ADVANCED ABV

Content contributed by Jenny Parker, Imperial Beverage

Alcohol by volume (i.e. ABV, or alc/vol) is a standard measure of how much alcohol (ethanol) is contained in an alcoholic beverage. The ABV standard is used worldwide.

DRINK	TYPICAL ABV
Fruit juice (naturally occurring)	less than 0.1%
Low-alcohol beer	0.0%–1.2%
Kombucha	0.5%–1.5%
Cider	2%–8.5%
Beer	2%–12% (usually 4%–6%)
Barley Wine (strong ale)	8%–15%
Mead	8%–16%
Wine	9%–16% (most often 12.5%–14.5%)
Dessert Wine	14%–25%

Alcohol by volume states what portion of the total volume of liquid is alcohol. To determine the ABV of a beer, a brewer typically uses what's called a hydrometer, which is an instrument that aids in measuring the density of liquid in relation to water. (It essentially free-floats in a cylinder or liquid.) The hydrometer will be calibrated to read 1.000 in water (at 60°F), and the denser the liquid (example: add sugar to the liquid), the higher the hydrometer reading.

Before yeast cells are introduced to ferment beer, the liquid is called "wort" (pronounced wert), and it's full of all kinds of sugars that were previously extracted from the grain. A brewer will take a hydrometer measurement of the wort (at 60°F) to determine what's called the original gravity (OG). Then yeast is pitched into the wort, and fermentation begins. As the yeast cells eat the sugar in the wort, they create two wonderful by-products: carbonation (CO2) and alcohol. And once the brewer has determined that our hungry yeast have had enough (could be days, weeks or months), s/he'll go ahead and pull another hydrometer reading (at 60°F) and record what's called the final gravity (FG).

CALCULATING THE ABV

The calculation for beer is:
Where 1.05 is number of grams of ethanol produced for every gram of CO2 produced and .79 is the density of ethanol,

- ABV = ((1.05 * (Starting Specific Gravity – Final Specific Gravity)) / Final Specific Gravity) / 0.79 * 10

However, many brewers use the following formula:

- ABV = (Starting Specific Gravity - Final Specific Gravity) * 131

LABELING LAWS (required items on all bottles of beer)

1. BRAND NAME

2. CLASS AND TYPE DESIGNATION

The specific identity of the malt beverage

3. NAME AND ADDRESS

The name and address of the producer/bottler or packer must appear on the label optionally preceded by an appropriate explanatory phrase such as "BREWED AND BOTTLED/PACKED BY", "BREWED BY" or "BOTTLED/PACKED BY"

(LABELING LAWS CON'T)

4. NET CONTENTS

There are no standards of filler for malt beverages

5. ALCOHOL CONTENT

A statement of alcohol content is optional unless

- It is required by State law (Michigan law does not require it)

OR

- It is prohibited by State law

6. FD&C YELLOW #5 DISCLOSURE

"CONTAINS FD&C YELLOW #5" must appear on the label of any malt beverage containing FD&C Yellow #5

7. SACCHARIN DISCLOSURE

"USE OF THIS PRODUCT MAY BE HAZARDOUS TO YOUR HEALTH. THIS PRODUCT CONTAINS SACCHARIN WHICH HAS BEEN DETERMINED TO CAUSE CANCER IN LABORATORY ANIMALS." must appear on the label of any malt beverage containing saccharin

8. SULFITE DECLARATION

"CONTAINS SULFITES" or "CONTAINS (A) SULFITING AGENT(S)" or identification of the specific sulfiting agent(s) must appear on the label of any malt beverage containing 10 or more parts per million (ppm) sulfur dioxide

9. ASPARTAME DISCLOSURE

"PHENYLKETONURICS: CONTAINS PHENYLALANINE." must appear on the label of any malt beverage containing aspartame

10. HEALTH WARNING STATEMENT

The statement below must appear on all alcohol beverages for sale or distribution in the U.S. containing not less than 0.5% alcohol by volume, intended for human consumption and bottled on or after November 18, 1989:

GOVERNMENT WARNING: (1) According to the Surgeon General, women should not drink alcoholic beverages during pregnancy because of the risk of birth defects. (2) Consumption of alcoholic beverages impairs your ability to drive a car or operate machinery, and may cause health problems.

