PUCKER UP! BREWING IMPERIAL IPA & HOP HARVEST UPDATE

Brew Your Own

THE HOW-TO HOMEBREW BEER MAGAZINE

NOVEMBER 2008, VOL.14, NO.7

PROJECTS ON TAP

build your own kegerator, multi-tap bar and rolling draft system

priming primer for perfect carbonation

homemade brew systems photos

building a recirculated mash home brewery

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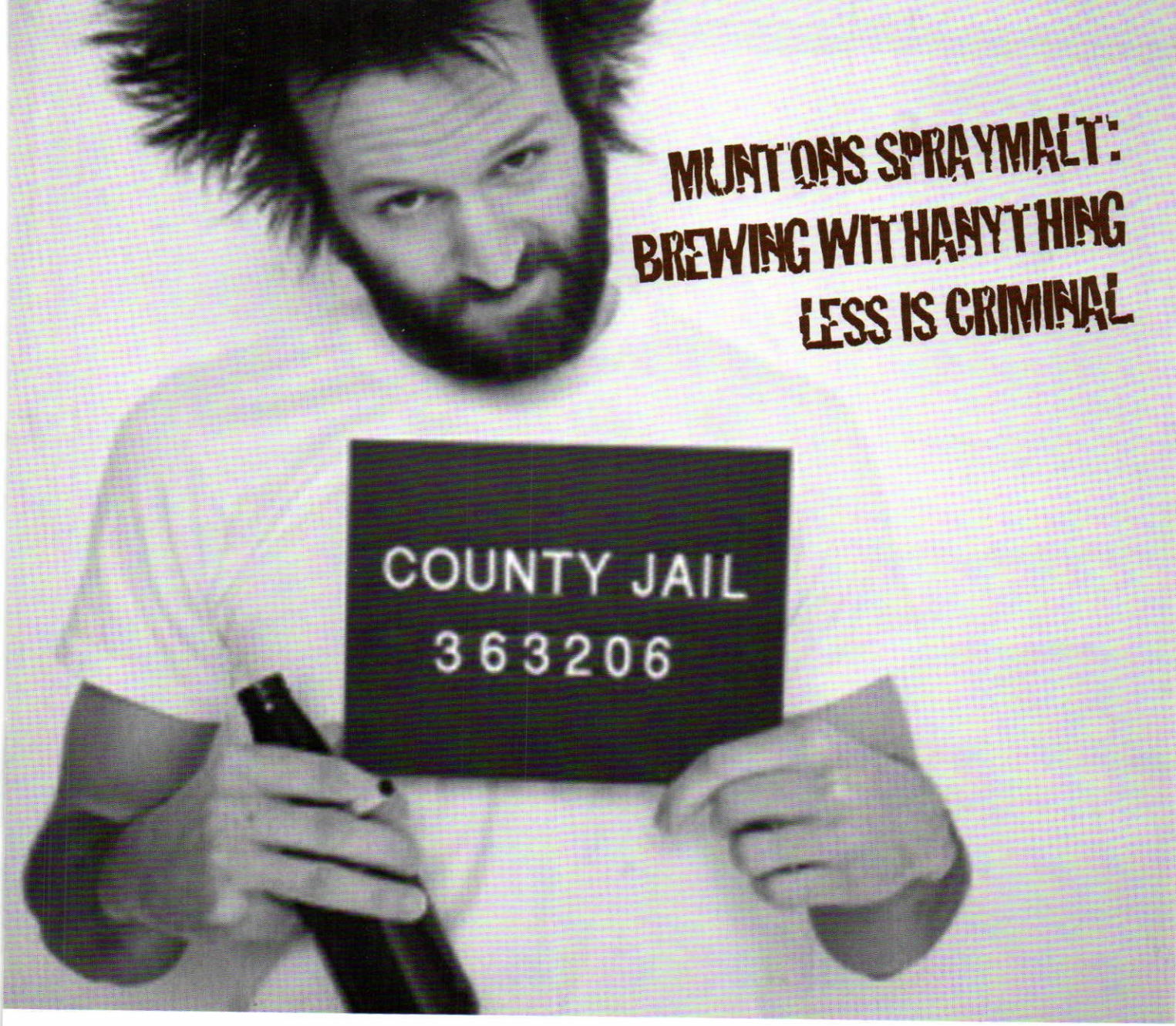
making sake at home
hybrid beer styles



SPRAYMALT
for better beer

- SPRAYMALT IS MADE ONLY FROM THE FINEST ENGLISH 2-ROW BARLEY MALT
- DELICATELY SPRAY DRIED EXTRACT FOR TASTE AND CONVENIENCE
- CHOICE - FROM THE LIGHTEST TO DARKEST, HOPPED AND UNHOPPED
- TRACEABILITY - FROM FIELD TO GLASS
- CONSISTENCY - MUNTONS QUALITY, EVERY TIME

Extra Light

Adds extra body and richness. Especially useful when brewing American Style Beers and Light Lagers.

Light

Great for all beer styles. Adds extra body and richness. Especially useful when brewing lighter beers such as lagers and pilsners.

Hopped Light

Adds extra hops as well as more malt. Perfect as a general kit improver - specially designed to retain the beer's natural balance.

Wheat

Great for all traditional wheat beer styles. Adds extra body and richness. Especially useful when brewing German Style Wheat Beers and as an aid to head retention in normal beer styles.

Medium

Rich malt flavour, ideal for bitters. Boosts the beer's natural body and results in a more rounded, mellow note to the final brew.

Dark

A superb addition to any Brown or Mild Ale. Dark Spraymalt will improve the body, adding extra rich malt flavour and natural color.

Extra Dark

A quality supplement for Stouts and Porters. Extra Dark improves body and adds natural color.

Spraymalt is available from specialist wholesalers: Crosby & Baker Ltd, LD Carlson Ltd, Brewcraft USA

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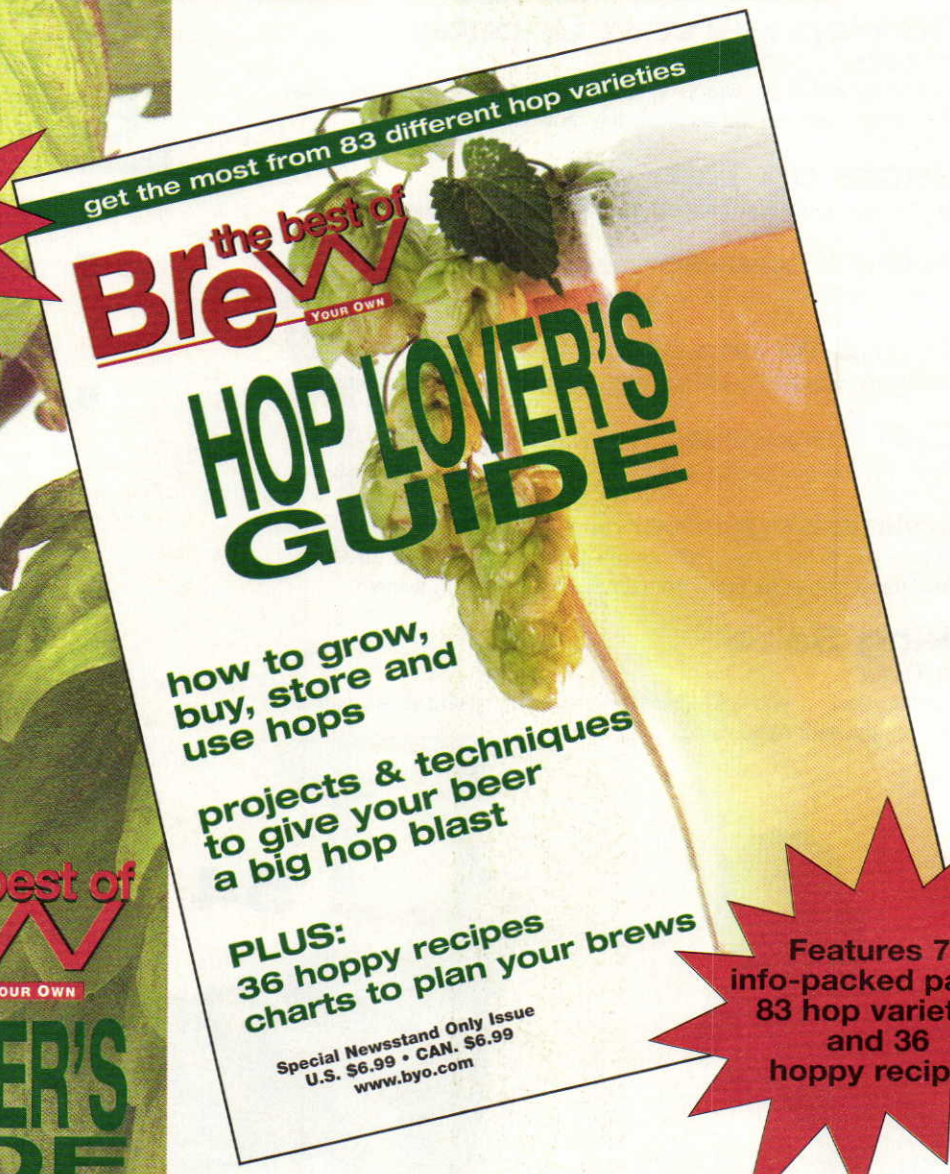
NEW!



the best of Brew Your Own
HOP LOVER'S GUIDE

Features 72 info-packed pages, 83 hop varieties and 36 hoppy recipes

We've collected and updated the best hops information from the past 12 years of *BYO* and included updated charts with the specs for 83 hop varieties including new varieties and suggested substitutions for hard-to-find hops. We've also detailed different hopping methods, hop growing info, hop-related build-it projects and 36 hoppy recipes. A few of the reasons you will love this new reference...

- Hopping methods for extract & all-grain brewers to get the most out of their hops
- Comprehensive charts for selecting the best hops or a substitute for a hard-to-find variety
- Backyard hop growing instructions

At just $6.99 retail, you won't find a hop information source as complete at such a value!

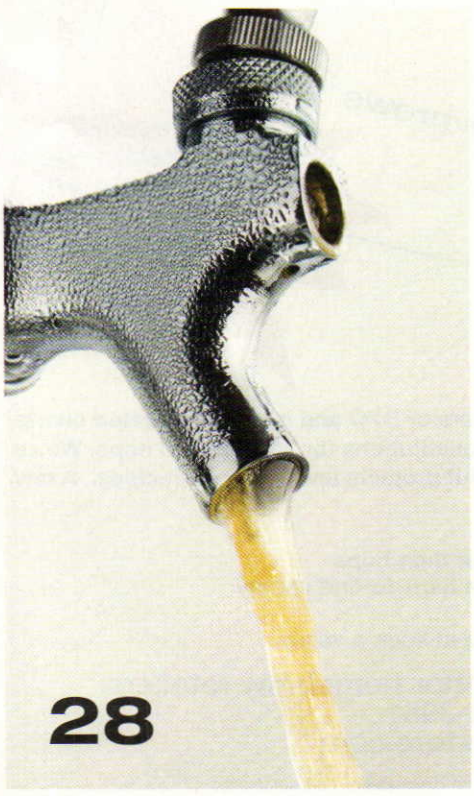
This special newsstand only issue is available at better homebrew retailers or order today by calling 802-362-3981 also available online at brewyourownstore.com

* Attention homebrew supply shop owners - call us today at 802-362-3981 to discuss volume discounts to resell the **Hop Lover's Guide** in your shop.

Brew Your Own
THE HOW-TO HOMEBREW BEER MAGAZINE

NOVEMBER 2008
Volume 14 Number 7

Features



Departments

Where to find it

How well do you really know your beer?

Graduate From "Beer Know-It-All" To Really Knowing It All.

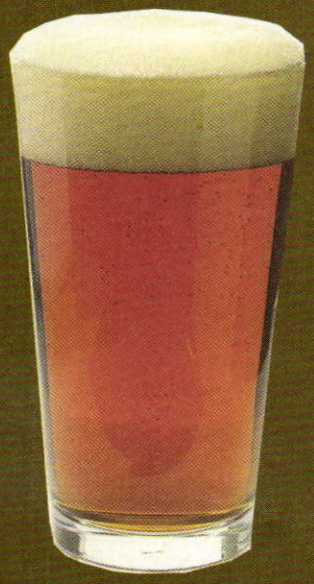
What's the difference between Saaz hops and Hallertau hops? What impact did the Bavarian purity law have on the evolution of brewing? Why is an American lager the best beer to drink when you're eating a spicy Thai dish? Beer novice or beer expert, there's still plenty to learn from ***The Beer Connoisseur*** on **herestobeer.com**. Educating you on such topics as the brewing process, beer and food pairings, the ingredients that go into beer, and the role of each ingredient in determining a beer's flavor, ***The Beer Connoisseur*** wants you to understand and appreciate beer like you never thought possible. Give it a try and find out for yourself why to know beer is to love beer.

Experience ***The Beer Connoisseur*** at

herestobeer.com

RECIPE INDEX

Page



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.

Brew Your Own
THE HOW-TO HOMEBREW BEER MAGAZINE

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Cover Photo: **Charles A. Parker**

Mail

A Green Brewer

In keeping with your brewing green theme, I thought I'd let you know what I did with the dip tube from my keg conversion. Tired of burning my arm while reaching into my new keggle to stir my wort, I fit a stainless kitchen spoon into the dip tube and hammered them together. Not only am I guaranteed a long enough spoon, but a cool arm as well. I've also notched the spoon and tube to measure the volume of the keg's contents. Keep up the green brewing.

Dave Galloway
via email

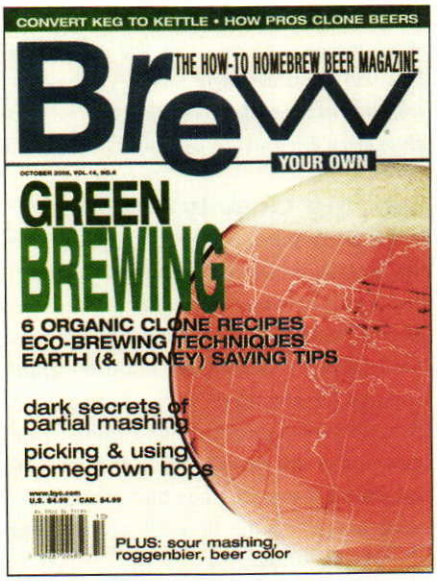
For many homebrewers, a big part of brewing is adapting "regular" items to a brewing task. It's good to see that even brewing items can be repurposed for other brewing tasks.

A Brewer Who Is, Perhaps, Not So Green

Drink water from the tap if you want to be green. Using water and putting it down the drain will not hurt anyone or anything other than your wallet. The earth's water vapor cycle will recycle all the water you use. And don't get me started on organic products. We enjoy an unprecedented standard of living and health because of drugs, chemicals and radiation. We could go back to the fifty's where the townies would come and get raw milk from my father's dairy tank. They took a chance on several different strains of bacteria. Hey, you can't get that part of the cow sterile before you put the milking machine on the teats.

Philip McCurdy
Phoenix, Arizona

Editor Chris Colby responds, "The Earth's water cycle (sometimes called the hydrologic cycle) describes the evaporation of water from aboveground sources (oceans, lakes, rivers, etc.), the condensation of this water vapor in the atmosphere and its return to the Earth's surface as rain. (Water also sublimes off snow and ice and enters the atmosphere as water vapor as well.) Although all the water you use will eventually return to Earth as rain, there's no guarantee that that rain will fall anywhere near you. For homebrewers who live in areas affected by drought, their water is more likely to fall on the heads of homebrewers in rainforests or on those who are experiencing flooding. Water from your tap is also treated at your municipal water plant and the water going down your sewer will be treated at a wastewater facility. Therefore, conserving water is a good idea for environmentally-conscious brewers. (And, as you mention, water costs money.)



"As for organic products, it can't be denied that some of their appeal has a Luddite cast to it. Some people don't like 'chemicals' in their food despite the fact that everything we eat — and every beer we drink — is composed of chemicals. Likewise, some are afraid of genetically engineered foods, even though the genomes of all crop species have been 'engineered' by selective breeding and, in the case of most major crops, hybridization.

"In the 1940s, farmers started using a combination of irrigation, synthetic nitrogen fertilizers, pesticides, herbicides and crop varieties bred for high yield and disease resistance. Ironically, in this context, this was called the Green Revolution.

"The Green Revolution transformed countries, such as Mexico, that were net importers of food into net exporters of food and stopped famine in countries that historically were prone to it. India, for example, has not experienced famine since the Green Revolution. (These days, when famine occurs on Earth, the reasons are political, not due to lack of food production.) Most experts attribute the fact that the planet is currently sustaining 6.7 billion human beings to the high-yield agricultural practices of the Green Revolution. Critics of organic farming point out that a return to low-yield agriculture would require widespread habitat destruction to make room for farms to feed the world's population. Also, organic farming gets some of its nitrogen from cattle manure and a large increase in the scope of organic farming would also

Contributors

KEVIN MATTIE is a financial analyst living in St. Louis, Missouri. He is married with four daughters and has been homebrewing for several years. Most weekends he can be found in his brewshop assembling next week's recipe, inventorying hops or cleaning equipment. Living in the same town as "The King of Beers," Mattie is intent on exposing as many people as possible to quality homebrew and opening their minds to the world of craft beers. In this issue, Kevin explains how to build a rolling kegerator on page 48.

BOB TAYLOR is a full-time daddy who also runs a computer repair business out of his home in Anchorage, Alaska. In addition to his homebrewing hobby, Bob is passionate about making sake. In fact, he put up a Web site (http://www.taylor-madeak.org) about making sake because he felt there just weren't any good online guides that teach people how to make sake at home — until now. Read his story about how to make your own sake on page 54.

TONY PROFERA currently lives and works in Charlotte, North Carolina and is a web developer by trade. He's been homebrewing since 1994 and has been mead making for the past five years. His favorite beer styles include IPAs, stouts, porters and most Belgian styles.

A long time member of the Carolina BrewMasters homebrew club (www.carolinabrewmasters.com), Tony regularly volunteers to help at the Charlotte Oktoberfest Beer Festival, and generously shared his plans for building the club's traveling kegerator with BYO for this issue. Check out the project on page 40.

necessitate an increase in the amount of land devoted to cattle grazing.

"Organic farming relies on crop rotation, compost, manure, 'green manure' (crops that actually add nitrogen to the soil) and biological pest control for food production. Organic enthusiasts point out that organic farming is easier on the soil, reduces erosion and favors biodiversity. (Organic cultivation methods are also very popular with North American and European gardeners.)

"Some people who favor organic foods do not fear chemicals or genetic engineering, they simply prefer food that is not laced with pesticide residue and is free of exogenous hormones or antibiotics. In addition, the high yields, disease resistance and transportability of today's crops usually come at the expense of flavor. If you've ever tasted a garden-grown heirloom tomato side by side with a supermarket tomato, the difference is remarkable. The reliance on a few high-yielding plant varieties has also reduced the diversity within crop species and many organic farms specialize in cultivars of plants that are not grown on non-organic farms.

"Finally, of course, some people simply want to do things they see as helping the planet. Brew Your Own is a homebrewing magazine. We're happy to occasionally kill some space on our Mail page — er, I mean address in a serious and balanced manner an interesting and newsworthy topic that affects our world today — but we are content to let our readers 'brew their own' opinions about green living and organic farming."

Defying Gravity?

In the September issue, the article "Save the Wort!" shows the pickup tube tilted downward into the kettle below the level of the bulkhead assembly. It also says "we're going to effectively lower the pipe opening to get more wort." Unless wort acts differently from other liquids, that assumes it can flow uphill. If the level of the wort is lower than any part of the bulkhead assembly, the flow will stop unless you tilt the kettle.

Mike Behrendt
via email

Wort acts just like other liquids and can, in fact, flow uphill under certain circumstances. If you have two vessels and you are siphoning liquid from one to the other, with the siphon tube extending from the bottom of one vessel to the bottom of the other, liquid in the siphon tube can temporarily move uphill as long as the level of liquid in the receiving vessel is lower than the level in the vessel being drained. Homebrewers see this everyday when they use a racking cane to drain liquid from a carboy or bucket. The pickup tube in the kettle works the same way — if there is a tube extending to the bottom of your fermenter, wort will travel up the pickup tube for a short period.

Questions, concerns, comments?

Contact us!

Brew Your Own — The How-To Homebrew Beer Magazine

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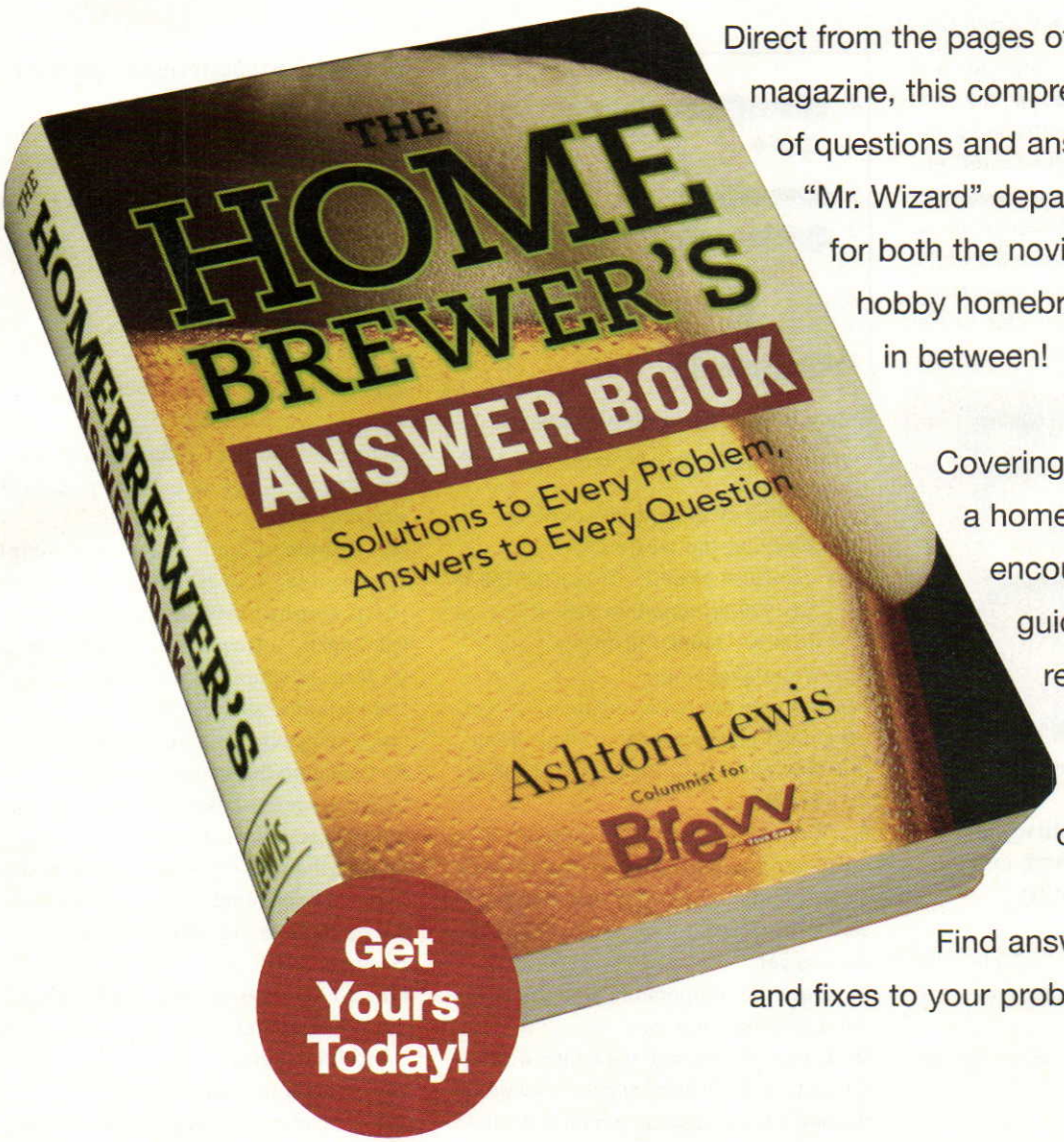
GOT BREWING QUESTIONS?

The Homebrewer's Answer Book



Direct from the pages of *Brew Your Own* magazine, this comprehensive collection of questions and answers from our popular "Mr. Wizard" department offers advice for both the novice and the advanced hobby homebrewer – and everyone in between!

Covering nearly every situation a homebrewer could encounter, this 432-page guide is the perfect reference for any amateur brewer. Fully indexed and organized by themes.

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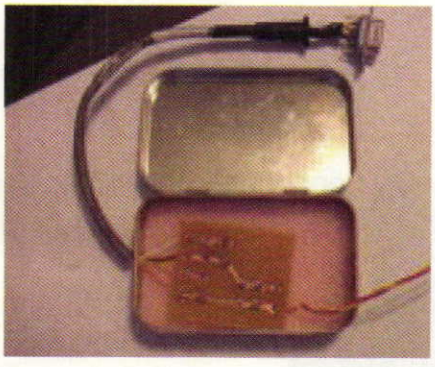
reader PROJECT

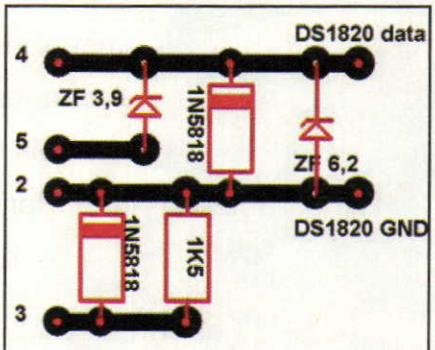
Web-based Homebrew Monitor

Erik van Oudheusden • Cedar Creek, Texas

I just got my lagering fridge up and running and brewed up my first German lager when I was called out to the road. Being a detail-oriented guy, I wanted to make sure my temperatures were maintained — and I wanted to be able to view it from anywhere in the world. Visit http://www.swampwaterbrewery.com/2008/06/lets-see-how-this-works-diy-web-temp.html for more information.



