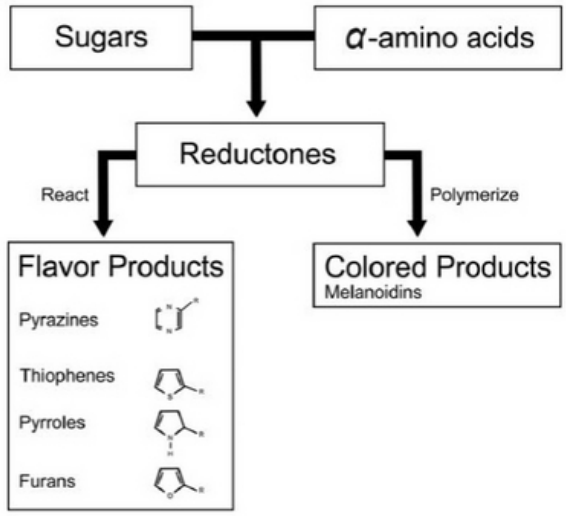
Maillard reaction influence the color, flavor and aroma of the finished beer. Melanoidins produced by the Maillard reaction produce color compounds that darken beer. Additionally, melanoidins and other compounds produce flavors in beer that are often described as toasty, malty, carmel, bready and roasted.

A brewer can control the amount and types of Maillard-derived reaction compounds that are in beer by selecting appropriate types and amounts of kilned malted barley in beer recipes. Using more and darker malts will increase the content of Maillard reaction products in beer and will produce a darker beer with more toasty, roasted aroma and flavor.

A brewer can also influence melanoidin content in beer by using decoction mashing techniques. Decoction mashing involves removing a portion of the grain from the main mash, then boiling them and returning them to the main mash. Boiling the grains causes Maillard reactions to occur and generates the melanoidins that can create a rich, malty flavor.

Another way that a brewer can influence the amount of Maillard reaction products in beer is by changing the duration of the boil. Longer boiling times lead to increased production of Maillard reaction products and can result in a darker, richer tasting beer. The downside to using boiling time to increase Maillard reaction products is that the Maillard reactions happening in the boiling vessel are reducing the amount amino acids and peptides in the wort. Reducing the amount of amino acids and peptides in the wort is not a bad thing, but the brewer should weigh using this technique against the need for free amino nitrogen (FAN) by the yeast, and any potential loss in the body and mouthfeel of the beer to the diminished protein content. BYO

Figure 3: Primary Maillard Reaction Pathways



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Serving Cask Ale

(Vertical) from a kegerator

by Christian Lavender

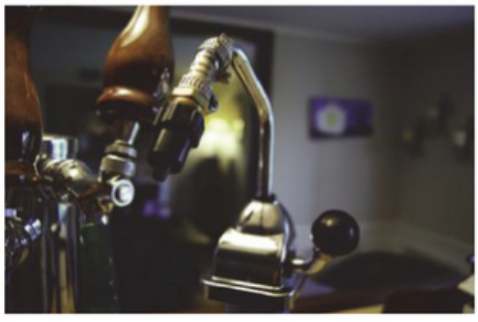
Serving homebrew from kegs has always seemed advantageous to me. In all reality, kegging may not save me money, time or storage space, but there's something almost magical about pulling a tap handle and serving a beer I made straight from the keg. Sorry bottles, you may not want to read any further.

As homebrewers, we are always striving to make and serve the highest quality beers. To me, cask-conditioned ales are some of the most special of all the "kegged" beers. Conditioning beer in casks produces some of the freshest and brightest tastes and aromas in homebrew imaginable. So how can we get those flavors running through a kegerator's tap without jeopardizing the integrity of what a cask beer should be? Sorry Campaign for Real Ale (CAMRA) advocates, you may not want to read any further.

If you are looking for small handcrafted kegs of beer, consider trying cask ales. The main difference you will find between cask-conditioned ales and regular beer is that cask ale is alive — it is never pasteurized and it is self-carbonated during secondary fermentation. As a result, cask ale is served with either a gravity feed or a hand pump instead of a CO_2 tank.

> "As homebrewers, we are always striving to make and serve the highest quality beers."

There are many homebrew shops that sell complete beer engine serving systems with pin or firkin casks, but this equipment can be expensive for the average homebrewer. As a way of tiptoeing into experimenting with cask beers, why not take advantage of some equipment you may already have lying around? For kegerator enthusiasts that want to take draft homebrew to the next level, converting your kegerator into a cask ale dispenser is a challenging, yet rewarding project. (For a complete rundown on the process of brewing and serving traditional cask-conditioned beer for homebrewers, read "Homebrewing Cask Ales" by Dave Louw in the July-August 2012 issue of *Brew Your Own*, and check out "Enjoy the Real Thing: Cask-Conditioned Ale " by Sal Emma in the May 1997 issue of *BYO* by visiting http://byo.com/story594.)