11. COUNTRY OF ORIGIN

ADVANCED
BEER STYLES

Content contributed by Andrew VanTil, Imperial Beverage

Styles have come to be understood in terms of technical parameters by which beer is measured. While this may be mainly of use in judging beer for competition, understanding some of these numbers and what they mean for how a beer tastes can deepen your understanding (and appreciation) of beer. Here are a few:

International Bitterness Units (IBUs)—This quantifies how bitter a beer is.
This is the measure of hop bitterness in beer. Technically, it is defined as milligrams per liter of isomerized alpha acids dissolved in beer. Typical IBUs range from 3-100 in beer. Hops need to be boiled to impart bitterness to beer. This is because the bitter (alpha) acids in hops won't dissolve in beer unless they are chemically altered slightly (isomerization). This is brought about by boiling the hops.

Standard Reference Method (SRM)—This measures the intensity of beer color.
Note that SRM is a measure of beer color density more than hue/tint. Keep this in mind when attempting to use only SRM numbers when describing beers. Within these Guidelines, beer color descriptors generally follow this mapping to SRM values:

Straw	2-3
Yellow	3-4
Gold	5-6
Amber	6-9
Deep amber/light copper	10-14
Copper	14-17
Deep copper/light brown	17-18
Brown	19-22
Dark Brown	22-30
Very Dark Brown	30-35
Black	30+
Black, opaque	40+

Gravity—This refers to how much fermentable sugar is in a beer before fermentation. The more sugar, the more alcohol and body. Hence, "high gravity" is a term applied to strong beers. Brewers around the world may use different units to measure this.

Alcohol—Most brewers talk about alcohol by volume (%ABV) instead of by weight.