Here is the finished, soldered monitor.



Here is the original monitor design.

Directions: Installing and configuring as root on your linux machine: DigiTemp

1. Download digitemp v3.5.0 for Linux from http://www.digitemp.com/software.shtml

2. Extract digitemp-3.5.0.tar.gz "tar -zxf digitemp-3.5.0.tar.gz"

3. Cd into digitemp-3.5.0

4. Copy DS9097 to /usr/bin

5. Run "sudo digitemp -s/dev/ttyS0 -i" (If you are using com2 it would be -s/dev/ttyS1) you should see something like the following:

- DigiTemp v3.5.0 Copyright 1996-2007 by Brian C. Lane
- GNU Public License v2.0 -
- http://www.digitemp.com
- Turning off all DS2409 Couplers.
- Searching the 1-Wire LAN
- 116BDF4C1000CF: DS1820/DS18S20/DS1920 Temperature Sensor
- ROM #0 : 116BDF4C1000CF
- Wrote .digitemprc

You can now run "sudo digitemp -a" (you should get results similar to whats here)

- Nov 21 08:38:01 Sensor 0 C: 27.38 F: 81.28

6. Run "digitemp -s /dev/ttyS0 -i -c /etc/digitemp.conf." This creates the config file digitemp.conf with your sensors. Watch the output to see what number the sensors get.

7. Check the temperature with "digitemp -aq -c /etc/digitemp.conf"

8. Dump the output data into a file: I dump to a file within Apache's wwwroot, that way I can access the temperature from anywhere. The command "digitemp -aq -c /etc/digitemp.conf > var/www/digitemp.txt" puts the output of digitemp into the file digitemp.txt

9. Automate this process:
type "crontab -e", this opens roots crontab.
Type "* * * * * digitemp -aq -c /etc/digitemp.conf > /tmp/digitemp; mv /tmp/digitemp /var/www/digitemp.txt" into that file, and save it.

Creating the graphs:

1. Create a directory to put the scripts, a directory to store the images, and a directory to store the data as follows:
"mkdir /etc/tempsensor"
"mkdir /var/www/temperature"
"mkdir /var/log/digitemp_rrd"

2. Install software:
You will need, PHP and RRDtool.
"apt-get install rrdtool"
"apt-get install php" (there are many php packages, install one with a console executable)

3. Download and install the scripts responsible for making the graphs: (http://hohenfels.com/tempsensor-0.2.tar.gz). Download tempsensor-0.1.tar.gz to your linux machine.
"tar xvzf tempsensor-0.1.tar.gz"
"cp -v tempsensor/* /etc/tempsensor"

4. Configure the scripts:
Open /etc/tempsensor/config.php and follow the comments in this file.
Change the script to read input data from "/var/www/digitemp.txt" if you followed the example in the previous step.

5. Automate:
Add a crontab entry the same way as in the previous step. The script should run every 5th minute.
The lines should look like this:
"*/5 * * * * php/etc/tempsensor/logdata.php"
"*/5 * * * * php/etc/tempsensor/graphdata.php"

6. Run the scripts manually to check if the sensor works.
`php /etc/tempsensor/logdata.php`
`php /etc/tempsensor/graphdata.php`

7. Visit http://your.ip.or.hostname/temperature or whatever you specified in the config file.

club PROFILE
West Coast Brewers

Perth • Western Australia

G'day blokes and sheilas! Check out our little club — the West Coast Brewers from Perth, Western Australia.

Perth is the capital city of Western Australia (WA), the most isolated capital city in the world. WA accounts for around one third of the country's land mass and has around 2 million people. It is also true that some country towns do have kangaroos leaping down the main street — take

The West Coast Home Brewers brew in the land down under.

a look at our Web site and you will see a Kangaroo with a mash paddle in his hand!

The West Coast Brewers (WCB) started ten years ago when the brewing scene in Perth was pretty much an underground operation. Full mash brewers had nowhere to source their ingredients and a few mates (which is Oz for buddies) came together to form a small buyers group, and the rest, as they say, is history. Kit beers were obviously available from the local brew shop, but none of them stocked grains or high quality liquid yeast or equipment such as large stainless steel pots, grain mills, etc.

These days, the "WCBers" are a group of thirty passionate brewers who meet monthly. The club has an ongoing education series that covers all aspects of our beloved brewing. We are blessed with a very healthy local microbrewing scene in Western Australia, so local brewers and beer gurus are happy to come along to meetings for guest appearances and present on the chosen topic of the month.

We hold quarterly competitions with a theme, which run along the same guidelines (the BJCP — Beer Judge Certification Program) and scrutiny as professional tests. For instance, we have just had a "Low Countries" competition, which saw a great range of excellent beers ranging from Belgian blondes to dark strong Belgian ales. The winter competition will see some excellent cold weather beers with a "Dark and Stormy" theme. The club also has a large number of entries in this year's Cryer Malt Perth Royal Beer Show and we held our first WA Amateur Brewers Awards last year.

Whenever possible, we all get together for a brew day and the obligatory Aussie BBQ (no shrimps here!). Regular brewery visits are also popular, and with some pre-arranging we get to go behind the scenes in the breweries for a close look at the large professional versions of our home breweries. The local breweries have been more than happy to have us come through and ask questions.

The majority of our members are full mash brewers, whose equipment ranges from stove top pots and the good old ESKI or picnic cooler, which is modified to be the mash tun, all the way to professional stainless steel set ups with heat exchangers, transfer pumps and temperature controlled cabinets. Large stainless steel pots converted into brew kettles and hot liquor tanks are common.

It is thirsty work living all the way over here in WA, so our brew scene is very much alive and well! Our Web site is constantly being upgraded and we would love to hear from fellow beer worshippers from around the globe and welcome new members. Visit www.westcoastbrewers.com.

WE WANT YOU

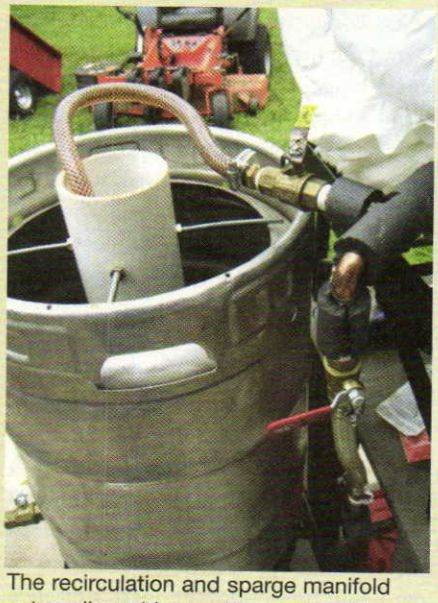
Do you have a system or a homemade gadget that will make our readers drool? How about a killer recipe or tip? Want to profile your club? Email a description and photos to **edit@byo.com** and experience fame among 100,000+ homebrewers!

If we publish your article, recipe, photos, club news or tip in Homebrew Nation, you'll get a cool ½ Liter German Stein (courtesy of White Labs) and a *BYO* Euro sticker.

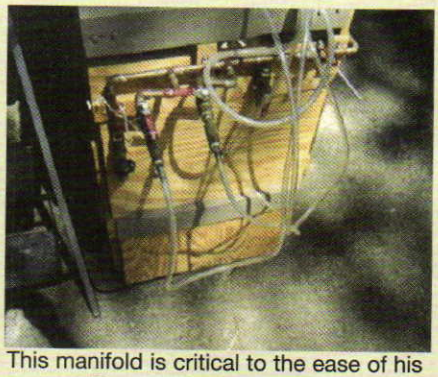
homebrew systems that make you **DROOL**

Fred Block • Campobello, South Carolina

Fred's brewing setup started out as a RIMS until he converted to a HERMS, using the wort chiller to also serve as a wort heater by placing the heat exchanger in the hot liquor tank.



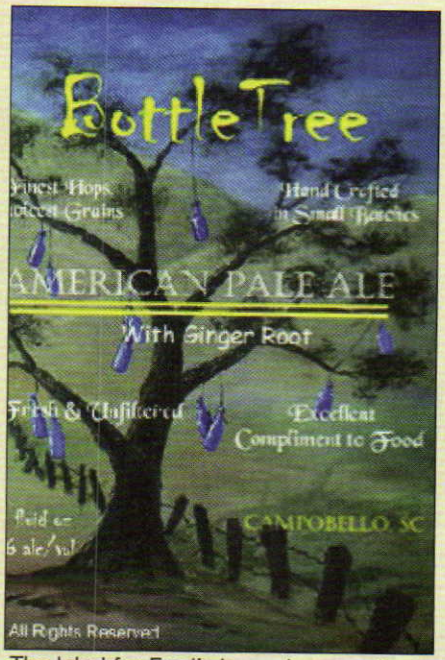
The recirculation and sparge manifold setup allows him to either recirculate wort from the mash-tun, through the heat exchanger in the HLT, back to the mash-tun, or to drain off wort runnings into the kettle without having to swap out hose connections.



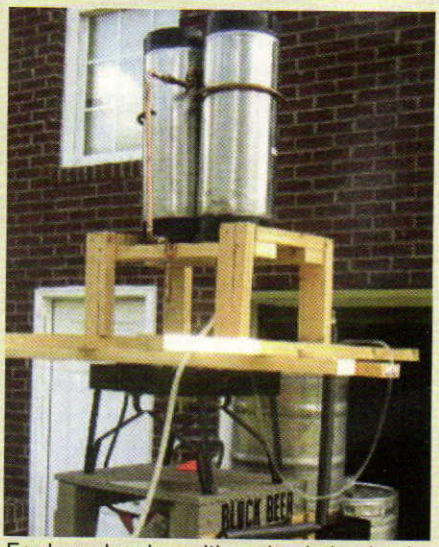
This manifold is critical to the ease of his system. By using standard quick disconnects, air, water, CO_2, beer, can all be passed through this isolatable manifold.

In this Sankey keg cleaning stand and connection setup, Fred removes the check valve out of the connection that normally goes to the tap, and uses that as the input. He can take the valve out of the $C0_2$ input connection and use this as the exit and attach a valve to the end of the exit hose, so that this keg can be pressurized.

The vision of my home brewery was started from the vision of having a commercial end product and then building in reverse. This meant Sankey kegs, proper labeling, etc. Then basic process maps were put together, starting very high level (all obtained from online resources), then drilling down in more and more detail. Before I built my system I had never seen a beer made or seen an actual homebrew setup. I had never made any sort of beer before. Since I had an end vision, I never considered any other option than all-grain. Then came the work of building the brewery. I'm not really a craftsman, just someone with a vision and some imagination. The brewery had to be on wheels to go in and out of the garage. It was probably nine months later that the first beer (an IPA) was made. Having never seen this before, I was simply fascinated when I saw my first primary fermentation churning in the carboys - the turbulence surprised me, and I was addicted to this craft, ever since. The brewery later became a RIMS and later a HERMS. The initial brewery had to be able to grow with me.



The label for Fred's home brewery is based on the traditional bottle tree, which is an ancient folk belief that has origins reaching as far back as the ninth century. Bottle trees are made by covering bare tree branches with colorful glass bottles to attract evil spirits.



For keg cleaning with recirculation back to the mash tun, Fred puts the kegs higher than the mash-tun.

replicator
by **Marc Martin**

Dear Replicator,

A couple of years ago a fellow homebrewer who lives in New Hampshire shipped an assortment of his favorite New England microbrews that are not available in my home state of Montana. All were very good but my favorite by far was Long Trail Brewing Company's Double Bag, which is a "sticke alt" beer that clocks in at 7.2% alcohol. This beer was extremely malty and delicious. I have asked my friend for a recipe clone of this fine brew, but he tells me that the Long Trail brewers are extremely secretive about their recipes. Perhaps you could help me formulate a recipe for Double Bag?

Gunnar Emilsson
Helena, Montana

If you are going to start a small brewery in the heart of Vermont, you might as well build it close to the Green Mountain National Forest. That's exactly what Andy Pherson did when he established Long Trail Brewing in Bridgewater. It's namesake, The Long Trail, is a lush, beautiful hiking trail (the oldest long-distance trail in the United States) that runs the length of the state of Vermont along the main ridge of the Green Mountains.

The brewery opened in May of 1989 and Andy was both company president and brewmaster. The brew house, which was located in the basement of Bridgewater Woolen Mills in Bridgewater, Vermont, quickly became cramped. With their beers gaining popularity, they relocated in 1995. This was a major expansion as they moved to a state-of-the-art brewery and visitor's center in Bridgewater Corners, a few miles away. This beautiful facility features an open-air deck overlooking the Ottauquechee River.

While the rumor may be that Long Trail are secretive about their beers, my mere mention of homebrewers brought a wealth of information. They are definitely in tune with grassroots brewing and their customer base.

Long Trail's brewmaster and production manager, Matt Quinlan, got his start in the industry working at a liquor store that featured specialty beers, both domestic and imported. He became the store's beer manager and met Andy Pherson who was peddling one of his first beers, Bicentennial Ale. Andy offered him a job in 1991 and now, seventeen years later, Matt is in charge of nine brewers and eight packaging staff in a 60-barrel brew house.

Matt first brewed Double Bag in 1994. It began as an experimental beer in their "Brown Bag" series. He took the strong, first runnings from several batches of their flagship beer, Long Trail Ale (an altbier), and set them aside in a separate, smaller fermenter. This essentially created a double strength recipe and hence the name.

Double Bag was originally only offered at the brewery, but quickly became so popular that it is now offered in both 12 and 22-ounce bottles. It has a rich, strong malt backbone with just enough German origin hops to provide balance. The addition of wheat adds body and helps create a lasting white head. As a testament of its popularity *Malt Advocate* named it their "Beer of the Year" in 2001.

Inspiration for describing a beer as a "Sticke-bier," which is German slang for "secret brew," originated from famed beer writer Michael Jackson who described the style as the tradition of brewing a small, secret batch of stronger beer as a special treat for brewery guests. Exactly how this beer began.

Now, after a hard day on your own long trail, you can enjoy a Double Bag Alt since you can "Brew Your Own."

For further information about Long Trail and their other fine beers visit www.longtrail.com or call 802-672-5011.

Long Trail Brewing Double Bag Alt
(5 gallons/ 19 L, extract with grain)

OG = 1.071 FG = 1.016
IBU = 25 SRM = 16 ABV = 7.2 %

Ingredients
6.6 lbs. (3 kg) Briess light, unhopped, liquid malt extract
1.5 lbs. (0.68 kg) light dried malt extract
1.0 lb. (0.45 kg) crystal malt (20 °L)
0.5 lb. (0.23 kg) crystal malt (60 °L)
0.25 lb. (0.11 kg) chocolate malt (350 °L)
0.5 lb. (0.23 kg) wheat malt
5.4 AAU Northern Brewer pellet hops (60 min.) (0.6 oz./ 17 g of 9% alpha acid)
3.6 AAU Northern Brewer pellet hops (30 min.) (0.4 oz./ 11 g of 9% alpha acid)
1.6 AAU Mt. Hood pellet hops (0 min.) (0.25 oz./ 7 g of 6.5% alpha acid)
½ tsp. yeast nutrient (last 15 minutes of the boil)
½ tsp. Irish moss (last 15 minutes of the boil)
White Labs WLP036 (Dusseldorf Alt Ale) or Wyeast 1007 (German Ale) yeast
0.75 cup (150 g) of corn sugar for priming (if bottling)

Step by Step
Steep the crushed grain in 2.0 gallons (7.6 L) of water at 154 °F (68 °C) for 30 minutes. Remove grains from the wort and rinse with 2.0 quarts (1.8 L) of hot water. Add the liquid and dried malt extracts and bring to a boil. While boiling, add the hops and Irish moss as per the schedule. During the boil, use this time to thoroughly sanitize a fermenter. Now add the wort to 2.0 gallons (7.6 L) of cold water in the sanitized fermenter and top off to 5.0 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 70 °F (21 °C). Hold at that temperature until fermentation is complete. Transfer to a carboy, avoiding any splashing to prevent aerating the beer. Allow the beer to condition for 1 week and then bottle or keg. Allow to carbonate and age for two weeks and enjoy your Double Bag Ale.

All-grain option:
This is a single step infusion mash. Replace the malt syrup and dried malt extract with 13 lbs. (5.9 kg) 2-row pale malt. Mix the crushed grains with 4.75 gallons (18 L) of 170 °F (77 °C) water to stabilize at 154 °F (67.8 °C) for 60 minutes. Sparge slowly with 175 °F (79 °C) water. Collect approximately 6 gallons (23 L) of wort runoff to boil for 60 minutes. Reduce the 60-minute hop addition to 0.50 oz. (14 g) and the 30-minute addition to 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 grain recipe.

Homebrew CALENDAR

November 1
Greensboro, North Carolina
Battleground Brewers
Skirmish in the Triad
The second annual homebrew AHA/BJCP sanctioned competition organized by the Battleground Brewers Guild. Registration will be open from September 20 until October 18. Entries will be accepted in all categories listed for the BJCP style guidelines. For more information, visit http://www.battlegroundbrewers.com

November 8
Albany, New York
Knickerbocker Battle of the Brews
The 13th year of the Saratoga Thoroughbrews competition, held at the C. H. Evans Brewing Company at the Albany Pump Station. 2008 BJCP style guidelines apply, all entries are $6. Deadline for entries is October 31. For more details, visit http://www.moonbrew.com/kbotb/.

November 22
Lake Harmony, Pennsylvania
Great Brews of America Homebrew Competition
An AHA sanctioned contest held in conjunction with the Great Brews of America Beerfest. Deadline for entries is November 17. There will be 24 categories of lager, ale or mixed-style beers, three categories of mead and one category of cider. $10 per entry. Full guidelines and submission information is available at http://www.splitrockresort.com/gba.php

November 28
Dunedin, Florida
Deadline: Walk The Line On Barleywine and Strong Beer Stumble
Registration for this year's competition of the "big" versions of all the BJCP styles of beer, mead, and cider (which includes "imperial" or "double" anything), will be accepted online only, starting on November 1 2008. Entry fee is $6 per entry. For more information about styles, guidelines and deadlines for the event, visit the Dunedin Brewers online at http://www.DunedinBrewersGuild.com.

BEGINNER'S block

Build a Chiller

by Betsy Parks

When you first begin brewing beer at home, building your own equipment might not be the first thing on your mind. However, there are a few projects that even the greenest brewers can accomplish that are fun to build and useful for any level of brewing, including constructing an immersion wort chiller, which will help to rapidly chill your wort to pitching temperature.

A finished immersion wort chiller should look something like this.

Basic design

An immersion chiller is easily built from a 25 ft. (~7 m) length of ⅜" diameter copper tubing, around 10" (3.5 m) of ⅜" diameter food-safe garden hose and two hose clamps. Copper tubing is easily shaped, but also easily kinked, especially when making 90° bends, so to prevent ruining sections of the tubing by kinking use a spring tubing bender, which you can buy inexpensively when you buy your tubing.

To make the shape of the chiller, which is a coil (see photo), you can use any tall cylindrical-shaped object, such as a corny keg. Be sure to choose a shape that will make the coil small enough so that there is at least 2" (5 cm) between the sides of your brewpot and the chiller.

Assembly

1. Wrap the copper tubing around the keg or cylinder to make the spiral shape, leaving a longer length of tubing — about 20" (~50 cm) - at one end.

2. Bend the long end of the tubing back inside the coil at a 90° angle so that it runs up the length of the coil towards the top. Then bend the top end another 90°.

3. Bend the short end of the tube at the other end of the coil 90° in the same direction as the long end you just bent.

4. Cut the food-safe garden hose to make two 5' (1.5 m) lengths, making sure at least one length still retains the threaded adapter end.

5. Slide each hose length with the cut sides over the two ends of the copper tubing and attach the clamps tightly.

Usage

Once you finish constructing your chiller, wash it off in the sink and sanitize it by putting it into your brewpot during the last 15–20 minutes of the boil, but be sure the newly constructed chiller is properly cleaned before you use it the first time. Next, connect one of the hose ends to a faucet with a threaded hose fitting. If you don't have a faucet like this, you can purchase a threaded or rubber adapter fairly inexpensively at a hardware store or homebrew shop. Now, take the other hose and put it into the sink, then drop your chiller into the brewpot with your wort.

To chill the wort, turn the faucet on with cold water and start taking temperature readings with a sanitized thermometer. Depending on the temperature of your cold water, you should be able to chill your wort down to pitching temperature in around 20 minutes, but keep track so you don't waste time and water, and to prevent overchilling.

Going Hybrid

Pushing the limits of beer styles

by Betsy Parks

Sometimes one beer style just won't satisfy your thirst. Instead of taking a sip of two or three beers at the same time, try developing your own hybrid style. These professional brewers, known for experimenting, offer some encouragement for going out of bounds.

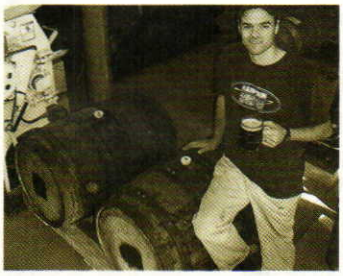
JOHN MALLETT, Plant Manager for Bell's Brewery, Inc. in Galesburg, Michigan. John joined Bell's in 2001. He was head brewer of Boston's Commonwealth Brewery, Brewmaster at the Old Dominion Brewing Co. in Ashburn, Virginia and founder and President of SAAZ, a brewing equipment and service provider.

When you brew out of style, you're heading into the green sections of the map, seeing what's out there. Maybe there's a good reason why no one's done it before, but it's fun to explore. At Bell's we like to play and as we develop we're honing in and narrowing down what's possible.

Often times we're talking about doing a beer because we may have a particular flavor that we're looking to highlight — or to explore the permutations of a particular ingredient. For instance, this summer we brewed Poolside, which was a cherry wheat beer brewed with a Belgian yeast. We decided to make it that way because we make a beer in the winter that is not a witbier, but had a lot in common with a witbier including the wheat and yeast. As we went into the summer and that beer was going away, we thought about the banana characteristics of the yeast we used, and banana with cherries sounded delicious.

Experiments are not always successful, though. I did a beer called Get Lucky that was not super lucky. It may have been too adventurous. I brewed a beer using Lucky Charms breakfast cereal and spirulina for color and then also threw in a little yerba matte green tea as well and the whole thing came out just crazy — not particularly drinkable. I think that the adjunct cooking stage of the Lucky Charms volatized some flavors that were never supposed to be in beer. Plus it turned just a sick, grey color — kind of nature's way of saying "stay away."

I love the playful spirit of homebrewing and the great, funny combinations people come up with, especially with adjunct sources like distinctive fermentables and distinctive spices, and the different flavors you can get from them that you wouldn't really play with on a commercial level. My advice is to try taking chances. Have a great time — that's the big thing. Be playful and don't be afraid to sewer a batch if it doesn't work. Not every experiment is a success — trust me, I know.



TODD CHARBONNEAU, Head Brewer for Harpoon Brewery in Boston, Massachusetts. Todd has been at Harpoon for over ten years and has occupied the Head Brewer position for six of those years. He is very passionate about beer style, but also about keeping an open mind.

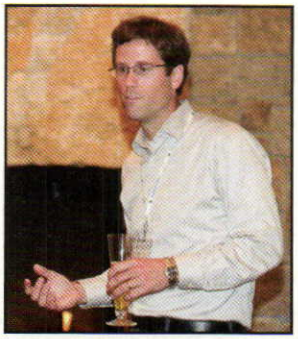
When it comes to making these kinds of beers, there are a couple of ways to look at it. In some cases a brewer may want attributes in a beer that traditionally come from different styles of beer. It can also be driven by a feeling of being restricted by a certain style. You may want something close to a Pilsner, for example, but have a twist in mind that doesn't fit the traditional Pilsner guidelines.

This is the beauty of American craft beer. Breweries have forever been forging ahead with flagship beers that may not fit exactly into a category or meet certain drinkers expectations. This doesn't make these beers bad. On the contrary, these are flavorful, satisfying beers that take house character and personal interpretation and run with it. One of our originals, Harpoon Ale, has been called a pale ale, an amber and an alt. We just call it ale.

We brew a lot of small batch stuff pushing the limits of gravity and ABV, as well as flavor and aroma profile. I think typically we try to accentuate the things we like about beer. The whole double this, imperial that — it's driven by what people love about beer; the flavors and aromas of malt, hops and yeast. We recently brewed a very dark wheat wine with German hops. Not to style, but that's how we wanted it.

We've brewed beers that never made it to production that even we wouldn't drink. Usually, problems arise when a brewer goes overboard with a wide range of flavor additions, such as fruit, spices, etc. Those things can be great additions but the flavors have to fundamentally match and get along to work.

Have fun and relax. If you like the malty breadiness of a Märzen, and the green, pungent hop aroma of an IPA, then make a beer that gives you those things. Studying styles is fun and rewarding, but don't let it bog you down if you haven't found just what you want. Also, be open to adapting to your environment. One of America's own styles, steam beer, was born out of necessity. If your fermentation is too warm and your British bitter isn't tasty, try a strain that works better in that temperature range next time. Don't worry about what the style snobs tell you.



NATHANIEL DAVIS, Brewmaster for the Research Pilot Brewery at Anheuser-Busch, Inc. Nathaniel started working for Anheuser-Busch in 1999 at the Fort Collins, Colorado brewery and then moved to St. Louis to join the Innovation and New Product Development team. He spends most of his time in the experimental microbrewery, known as Michelob Brewing Co., at Anheuser Busch's headquarters in St. Louis, developing recipes for new beers.