Parts & Tools

(1) 5-gallon (19-L) Corney keg

For the Adjustable Pressure Relief Valve

- Control devices pressure relief valve # CR25-100
- WIKA pressure gauge 0-30psi (back mount) # 4302028
- Forney brass tee ¼-inch female NPT # 75363
- Camco ¼-inch male NPT x ¼-inch female inverted flare # 59953
- Ball lock gas disconnect, ¼-inch male flared

For the LPG Breather

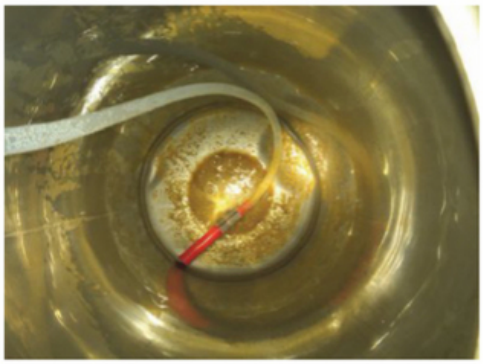
- Low-pressure LPG regulator ¼-inch inlets
- (2) ¼-inch flare x ¼-inch NPT male
- (3) barbed swivel nut, ¼-inch flare, 5/16-inch barb
- 2-4 feet (61-122 cm) 5/16-inch vinyl I.D. hose
- Ball lock gas disconnect, ¼-inch flared

For the Beer Engine

- Valterra RP800 Chrome Rocket Hand Pump
- Anderson metal ⅜-inch NPT male x ⅜-inch hose barb
- (2) extra small stainless steel hose clamp
- 2 feet (61 cm) of ⅜-inch I.D. clear vinyl tubing
- Sparkler nozzle

1. KEG MODIFICATIONS

I've seen some mock cask ale setups using homebrew "soda" kegs. The keg is laid on its side with the long-sided dip tube on the top and the short side on the bottom. The gas post is fitted on the side with the long-sided dip tube. The long side of the dip tube is bent upwards to reach an air pocket. This configuration mimics a cask lying on its side and is closer to how an actual cask sits. The secondary fermentation trub is dispersed along the bottom of the keg and air is vented off periodically. The keg is left in this horizontal position and connected to a beer engine on the bottom post and the top post is fitted with a simple venting line for breathing and air displacement. If you have a keezer you might have enough room to lay your kegs on their side. For those who have a smaller kegerator with less space inside, we need to design an upright keg cask. We need to be able to dispense the cask in a vertical position, but still use natural carbonation, venting and a beer engine. So, some small modifications are necessary.



2. MODIFY YOUR KEG

One way to modify a keg is to use a floating filter on the end of a tube called a CaskWidge. Not a lot of modification (cutting, drilling, etc.) is necessary to serve real ales upright in homebrew kegs if you use a CaskWidge. The CaskWidge attaches to a short-sided dip tube (gas side) with a floating filter attached to the end that draws beer from near the top of the keg and follows the beer down as the beer is drawn out. This will run you about $35 online, so you may choose an alternate method. My alternate method is to just shorten the dip tube 3-4 inches (8-10 cm) depending on how much trub you normally gather at the bottom of your keg and curve it upwards or to the side. This is a minor modification that will allow you to draw beer out and leave behind the trub that has settled at the bottom of the keg.

3. LPG BREATHER

Next, you will need to create a breather that will allow you to keep a CO_2 blanket on your beer as it is being drawn out via the beer engine. You can purchase a cask aspirator valve, but you might already have these parts (listed on page 93) lying around. The CO_2 should only be turned on during dispensation to allow a low level of gas to displace the liquid that is drawn out. Traditionally, soft spiles are used in casks that have holes by which air normally enters the cask as the beer is dispensed. They are replaced by hard spiles (which allow no air through) after each drinking session. Because your homebrew may not go as fast as a commercial cask, we need to make sure the cask beer doesn't go bad too quickly. To do this we use an LPG low-pressure gas regulator (1 psi) hooked to a CO_2 tank to keep a blanket of CO_2 on top of the beer. CAMRA does not endorse this method, but know this does not add to the beer's carbonation level or assist in the delivery to the glass.

4. ADJUSTABLE PRESSURE RELIEF VALVE

After you rack your beer into a secondary keg, attaching a spunding valve or adjustable pressure relief valve will allow you to control the CO_2 pressure inside the keg as it winds down fermentation. The beer will naturally carbonate itself to whatever pressure you set the valve. You can purchase these already assembled from most homebrew shops or you can build one yourself. See the parts and tools list on page 93 for what you need.