ADVANCED **BEER STYLES**

Style	Origin	Type	OG	FG	ABV%	IBU	SRM	Commercial Examples
Lite American Lager	USA	Lager	1.028-40	0.998-1.008	2.8-4.2	8-12	2-3	It'll have Light in the name
Standard American Lager	USA	Lager	1.040-50	1.004-10	4.2-5.3	8-15	2-4	PBR, High Life, Bud, Coors Original, Labatt
Premium American Lager	USA	Lager	1.046-56	1.008-12	4.6-6.0	15-25	2-6	MGD, Corona, Heineken, Stella, Red Stripe
German Pilsner (Pils)	Germany	Lager	1.044-50	1.008-13	4.4-5.2	25-45	2-5	Victory Prima, Bitburger, Konig, Left Hand Polestar
Bohemian Pilsner	Czech Republic	Lager	1.044-56	1.013-17	4.2-5.4	35-45	3.5-6	Pilsner Urquell, Krusovice Imperial, Czechvar
Classic American Pilsner	USA	Lager	1.044-60	1.010-15	4.5-6.0	25-40	3-6	
Oktoberfest/Marzen	Germany	Lager	1.050-57	1.012-16	4.8-5.7	20-28	7-14	Paulaner, Ayinger, Hofbrau, Great Lakes, Spaten
Traditional Bock	Germany	Lager	1.064-72	1.013-19	6.3-7.2	20-27	14-22	Einbecker Ur-Bock
Doppelbock	Germany	Lager	1.072-112	1.016-24	7.0-10.0	16-26	6-25	Salvator, Ayinger Celebrator, WeihenstephanerKorbinian, SpatenOptimator
Blonde Ale	USA	Ale	1.038-54	1.008-13	3.8-5.5	15-28	3-6	
American Wheat Beer	USA	Ale	1.040-55	1.008-13	4.0-5.5	15-30	3-6	Oberon, Harpoon UFO, WidmerHefeweizen
California Common Beer	USA	Lager	1.048-54	1.011-14	4.5-5.5	30-45	10-14	Anchor Steam, Flying Dog Old Scratch
Standard/Ordinary Bitter	England	Ale	1.032-40	1.007-11	3.2-3.8	25-35	4-14	Boddington's
Special Best/Premium Bitter	England	Ale	1.040-48	1.008-12	3.8-4.6	25-40	5-16	Fuller's London Pride, Black Sheep, Honkers Ale
ESB (English Pale Ale)	England	Ale	1.048-60	1.010-16	4.6-6.2	30-50	6-18	Fuller's ESB, Sam Smith Old Brewery Pale, Bass Ale, Marston's Pedigree Bitter
Scottish Ale (Export 80/-)	Scotland	Ale	1.040-54	1.010-16	3.9-5.0	15-30	9-17	Belhaven Scottish, Broughton Merlin's
Strong Scotch Ale (Wee Heavy)	Scotland	Ale	1.070-130	1.018-56	6.5-10.0	17-35	14-25	Traquair House Ale, Belhaven Wee Heavy, Dirty Bastard, Orkney Skull Splitter
American Pale Ale	USA	Ale	1.045-60	1.010-15	4.5-6.2	30-45	5-14	Sierra Nevada, Stone, Great Lakes Burning River, Bear Republic XP
American Amber Ale	USA	Ale	1.045-60	1.010-15	4.5-6.2	25-40	10-17	North Coast Red Seal, Lagunitas Censored, Bell's Amber
American Brown Ale	USA	Ale	1.045-60	1.010-16	4.3-6.2	20-40	18-35	Bell's Best Brown, Moose Drool, Brooklyn Brown
Mild	England	Ale	1.030-38	1.008-13	2.8-4.5	10-25	12-25	
Northern English Brown Ale	England	Ale	1.040-52	1.008-13	4.2-5.4	20-30	12-22	Newcastle, Sam Smith Nut Brown, Hobgoblin, Avery Ellie's Brown
Brown Porter	England	Ale	1.040-52	1.008-14	4.0-5.4	18-35	20-30	Fuller's Lonon Porter, Sam Smith Taddy, St. Peter's
Robust Porter	England/US	Ale	1.048-65	1.012-16	4.8-6.5	25-50	22-35	Great Lakes Ed Fitz, Anchor, Rogue Mocha, Bell's Porter
Dry Stout	Ireland	Ale	1.036-50	1.007-11	4.0-5.0	30-45	25-40	Guinness Draught, Murphy's, Beamish, O'Hara's
Oatmeal Stout	England/US	Ale	1.048-65	1.010-18	4.2-5.9	25-40	22-40	Sam Smith, McAuslan, Anderson Valley Barney Flats, New Holland Poet
Foreign Extra Stout	UK/Tropics	Ale	1.056-75	1.010-18	5.5-8.0	30-70	30-40	Lion Stout, Dragon Stout, Cooper's Best Extra
American Stout	USA	Ale	1.050-75	1.010-22	5.0-7.0	35-75	30-40	Rogue Shakespeare, Sierra Nevada, North Coast Old No. 38
Russian Imperial Stout	England	Ale	1.075-115	1.018-30	8.0-12.0	50-90	30-40	Expedition, Old Rasputin, Stone, Sam Smith, Avery the Czar, Storm King
English IPA	England	Ale	1.050-75	1.010-18	5.0-7.5	40-60	8-14	Sam Smith, Goose Island, Brooklyn East India
American IPA	USA	Ale	1.056-75	1.010-18	5.5-7.5	40-70	6-15	Two Hearted, Stone, Racer 5, Hop Devil, SN Celebration, Centennial
Imperial IPA	USA	Ale	1.070-90	1.010-20	7.5-10.0	60-120	8-15	Avery Maharaja, Bell's Hop Slam, Stone Ruination,
Weizen/Weissbier	Germany	Ale	1.044-52	1.010-14	4.3-5.6	8-15	2-8	Schneider, Plank, Ayinger, Erdinger
Saison	Belgium	Ale	1.048-65	1.002-12	5.0-7.0	20-35	5-14	Saison DuPont, Ommegang Hennepin
Gueuze (Lambic)	Belgium	Ale	1.040-60	1.000-06	5.0-8.0	0-10	3-7	Boon Oude, Cantillon, Lindeman's Cuvee Rene
Fruit Lambic	Belgium	Ale	1.040-60	1.000-10	5.0-7.0	0-10	3-7	
Trappist	BE/NL	Ale	Varies-- remember "Trappist" designates origin					
Belgian Blond Ale	Belgium	Ale	1.062-75	1.008-18	6.0-7.5	15-30	4-7	Leffe, Affligem, Grimbergen
Belgian Dubbel	Belgium	Ale	1.062-75	1.008-18	6.0-7.6	15-25	10-17	Westmalle, St. Bernardus 6, Corsendonk Brown, Chimay Premiere,
Belgian Tripel	Belgium	Ale	1.075-85	1.008-14	7.5-9.5	20-40	4.5-7	Westmalle, ChimayCinq Cents, TripelKarmeliet, Victory Golden Monkey
Belgian Golden Strong	Belgium	Ale	1.070-95	1.005-16	7.5-10.5	22-35	3-6	Duvel, DT, Piraat, Avery Salvation,
Belgian Dark Strong	Belgium	Ale	1.075-110	1.010-24	8.0-11.0	20-35	12-22	Rochefort 10, St. Bernardus 12, Chimay Grande Reserve, Gulden Draak