From my perspective, flavor and balance in brewing is king and it ought to trump style at the end of the day. I like to think as brewers that we are constantly interpreting style and that we can bend and break the rules. The attraction to brewing this way is that in order to surprise and push the boundaries you need to understand the style, then you can brew something truly new and that's when the magic takes place.

What we do is start with a target profile in mind because sometimes style is a good way of explaining to people what to expect. This is different than what I would do if I were homebrewing. Sometimes you want to brew in order to see if you can do a classic, traditional approach to the style, and a lot of times you want to put your fingerprint on that style. For example, our Shock Top is quite traditional in the Belgian-style witbier, but you won't see a big, spicy yeast. We also layer in lemon and lime peel with the orange peel and coriander, which is a different twist on the style. If you're brewing at home the same kind of thing happens.

To experiment, think of some of the classic styles that have unique features that distinguish them, such as Belgian-style witbier I mentioned, Bavarian-style hefeweizens with spicy, fruity characteristics or American-style pale ale with a pine and citrus hop character. These styles all have elements that you can lift out and apply to a different style. Mix and match and you can come up with some really interesting things.

If you go back to this matrix approach, though, sometimes you can take the head of one style, the body of another and the legs of still another and you can end up with a frankenbeer with characteristics that clash, like taking the oomph of a doppelbock and applying that element to a lighter beer like a hefeweizen.

The basic process and the passion of homebrewing and how that can apply to being creative is exactly the same, whether you're brewing 5 gallons or more. Most homebrewers I know spend a lot of time studying the style and what defines them, and spend a lot of time trying to recreate that. When you're doing that, try writing down elements of a style you love and if you think those elements might lend themselves to another style in a harmonious way. It's either going to work out like you thought it would, or it will surprise you and you can learn from it.

Priming With Maple

Pitching rates and malt extract flavors

"Help Me, Mr. Wizard"

by Ashton Lewis

Maple carbonation

I recently brewed an old ale with an OG of 1.082 and an FG of 1.015. During the last 10 minutes of the boil, I added about 12 ounces (340 g) of maple syrup. The pre-fermentation sample to obtain the OG had a very nice maple aroma and flavor to it. I siphoned the beer into an aging vessel for some long-term storage and am now considering my options. Given the high alcohol content, I want to bottle it and drink it sparingly so that I can see how it matures over time. My intent is to have a low volume of carbonation, say on the order of 1.5 using maple syrup so that I can reintroduce that aroma and flavor. My understanding is that maple syrup is sucrose, and to obtain a CO_2 volume of 1.5 in 5 gallons (19 L), it would require approximately 4 ounces (113 g). The final amount in the aging vessel is about 4¼ gallons (17 L). What adjustments do I need to make given that I am using maple syrup in liquid form? How should I be measuring this and what amount is appropriate for 4¼ gallons (17 L)?

Mark Daspit
Tracy, California

I assume that the maple syrup aroma faded some during fermentation and that is the reason why you wish to add more maple syrup to the beer at the time of bottling. I'm not sure how you did your calculation and want to walk through a fairly easy method used to calculate priming sugar requirements. Step one is to measure carbonation level in grams per liter instead of volumes. One volume of carbon dioxide is roughly equivalent to 2 grams of carbon dioxide per liter. So in your case you want 3 grams (0.12 oz.) of carbon dioxide per liter of beer and you have 16 liters of beer. This means that you want to get 48 grams/1.7 oz. (3 x 16) of carbon dioxide in your beer by fermenting sucrose from maple syrup. When sugar is fermented by yeast, ethanol and carbon dioxide are produced. Carbon dioxide represents 49% by weight of the sugar. If you want 48 grams (1.7 oz.) of carbon dioxide you will need 99 grams (3.5 oz.) of sugar (48 ÷ 0.49 = 99).

You want to use maple syrup and need to take into account the water contained in the syrup. Maple syrup has standards and most maple syrup has a concentration of 66 °Brix. The Vermont grading standards are a little different and Vermont maple syrup is a little more concentrated. In any case, if you know the Brix of the syrup you are using you can calculate the weight of syrup required by dividing 99 grams (3.5 oz.) of sugar by 0.66 (assuming 66 °Brix) and now know that you need 150 grams (4,252 g) of maple syrup. The 4 ounces (113 g) you refer to is in line with my 99 grams (3.5 oz.) and it looks like our methods are in agreement. The adjustment you need to make requires the 66 °Brix correction factor.

The above can be simplified into the following: Required syrup (grams) = liters of beer * desired carbon dioxide produced during conditioning ÷ 0.49 ÷ 0.66. This equation can be used for any priming problem simply by adjusting the value 0.66 to the sugar concentration of whatever priming sugar you plan on using.

In my experience, many of the nuance aromas associated with whatever special ingredient added to beer is often lost in primary fermentation. If the ingredient is added to the kettle then the volatile stripping can be even more pronounced. We brew an exceptional coffee stout at Springfield Brewing Company (OK, I'm biased, but it's really delicious) and the best way for us to get the intense coffee aroma in our stout is to add the coffee to the beer after fermentation. I think the subtle nutty notes of an ingredient like maple syrup will certainly be retained by the method you suggest!

Pitching rates

I'm trying to make sense of BYO's latest article on yeast pitching rates and correlate it with yeast suppliers' data. The rule of thumb is 1 million cells/ milliliter / °Plato. I get that. However, when I go to Wyeast Labs (www.wyeast.com), they not only reference this formula, but also indicate the following interesting points about their Activator product:

1. Each package contains >100 billion yeast cells
2. Each package is designed to successfully ferment 5 gallons of wort with an SG ≤1.060 (or 15 °P)

When you apply the rule of thumb to the second bullet above, you are led to believe that each smack pack contains 280 billion cells (not 100). Are they not following the very rule of thumb they recommend? I suppose 280 billion is greater than 100 billion, but do I really want to purchase a product that is only guaranteed to have ~⅓ of the yeast cells I need for my 1.060 wort?

Todd Morgan
Olympia, Washington

I went to the Wyeast Web site to do a little bit of recon before answering this question. I found the site very informative and did see much of the information described in your question. What I could not find was any reference to the general rule you cite in your question. However, there is a chart on pitching rate that you may find very useful. Although at first glance the information on the Wyeast Web site seems inconsistent with the assumptions you make in your question, pitching rate is not black and white and the "rule of thumb" pitching rate of 1 million cells/ liter/°Plato is a rule of thumb. If there is no room for a range of pitching rates companies like Wyeast could only satisfy one type of customer, for example the 12 °Plato group, with their yeast packets.

So here is the real scoop about pitching rate. Commercial brewers use a rate that ranges from about 5 million cells/mL to

about 20 million cells/mL. The rule of thumb for a 12 °Plato wort dictates a pitching rate of 12 million cells/mL, which is in the middle of the range. In general, ale brewers who want ales with more pronounced esters pitch on the lower end of the range and ferment warmer. Lager brewers tend to pitch at higher rates and ferment cooler. And both ale and lager brewers increase pitching rate with their higher gravity beers. Remember that most of the beer brewed in the world is lager so the rule of thumb is heavily influenced by lager brewers.

It does seem that the minimum cell density of 100 billion cells per packet tends towards the low side of the typical range of pitching rates. But these packets also have an activator to get things metabolically rolling and this is factored into the amount of cells in each packet. Another item discussed on the Wyeast Web site is propagation. If you want to pitch at a higher rate you can propagate or add a second packet of yeast. Like most things in brewing you can spend a lot of time and effort trying to follow textbook rules and even monitor the process to verify that you are indeed following the rules. For example, if you had a microscope and hemocytometer you could do yeast counts to monitor pitching rate. And you can also taste your beer and ask the question, "did everything go OK?"

If everything did not go OK, and your beer suffers from faults that are too numerous to count, then you probably need to carefully evaluate your whole process. This is not normally the case and some problems are often suspected before finishing the beer and tasting. If you fear that you are under pitching there are several symptoms associated with under pitching that are pretty easy to spot. Slow, lagging fermentations are one common symptom and beers with odd aromas are another. If you are using these yeast packets without problems then I fear you have early signs of becoming a homebrewing hypochondriac. Not to worry, this is not an irreversible illness and recovery is possible. If you are having problems associated with under pitching, increase your pitching rate and see if the problems go away.

I think I have become more grounded with experience. In my younger and more boisterous days I was sometimes guilty of thinking bad thoughts such as, "those guys, I know what they're doing, they're trying to confuse the facts and trick me into thinking that [fill in the blank]." That line of thinking may work for some consumer products, but doesn't hold much water with art supplies.

Yeast is an art supply for the brewing artist. Some of us make rock-solid beers by pitching 5 million cells per mL and others make rock-solid beers by pitching 20 million cells per mL (that must read like total geek speak to the non-brewer!). I don't believe any yeast supplier does anything to confuse or "cheat" their customers and they pick a product to market that hopefully fits the needs of most of their customers. If your needs are different, use the information about the product to make the necessary medications.

Malt extract taste?

I had an epiphany the other night during a beer testing at my local homebrew club. One of the tasters made a very profound statement after tasting a homebrew: "You used malt extract, didn't you? The taste is unmistakable." After that statement was made, I realized that I could also detect a distinct taste that was common in all of my beers (I am predominantly a malt extract brewer) and not present in all-grain examples that I have tasted. The other homebrewers could not detect any difference that would give away the fact that malt extract was used. Afterward, no mention was made as to whether malt extract was used in their brews and the gentleman who made the comment could tell whether the beer used extract or not. I was amazed, impressed and shocked that anyone could discern this malt extract characteristic and was amazed that I could taste the difference as well.

From everything that I have read about malt extract brewing compared to all-grain, I have never read anything about a distinct flavor being imparted by the malt extract to distinguish it from all-grain. On the contrary, I have always noticed that many authors have gone to great lengths to not point out flavor differences and if there are any differences, it is due to the difference in the process of all-grain mashing at home compared to grain mashing at the extract manufacturer, but never a malt extract flavor due to it being an extract. Can you please shed some light on what this malt extract flavor is that he and I are detecting that the others in my group could not taste?

Kevin Brock
Seattle, Washington

I think that many authors who write for the homebrewing audience are sensitive to the fact that many homebrewers brew beers from extract because extract brewing is less time consuming, requires less equipment and is less involved than all-grain brewing. In fact some all-grain brewers have the attitude that if you don't brew beer from all-grain you are not a real brewer. To me this is akin to the "Real Men Don't Eat Quiche" movement of the 1980's. Call it homebrewing PC or blame it on hypersensitivity to criticism in today's world, but homebrewing authors, myself included, do not go out of our way to denigrate beers made from extract.

Why would authors choose such a tack? One fact is that the quality and freshness of extracts today has improved greatly and there is really a great selection of extracts on the market. When I began homebrewing in the 80s old, dusty cans of extract with packets of dried yeast way past their expiration dates were not uncommon. I vividly remember seeing whole hops at a health food store in Blacksburg, Virginia that were really, really old looking and thinking, "so this is what lambic brewers use." Things are very different today, especially with greater selection and alternate choices of where ingredients can be purchased. If you live in a tiny town and do not have a homebrew store nearby or if the local source does not have fresh ingredients, you can buy from

Internet-based retailers.

So what does any of this have to do with extract beers having a distinct flavor? The fact is that some extract beers stick out like a sore thumb, just like beers stored in green or flint glass. Malt extract, especially liquid extract, changes with age. As malt extract sits, non-enzymatic browning reactions, also known as the Maillard reaction, occur. Many of the products of the Maillard reaction are aldehydes and these compounds can be smelled and tasted. Colored compounds are also produced and aged malt extract is darker than fresh malt extract. The bottom line is that malt extract can contribute significant amounts of these products and the wort made from aged malt extracts will taste differently than wort made from fresh malt extract or all-grain mashing performed at home. So freshness is one thing that can lead to an extract brew flavor.

Also, not all extracts are created equally. Just as some commercial beers are better than others, some extracts stand out from the crowd. I had an opportunity to visit a malt extract manufacturer when I was in graduate school. I was rather surprised that their chosen mashing method ensured an extremely low fermentability in the extract and that their chosen method of processing the wort after mashing made for a very dark "pale" extract. And to no surprise beers made from this brand of extract had a very distinctive flavor. Trained tasters can detect these traits, especially when a particular flavor is only associated with certain products, such as malt extracts. The fact is that not all malt extracts have these distinctive flavors and not all extract beers can easily be identified by trained tasters when presented in blind tastings.

I have brewed beers from extract that had no flavors that made them distinguishable as extract beers and extract beers that did have an obvious and identifiable flavor note. Just because someone can determine that you brewed a beer using extract does not make it bad. If I taste an unknown beer and comment, "this beer was fermented using a Bavarian weizen yeast" I am saying nothing about the quality of the beer. It could be really awesome or really awful, but both beers can be identified as weizen beers.

Brew Your Own Technical Editor Ashton Lewis has been answering homebrew questions as his alter ego Mr. Wizard for the last 12 years. A selection of his Wizard columns have been collected in "The Homebrewer's Answer Book," available online at brewyourownstore.com.

Do you have a homebrewing question for Ashton? Send inquiries to *Brew Your Own*, 5515 Main Street, Manchester Center, VT 05255 or send your e-mail to wiz@byo.com. If you submit your question by e-mail, please include your full name and hometown. In every issue, the Wizard will select a few questions for publication. Unfortunately, he can't respond personally. Sorry!

Imperial IPA

Hoppy with a chance of hoppiness

by Jamil Zainasheff

Like many people, when I was new to craft beer I favored beers with a maltier balance, ones that were not so bitter. At that time a homebrew shop owner told me that most people start out preferring malty beer styles, but eventually everyone craves hoppy beers. He was right and it didn't take long before I began to appreciate and then crave beers with a bold hop bitterness, flavor, and aroma. India pale ale quickly became an everyday beer for me. I think this appreciation of hop bitterness and character eventually develops in almost all craft beer lovers and for many, that craving just can't be satisfied. Like horror movie zombies hungry for brains, hoppy beer lovers seek out new beers to satisfy their ever increasing hunger for hop bitterness, flavor and aroma. For those infected with this *Humulus lupulus* disease, one of the best cures on the market is a couple of pints of imperial IPA.

Imperial IPA is a beer bigger in alcohol strength, hop bittering and hop character than standard India pale ale. However, the malt character in an imperial IPA is not necessarily bigger than that found in an American IPA. Too big a malt character makes a beer more like a barleywine. Often brewers will ask, what is the difference between an imperial IPA and an American barleywine? American barleywine has a much richer malt character, more body, more alcohol and less hop character than an imperial IPA. A barleywine is generally something you sip, while an imperial IPA is something you drink by the pint. Drinkability, despite an intense hop bitterness and intense hop character, is critical for a great imperial IPA.

IMPERIAL IPA by the numbers

OG:	1.070–1.090 (17–21.6 °P)
FG:	1.010–1.020 (2.6–5.1 °P)
SRM:	8–15
IBU:	60–120
ABV:	7.5–10%

An imperial IPA should be intensely hoppy. A drinker new to hoppy beers might consider the hop bittering, flavor and aroma overwhelming. The aroma and flavor are usually full of citrus and pine notes from the liberal use of American hop varieties. Grassy, resiny and fruity hop notes are also common. This style, like many American-style beers, has a clean fermentation character. Alcohol can be evident, but it should never really be hot or harsh. These beers range in appearance from golden to a reddish copper. While there are excellent examples of the style that are filtered clear, a hazy appearance is not a problem. Massive dry hopping can leave a beer quite hazy from all that hop goodness. The overall flavor should be about hops and malt is only a secondary characteristic. It should be a clean, relatively simple malt background that supports the massive hop load, but does not try to balance it. If you want more balance with your hops, think about brewing an American barleywine instead. Same goes for the mouthfeel and finish. Imperial IPA never has more than a medium body and should have a dry to medium-dry finish. A big body or sweet finish is a flaw and more appropriate for a barleywine.

While one might describe imperial IPA as a bigger than normal IPA, you can't just make a bigger IPA. Well, you can, but the result is likely to be too heavy, with too much residual sweetness. The best

RECIPE

Hop Hammer
(5 gallons/19 L, all-grain)

OG = 1.079 (19.2°P)
FG = 1.013 (3.3°P)
IBU = ~100 SRM = 7
ABV = 8.8%

Vinnie Cilurzo of Russian River Brewing Company in Santa Rosa, California brews what is arguably the world's best example of this style, Pliny the Elder. Despite the huge hop levels and higher alcohol strength, it is superbly drinkable. Vinnie very generously shared his recipe with the brewing community and just about everyone interested in this style has seen his recipe. The recipe below, while a little bigger in starting gravity than Vinnie's, is a descendant of his original.

Ingredients

13.5 lb. (6.12 kg) American two-row malt (2 °L)
0.5 lb. (227 g) wheat malt (2 °L)
0.5 lb. (227 g) crystal malt (40 °L)
1.25 lb. (0.56 kg) corn sugar (0 °L)
26.25 AAU Warrior pellet hops, (1.75 oz./50 g at 15% alpha acids) (90 min.)
22.75 AAU Chinook pellet hops, (1.75 oz./50 g at 13% alpha acids) (90 min.)
12 AAU Simcoe pellet hops, (1.0 oz./28 g at 12% alpha acids) (45 min.)
14 AAU Columbus pellet hops, (1.0 oz./28 g at 14% alpha acids) (30 min.)
15.75 AAU Centennial pellet hops, (1.75 oz./50 g at 9% alpha acids) (0 min.)
12 AAU Simcoe pellet hops,

(1.0 oz./28 g at 12% alpha acids) (0 min.)
35 AAU Columbus pellet hops, (2.5 oz./71 g at 14% alpha acids) (dry)
13.5 AAU Centennial pellet hops, (1.5 oz./43 g at 9% alpha acids) (dry)
18 AAU Simcoe pellet hops, (1.5 oz./43 g at 12% alpha acids) (dry)
White Labs WLP001 (California Ale), Wyeast 1056 (American Ale) or Fermentis Safale US-05 yeast

Step by Step

I use Great Western Malting Co. Premium two-row malt as my base grain, but there are many other similar malts that work equally as well. The crystal malt and wheat malt I use are also from Great Western.

Mill the grains and dough-in targeting a mash of around 1.5 quarts of water to 1 pound of grain (a liquor-to-grist ratio of about 3:1 by weight) and a temperature of 150 °F (66 °C). Hold the mash at 150 °F (66 °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 (24.4 L) and the gravity is 1.061 (15.1 °P).

The total wort boil time is 90 minutes. Add the bittering hops right at the beginning, with 90 minutes remaining in the boil. Add the other hop additions according to the schedule and Irish moss or other kettle finings at 15 minutes left in the boil. Chill the wort rapidly to 67 °F (19 °C), let the break material settle, rack to the fermenter, pitch the yeast and aerate thoroughly.

Use 15 grams of properly rehydrated dry yeast, 3 liquid yeast packages, or make an appropriate starter. Ferment at 67 °F (19 °C), slowly raising the temperature to 70 °F (21 °C) as the fermentation begins to slow. With healthy yeast, fermentation should be complete in a week, but don't rush it.

As soon as the bulk of the yeast begins to drop, transfer the beer to a second fermenter and add the dry hops. The pellets should break up and eventually settle to the bottom of the fermenter. This might take a few days, so don't panic. Let the beer sit on the hops for another 7 days, approximately 7 to 10 days total.

Rack to a keg and force carbonate or rack to a bottling bucket, add priming sugar, and bottle. Target a carbonation level of 2 to 2.5 volumes.

Hop Hammer

(5 gallons/19 L, extract with grains)

OG = 1.079 (19.1 °P)
FG = 1.013 (3.3 °P)
IBU = 100+ (315 calculated) SRM = 6
ABV = 8.8%

Ingredients

8.0 lb. (3.63 kg) Briess light liquid malt extract (2 °L)
0.5 lb. (227 g) Great Western wheat liquid malt extract (4 °L)
0.5 lb. (227 g) Great Western crystal malt (40 °L)
1.5 lb. (0.68 kg) corn sugar (0 °L)
26.25 AAU Warrior pellet hops, (1.75 oz./50 g at 15% alpha acids) (90 min.)
22.75 AAU Chinook pellet hops, (1.75 oz./50 g at 13% alpha acids) (90 min.)
12 AAU Simcoe pellet hops, (1.0 oz./28 g at 12% alpha acids) (45 min.)
14 AAU Columbus pellet hops, (1.0 oz./28 g at 14% alpha acids) (30 min.)
15.75 AAU Centennial pellet hops, (1.75 oz./50 g at 9% alpha acids) (0 min.)
12 AAU Simcoe pellet hops, (1.0 oz./28 g at 12% alpha acids) (0 min.)
35 AAU Columbus pellet hops, (2.5 oz./71 g at 14% alpha acids) (dry)
13.5 AAU Centennial pellet hops, (1.5 oz./43 g at 9% alpha acids) (dry)
18 AAU Simcoe pellet hops, (1.5 oz./43 g at 12% alpha acids) (dry)
White Labs WLP001 (California Ale), Wyeast 1056 (American Ale) or Fermentis Safale US-05 yeast

Step by Step

Mill or coarsely crack the specialty malts. Mix them well and place loosely in a grain bag. Steep the bag in ½ gallon (~2 liters) of 170 °F (77 °C) water 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 around 6.5 gallons (24.4 L) and the gravity is 1.061 (15.0 °P). Stir thoroughly to help dissolve the extract and bring to a boil.

Once the wort is boiling, add the bittering hops. The total wort boil time is 90 minutes after adding the bittering hops. Add the other hop additions according to the schedule and Irish moss or other kettle finings at 15 minutes left in the boil. Chill the wort rapidly to 67 °F (19 °C), let the break material settle, rack to the fermenter, pitch the yeast and aerate thoroughly. Follow the fermentation and packaging instructions for the all-grain version.

imperial IPAs have a dry finish and the finishing gravity should be in the 1.010 to 1.015 (2.6 to 3.8 °P) range, no matter how big the starting gravity. This is a key facet of keeping the beer drinkable.

My good friend Mike "Tasty" McDole has won more than a few major awards for his imperial IPA, so I asked him what he considers to be the single most important aspect of brewing this style. He told me, "This is a very hop forward beer and you cannot achieve that goal unless you keep the malt character from getting in the way. The best way to do that is to use simple sugar."

Russian River Brewing Company's Pliny the Elder, which many consider the finest example of this style, also uses simple sugar to ensure a dry, light malt character. I feel the addition of simple sugar (corn sugar, cane sugar, beet sugar) is critical to making a great example of this style. Put aside any fears you might have that adding sugar will make your beer too thin or "cidery." That is only an issue when using a very large percentage of sugar. Target around 10% of the grist as simple sugar. These easily fermentable sugars also assist in achieving a low finishing gravity. If you're an extract brewer and need more attenuation, replace more of the base malt extract with simple sugar. If you need less attenuation, then shift the percentage toward the base malt.

The majority of the grist in an imperial IPA is domestic two-row malt or a light colored extract made from the same. A good quality domestic two-row malt provides a nice background malty, clean, slightly bready character, which is evident in the beer, but not overwhelming. That is what you want, malt character, but one that doesn't cover the hop character. If you decide to use an English pale ale malt, which is kilned a bit darker and has a bit richer malt flavor than the domestic two-row, be cautious that any other specialty malts you add don't push the malt flavor over the top and begin to make the beer less drinkable.

In the best examples, the use of specialty malts for flavor and head retention is restrained. A small amount of crystal malt, for a subtle touch of caramel, is a nice addition. A little wheat is common in many recipes to improve head retention. Some examples obviously have more crystal and

other specialty malts added, but that can negatively impact drinkability, as the beer starts becoming richer and sweeter. If you want to make a darker beer, switching to darker specialty malts rather than increasing the amount of a lower color specialty malt, is the way to go. It does change the flavor, but it will help to preserve the dry finish required for the style. Keep in mind the best examples of this style, such as Pliny the Elder, are all on the pale end of the range.

This is a great style for extract brewers, as there are plenty of high quality pale malt extracts on the market and the focus in this style is really on the hops. When choosing an extract, avoid any with a low level of fermentability. If your favorite extract doesn't quite attenuate enough, swap out a little more of the malt extract with simple sugar the next time you brew this beer. For all-grain brewers, a single infusion mash works well. Target a mash temperature range of 148 to 152 °F (64–67 °C). If you are making a higher gravity beer or are approaching a double digit percentage of specialty malts, use the lower end of this temperature range to ensure the beer attenuates enough. If you are making a smaller beer, use the higher end of the range to retain a bit more body.

The intense hop character of this beer style comes from a combination of an insane amount of hops and selecting the right hop varieties. One very important thing to keep in mind is that the hop varieties and quantities are more important than their alpha acid levels. Once the bittering gets past a certain level, you're only interested in the oils, resins and other hop compounds that add flavor, aroma and mouthfeel. If you're getting ready to brew the recipe in this article and you can't find Simcoe at 12%, don't worry about it. Simcoe at 10% or 14% is just fine. As long as the alpha acid range is somewhere in the ballpark, keep all the quantities the same as in the recipe. For most beer styles the bitterness to starting gravity ratio (IBU divided by OG) is somewhere between 0.3 and 0.7. A bitter beer like an American IPA would range around 1.0. For an imperial IPA, if your recipe's IBU/OG ratio isn't somewhere around 3.0+, then you're not adding enough hops.

One of the things to keep in mind is that you're trying to build an intense, but harmonious hop character. Combining random hop varieties can result in some weird flavors. Hop selection is flexible, but many aficionados of this style consider the citrusy and evergreen characteristics of American type hops a requirement. Columbus, Centennial, Simcoe, Chinook are all good choices. Lower alpha acid hops, such as Cascade are fine too, but you'll want to focus on the higher alpha acid hops. The higher alpha hops have characteristic resiny flavors and higher bittering potential, which will reduce the amount of hop vegetable matter that ends up in your kettle. When selecting hop varieties you can select as many varieties as you want, but try to make sure they're all grouped into no more than two hop flavor families. For example, select hops which all share citrusy and evergreen characteristics as their prominent attribute. Don't start mixing herbal, floral, spicy, citrus and evergreen all in one recipe.