You will need to wrap the threads of each part with Teflon tape for assembly. Mount the pressure relief valve to the left side of the tee connector. Next, screw the pressure gauge into the top side of the tee connector. The inverted flare fitting's male threaded side will screw into the right side of the tee allowing you to screw the ball lock to the inverted flare side to complete the assembly.

5. DIY BEER ENGINE

Traditionally cask ales are either kept in a cellar or slightly refrigerated while the beer is siphoned off using a hand pump called a beer engine. The beer engine is an airtight piston with a ½- or ¼-pint chamber. When the beer engine's handle is pulled down, this raises the piston. The subsequent vacuum pulls the beer out of the cask and into the glass. If you are drawing beer from a cask that is not newly tapped, you will usually have to draw and throw away the first pint of the night. This is because the beer goes stale in the beer engine lines. You can build the beer engine from the parts listed on page 93.

To put the beer engine together you need to slip the clear vinyl tubing over the end of the hand pump faucet and fasten it in place with a hose clamp. (You may need to put the tube in hot water for a few minutes to soften the rubber. This will allow some stretch in the tube for an easier slip on over the faucet neck.) Next, push the hose barb fitting into the other end of the vinyl tube and fasten down with the other hose clamp. Finally, use some Teflon tape on the sparkler threads and screw it on to the male threaded side of the hose barb fitting.

6. START PUMPING

Photo courtesy of Northern Brewer

When dealing with cask ales, it is important to realize the many steps that need to be taken to keep the cask ale fresh and free of souring. First, you must let the ale become properly conditioned before you serve it. By letting it settle with an adjustable pressure relief valve (spunding valve) you allow the sediment to settle to the bottom of the keg. Normally, the process for tapping a cask ale is far more time-consuming than a regular keg of beer, and demands attention to detail, but this kegerator-style cask makes the whole process a bit easier. BYO

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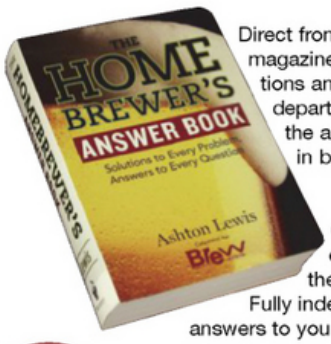

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last call
by Christopher McGowan

Kick the Keg Night

Club helps marathon bombing victims

Last year, I built a portable 10-tap bar to be used at my wedding. My wife-to-be and I decided it would be smart to give it a test run before the wedding, just to make sure there were no leaks or other problems in the system. So we turned to our brew club, The North Shore Brewers, based in northeastern Massachusetts about half an hour north of Boston, and suggested a "Kick the Keg Night," where any member could come over with a keg of homebrew, hook it up to our bar, and the club would help them kick that keg. The idea was that you could finally get rid of that keg that's been sitting around but doesn't ever seem to run out, and at the same time; we could test out the new bar.

It turned out to be a huge success, many kegs were kicked, and we were able to fully test the system. In fact, it was so much fun we decided to make it an annual event.

We were planning this year's Kick the Keg Night around the time of the Boston Marathon. The tragedy of the bombings affected us all very deeply. Many of our club members either knew somebody there, had a friend of a friend in the hospital, or had another connection along those lines. We were all glued to the television as the dramatic events of the next few days unfolded and our hearts and minds were with the victims.

The city of Boston created the One Fund to accept and distribute donations to the victims to help cover their medical expenses, and the club decided that we should do something as a group to help those affected too. The best way, we decided, would be to expand Kick the Keg Night into a daylong fundraiser for the One Fund.

So in August, we rented a function hall on Winter Island in Salem, Massachusetts and invited members and their guests to attend for a day full of homebrew-related events and tastings. We asked for a small donation for attendance and sold raffle tickets for prizes generously provided by local and national brew-related businesses with all of the proceeds going to the One Fund.

The day started with a "Build Camp" where we each built a chalkboard tap handle. After the power tools were put away, we wheeled in the bar and hooked up the kegs. We had 14 kegs this year, and people were able to taste the beers and talk with the homebrewer who made each beer they were trying. There was a great variety too: IPAs, witbiers, Irish reds, porters, cider, a Berliner weiss and even a beer made with peanut butter and bananas that we were calling the "Elvis."

We also had talks on yeast propagation and storage by one of our members who works in this area, tasted experimental brews that used new hop varieties, and there was even a "Winemaking 101" session put on by one of our members who is also a very skilled winemaker.

Throughout the day, we sold raffle tickets, t-shirts and glasses, and we held an informal "Peoples' Choice" competition. Of course, when we tallied the competition votes, we had a 3-way tie!