"The intense hop character of this beer style comes from a combination of an insane amount of hops and selecting the right hop varieties."

To achieve an intense hop character, you can't be shy in the amount of hops you add or the timing of the additions. A 5.0-gallon (19-L) batch of beer requires around ¾ to 1 lb. (340 to 450 g) of hop pellets. As for timing of the additions, you do want to ensure you have hops throughout the boil and after. The Dogfish Head brewery has gone as far as inventing a continuous hopping machine to add hops throughout the boil. I don't think it is necessary to go that far, but making sure you have some hops at the beginning of the boil, mid-way through the boil, at the end of the boil, and dry hop additions at the end of fermentation is important to proper flavor development.

The amount of hop material in the kettle and fermenter will be massive. You might want to scale up the 5-gallon (19-L) recipe in this article to 6 gallons (23 L) to get a finished 5 gallons (19 L), otherwise expect to end up with around 4 gallons (15 L) of finished beer. You might ask yourself if such a huge amount of hops and such losses in wort volume are worth the trouble. If you're a hop aficionado, the answer is absolutely yes! One taste of this intense beer and you'll be hooked.

Yeast selection is simple for this style. You want a yeast strain with a clean, neutral character and one that will attenuate well. My favorites are White Labs WLP001 California Ale, Wyeast 1056 American Ale and Fermentis Safale US-05. Other strains worthy of experimentation are White Labs WLP051 California V, Wyeast 1272 American Ale II and Wyeast 2450 Denny's Favorite 50.

Ferment this beer with plenty of healthy, clean yeast at a moderate temperature. I like to start fermentation around 67 °F (19 °C), slowly raising the temperature to 70 °F (21 °C) as the fermentation begins to slow. This helps control any hot, solvent-like notes in this higher than normal ABV beer. Ramping up the temperature as the fermentation begins to slow will help ensure complete attenuation. If you are a brewer that repitches yeast from one batch to another, do not reuse the yeast from this batch of beer. The high hopping level has considerable negative impact on yeast viability (as does the alcohol content of this beer), so it is better not to reuse this yeast.

One last bit of advice. These beers are best consumed within the first couple months, to fully enjoy the brightest, most intense hop character.

Jamil Zainasheff writes "Style Profile" for every issue of Brew Your Own.

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by **Chris Colby**

2008 HOP HARVEST UPDATE

After a year of limited hop availability, many homebrewers are wondering what the future will hold. In order to find out, I spoke to Ralph Olson (HopUnion), Sean McGree (Brewers Supply Group), Karl Vanevenhoven (Yakima Chief) and Dave Wills (Freshops).

New Hop Acreage Planted

The primary reason for this year's hop shortage was that the number of acres of hops worldwide had fallen below a sustainable level. Given the lure of skyrocketing hop prices, there was a net increase of roughly 11,000 acres of hops around the world in 2008. The largest part of this increase occurred in the United States, which added approximately 8,500 acres of hops. Germany, the country with the largest area of hop acreage, added about 2,000 acres. In contrast, the Czech Republic, Slovakia and Russia all showed a net decrease in hop acreage.

Looking at the gains and losses in total acreage, however, obscures the separate trends in alpha vs. aroma hops. Hop growers divide hops into two categories, high-alpha and aroma. High-alpha hops are those that are grown primarily for their alpha acid content. Aroma hops are grown mostly for their oils. (Some aroma varieties have a fair amount of bitterness and are sometimes also called dual-purpose hops, because they can be used for both bittering and aroma.)

In the US, 7,500 of the 8,500 acres of new hops were high-alpha hops, with CTZ (Columbus, Tomahawk and Zeus) and Summit being the most widely-planted varieties. In Germany, roughly three-quarters of the new acreage was alpha hops. In the Czech Republic, 10 acres of alpha hops were planted while over 300 acres of aroma hops were pulled up.

In the United States, much of the added aroma hop acreage was Cascades, with some Ahtanum, Simcoe and Centennial also planted. Some US-grown aroma hops actually decreased in acreage, as they were pulled to make room for alpha hops or some of the more popular aroma or dual-purpose varieties.

So, although net hop acreage is up, the increase in aroma acreage is small and focused on relatively few varieties. Most of

Looking TOWARDS our Bitter FUTURE

the new hop acreage was devoted to high-alpha hops. (See the chart below for a breakdown of hop acreage changes by country and alpha or aroma.)

2008 Growing Season

In the US, many growers were hoping to get better-than-average yields from their first year hops. In a good year, first-year hops can yield up to 80% of that from an established vine. However, a cold spring in Yakima meant that the "baby hops" didn't do as well as hoped. (This was especially true for high-alpha hops.) For established plantings, however, the weather during the US growing season didn't provide any major problems for hop farmers.

Overall, the US harvest was good. Aroma hops, which are harvested first, yielded well and their alpha acid levels were above average. As this article was being finalized, the high-alpha harvest was still in progress. Predictions for the alpha crop was that it would be a bit spottier in terms of yield and alpha acid percentages would be down slightly. Some high-alpha varieties were plagued with powdery mildew and this resulted in lower yields and quality. Also, some of the US crop might be a bit seedier this year, perhaps because of a windier-than-average growing season. (Wind will transport pollen from wild male hops to cultivated hop yards, where it will fertilize female cones.)

Around the world, the story was pretty much the same — 2008 was a decent year, with the usual ups and downs. Germany's crop was pretty good, with good yields and higher-than-average alpha acid percentages recorded. At the time this article was written, expectations were that yields might be 10–15% above what was contracted for. The Czech Saaz harvest likewise looked good, with good alpha acid levels (in stark contract to last year's crop). Unfortunately, England received some unusual rainfall this year and flooding resulted in lower quality hops (although the quantity of hops met expectations).

The Present and Our Bitter Future

This year, hop prices are expected around $20–30 per pound, much higher than the $2–3 per pound they were in 2006. Homebrewers can expect 2009 to be similar to, or maybe slightly better than, 2008 in terms of hop availability and pricing.

This year, there were a lot of "baby hops" planted, and nothing much came from them. Next year, however, these plantings will be mature hopyards and could yield a full crop if weather conditions are favorable. This means that high-alpha hop availability should stabilize after the 2009 harvest. Aroma hop availability should stabilize after the 2010 harvest. Although farmers have concentrated primarily on expanding their acreage of alpha hops in the past two years, the demand for aroma hops is still growing, thanks mainly to the craft brew industry. And, since aroma hops are harvested before alpha hops, farmers can expand their fields without putting more stress on their processing plants, which are very busy during harvest time.

With the maturing of hopyards planted in 2007 and 2008, and the small expected increase in acreage in 2009, the current hop shortage should be over soon.

AROMA HOP ACREAGE

Country	Existing in 2007	Planted in 2008
Germany	24,997	455
Czech Republic	12,664	-309
United States	10,976	1001
Slovenia	3,415	205
England	1,977	173
Poland	1,942	35
France	1,814	128
Ukraine	1,527	343
China	1,359	74
Slovakia	865	-124
Worldwide	62,860	1,982

HIGH-ALPHA HOP ACREAGE

Country	Existing in 2007	Planted in 2008
United States	19, 934	7,499
Germany	16,378	1,413
China	12,553	336
Poland	3,443	0
Spain	1,216	0
Ukraine	1,021	188
South Africa	1,082	15
Australia	1,067	0
England	642	0
Bulgaria	368	0
Worldwide	59,146	9,474

Source: International Hop Growers Bureau, from report compiled by Sean McGree posted on Brewers Supply Group (www.brewerssupply-group.com). Only the top ten countries in each category are shown.

PROJECTS

on tap

contents

photo by charles a. parker

HOME KEGERATOR

by **Forrest Whitesides**

There are two major steps that both beginner and journeymen homebrewers spend a lot of time thinking about and planning for: brewing exclusively with malted barley (i.e. going all-grain) and kegging their homebrew. In this project, I'll outline the latter as we'll build a basic, two-tap kegerator. It's not a cheap project, but the benefits are tremendous and well worth the money, in my opinion. (The other two projects in this collection of DIY stories are kegerators built for other uses.)

Refrigerator or Freezer?

Before you can get started buying all of the needed hardware, you need to decide if your kegerator is going to be housed in a refrigerator or chest freezer. Using a refrigerator is generally less expensive overall and requires less equipment, but a decent-sized chest freezer can usually accommodate more kegs (and thus taps). Also, used refrigerators can be had for very little money — and in some cases are free if you can pick them up yourself. Check www.craigslist.org for appliance classified ads in your local area. Be aware, however, that old refrigerators consume a lot of power. Although the upfront cost may be right, a newer refrigerator may end up saving you money after a year or so of operation.

I opted to go with a refrigerator because it fit my brewing needs (and available space), required minimal hardware and was less expensive overall than going with a chest freezer. I ended up buying a new unit because I lucked into a model-clearance sale and got it really cheap. It's an "apartment-sized" refrigerator/freezer combo, which looks just like a normal fridge, but it's about 12 cubic feet (0.34 cubic meters) inside instead of the normal 18 cubic feet (0.51 cubic meter) or larger. It's perfect for a two-, three- or even four-tap setup. And the freezer section can be used for long-term storage of

hops, spices, yeast slants and various other brewing ingredients and supplies. A traditional-sized refrigerator can typically hold four or five kegs (and sometimes more). If you plan to have (now or eventually) more than five or six taps, a chest freezer is most likely your best choice. It'll allow you plenty of room to expand over the long haul. I've seen chest freezer kegerators with 10 or more taps.

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

Kegs, Shanks and Faucets

Now that you've got your refrigerator (and a thumbs-up from your significant other), it's time to pick out kegs, shanks and faucets.

Used kegs are the cheapest way to go, and are generally very reliable. You can typically find used, pressure-tested 5.0-gallon (19-L) Cornelius kegs for about $30–40, whereas new kegs run about $100. If you buy used, it is imperative to replace all of the rubber seals before using it for homebrew. It'll only cost about $10 total and will guarantee that your beer doesn't end up tasting like whatever was in the keg before you bought it (usually soda of some sort). Some homebrew shops sell their kegs "reconditioned." This usually means that all the rubber O-rings have been replaced. They also may have been cleaned and it pays to ask what is involved in the reconditioning. Kegs are usually stored under pressure and a quick pull at the pressure release valve on the lid should reveal if the keg is holding pressure.

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

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

There are many faucets available on the market right now, ranging from cheap brass units to high-end stainless with a brushed nickel finish. If you have the money, I highly recommend the forward-sealing style faucets. In a forward-sealing faucet, the flow of beer is stopped near the front of the faucet, not the back as in most faucets. This means that, when you pour a beer, it does not flow through a tap that has beer residue in it that has been exposed to oxygen. They're easier to keep clean (and they look really cool). But any faucet will work, so there's no need to spend a lot on faucets right away.

CO_2 — Hit the Gas

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

PARTS LIST

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

TOOLS
elelctric drill
7/8" hole saw
screwdriver

Balancing Your Draft System

In order for kegged beer to have the correct level of carbonation, it must be stored at the correct temperature and pressure. Most homebrew texts contain a table relating temperature and pressure to carbonation (or see the May 2000 issue of *BYO*).

Most refrigerators keep their temperature around 40 °F (4.4 °C). If you put between 7 and 12 PSI of CO_2 pressure on your beer, it will equilibrate to contain 2.0 to 2.5 volumes of dissolved CO_2 — and this range covers most "normal" beer styles. (See the article concerning priming sugar on page 62 for typical carbonation levels in the most commonly brewed beer styles.)

When you dispense your beer, it moves through your beer lines and, in the case of a tower system, your tap may also be several feet above the keg. The pressure in the keg will push the beer through these resisting factors. If your beer line is too short, beer will be propelled from the tap at a high rate, causing excess foaming in the glass. If your beer line is too long (or your beer needs to be pushed a long vertical distance), the beer will pour very slowly. It will also likely be foamy because the low pressure at the tap will cause CO_2 to break out of solution. Ideally, you want your kegging lines and taps to "absorb" most of the pressure on the beer, but still leave enough force behind the beer so you can pour at a reasonable rate. In the kegerator system we describe here, the relevant resistances are:

vertical height: 0.5 PSI per foot

3/16" beer line: 2–3 PSI per foot

So, if our keg pressure is set at 10 PSI, we want our dispensing path to "soak up" most of this. In our system, the taps are roughly at the same height as the top of the keg, so they won't require any pressure to push beer uphill when the kegs are full. (When almost empty, it would take about 1 PSI.) At 2 to 3 PSI per foot, we would need 3 to 5 feet (1–1.5 m) of beer to supply the proper resistance.

Of course, these calculations are only as valid as the estimates of resistance. In practice, it pays to make the calculation, but begin with a longer-than-calculated beer line and then shorten it, as your experience dictates.

A gas regulator is required as well. It attaches to the cylinder and allows you to set the pressure of the gas imposed on the keg, which is how you set and adjust the carbonation level in the beer. Dual-gauge regulators also show how much pressure is remaining in the cylinder. (This is shown in photo 2.) You should know, however, that the gauge reading tank pressure doesn't start to drop until the tank is almost empty. This is because the cylinder is under pressure and the carbon dioxide inside exists as a mix of liquid and vapor. As long as there is still liquid in the tank, the vapor pressure will be constant. In a refrigerator (at 40 °F/4.4 °C), the pressure will be about 600 PSI. At room temperature, the pressure will be around 850 PSI.

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

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

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

Other Equipment

For each keg in your kegerator, you'll need: a liquid and gas disconnect, a length of gas and beverage tubing, and a pair of hose clamps. Be sure to match your disconnects to the type of kegs you have: either ball lock or pin lock. They are not interchangeable. One other critical piece of equipment for your kegerator is a drip tray. These are usually made of stainless steel and start at around $40, going up for longer trays. For attaching to a refrigerator door, you'll need one that has a mounting bracket (as opposed to drip trays that just lay flat under vertically mounted taps). Instead of screwing mine into the door, I glued some felt-backed magnets to the tray (as shown in photo 3). This makes it easier to remove the tray for cleaning, moving the kegerator, etc.

While not required, you'll also certainly want some swanky tap handles for your faucets. There are many styles available, and they run the gamut on pricing. You can even make your own cast tap handles, as shown in the March-April 2006 issue of BYO.

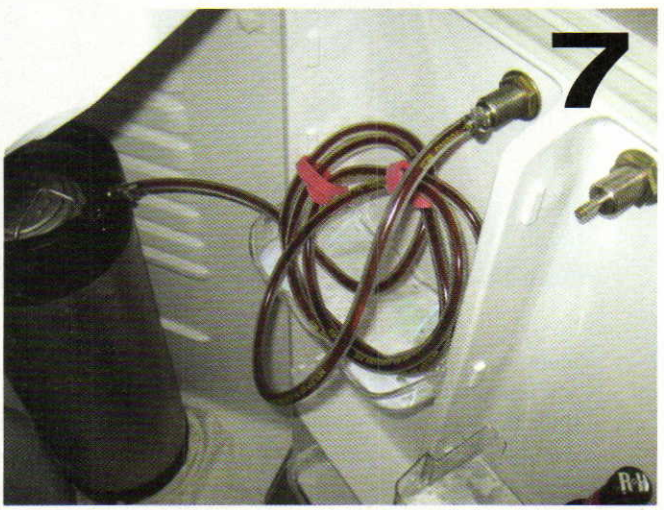
Where Do I Get All This Stuff?

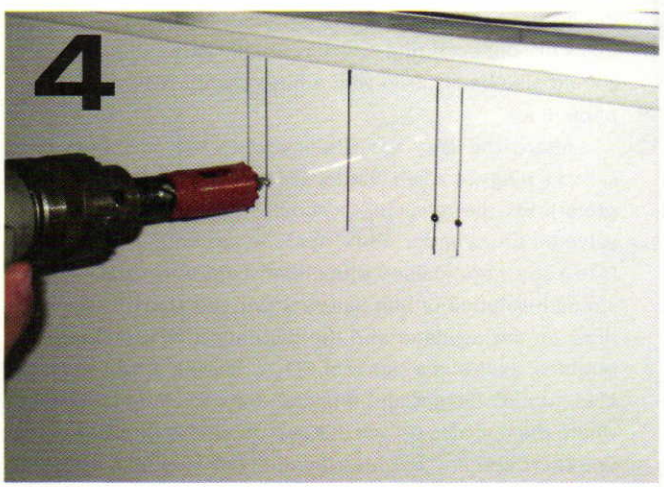
Most homebrew suppliers that stock kegging equipment offer refrigerator conversion kits, and they're usually a little cheaper than buying the parts individually. They also stock beverage and gas tubing and other consumables. There are also vendors that specialize in kegging equipment only, including full kits.

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

Before you buy a brand-new shiny cylinder, be aware that most shops will not fill your tank while you wait. Instead, they will exchange your empty tank for a different full tank, much like how a propane exchange program works. Be sure to ask your local supplier if they will fill your personal tank or if they do exchanges only. It may be cheaper for you to just "buy" one of their tanks and keep exchanging. It's also possible that a shop's cylinder prices will be much higher than can be found online, so you'll need to do some comparison shopping first.

There has been a lot of discussion about the "grades" of CO_2 that are available. Almost any place where an individual can purchase CO_2 in small amounts will be selling food-grade gas. There is also industrial-grade CO_2, which has more impurities than food-grade gas. If in doubt, ask your supplier which grade they sell. My local supplier (County Welding Supply in Wharton, New Jersey) sells both grades and will not sell you industrial grade if you say it's going to be used in a kegerator. A good supplier knows the dif-



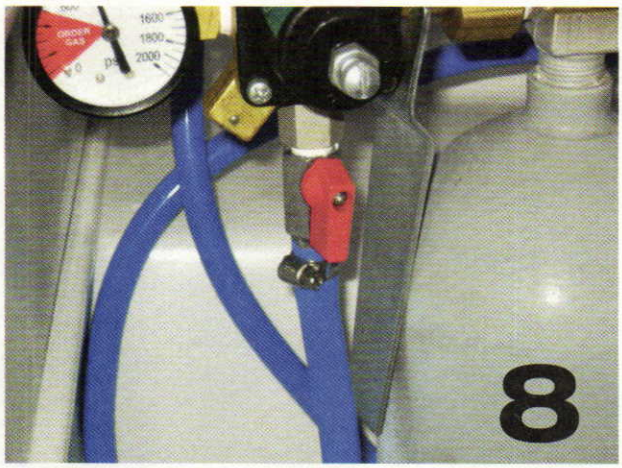


ference and will inquire about the end use of the gas.

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

Convert the Fridge

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



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

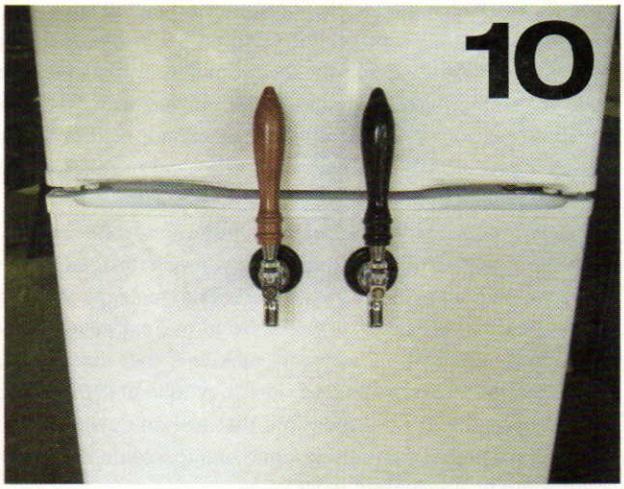
The resulting holes should be a tight fit for the shanks. Work them through the hole and tighten the nuts on the inside of the kegerator (which is what your fridge now is, officially). This can be seen in photo 5. For a little extra thermal security, you can seal the edges of the holes with a little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

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

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

Testing, Testing

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



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

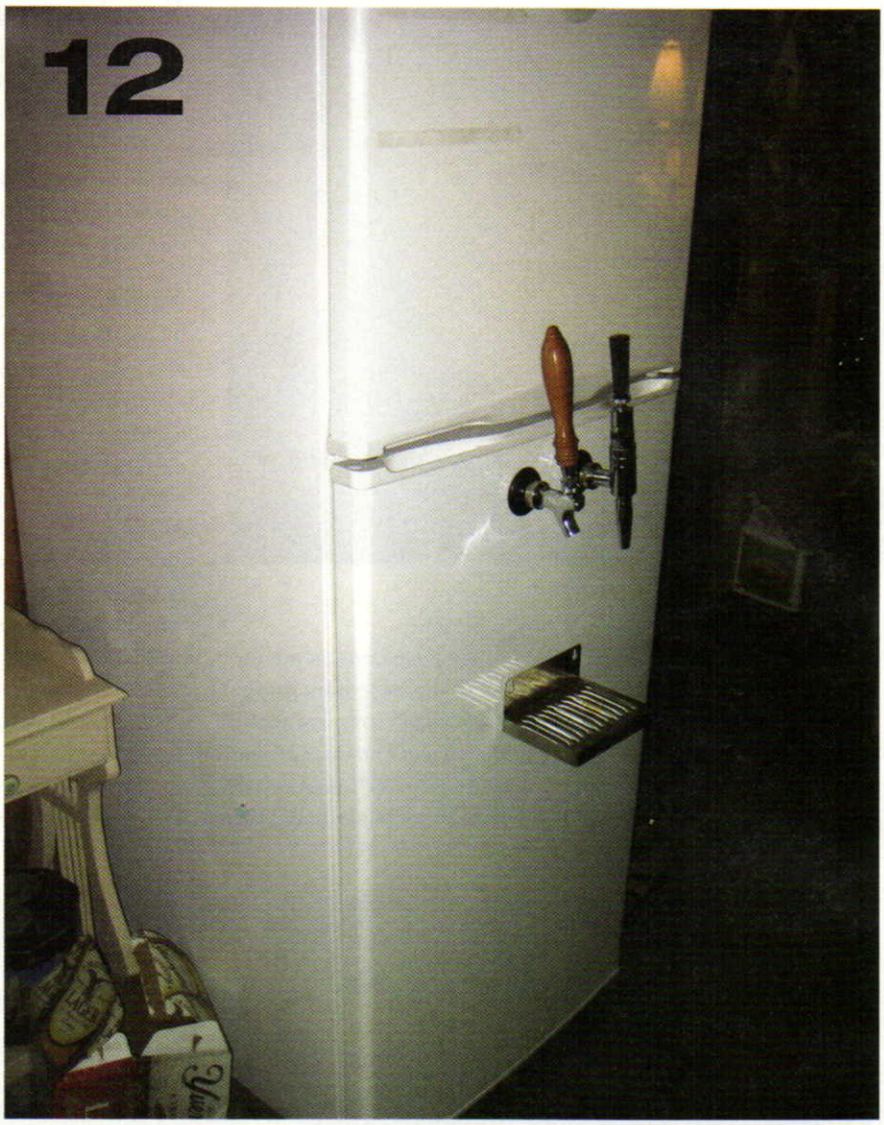
you with an empty cylinder in a very short time.

Now attach the beverage tubing to the hose barb on the liquid disconnect (usually black plastic) and the hose barb on the shank and secure both connections with a hose clamp (as shown in photo 9). As a staring point, use about 10 feet (3.0 m) of beverage tubing. Attach the liquid disconnect to the "OUT" post on the keg, turn the gas back on, put some kind of container under the tap, and pull the handle toward you to open it. The water in the keg will now flow out through the faucet. Watch the beverage "out" side for liquid leaks. Tighten and reseat connections that show any leakage at all.

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

Kegging Time

When your first batch of beer destined to be kegged is ready, rack it over to a sanitized Corny keg. (As an option, you may want to connect the gas to the empty, sealed keg before racking. Dial your regulator down to 3 PSI or so and fill the keg with CO_2 gas. Pull the pressure release valve a couple times to vent it (and get rid of some of the residual air) and let the keg fill again with CO_2. You will hear the CO_2 cylinder creak when you do this. Then, right before you are ready to rack the beer, release the pressure on the keg fully and open it. A "blanket" of CO_2 will hang there in the keg long enough for you rack the beer under it.) Once the beer has been racked, attach the gas and dial the pressure up to serving pressure (typically, around 10 PSI). Vent the keg a few times by pulling on the pressure release valve. This will let gas — a mix of CO_2 and air — out of the headspace and replace it with CO_2. Now go ahead and take a full keg of your homebrew and put it in the kegerator (and giggle with glee about all the time and effort you



saved by not bottling this batch). Let it chill overnight and you can decide how to carbonate it the next day. Cold beer carbonates faster than room-temp beer because CO_2 dissolves more readily as the temperature decreases, so you can't carbonate the beer while it's still warm.

There are a few ways to go about force carbonating the beer. The first way is to set the regulator to 8 to 12 PSI (a common serving pressure range) and let it sit for about a week or so. The gas will gradually dissolve into the beer at the correct serving pressure and once it is, you're ready to go. A faster way to carbonate your beer is to set the regulator to 25 to 30 PSI for a few days and let the beer sit. Then, dial the pressure back down to about 10 PSI when you are ready to serve it.

A "quick and dirty" method (which you might use if you had just chilled the beer and you had guests arriving that same day) is to crank the gas to about 35 PSI then shake the keg vigorously for a minute or so. You will hear the gas cylinder creak as CO_2 is released. Repeat several times, until the creaking diminishes greatly, then dial the gas down to your serving pressure. You can start pouring immediately, but it would be better to wait a few hours to let the gas "sink in." This method isn't ideal, but it will work in a pinch. Expect to have bigger bubbles.

Getting your system in balance takes some trial and error and some patience. Just as a baseline, I recommend starting off with 10 feet (3.0 m) of beverage line and use 10 PSI for the serving pressure. Temperature also plays a role in carbonation: lower temps generally mean more fully dissolved CO_2 (usually less head and foam when poured). The general consen-

sus is that a good serving temperature is between 36 and 40 °F (2.2–4.4 °C), although some styles may warrant a slightly higher temp. And of course, personal taste will be the final deciding factor.

The parameters listed above will get you in the general ballpark and should result in an excellent first kegging experience. For some handy formulas to help get your system fully tuned to your liking, see the side bar on page 32 or check out http://kegman.net/balance.html.

The setup may be intimidating at first, but in no time you'll be enjoying your brew on tap with friends and family. It's a beautiful thing. (The last three photos show the completed project.)

Chest Freezer Option

If you decide to make your kegerator from a chest freezer, the overall project is very similar, but there are two differences.

If you have a chest freezer that opens on top, you can't drill through the front wall of the freezer as there are coolant lines there. So, you have two choices for installing taps — add a collar or a tower.

To make space for the shanks to be inserted, you can install a collar above the lip of your chest freezer. To do this, remove the screws that hold the lid on and remove it. (It will likely have wires running to a light; so be careful not to rip those out.) Then, build a "collar" out of 2 x 6s that rests on the walls of the chest freezer. (Essentially, you make four wooden sides that makes the chest freezer 6 inches deeper.) Screw the chest freezer lid into the collar and drill your shank holes in the wooden collar. Don't drill any holes in the freezer part if you install an drip tray.

Your second tapping option is to install a tower in the lid of the freezers. Towers are fairly pricey (usually starting at over $100) and come in single or multi-tap configurations. Installing a tower involves drilling a hole in the freezer lid and running the beer lines up through it, into the tower, which is bolted to the lid. A drip tray can simply sit under the taps.

Of course, you don't want to serve beer at 0 °F (-20 °C), the temperature of most freezers. As such, you need to install a thermostat. For about $70, you can get a thermostat that plugs into the wall outlet. the freezer is then plugged into the thermostat. A probe monitors the temperature inside the freezer and turns the power on and off to the freezer.

Nitrogen Stout Tap Option

If you are a fan of dry stouts or other styles of beer that can be served from a nitrogen tap, you can also install a stout tap in your kegerator. I'll outline this project (and explain the mechanics of "nitro pours") in an upcoming issue of Brew Your Own. Until then, happy kegging.

Forrest Whitesides' first kegged beer was a milk stout brewed with coffee malt and fermented with a Belgian yeast strain. He has a wanton disregard for style guidelines. In addition to writing the "Projects" column for each issue of Brew Your Own, *Forrest also wrote about building a stir plate in the July-August 2007 issue.*

BRUTUS 10 and me

Mark Skrainar
Indio, California

Mark Skrainar modifed his Brutus 10 to include an inline wort aerator and thermometer after the wort chiller (see inset picture). Mark says, "After reading the article on the Brutus 10, I was more than amped to build my all-grain system and I wanted to do it as soon as possible. I always tossed around the idea of building a sculpture and had many paper and pencil sketches of different designs that I wanted to do. When I read the article, I knew I wanted to do a single-tier system. The plans made it look so easy, and it was. The following day I found myself at the metal shop getting the metal. The welding of the frame structure was done in two weekends. The only time consuming part of this build was rounding up the ASCO valves and other odds and ends. Now after my first brew, I have already started designing some additions that will come in the near future (hard plumbed water lines with a filter that will fill all three kettles and connect into the Therminator via a bypass in front of the water filter). This was an easy project for those of us that have the equipment to weld or for those that can take it to a local welder to build the frame. The rest is up to your imagination. I have to thank Lonnie McAllister for writing and sharing his dream."

In the November 2007 issue of Brew Your Own, we published the plans for Brutus 10 — the single-tier brewery designed by Lonnie McAllister, homebrewer and host of the podcast "Alenuts".

Lonnie's design featured two pumps for moving liquids on brewday and two temperature controllers for maintaining temperature in the hot liquor tank and the mash tun. Clever design elements included the tubing being affixed to the lids of the vessels so brewers could switch from recirculating the mash to running off the wort and sparging simply by moving two lids. The wiring was hidden inside the frame and even the propane gas was routed through one of the hollow stainless steel beams to the burners, giving the design a clean look.

Since then, many *BYO* readers have built their own Brutus 10. Here are a few examples.

To get a copy of the Brutus 10 plans, order the November 2007 issue at brewyourownstore.com

Jeff Kersbergen
Iowa City, Iowa

Jeff says, "I found Lonnie's web site and gears started to move in my brain. About the time of our 16th anniversary, my wife asked what I wanted. I mentioned Brutus and was given the green light to start buying the pieces to put her together.

I'm not much of a welder, but a case of beer will get you a stand welded together (Thanks Keith and Mike). Slowly the parts started to come in and over the course of three weeks it was mostly done. All in all, it was really easy to build! I changed a few things. For example, the stand is a bit taller and the control panel is mounted on a cabinet because the place where I store it is narrow (and it gives me a place to set my beer). The only trouble I had was with the Love temp. controllers; they changed the design and the wiring was a bit of a task, but a phone call to tech support fixed it up. On brew day I put her out in the driveway so everyone that goes by can have a look . . . a few even go around the block to have a second glance."

Wes Barker
St. Joseph, Missouri

When asked why he built his Brutus, Wes said, "What appealed to me was just how much easier it makes the brewday. (That and my wife wanted my beer making out of her kitchen). I love brewing, but it's alot of work. Now all I have to do is swap a few quick connects around, stir the mash a bit and add my hops. Too bad it doesn't make cleanup that much easier, but I'm working on that. I decided to go with the "Tippy-Dump" mash system for ease of dumping the grain. The mash tun is modified with a grain shoot too, as you can see. I went with a high-pressure propane setup as well using 10" Banjo burners. I also decided to go with couplings welded in the side of the keg for my liquid return on each kettle. This lets me use quick connects inside the keg to switch between my sparge ring and my recirculator as well as remove the mash screen. I also did hard piping inside the kegs for the returns. Eventually i want to interchange a spray ball in there for cleanup as well.

"The best part of the build was just the learning involved. The worst part of the build was probably the welding also, I was a little afraid of messing the welding up myself so I subbed it out. The welders thought I was building a spaceship when I first brought the plans to them, judging by the look they gave me.

"This has been the single most rewarding project I've ever undertaken. I swear I stand in the garage for an hour sometimes just staring and marveling at my creation. Brew on!"

CLUB KEGERATOR

by **Tony Profera**

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

Serving 25–35 5.0-gallon (19-L) Cornelius kegs of homebrew to thirsty event patrons over a 6-hour period was becoming increasingly problematic. With a desire to showcase club homebrew at the festival, the organizing committee agreed to fund the materials to build a custom festival draft dispensing system. Two design plans were proposed to the committee. The design selected is actually the smaller of the two! It was quickly determined that the larger design, although impressive, would have blown the budget. So, it was shelved for the smaller design that was approved and has come to be known as "Junior."

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

MEET JUNIOR

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

THE DRAFT TOWERS

"Irish Coffin" style draft towers are made from solid 1" red oak. Equally spaced holes are drilled into the serving side faces of the draft boxes to accommodate the faucets (as seen in photo 1) . The tower's lids remove for access to the faucets, shanks, tail pieces,

and hoses (as seen in photo 2). The interiors of the draft boxes have been coated with several layers of marine grade polyurethane. Interior joints are sealed with aquarium silicone to waterproof the boxes.

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

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

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

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

THE BASE AND BAR TOP

The base framework is made from standard sized 2" x 4" pine and

OVERALL SYSTEM DESIGN FEATURES

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

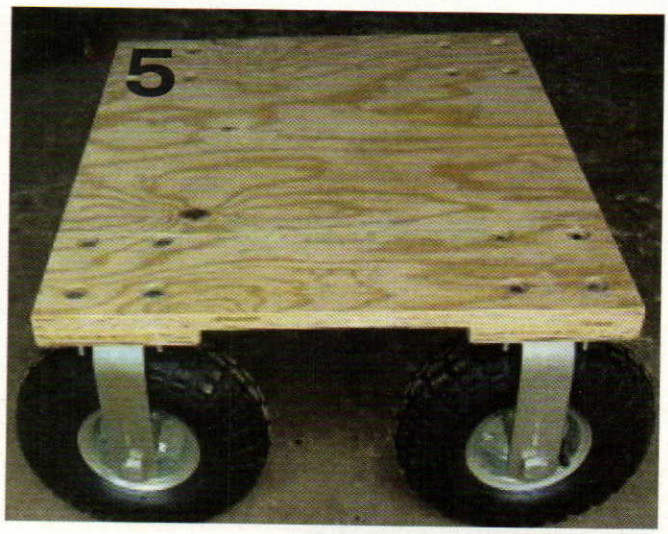
DRAFT SYSTEM PARTS LIST

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

is skinned with ½" oak veneered plywood (as seen in photo 4).

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

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



kegs. The bottom surface of the base has 8 strips of HDPE (cutting board) installed to protect the wood from ground moisture, and scratch damage.

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

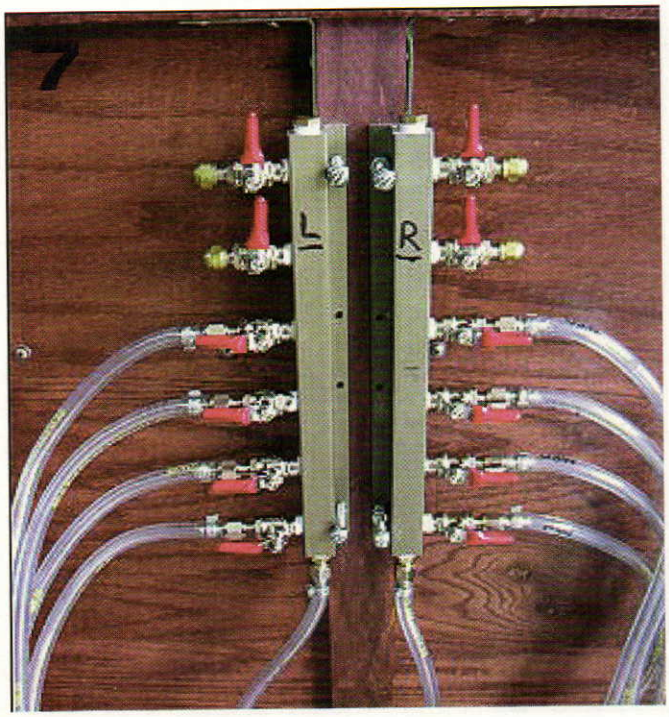
TUBS and CARTS

Large, heavy-duty food service poly tubs are used to hold up to six kegs on ice each. They sit on rolling carts made from 1 ½" marine grade plywood (as shown in photo 5). Non-swiveling cast-

ers with large pneumatic tires were installed to permit the carts to roll in and out to perform keg maintenance without turning the festival site into a mud bog. This works surprisingly well. Sometimes the simplest solutions are the ones that work best.

GAS CYLINDER CART, TANKS and GAS

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

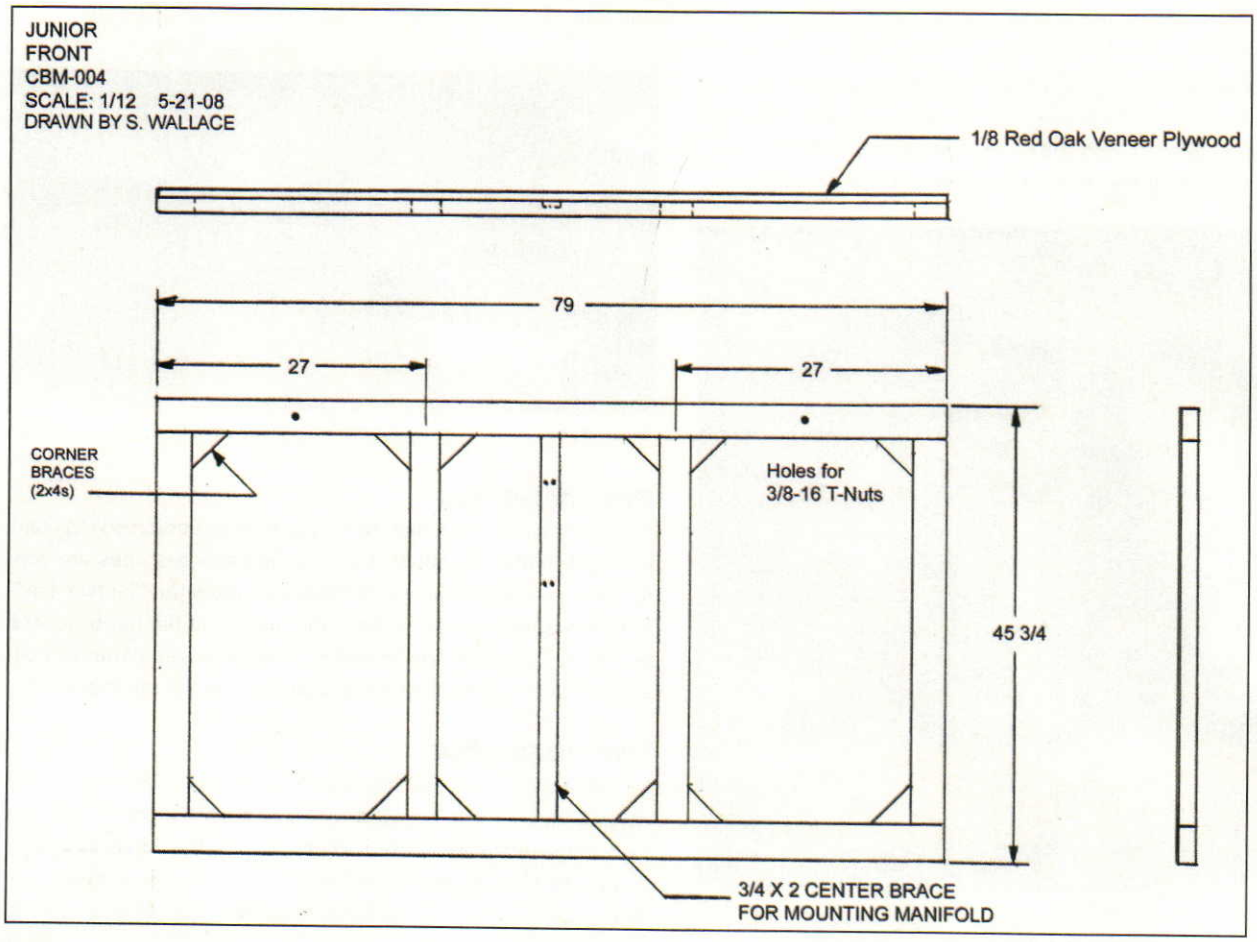


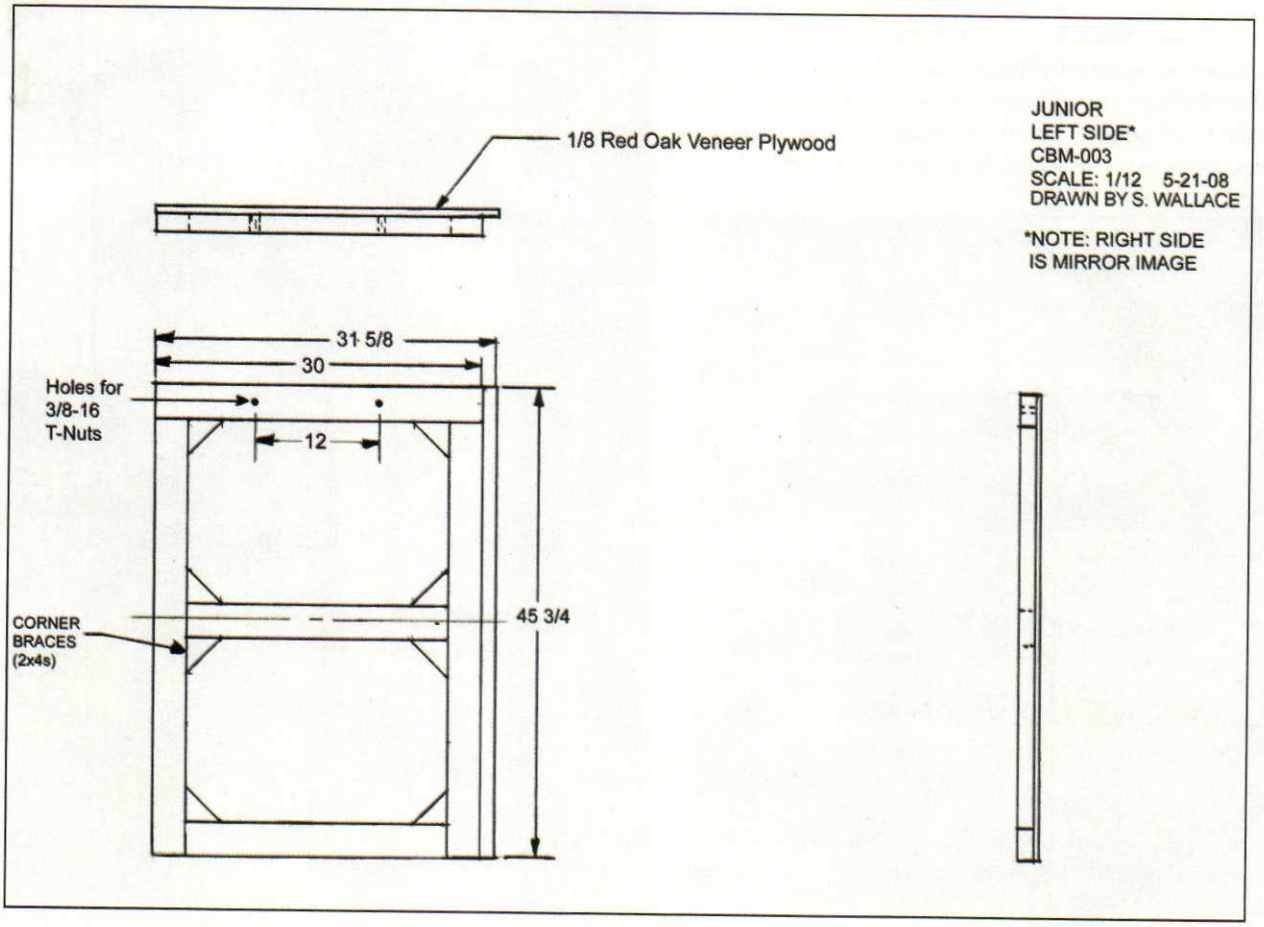
GAS MANIFOLDS

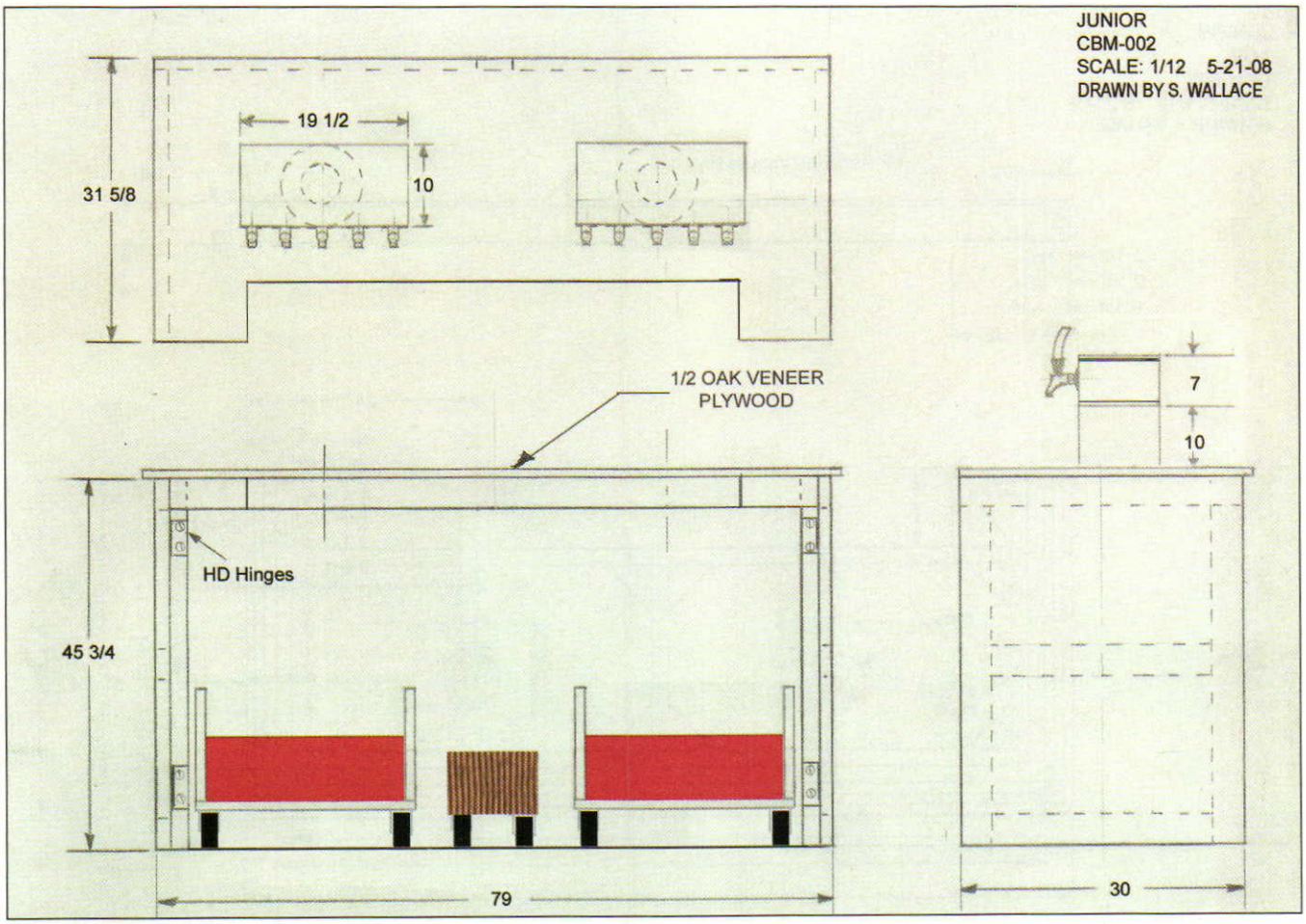
For redundancy, each draft tower has its own dedicated CO_2 tank and distribution manifold. Each of the keg's gas lines are controlled by a shutoff valve with backflow preventer. The two manifolds are bolted side by side to the interior of the bar base, and can be removed for storage and maintenance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

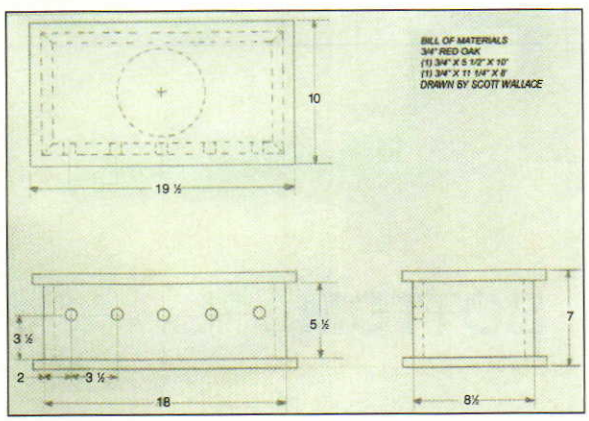
THE HOPINATOR

It's no surprise that we hop heads crave hop flavor! A device called a Randall can be used to infuse fresh hop flavor into any beer. Most often, it is used when pouring IPAs and pale ales. Using a modified water filter housing, the canister is filled with fresh aroma hops (such as Simcoe or Cascades) and the home-


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


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





brew is pushed by CO_2 pressure through a filter bed of hops immediately before the pour. (The idea for, and name of, the Randall originated with the Dogfish Head brewery.) Unfortunately, many Randalls exhibit foaming and flow issues that force their operators to continuously adjust the CO_2 pressure, hop quantity, and hose length before giving up and abandoning its use, or pouring the beer into a large pitcher for sampling once the foam dissipates. A redesign of this system was needed to overcome the obstacles. The Hopinator, as we call it, is the result of that redesign effort. Several design features were employed to improve overall function, ease of use and to reduce foaming.