There was a break for dinner and while we got the grill going, we played a few games and generally enjoyed a sunny, 80 °F (27 °C) summer day on an island with good homebrew. After dinner we began raffling off the prizes including a complete starter kit (which was fittingly won by a member whose son is interested in getting back into the hobby), a conical fermenter, brewing software, and a *Brew Your Own* magazine subscription.

After the raffles were done, it was back to kicking kegs and enjoying each other's beers. At the end of the day, we raised $750 for the One Fund and gained a few new members. There are already talks about doing it again next year. BYO

> "We had 14 kegs this year, and people were able to taste the beers and talk with the homebrewer who made each beer they were trying."

Photo courtesy of Leslie Mosley

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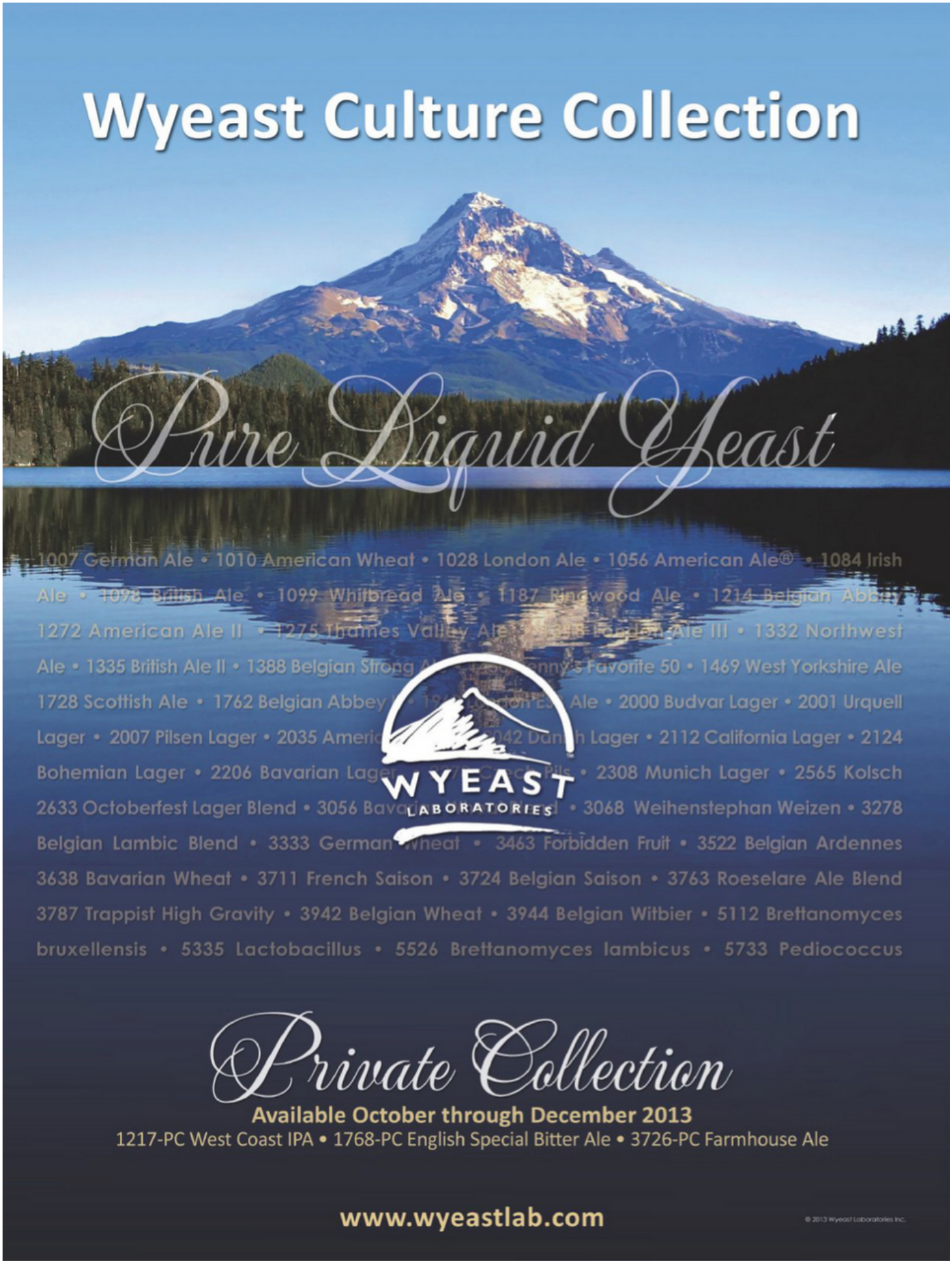
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