The beer enters the canister through a custom-machined stainless steel tube. Tube holes are concentrated near the base to force the beer to filter through most of the hops. The Hopinator uses a 9-foot (~3-m) length of thick wall beer line. The beer hose is wrapped around the large diameter support shaft (as seen in photo 11). Extreme efforts were made to keep the beer line from making any abrupt turns, which might cause turbu-

DESIGN DRAWINGS

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

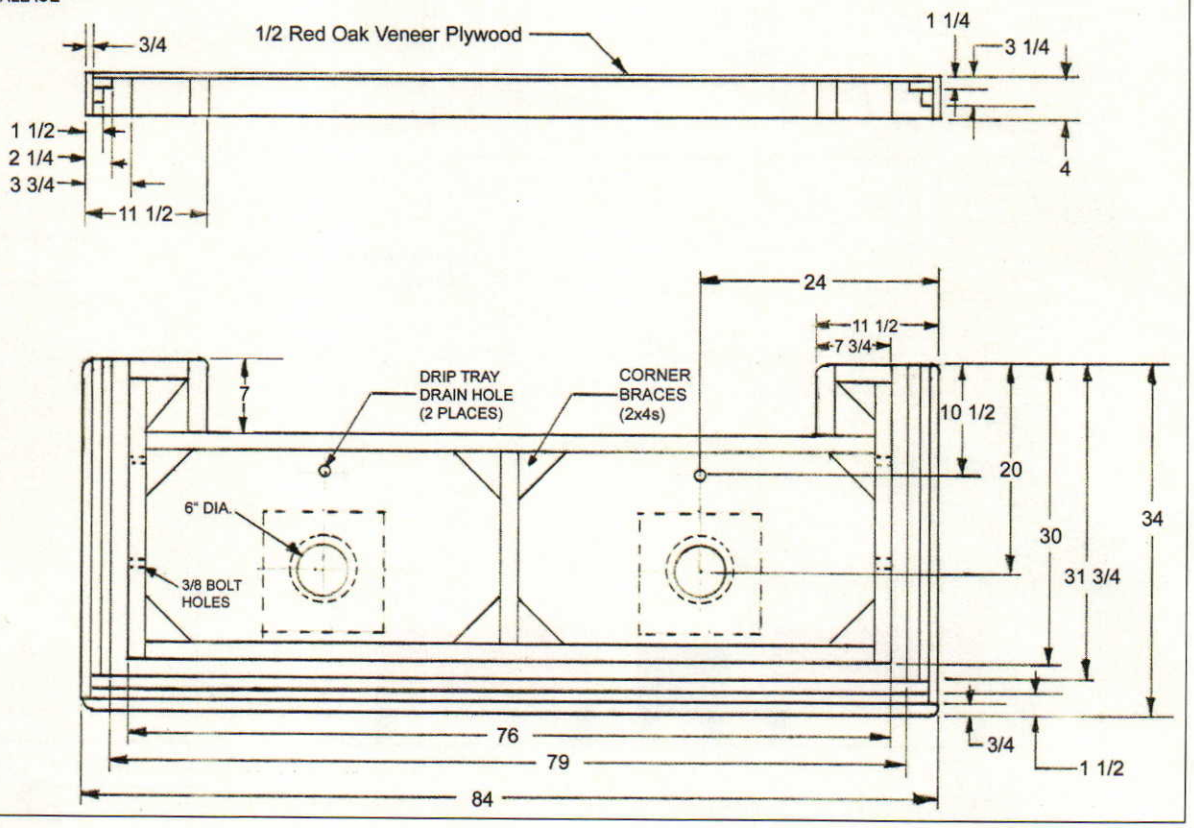
The front and side views of the bar's base can be seen on page 44. The full bar (top, side and back, with towers in place) can be seen on page 45 along with the plans for the Irish coffins (top, front and side). On page 46, drawings of the bar top (with tower placement) and the design of the stainless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

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

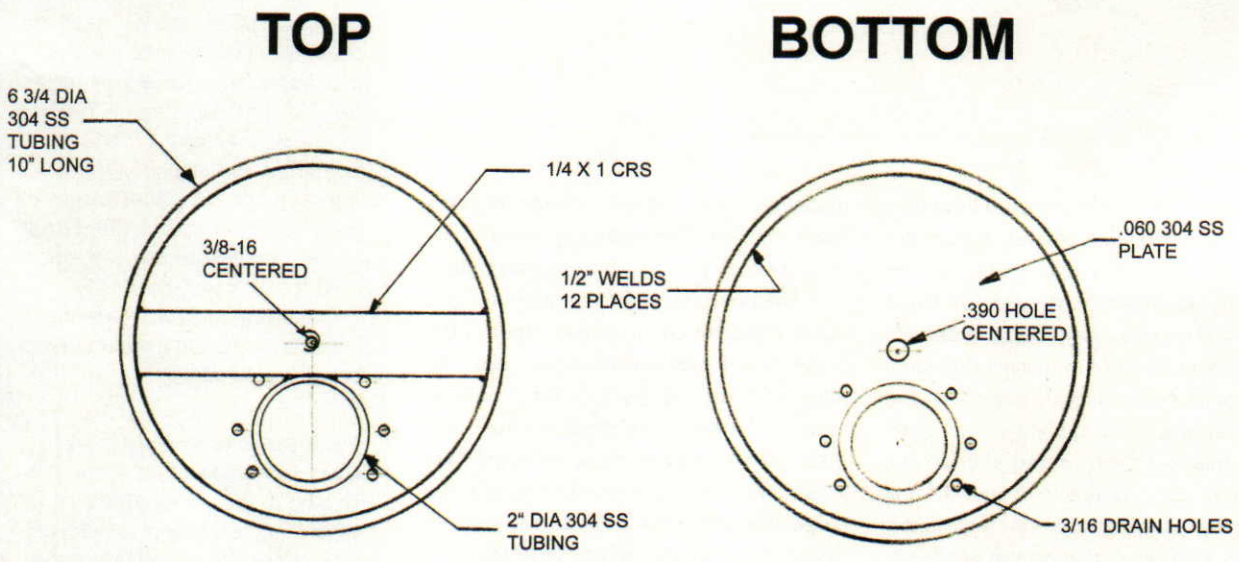
From Plans to Performance

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

JUNIOR
TOP
CBM-005
SCALE: 1/12 5-21-08
DRAWN BY S. WALLACE



JUNIOR
PEDESTAL
CBM-006
SCALE: 1/4 5-21-08
DRAWN BY S. WALLACE



lence. I think it's a great design, but don't just take my word for it, it was one the winners in the 2008 Popular Mechanics DIY Rally Competition. The Hopinator could also be built as a stand-alone project and the full plans for it will be presented in a future issue of *Brew Your Own*.

SYSTEM SETUP, PORTABILITY and STORAGE

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

Tony Profera is a member of the Carolina Brewmasters. This is his first BYO *article.*

by **Kevin Mattie**

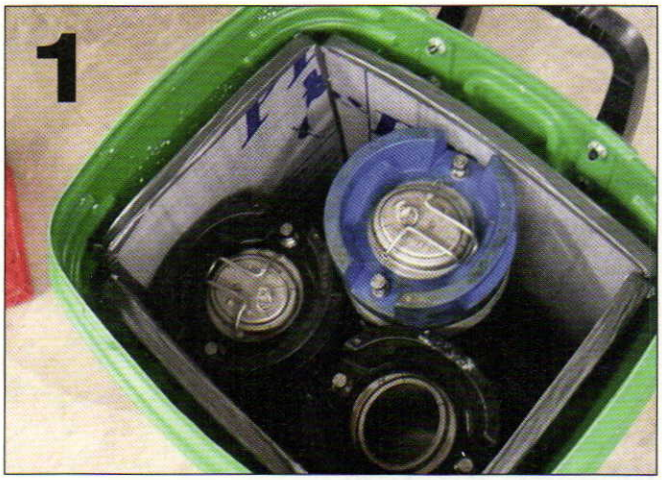
ROLLING KEGERATOR

Like any homebrewer, I find it hard to wander through a department or hardware store without looking at items and wondering, "Could I ferment in that? Would that be good for storing grains? How many carboys could I fit in there?" It's in a homebrewer's nature to adapt everyday items into brewing equipment.

This summer, my wife's parents were celebrating their 50th wedding anniversary. Apparently, the enormous amount of beer I've brewed and served the last two years has earned enough of a reputation that I was on the hook to bring 15 gallons (57 L) of beer for the party. With the party at their house, I couldn't rely on my normal kegging system for serving and had to draw on my DIY skills to come up with some sort of portable keg dispensing system. This was going to be a large Irish family from the East Coast along with local friends and neighbors. I was excited about brewing three good beers that everyone would enjoy. I decided on an Irish red ale, a cream ale and a Belgian wit. All three of these recipes I've brewed before with great success and I knew they were crowd-pleasing beers.

My biggest concern was coming up with a serving system worthy of the event. After all, dropping a couple cornies in a bucket of ice with a picnic tap might be fine for a backyard BBQ or a frat party, but this event was going to be catered, bartender and all. I didn't want Uncle Leo fiddling with a wet, sticky picnic tap and serving himself a cup-o-foam. No, I had to come up with something from scratch, without a lot of scratch.

One day I was walking through the local big box store when I passed by some of those rolling trash bins we all have



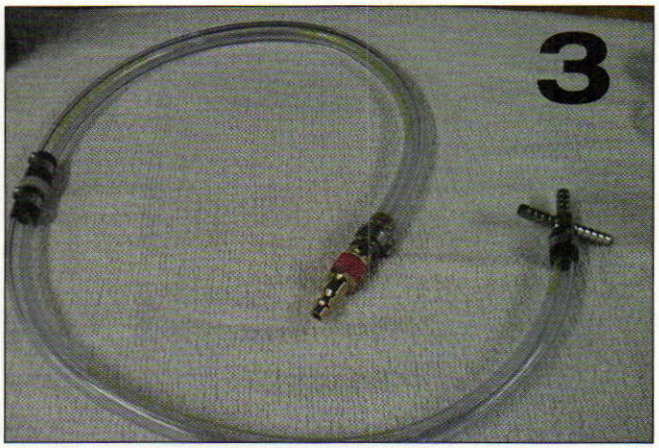
in our garage. Initially I walked by without thought, then it struck me. I back pedaled, pulled one of the cans out into the aisle and peered inside. The homebrewer in me took over. Could it be? Would they fit? I walked over to the hardware section to find a tape measure and initial estimates looked promising. Confident in my measuring skills, I laid down the $19 for the new trash can and headed home.

When I got there, I rolled the rig into my basement brewshop and immediately grabbed three empty Corny kegs. As you can see from photo 1, they fit — even allowing for some insulation. This was going to work just fine. So now it was on with the particulars of designing and assembling the system.

In my mind I broke down the project into three phases; portable CO_2 system, insulated containment and tap setup.

Phase I: Portable Carbon Dioxide System

Rather than breaking down one of my two CO_2 rigs at home, I decided to pick up one of those Kobalt portable CO_2 systems (seen in photo 6) used for pneumatic brad nailers and staple guns. Hey . . . it's the kind of item I need around the house anyway. Plus, the Kobalt system comes with a regulator that is suitable for dispensing beer at a low pressure, although I should point out that the pressure gauge is not really designed to read accurately at the PSI values that beer is served at.



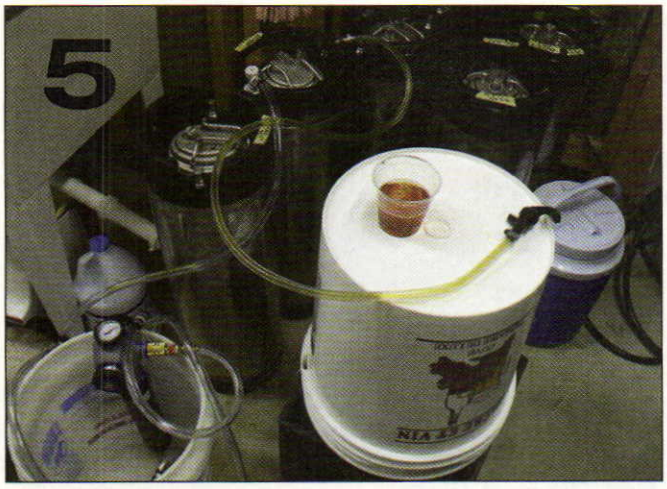
Set Up is a Gas

I also picked up a four-way splitter as well as a hose barb and an additional air-hose disconnect (as seen in photo 3, above).

The first order of business was to assemble the gas lines, splitter and quick disconnect, and then adapt this system to my ball locks. In addition, I installed a check valve to insure we didn't have any beer back-flow into the regulator. I cut three pieces of gas hose and picked up some spare gas disconnects. (These are shown in photos 3 and 4).

PARTS LIST

Rolling garbage can
Kobalt CO_2 system
Four-way splitter, hose barb, air hose disconnect and check valve
4' x 8' sheet 1" foam board insulation
duct tape
construction grade plastic garbage bag
two pieces of wood trim and 8 nuts and bolts
driptray plus two 4" L-brackets
plastic drain valve
the usual kegging stuff



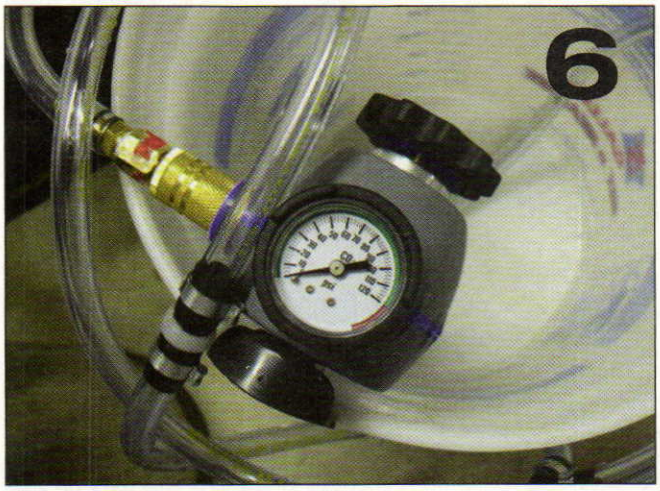
Once I had everything connected, I submerged the hoses into my shop sink and hooked up the CO_2 system to check for leaks. Everything seemed air tight.

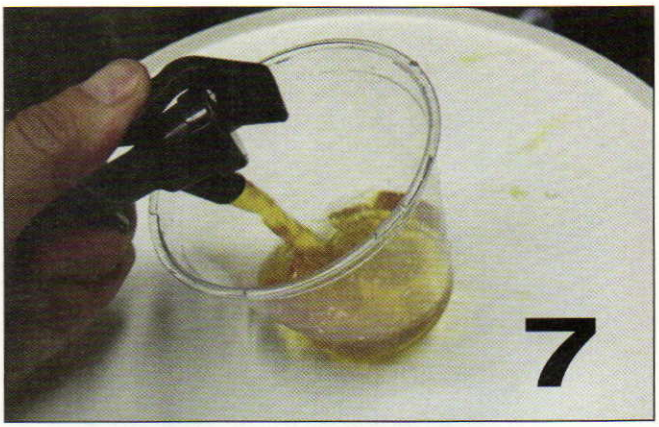
Next (as shown in photo 5, above), I hooked the rig up to one of my filled cornies that was conditioning in my brewshop, along with a picnic tap. Setting this system at 10 PSI was much too high and even using 7 feet of (3/16ths) beer line, the beer flowed too fast and foamed more than I wanted. It was obvious I would have to find the right "feel" for a good pour. I shut off the gas, released the excess pressure from the keg, dialed up the pressure only enough to hear the gas transfer to the keg until the needle came just off of the peg. I retried a sample draw and it worked perfect. (You can see a test pour in photo 7.)

For the details of balancing a kegging system, see the sidebar on page 31.

Rig Ready

I now had a complete, portable CO_2 system that didn't require me to dismantle my home systems. This rig would come in handy at other events like tail gates and local club meetings where the "corny-in-a-tub" was adequate. And, the 9 oz. (255 g) or 20 oz. (566 g) cylinders hold a lot more CO_2 than those little 12 gram CO_2 cartridges. Any local sporting goods store that sells paint ball equipment will refill these canisters for anywhere between $2.50 to $6.00, depending on the size.





Phase II: Insulate the Unit

With the CO_2 system done, it was on to building out the containment system. For insulation, I returned to the big box store and picked up a 4 x 8 sheet of 1" foam board insulation. Using the general outline of the trash can, I cut out sheets of the foam board that would form an interior liner. As shown in photo 8 below, I also lined the bottom of the rig with two sheets of the foam board to provide a more stable base for the kegs.

Put A Lid On It

Knowing that this rig would be sitting out in the hot sun part of the time, I wanted to make sure the top was well insulated and that the beer lines were not exposed to the hot "attic" of the container. I ended up using sheets of the foam board to build a lid, which can be seen in photos 9 and 10. Closed up, this unit should hold temperature very well. To make sure I didn't have to deal with a zillion styrofoam beads the rest of my life, I used duct tape

to wrap the edges. The extra 15 minutes was well worth it. Even with the insulation, the three cornies still fit nicely.

Now this garbage can was beginning to look more like a cooler. I planned to line the interior with two sheets of construction grade plastic bags as additional insulation and to keep my styrofoam from getting water logged. This can be seen in photo 11.

Down the Drain

To help with the breakdown after the party, I decided to install a cheap drain (shown in photo 12) at the bottom. This would also make life easier if I had to refresh the ice during the day.

Phase III: Tap Setup

For mounting the taps I was going to take a basic approach. First I lined up and drilled three evenly spaced holes. To give the taps some reinforcement, I found a scrap section of 3" wide trim wood

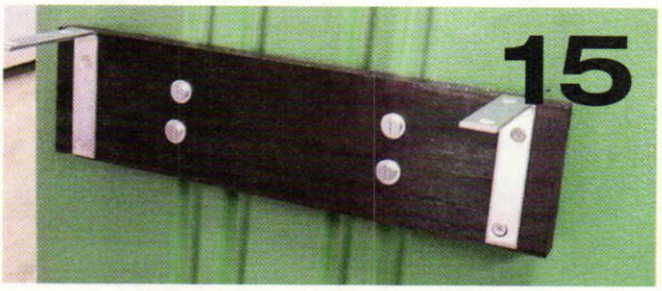
laying around. I mounted the board temporarily with a clamp and drilled out the shank holes (seen in photo 13) and four smaller holes for mounting with machine bolts. This piece of wood (photo 14) was necessary because the thin walls of the garbage container would not allow the shanks to tighten down completely.

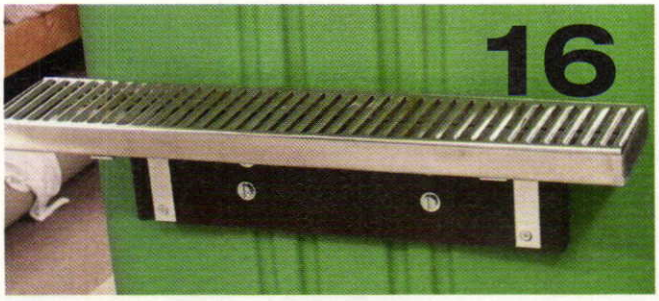
Drip Tray

I still had some wood left over so I decided to cut another piece to mount a drip tray. Using two 4" L-Brackets (seen in photo 15) and some Velcro, the drip tray would add a nice finished look to the rig. I came across some leftover stain and decided to dress up these mounting boards a bit.

There was a nice visual contrast coming together now with a basic green garbage can, some nice mahogany stain and the inviting shine of three taps. No doubt, this rig was going to make people stop and look.

In photo 17 (on page 52), you can see the interior view of the shanks as well as the mounting bolts for the tap support.





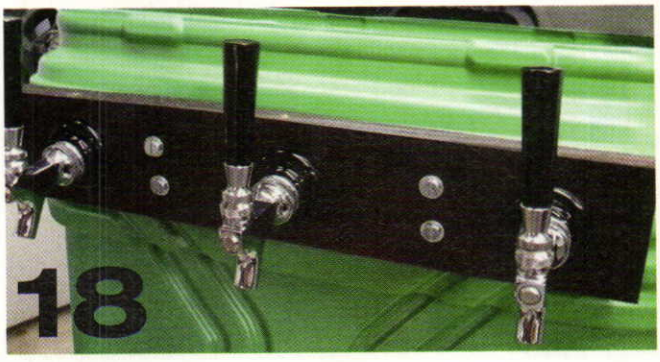
Keeping the black plastic liner pushed over the shanks will insure they stay colder and minimize problems associated with warm taps.

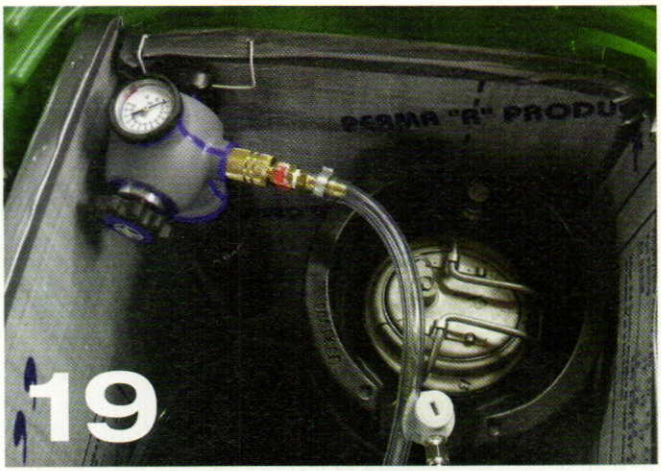
One of the universal questions among homebrewers building a home kegerator system is whether to keep the CO_2 unit inside or outside. I really had no choice because I could not risk a curious partygoer tinkering with my system. This unit had to be inside, hidden from view. The Kobalt system comes with a belt

clip, so to keep things simple, I just took a piece of coat hanger and bent it a few times to form a hook and jabbed the prongs into the insulation wall. (This is shown in photo 19.) It was plenty rigid to hold the CO_2 unit, and would prevent it from moving around or getting submerged in the ice water.

Test Run

This project was quickly coming to the end. My CO_2 system was setup. I had a garbage can that should be insulated enough to rival any good cooler. And I had a three-tap setup complete with hardwood trim and drip tray. Just for grins (and because I didn't want my first trial to be at the event), I decided to drop in a par-





tial corny from my kegerator to do a test run. I gave the corny an hour to settle after moving to avoid foaming. I bled the excess pressure from the keg. I dialed up the CO_2 unit until the needle came just off the peg. I pulled the tap into a cup to flush the lines. I grabbed a clean glass. Tipped it under the tap at 45 degrees. I gave the tap a pull . . . and (as seen in photo 20) there was beer!

Finishing Touches

Aside from a bit of cloudiness due to the yeast being kicked up, I had drawn a perfect pint. This unit was fully functional and ready to roll.

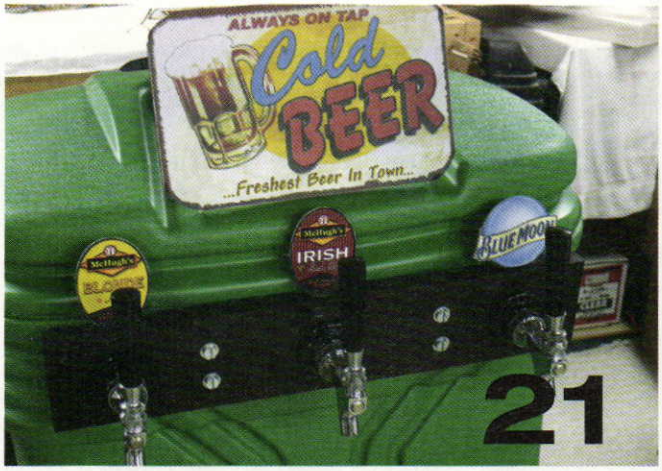
I decided to spruce up the rig with some bar-like adornments. After all, people were going to need to know what they were drinking. I printed off a couple generic labels and came up with a beer sign (as shown in photo 21).

There was no way people were going to pass by this rig without stopping and having a sample.

Roll Out the Kegerator, It's Party Time

Early on the morning of the party I drove over to the in-law's house with my new rig, four filled cornies (I decided to bring a second keg of the cream ale) and some assorted tools. This rig was going to be set outside in the back yard amongst the tables and chairs, beer garden style.

I decided to place it under a large shade tree to minimize exposure to the direct sun. To keep the tap handles at a more



user-friendly height, I decided to go ahead and set the rig on top of two side-by-side milk crates, that were covered with a black plastic bag.

I placed the three cornies into the rig and iced them down. The fourth keg I left in the garage inside my 10-gallon cooler, packed in ice. To prevent any accidents, I decided not to hook up any gas or beer lines until the party started at 5:00 PM. With about 10-hours to rest, the kegs should run clear by the time the party started. I tossed a white sheet over everything, just to try and keep things a bit cooler until the party.

When I returned to the house just before five, the ice was only partially melted and the kegs were nice and cold. I screwed on the tap handles, hooked up the gas and beer lines, dialed up the CO_2 unit and flushed the lines, and posted my beer signs. With fingers crossed, I moved from left to right, testing the flow and carbonation of each beer. The wit, the Irish red and the cream ale all poured smoothly, with the perfect head. Despite my confidence in the system, it was a huge relief to know everything was going as planned.

The garbage kegerator was the talk of the party. By the end of the party we had floated all three kegs and gone through half of the extra cream ale. I should note that replacing a keg half way through requires scooping out some of the ice, but the minimal amount of work was worth it.

Everyone enjoyed the beer. Even non-beer drinkers admired and appreciated the design. The anniversary couple was extremely grateful for such a unique idea. Oh...and Uncle Leo? Well, he is now a huge fan of homebrewed Irish red ale.

This project is easy if you have experience working with kegging equipment. It's made mostly of items you probably already have and everything can be broken down after a party to be returned to its original purpose. You should understand the concept and your final product may vary, but that is what makes DIY projects like this uniquely yours.

Kevin Mattie is a homebrewer from St. Louis, Missouri. This is his first article for Brew Your Own.

by **Bob Taylor**

MAKING SAKE

AH, SAKE: THE JAPANESE ELIXIR so famous for its potency. Often referred to as "rice wine," this refined beverage can often reach 22% alcohol by volume through natural fermentation alone. Steeped in tradition and shrouded in mystery, refined Japanese sake - seishu to the Japanese - is produced through an exotic and complex process perfected through hundreds of years of trial and error. Love it or hate it, sake is powerful mojo indeed.

Dare we attempt to make sake at home? OF COURSE WE DO!

SAKE RECIPE

10 lbs. (4.5 kg) short grain white rice
40 oz. (1.13 kg) Cold Mountain Rice Koji
(2x 20 oz. tubs)
2 gal. (7.6 L) cold water
0.75 tsp. brewer's yeast nutrient
1 pinch Epsom salt
(magnesium sulfate — $MgSO_4$)
1.25 tsp. Morton Salt Substitute
(containing potassium chloride — KCl)
1 pack Wyeast Sake #9 Yeast

What is This Stuff?

Alcohol content and lack of carbonation and hops aside, sake isn't really all that different from beer. Like beer, sake is made from four very basic ingredients:

Water
Rice
Koji
Yeast

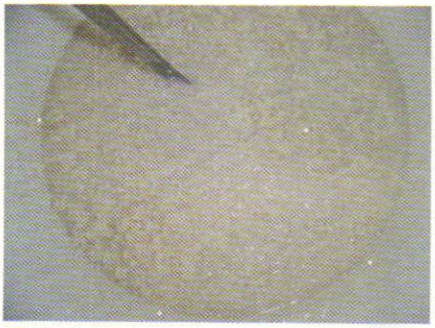
GET YOUR MOTO RISING

When making sake, the first ingredient to consider is water, which is something we're all familiar with. The water used for making sake should meet the same requirements that hold for beer: clean, good tasting and chlorine-free. If the water used for sake meets those requirements, minimal mineral adjustment will be necessary (more on that later).

Rice, of course, is the staple food grain for all of Asia. Japan does not, under any circumstances, export their rice, so getting genuine Yamada Nishiki sake rice is out of the question for even the largest of North America's sake producers. Fortunately, the US grows some excellent quality, hybrid, medium-grain rice. My personal favorite is Kokuho Rose sushi rice, which is grown in California, but any medium-short grain rice you can get your hands on will produce very respectable homemade sake.

Rice for making sake must be milled (polished) in order to remove the husk, germ and bran material. This causes a couple of problems when it comes to making a fermented beverage out of the grain. First, without these parts rice can't be malted, so how can the yeast get the simple sugars they need to ferment our sake?

The answer is koji. A small portion of the rice used to make sake is incubated with the spores of a very specific strain of mold called *Aspergillus oryzae*. This mold is known for its ability to create a lot of amylase enzymes — the very enzymes we need to break down our rice starches and make them available for the yeast. Koji will very likely prove to be the most difficult product to find. Asian grocery stores in your area may stock Cold Mountain Rice Koji next to the miso in their refrigerator. If you can't find that product, you can order koji-kin (koji spores) from Vision Brewing (http://www.visionbrewing.com/sake/) and produce your own koji.



Stir in the koji twelve hours before steaming the tomezoe (final) addition of rice. The bits of koji are slightly darker than the surrounding rice and liquid.

Freshly steamed rice, which is firm, slightly translucent, and only minimally sticky when compared to white and mushy simmered rice.

> "Japan does not, under any circumstances, export their rice, so getting genuine Yamada Nishiki sake rice is out of the question for even the largest of North America's sake producers. Fortunately, the US grows some excellent quality, hybrid, medium-grain rice."

The second problem is that polished rice is very poor in the nutrients that yeast need for a healthy fermentation — particularly magnesium and potassium. For this reason, the recipe on page 55 calls for some salts and brewer's yeast nutrient, which are available at your local homebrew supply store or your local grocery store. These ingredients aren't required — you can make sake without them — but they're not expensive and omitting them will slow your fermentation down and alter the flavor of the finished sake.

Then there is the final ingredient: yeast. Wyeast WY3134 Sake #9 is my choice. In fact, it's the second most commonly used yeast strain by professional sake brewers worldwide. White Labs also produces WLP705 Sake Yeast, which is available each year in September and October. Any neutral white wine yeast is also an acceptable substitute.

Gear Good to Go?

The list of required equipment is surprisingly short, and most of it is probably already in the average homebrewer's equipment kit. You will need a racking cane, vinyl tubing, airlocks, one-hole stoppers and a plastic bucket fermenter, which are probably already in your inventory. Besides basic homebrewing equipment, you'll also need a few pieces of very inexpensive specialized equipment:

- **A steamer.** Multi-tier bamboo steamer baskets are commonly available and dirt cheap. They need to be lined with a layer of cheesecloth to steam rice with them. For even cooking, don't try to steam more than two tiers of rice at a time.

- **One-gallon glass jugs.** These will serve as secondary fermenters and clarifying vessels. I suggest having at least four of them to make rotating through them easier.

- **A small fruit press.** This device, while not required, will make pressing sake from the rice lees later on much easier. If you own one, use it. If you don't own one, you can get away with using your hands to press the lees in a nylon paint straining bag.

Add rice to the moromi after cooling it by thoroughly mixing it with the chilled water.

Strain the fully fermented moromi through a fine nylon mesh bag to separate the kasu (rice lees) from most of the liquid before finally pressing it to extract the rest of the sake.

How Sake is Made

The process itself is where homebrewers are tempted to take shortcuts. At first glance it appears very complex, labor intensive, and intimidating. It's really not that bad! It helps to think of it as all-grain brewing, but with the mash and fermentation happening at the same time over a longer period of time. Like any other complex task, it helps to break things down into steps, and sake has three main steps with only one having a series of sub-steps:

1. Moto. This is a yeast starter. The traditional yamahai moto technique relies on using *Lactobacillus* bacteria to acidify the mash at this point, which is why pasteurization is important later on. The low pH helps to protect the fermenting sake from spoilage.

2. Moromi The primary fermentation, but to get a complete fermentation the mash needs to be built up in stages, with each stage doubling the total amount of the mash:

a. Hatsuzoe. First addition of koji, water, and rice.
b. Nakazoe. Second addition.

c. Tomezoe. Final addition.

3. Yodan The stabilization step where the nigorizake (cloudy sake) is separated from what's left of the rice after fermentation is nearly complete. Water can be added to dilute the alcohol content, and the sake can be fined or filtered to clarify.

One final point of sake brewing that needs to be addressed is temperature control. The Japanese have a long tradition of only brewing sake in the winter months, much the same way German brewers used to brew. This is the "kan-zukuri" or "cold brewing" method. With modern refrigeration equipment, keeping to that traditional timetable isn't strictly necessary, but for the homebrewer on a budget it can help.

Making sake requires frequent stirring, which means an open fermenter, so keeping the fermentation temperature as close to 50 °F (10 °C) as you can get it during primary fermentation is necessary to keep the sake from becoming too sour from runaway *Lactobacillus* activity.

Steamed Rice

Rice needs to be cooked to gelatinize its starch before it can be used to make sake. When dealing with large volumes of rice, steaming is the preferred method of cooking. There are a few reasons for this, but it all boils down to ease of handling. It's a lot easier to steam a large volume of rice than to simmer it, and the resulting cooked rice kernel is much firmer and less sticky than simmered rice, resulting in clumps that are much easier to break up. Steaming also volatizes and removes a lot of the fats that are still present on the outside of the rice kernel, resulting in a more delicately flavored sake.

The process for steaming rice is fairly straightforward.

1. Wash the rice thoroughly in cold water until the runoff is no longer cloudy.

2. Place the rinsed rice in a large bowl and add enough cold water to cover by about three inches. Place this in the refrigerator to soak for 8 to 12 hours, overnight is fine. During this time the rice will soak up the water that will actually cook it during steaming, so it's important to get the right amount of water into the grain. Properly soaked rice is just slightly less than crunchy and breaks up easily, but is not squishy.

3. After soaking, allow the rice to drain in a colander for half an hour while you prepare the rest of your steaming equipment.

4. Place the drained rice in a bamboo steamer lined with cheesecloth (or whatever kind of steamer you own), cover, and steam for 45 minutes. Keep an eye on the water level in the steamer during this long steaming time and add water as required.

Step-by-step: How to Make Sake

Starting with the moto, a basic batch of sake takes about six weeks to complete. There are many steps in the process, so it helps to keep a checklist and a calendar. Here are the basic steps, broken down, for

making sake according to the recipe on page 55.

Moto

1. Prepare 2.5 cups (591 mL) of cold water by adding 0.75 teaspoon of yeast nutrient and a pinch of epsom salt. Stir until dissolved, then add 0.5 cup of koji. Cover the container and store it in the refrigerator overnight.

2. Meanwhile, rinse 1.5 cups of rice and cover with 2 to 3 inches of water. Place this next to the koji in your refrigerator and allow to soak overnight as well.

3. The following morning, drain and steam the soaked rice. After steaming, de-pan and mix the hot rice with the chilled koji and water mixture in your sanitized fermenter, using your clean hands (yes, your hands are the best tool for the job here) to mix and make sure all the rice clumps are broken up. The temperature of the mixture will fall to the 75–80 °F (24–27 °C) range.

Allow this mixture to remain at an ambient room temperature of around 70 °F (21 °C) for two days, stirring twice a day with a sanitized spoon. Over the next 48 hours the koji will work its magic and the rice will almost completely liquefy.

4. After the two days have gone by, cool the rice and koji mash down to as close to 50 °F (10 °C) as you can get it, then pitch the sake yeast. Hold the mash at this cool temperature for the next 12 hours.

5. Once the 12 hours have gone by, it's time to allow the temperature to come back up to the 70 °F (21 °C) range so the starter's fermentation can carry out as quickly as possible. Stir the mash with a sanitized spoon twice a day for the next three days, then once a day for three days after that.

6. The basic fermentation of the moto is completed after nine days. The temperature should again be lowered to 50 °F (10 °C) and the moto allowed to rest for another five days. After those five days pass, the moto becomes ready for the moromi build up.

Moromi

In order to ensure a complete fermentation, it's best not to add all of the rice and koji at once. Just like syruping a wine, gradually adding the fermentables coaxes the yeast into going above and beyond their usual alcohol tolerance. Rice, koji, and water are added three times over a period of four days.

Hatsuzoe

1. The first addition of rice will be 2.5 cups, which needs to be rinsed and covered with water to soak twelve hours before you plan to steam it. While you're rinsing the rice, stir 1 cup of koji into the moto.

2. The next morning, steam the rice for this addition. While steaming, dissolve 1.25 teaspoon of Morton salt substitute in a little warm water (this is the only time you will need to do this), then add enough cold water to make a total of 2.75 cups (651 mL). Place this in the refrigerator to chill until the rice is done.

3. After the rice is finished steaming, de-pan it and mix with the chilled water from step two. Use your clean hands to break up all the clumps and then, when the temperature of the rice drops below 85 °F (29 °C), mix it into the moto. The temperature of the moromi mash should settle somewhere in the 70–74 °F (21–23 °C) range. Keep the mash at room temperature and stir every 2 hours for the next 12 hours, then twice a day for the next 36 hours.

Nakazoe

1. On the evening of the day after you started the hatsuzoe step, prepare 6 cups of rice for steaming. At the same time, stir 1.5 cups of koji into the moromi mash.

2. Steam the rice the next morning as usual, then de-pan and add 8.75 cups of well-chilled water. Mix well and, as before, add it to the moromi when the rice is sufficiently cool.

Tomezoe

1. Immediately following step two of nakazoe, allow the moromi to rest at room temperture for twelve hours, then stir in all of the remaining koji (20 ounces). Afterward, wash and soak all of the remaining 5 pounds of rice for the final addition.

2. The following morning, drain and steam the soaked rice. Work in batches if necessary, this is a lot of rice for even the most ambitious of steamers. The freshly steamed rice will need to be mixed with 1 gallon plus 1 cup (237 mL) of cold water before being added into the moromi.

3. Let the moromi, now at nearly 4 gallons (15 L) volume, rest overnight at room temperature. You can observe the odori or "dancing ferment," which is sake's version of the high kräusen that homebrewers are familiar with.

Now that the moromi is built up and fermentation is well underway, it's time to get the temperature down. Move the fermenter to a location that will maintain it at as close to 50 °F (10 °C) as possible and allow it to ferment undisturbed for the next three weeks.

Yodan

As the fermentation nears its close, it wouldn't be a bad idea to keep an eye on the specific gravity. Once the gravity has dropped below 1.000, it is time to separate the sake from the rice lees (called kasu). Use a racking cane to siphon the cloudy nigorizake out from under the floating cap of kasu and into sanitized one gallon glass jugs until you can't draw off any more liquid. Things will tend to clog up here, and that's okay, you can just pour the remaining liquid and kasu into a nylon straining bag and use either your hands or a small fruit press to extract as much sake from it as you can. Aeration isn't a huge concern here because there is still a little bit of active fermentation going on to help clean things up, but do try to keep things sanitary and splashing to a minimum.

Secondary, Clarifying, Maturing and Packaging

You should now have about three gallons of milky white nigorizake with an alcohol content somewhere between 18% and 22% by volume. Put stoppers and airlocks on the secondary fermenters and keep them at 50 °F (10 °C) so they can finish fermenting. In a couple weeks the cloudy rice particles will settle into a fluffy white layer of sediment on the bottom of each jug and

you can just siphon the clear sake off into another sanitized vessel.

At this point in the process, you will have pale yellow sake that is no longer milky, but can't quite be called clear. To render it brilliantly clear (and largely colorless), commercial sake producers use activated charcoal filters. For homebrewers, take a page from the winemaking book instead: bentonite. Used in a ratio of ½ teaspoon per gallon (3.8 L), bentonite finings will remove most of the haze from homebrewed sake in a matter of days.

To use bentonite, start with 8 fluid ounces (237 mL) of very hot water and slowly whisk in 1.5 teaspoons of granular bentonite. Once it has become a smooth slurry, divide it evenly between your containers of hazy sake, cap, and gently shake to distribute. In about three days, all of the bentonite will have settled out, taking almost all of the haze particles with it.

While you're at it, there's no reason why you can't stabilize the sake by pasteurizing it immediately after adding the finings. It's very easy to do. Place your jug of sake in a pot large enough to hold it plus a water bath, then add enough tepid (to avoid shocking the glass) water to come up to the shoulder of the jug (or the pot if the jug is much taller than the pot). Place a thermometer down the neck of the vessel and apply heat. Watch the thermometer carefully, and when it reaches 140 °F (60 °C), remove the sake from the water bath, take out the thermometer, and cap the sake tightly. Allow the pasteurized sake to cool completely before refrigerating.

Once pasteurized, you can bulk age sake like this for up to six months before siphoning into smaller bottles and re-pasteurizing. Clarified, double-pasteurized sake has a shelf life of up to a year at room temperature, and considerably longer if kept refrigerated and away from light.

Conclusion

Once you know the technique, where to find the ingredients and have a few pieces of inexpensive equipment, making a batch of sake can be rewarding. For more information, visit my Web site http://www.taylor-madeak.org.

Bob Taylor is a homebrewer from Anchorage, Alaska. This is his first feature story for BYO.

Sake Glossary

doburoku - Traditional Japanese homebrew sake. It is not filtered (at all), unpasteurized, and often fermented at room temperature.

genshu - "Undiluted" or "full-strength" sake, to which no water has been added to decrease its alcoholic strength.

ginjo - "Premium," which means any sake made with rice that has been polished down to no more than 60% of its original weight.

hatsuzoe - "First addition." This refers to the first addition of rice and koji to the main sake fermentation.

junmai - "Pure" or "all-rice" sake that has been made with only water, rice, koji, and yeast.

kan-zukuri - The traditional "cold brewing" method of making sake, which refers to keeping the fermentation in the low 50 °F (10 °C) range.

kasu - Sake lees. The bits of rice that the koji couldn't break down, which are separated from the sake through pressing.

koji-kin - *Aspergillus oryzae* mold spores.

kome-koji - Rice that has been incubated with koji-kin and is ready to be used to make sake.

moromi - The sake's primary fermentation mash.

moto - The yeast starter step in making sake, also called shubo.

muroka - "Unfiltered sake." Sake that has been separated from the nigori by decanting, but has not undergone the usual charcoal filtration (or bentonite fining).

nakazoe - "Second addition." This refers to the second addition of rice and koji to the main fermentation.

nigorizake - "Cloudy sake." Sake that has been pressed from the kasu lees, but not separated from the finer rice particles and yeast.

odori - "The dancing ferment." This refers to the very fizzy nature of the sake's primary fermentation.

seishu - The "official" Japanese name for sake.

shubo - The yeast starter stage in the sake brewing process. Also called moto.

tomezoe - "Final addition." This refers to the third and final addition of rice and koji to the sake's primary fermentation.

yodan - "Stabilizing addition." The step following moromi in which water or koji and rice can be added to sake to adjust its final alcohol content and flavor profile.

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Priming

Getting the bubbles into the brew

by Jon Stika

Once fermentation has finished and your beer has conditioned, it's ready to drink except for one thing — carbonation. Fermented beer stored at atmospheric pressure retains some dissolved carbon dioxide (CO_2), but not enough to provide the "fizz" expected in a beer. The way most homebrewers add carbonation is by transferring their beer to a pressure vessel — a keg or bottles — and adding priming sugar. The sugar is fermented, the CO_2 is trapped and this carbonates the beer.

Priming a batch of homebrew can be as simple as adding a standard ¾ cup of sugar to a 5-gallon (19-L) batch of beer, racking it into some bottles, applying a cap . . . and waiting. This is how most beginning homebrewers package their brews as they learn the ropes of making their own beer. But for most homebrewers, the time will come to move beyond the basics and explore the world of beer as you perfect your craft. Priming, as defined in *The Homebrewer's Answer Book* by Ashton Lewis (a.k.a. BYO's Mr. Wizard) is, "the practice of adding sugar to fermented brew before bottling to reintroduce fermentation and carbonate the brew in bottle." On our quest to discover the many styles of beer and advance from making good beer to making great beer, it often becomes necessary to take a closer look at even the simplest aspects of brewing — priming included.

Upon close examination of the process of priming your beer there are several questions that may arise. What are the different methods of priming beer? What is the appropriate level of carbonation for a given style of beer being brewed? What type of fermentable sugars can I use for priming? How much priming sugar should I use and how should it be prepared? Is a different approach necessary when priming beer that is destined for a keg instead of a bottle?

Photo by Charles A. Parker

Priming with sugar

There are several approaches to priming a batch of beer that vary by both complexity and ingredients. The simplest method, outlined at the beginning of this article, is to add a certain amount of refined sugar to achieve a target level of carbonation. To do this accurately, you need to take into account the carbon dioxide already dissolved in the beer, which can be estimated from the temperature of the beer. More gas dissolves into cold liquids than into warm liquids.

The basic process of using anhydrous glucose, glucose monohydrate (two forms of dextrose a.k.a. "corn sugar") or sucrose (a.k.a. "cane" or "beet" sugar) to prime a batch of beer destined for bottles can be found on the *Brew Your Own* Web site at http://www.byo.com/referenceguide/primingchart/. This chart allows you to determine the amount of priming sugar needed to hit the desired level of carbonation. Typical carbonation levels by beer style are also given to provide a guide to determine a target to shoot for. If you ferment 5.0 gallons (19 L) of ale at 70 °F (21 °C) and add 0.75 cups of corn sugar (glucose monohydrate), which weighs about 4 oz. (113 g), you will yield about 2.2 volumes of CO_2 — an amount at the top of the scale for most English-style ales and at the bottom for most American-style ales.

If you are wondering what volumes of carbon dioxide are, volumes are a means of measuring CO_2. Because all beers range in carbonation levels, one way to measure those levels is by volume. Most beers have around 2 to 3 volumes of CO_2 and the most common measure is 2.5 volumes. Volumes of CO_2 do vary significantly by style, however. For example, some British ales can have 1.5 volumes, which may seem nearly flat, while some Belgian-style ales can reach up to 4 volumes — and German weizens can be anywhere from the average 2.5 all the way up as high as 5 volumes. You can also measure CO_2 on a scale of grams of carbon dioxide per liter of beer. The average carbonation level of 2.5 volumes is roughly 5 grams per liter, 2 volumes is about 4 grams and 3 volumes is about 6 grams per liter. Refer to the chart on page 64 for some common styles and their levels of carbonation.

After determining the desired amount and type of sugar needed, bring a pint of water to a boil, remove from the heat source and slowly add the sugar to the water, stirring to dissolve. Bring the solution back to a gentle boil for 15 minutes to sanitize it, cover and let cool. This process can be accelerated with a cold water bath. Then add the sugar solution to a sanitized bottling bucket and rack the finished beer into the bucket before transferring the primed beer into sanitized bottles and capping them with sanitized caps. If you rack the beer into the priming sugar, it should dissolve evenly. If you add the sugar to your beer, you should stir it lightly for even distribution. To use this method of priming when packaging beer in kegs, simply use half as much priming agent as necessary for bottling.

When you rack the beer to your bottles, put a cap over each bottle as quickly as is feasible. Then after you have filled a few bottles, crimp the caps. The less oxygen you expose your beer to during bottling, the better.

Priming with PrimeTabs™

Another fairly simple approach to priming is the use of PrimeTabs™ and Cooper's Carbonation Drops. These are sugar tablets that can be added to bottles containing beer right from the secondary fermenter. The tablets are proportioned so that a set amount of the tablets in a twelve ounce bottle produce a specific level of carbonation. (See the carbonation priming chart for information regarding volumes of CO_2). For example, three PrimeTabs™ per twelve ounce bottle would provide a degree of carbonation a little over two volumes of CO_2, and four or five tablets would result in a level of carbonation close to three volumes of CO_2 similar to the level of carbonation in most American lagers. The greatest advantage of the Cooper's drops and PrimeTabs™ is the convenience of not having to measure or boil a sugar solution and mix it into the beer in a separate vessel. The finished beer may be racked directly from the secondary fermenter into bottles and then

A simple approach to adding priming sugar to your beers is by using PrimeTabs™. These dextrose tablets work exactly the same as adding priming sugar, but are already premeasured to provide certain levels of carbonation per tablet when added to a 12-oz. bottle.

Cooper's Carbonation Drops are hard sugar priming drops that are used at a rate of 1 drop per 12 oz. bottle or 2 drops per 22 oz. bottle.

the desired number of tablets added to each bottle prior to capping.

Priming with malt

But what if you wish to make a truly "all malt" beer instead of one primed with non-malt sugars? Priming with malt is most certainly an option, depending on how you wish to prepare the malt to do the job. The easiest method of priming with malt is to prepare a solution of dried malt extract in the same manner as for dextrose or sucrose. However, since dried malt extract is not equal to dextrose or sucrose in terms of extract weight or fermentability — and the resulting production of carbon dioxide — you will need to use a greater amount of malt extract than sugar to achieve the same degree of carbonation. Therefore, it takes more dried malt extract (DME) to provide the same priming power of dextrose. As a rough guide, 1.25 cups of dried malt extract would be the equivalent of 1 cup of regular corn sugar (glucose monohydrate). (The exact amount would vary with the fermentability of the extract.) If you plan to use liquid malt extract (LME) instead of dry malt extract, you will need to use 1.15 times as much LME as DME to account for the 15% difference in moisture content between LME and DME. If you are using LME, it would be better to weigh it out rather than measure it by volume.

Another method of priming with malt is to reserve some fresh wort (gyle) from a batch of beer being brewed and store it cold in a sanitized container to be added back at priming time. This particular method is not recommended for bottling as it is more difficult to precisely determine the fermentability.

A similar yet also tenuous method for an average homebrewer (and therefore limited to kegging rather than bottling) to prime beer is to package the beer before fermentation is complete. If a particular recipe is known to finish at a certain specific gravity, the vessel could be closed before that final specific gravity is reached, allowing the remaining sugar to ferment in a closed vessel to provide the

necessary carbonation.

Priming with this technique requires careful monitoring of specific gravity as fermentation proceeds in order to transfer the beer from fermenter to keg at the proper time. Once kegged, the pressure must be closely monitored, and any excess pressure relieved as necessary until fermentation is complete.

Kräusening

Last, but most certainly not the least method of priming your brew, is the traditional method known as "kräusening." Kräusening is performed by adding beer that is at "high kräusen," or peak activity, of primary fermentation to a finished batch of lager beer.

The still-fermenting dose of beer adds both sugar and active yeast to a batch where fermentation is otherwise complete, providing the final amount of carbon dioxide to carbonate the beer. Kräusening has the same issues as priming with gyle or packaging a still-fermenting beer in that it is difficult to determine precise fer-

Levels of Carbonation in Various Beer Styles

Style	Volume of CO_2
American Ales	2.2–3.0
British Ales	1.5–2.2
German Weizens	2.8–5.1
Belgian Ales	2.0–4.5
European Lagers	2.4–2.6
American Lagers	2.5–2.8

Different styles of beer are typically carbonated to varying levels. In homebrew, the level of carbonation is altered by adding more or less priming sugar to your bottles or storing your kegged beer under different amounts of CO_2 pressure.

mentability of the priming agents involved.

This method should also be reserved for kegging rather than bottling, as the final level of carbonation is difficult to determine precisely with equipment available to the average homebrewer. This method of priming may be particularly suited to a high gravity beer where a fresh infusion of yeast at the end of normal fermentation will not only carbonate the beer but help condition it as well. The conditioning of the beer by the yeast may help reduce diacetyl (i.e. butterscotch), hydrogen sulfide (i.e. rotten egg) and acetaldehyde (i.e. green apple) that may be present in the beer. While this conditioning is carried out by the yeast regardless of the method of priming, kräusening supplies yeast at peak activity along with unfermented sugars from the malt to help them do the job.

Conditioning

Once the beer is primed, you want the yeast to ferment the sugar as quickly as possible. As such, it helps to keep your bottles in a warm location for awhile after bottling. If you can hold the bottles at 75–80 °F (24–27 °C), the refermentation should occur in three to four days for regular-strength ales. (For strong ales or lagers, the health or density of yeast is likely less and bottle conditioning may take longer). Because such a small amount of sugar is being fermented, you don't have to worry that the warm bottle conditioning will make your beer estery, as it would be if you fermented the entire batch warm. Once the yeast has consumed the sugar, store the bottles in a cool location — preferably refrigerated — a few days before serving.

Priming your homebrew can range from using a simple scoop of table sugar to the traditional method of kräusening. If you are ready to advance beyond the basics, it may be time to take another look at this final step of the brewing process.

"Kräusening is performed by adding beer that is at 'high kräusen,' or peak activity of primary fermentation to a finished batch of lager beer. The still fermenting dose of beer adds both sugar and active yeast . . ."

Jon Stika is a homebrewer from North Dakota. He writes "Techniques" for every BYO.

The Outer RIMS

Building Brutus Ten with some sci-fi twists

Advanced Brewing

by John Palmer

I have often thought over the years that, being a world-famous home brewer, I probably should have an equally world-class home brewery. The trouble is, I really like the simplicity of a three-tier gravity fed system. And, as much as I like the ability to directly heat my mash pot to do step temperature rests, I really like the simplicity of a single infusion mash in a 10-gallon (38-L) round beverage cooler. My wife might say that it's due to laziness, but honestly, it's an appreciation of simplicity and elegance. Still, I am an engineer, and the drive to create a technological monster was inescapable.

I was greatly enamored of the Brutus Ten system that Lonnie McAllister described in the November 2007 issue of BYO and decided to build a system like it.

Requirements

1. I wanted precise control of mash and wort temperature. Fortunately, that is the stated virtue of RIM (Recirculation Infusion Mash) and HERM (Heat Exchanging Recirculating Mash) systems. However, two things about these common systems bothered me: First, that I already owned three burners and three vessels, and didn't want to mess with an electric heating element, and secondly, the risk of overheating the wort and denaturing enzymes in the exchanger while heating the mash. Therefore I wanted digital temperature control of the wort temperature as it exited the heat exchanger.

2. I wanted temperature controllers for the mash tun and hot liquor tank. The boil kettle could be manual.

3. I wanted to use a single pump to keep the cost down.

4. I wanted to stand at the control panel and throw switches during the brew cycle, instead of redirecting hoses.

5. The rig had to be easy to take apart and clean at the end of the brew day, because I am keen on simplicity and elegance.

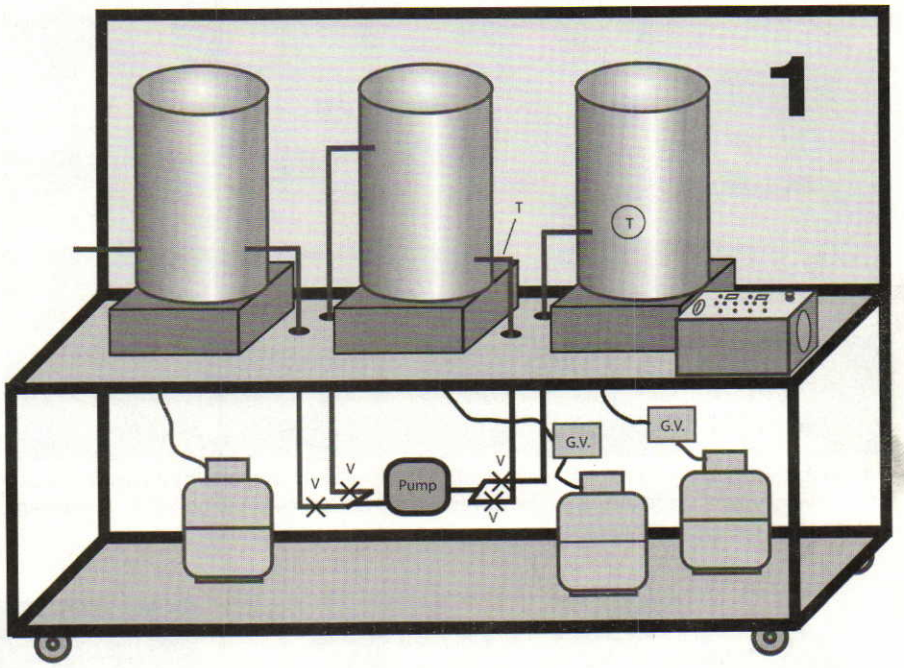

Figure 1: A schematic of my RIM system. The wort flow valves are indicated by the Vs. The thermocouples for the temperature controllers are indicated by the Ts. Safety chains and fine details not shown.

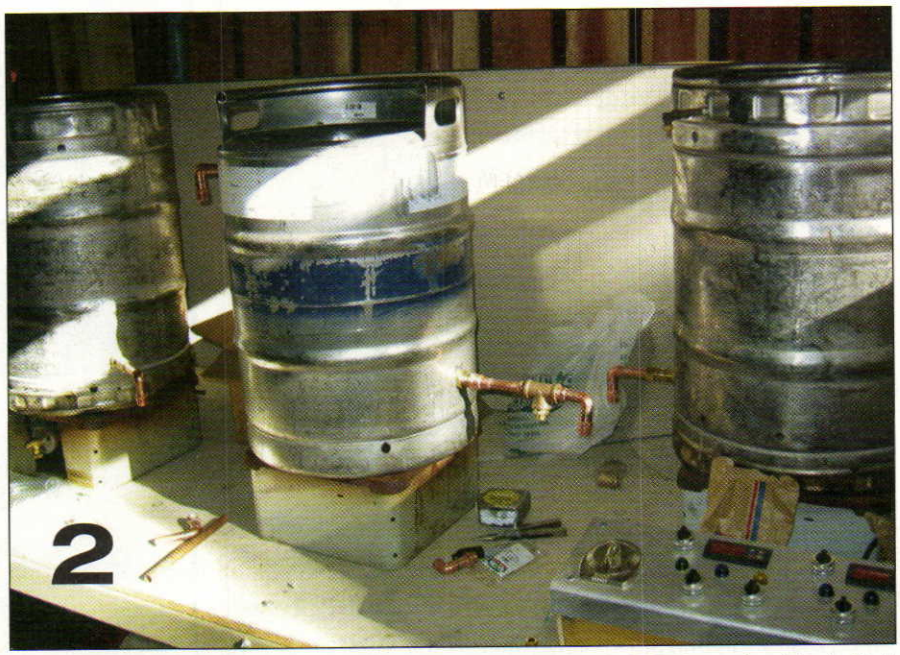

Figure 2: Here is the brewstand in progress. The hot liquor tank (HLT) is on the right, behind the control panel. The silicone tubing will connect onto the copper fittings coming out of the kegs, and go through the table to the pump and valves below.

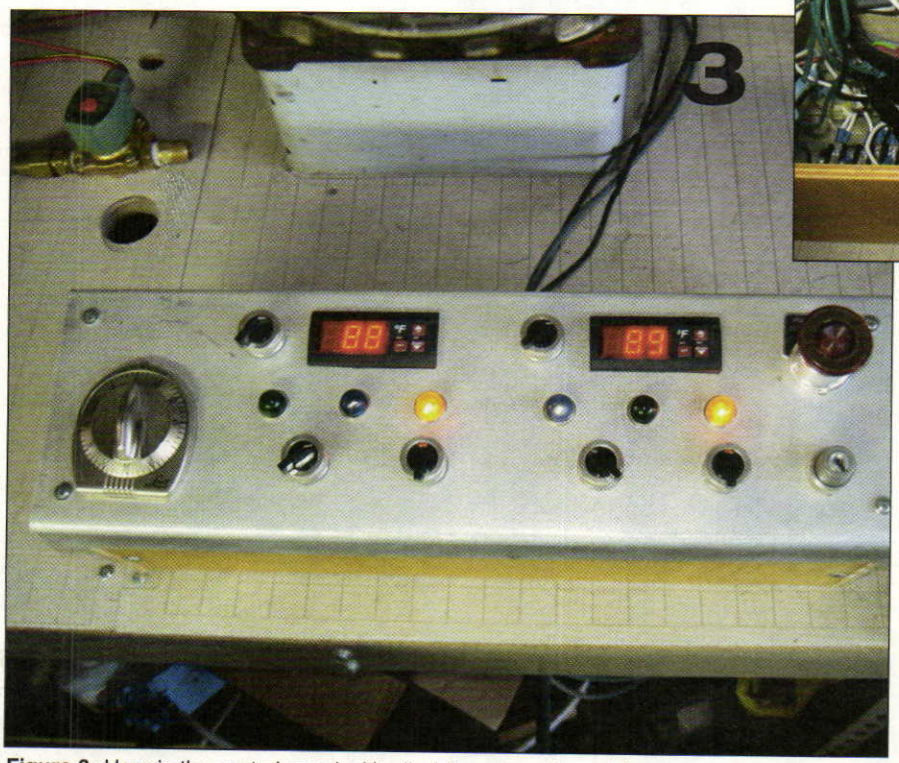

Figure 3: Here is the control panel with all of the elements on. The pump and stirrer circuits are on (yellow lights), and the wort flow valves are set to Recirculate (blue lights). A standard kitchen timer has been mounted on the panel to go "ding" when the mash is done.

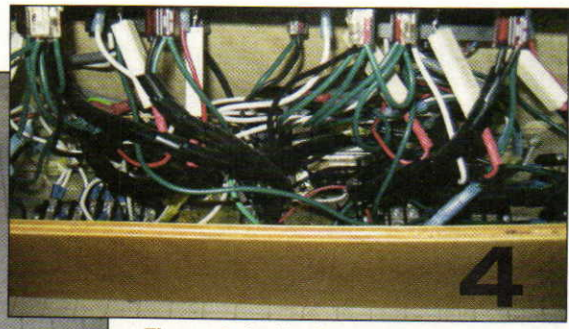

Figure 4: Inside the control panel you can see the mess of wires that connect the transformers to the switches and bus bars.

Concept

In Lonnie's original Brutus Ten design, he had solenoid ASCO valves controlling the gas flow to the burners, and manual redirection of fluid flow to the kettles from the pumps. I thought it would be cool if I could flip a couple of three-position switches on the control panel and use the ASCO valves to redirect the flow of the liquids. In essence, the inlet source of the pump would be controlled by one switch, and the outlet destination of the pump would be controlled by another. The hot liquor tank and mash/lauter tun would

feed the inlet side, and the outflow could be directed to either the mash/lauter or to the boil kettle. A direct consequence of these design choices is that the system is not capable of continuous sparging, I can only batch sparge using it. The valves and controls allow 4 modes:

First, hot water can be pumped from the HLT to the mash tun for infusion.

Second, the wort can be recirculated in the mash tun.

Third, the wort can be pumped from the mash tun to the boil kettle.

Lastly, hot water can be pumped directly to the boil kettle, which isn't terribly useful, except perhaps for cleanup.

On brew day, the procedure would consist of pumping water from the HLT to the mash for the first infusion, stopping the pump to stir and dough-in, and then switching the valves and starting the pump for recirculation. The wort is drawn from under the false bottom in the mash tun and returned to the top of the mash via a ring that sits on top of the grainbed. During recirculation, the temperature controller would turn on the gas valve when it sensed that wort temperature was below the set temperature on the controller. The set temperatures are input directly to the controller, and a kitchen timer mounted to the panel alerts the brewer when a rest is done and it is time to input the next set temperature. When the mash is done, the first runnings wort is pumped over to the boil kettle. The mash tun can then be refilled with the batch sparge, stirred and recirculated, and then the second runnings are pumped to the boil kettle. Come to think of it, a pseudo-continuous sparge could be conducted by cycling the switches back and forth between adding hot water to the mash tun and sending wort to the boil kettle, but that would require careful attention and probably wear out the switches.

Execution

At some point, however, you have to stop looking at the stars and start building the spaceship. Here are the details of my build of the single-tier system.

Brewstand

Parts:

Gorilla Rack

Hardie Backer backer board

I started out by figuring out how I wanted to make the stand. For simplicity, I chose the Gorilla Rack modular storage rack system because they are very sturdy and easily configurable. The design of my stand is not fancy by any stretch of the imagination — just a single level table about 30 inches (76 cm) high with a full backboard for heat protection. I used half-inch particle board for the top and back, and covered both with quarter-inch backer board for both water and fire protection.

The propane burners sit on top of the table and directly support the kegs. I also added safety chains attached to the backboard to prevent the kegs from tipping over during an earthquake (seriously, I live in Southern California).

Control Panel

Parts:

aluminum
plywood
Love On/Off Temperature Controllers (ref. TS-13010)
Square D rotary switches
14V lamps
Bus bars
resistors

The heart of the system, of course, is the control panel. I looked to popular sci-fi movies for inspiration. I thought the visual computing setup in Steven Spielberg's *Minority Report* would be cool, but I don't know how to write programming language and quickly dismissed it as too complicated. Instead I decided to go retro — I wanted switches to throw. I headed to the local electronics surplus store to look for parts, and there I found the control panel from what looked to be a 1970's vacuum furnace. It had two analog meters for monitoring temperature and pressure, lots of the Square D two and three position rotary switches I wanted, and bubble lights. I also wanted one of those big red kill switches for the system; not so much for the safety aspect, but because they look cool. They didn t have any at the surplus store, but I was able to find one on eBay for a reasonable price. I should mention that eBay really is the inventor's friend when it comes to finding parts. I looked all over the internet for the E-stop and the ASCO valves, going direct to the manufacturer, and was amazed at the prices. They wanted hundreds of dollars for those things! Generally I could find the same thing on eBay for about one half to two thirds of the retail price.

The front of the control panel is shown in Figure 3. I made the front of the panel out of a remnant piece of aluminum extrusion that I found at a local metal supplier. It cost about 5 bucks. I used my orbital sander to uniformly roughen the surface, giving it a nice matte finish that doesn't show scratches. The rest of the control panel box was constructed from ¾" plywood. The inside of the control panel was a different kettle of fish . . . or perhaps more like a barrel of cats. (Note to self: next time build the inside first, and then lay out the panel once you have allowed room for everything inside!) There were probably other ways of achieving my goals, but my best design utilized eight step-down transformers to power the gas valves and indicator lights, and it was quite a job fitting all those transformers, wiring, and the cooling fan inside the shoebox-sized space.

Basically the way it works is that the two temperature controllers act as the thermostats to the water heater gas valves. The pilot lights are mounted inside the burner housing and need to be lit manually. Each controller has its own on/off switch on the panel. The 110V ASCO valves are controlled by two sets of three position switches, with indicator lights wired in parallel to show which valve is open. The light circuits are all the same, consisting of a small 12.6V step-down transformer running an ordinary 14V, 240mA bulb on AC current in series with a 50 ohm, 10 watt resistor from RadioShack. The resistor acts as a current limiter to

increase the bulb life and reduce the power that is diverted from the main load.

Finally, there are separate switches and indicator lights for the pump and an HLT stirring motor. The pump switch is located between the wort valve switches, and the stirring motor is off to the right side of the panel. The E-stop is the main On/Off button for the panel and also turns on the cooling fan. The key switch on the lower right is not actually connected to anything; it just seemed a shame not to include it. Indeed, I wish I could have incorporated the analog meters, but they are about 8 inches deep and took up too much space.

Gas System

Parts:

Robert Shaw #700-400 Combination
Gas valve with pilot
Low pressure propane regulators
Superb Propane Burners

The Love temperature controllers act as the thermostat inputs to the gas valves. I mounted the pilot light assembly inside the burner housing so that once the pilot is lit, the burner would come on automatically with the controller. Each burner has its own propane tank with a low pressure regulator feeding the gas valve. A combination gas valve is one that can be run with either propane or natural gas. The valves I used are designed to run on 24 VAC and needed transformers. 110VAC valves are also available but they were generally more expensive and designed for larger gas pipes. The Grainger catalog has a wide selection to choose from.

Fluid System

Parts:

Copper pipe
Brass Fittings
ID Silicone tubing
ASCO Red Hat 8210G2 valves
Blichmann Quickconnector fittings

The inlet and outlet tubing go through access holes in the table top to the pump and fluid valves underneath. Ideally, I would have liked all stainless steel tubing for the fluid lines, but the cost was prohibitive. Next I thought to use copper and brass pipe, but ease of disassembly and cleaning became an issue. I finally settled on a combination of brass fittings, silicone tubing and Quickconnectors. The final layout is still in flux as I decide how and where to mount the valves to the frame.

As you may have noticed, my system is not actually running yet. I have been working on it for the past year, but it seems there is always some other project that needs doing on the weekend instead. The only remaining tasks are to install the gas and fluid systems to the brewstand and fire it up. Hopefully that won't take too many more weekends to accomplish. When it's finished and tested, I'll update *Brew Your Own* readers on how it performs. Wish me luck, good brewing and keep watching the skies!

John Palmer is the author of "How to Brew" (Brewers Publications, 2006). He writes "Advanced Brewing" for each issue of BYO.

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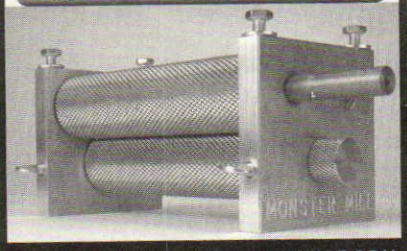

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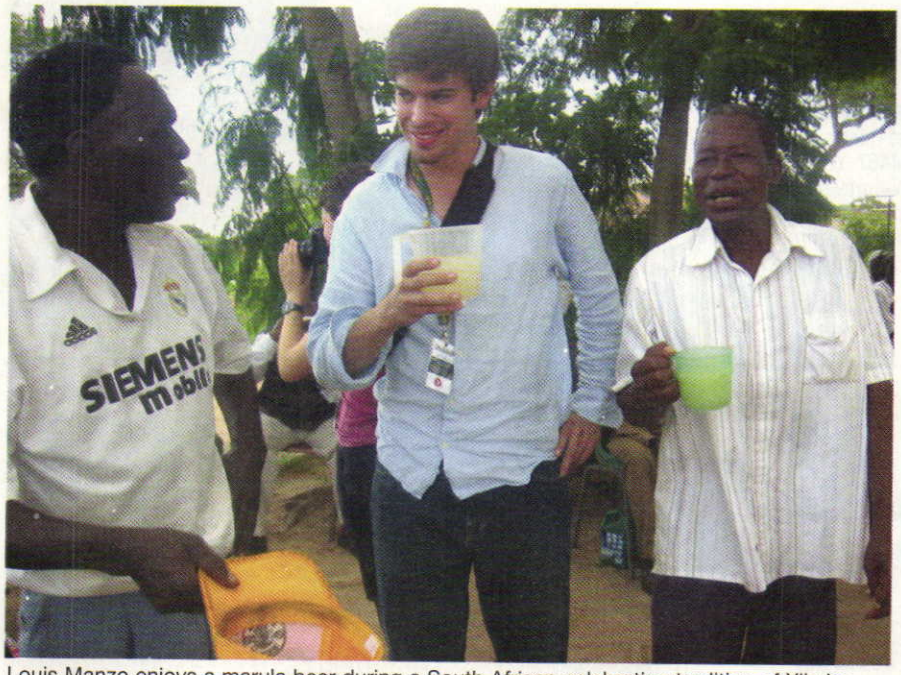
The daylong homebrewed drinking festival, Xikuha, which is an ancient tradition in South Africa, celebrates the little green fruit of the ubiquitous marula trees. Think you have what it takes to throw your own Xikuha? First you'll need to assign a truth-worthy chief, a taste tester, and a whole pack of villagers. Still game? Follow these steps and find out what it takes:



Louis Manzo enjoys a marula beer during a South African celebration tradition of Xikuha, which peaks in prevalence in January and February.

Proclaim Xikuha

Xikuha does not happen every year, only when the marula harvest is bountiful. Luckily, the marula harvest is bountiful almost every year. When proclaiming Xikuha, the chief must consider a number of factors. First, Xikuha can only be celebrated outside under a shady tree. Second, the chief must dictate the terms of Xikuha, explaining to the villagers how much beer they must bring or what fine they will face. In rural South Africa, the chief demands five liters of marula beer per family or a fine of 10 Rand ($1.50 US).

Brew the beer

The villagers take center stage in step two as they make the beer — the heart and soul of Xikuha. To brew official marula beer, first peel the marulas (discard the peels) and throw the fruit into a bucket to drain out the initial juices. Next, move the still-whole peeled marulas (or other seasonal fruit) and place them in a second bucket and then mash the soft innards into a porridge-like consistency. Remove the hard round nuts from the bucket, squeezing each to remove any last drop of juice, and then discard. Add water in approximately equal proportion to the marula mash. Add the juice from the first bucket and mix well. Let the brew sit covered outside for one, two or even three days depending on your desired strength of beer. Be sure to consider the location of your Xikuha and adjust accordingly. Hotter weather produces a stronger brew. In South Africa, with summer temperatures in the north consistently hovering around 100 °F (38 °C), a three-day marula beer concoction drinks like a shot of flavored vodka. Skim and discard the top foam layer of the beer when the day of Xikuha arrives.

Collect the beer

Balancing a bucket of beer on one's head — and holding another by the arm — each villager must bring his or her offering to the shady tree where the chief ordered Xikuha to take place. As each bucket of beer nears the tree, an elder should blow short, chopping blasts from a kudu horn to celebrate the arrival of more beer. If a kudu horn is not available, consider an air horn, a bell or even a simple "yippee."

Next, a taste tester must scoop a mug of beer from each bucket and drink it to ensure that no one is trying to poison the chief. This can be a difficult job as the day wears on. Be sure when choosing a taste tester to consider such factors as dedication to the chief, bravery, courage and alcohol tolerance. If the taste tester lives, proving that the beer is not poisonous, he or she then pours the bucket of beer into a large communal vat. If the taste tester appears poisoned, call 911.

After all the beer has been brewed, collected, tested and poured into a communal vat, the chief must rise and give a short speech. Then, the chief must solemnly pour a glass of beer from the large communal vat onto the trunk of the tree, whose shade everyone is enjoying, as a blessing for the gods and thanksgiving for the marulas.

Feast and drink

To ensure a healthy day of drinking, a quick but intense feast is a must. The chief, along with his closest advisors, eats separately and should feast on wildebeest — if in season — or ribs and sausages. The rest of the villagers should eat cheap hot dogs.

After feasting, indulge in all that is Xikuha. Your marula concoction should smell ungodly but surprisingly also taste like Smirnoff Ice. Drink and be merry but also remain faithful to the spirit of Xikuha. Scooping beer from the communal vat, pass large pitchers back and forth around the shady circle. No need for cups, just a thankful spirit for fruit, beer, friends and the traditions of a distant people.

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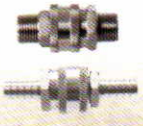

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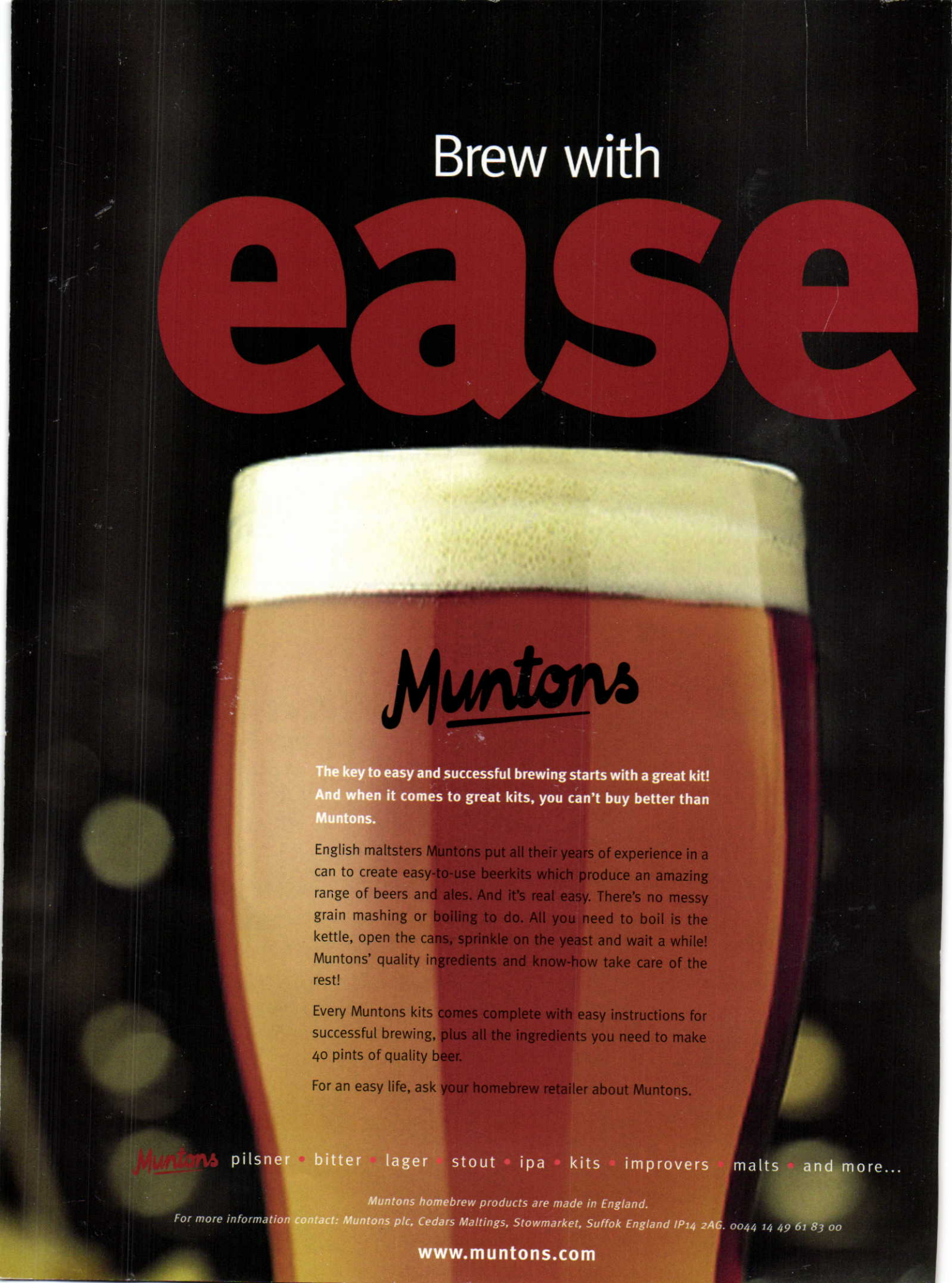
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