ADVANCED BEER FLAWS

Content contributed by Andrew VanTil, Imperial Beverage

OTHER ORGANISMS AFFECTING BEER FLAVOR

Apart from brewer's yeast, other yeasts and bacteria have been historically important in all beer production—brewers didn't know how to keep these organisms out of their beer. With the advent of modern microbiology and the understanding of sanitation in the brewhouse, this has largely been eliminated from most (well-made) beer styles. Today, the majority of beers produced in the world are fermented with a single yeast culture under sanitary conditions. Some notable exceptions of this development include the classical highly acidic styles of Belgium and northern Germany. Lambics are spontaneously fermented without inoculation of brewer's yeast. Wild yeast and bacteria in the brewhouse and in the oak barrels used for aging accomplish a mixed fermentation. Flemish Red and Brown ales employ a mixed fermentation where brewer's yeast is pitched for a primary fermentation followed either by maturation in large oak tuns for the development of acetic and lactic character from "bugs" endemic to the oak (Flemish Red Ales), or by maturation under warm conditions, accelerating the development of lactic sourness (Flemish Brown Ales). Berliner Weisse and Leipziger Gose typically undergo a standard ale fermentation followed by the inoculation of lactobacillus.

"Today, the majority of beers produced in the world are fermented with a single yeast culture under sanitary conditions."

In addition to these classical styles, soured and funky beers have developed a following in the "wild ales" and "sour ales" of craft brewing in the United States. Brewers are using wood maturation and carefully cultivating bugs in their barrels to promote the development of sour character, blending lots to bottle complex (and still palatable) beers like their classical beer cousins. Some are even experimenting with spontaneously fermented beers. Up until recently, conventional wisdom suggested that making a good beer with spontaneous fermentation was only possible near Brussels in Belgium for lambic production.

Some brewers are also employing fermentation in stainless steel under sanitary conditions with inoculated cultures of wild yeast and bacteria. This is true among craft brewers and at least some brewers in Belgium. In any case, most of these bugs consume sugars/starches that regular brewer's yeast do not ferment, making these organisms a problem or a benefit for longer term maturation of beer, depending on the brewer's intent. Here are some of the major actors in use both in classical and modern styles:

Brettanomyces—This "wild" family of yeasts contributes a variety of funky characters and a mild acidity often eliciting descriptions like "horse blanket" and barnyard. These yeasts play a major role in styles like lambic, a supporting role in styles like saison, and (both) in styles like English Old Ale.

Lactobacillus, pediococcus—These bacteria produce lactic acid and are responsible for the clean lactic tartness in styles like Berliner Weisse. Pediococcus goes a bit further to produce diacetyl (buttery) and goat-like flavors over time. As brettanomyces reduces diacetyl eventually, it is often used in concert with pediococcus.

Acetobacter—These bacteria over time can oxidize alcohol into acetic acid (vinegar), which isn't necessarily a bad thing in styles like Flemish Red Ale.

BRETTANOMYCES

This "wild" family of yeasts contributes a variety of funky characters and a mild acidity often eliciting descriptions like "horse blanket" and barnyard. These yeasts play a major role in styles like lambic, a supporting role in styles like saison, and (both) in styles like English Old Ale.

A FEW WORDS ABOUT (BAD) BEER FLAVOR

We've spent some time talking about what the various ingredients of beer contribute to beer flavor and aroma. This has been largely in the context of the flavors that we expect to find in well-made beer. But not all beer is well-made, and all beers will go bad eventually (heat, light, oxygen, time). Brewers work very hard to make products that don't exhibit technical flaws and that are shelf stable so that they don't have offensive off flavors, but we all know that there are bad (and old) beers on the market. Below are some of the flavors we don't usually want in our glass:

Fatty flavors—Usually from the breakdown/oxidation of fatty acids in beer. Can be described variously as soapy, cheesy, rancid butter, stinky cheese, old hops.

Acidic/Tart/Sour (lactic, or vinegar)—While all beers have balancing acidity according to the style, some are clearly more tart than they should be. This is a sign of infection. See above for discussion of acid-producing bacteria and wild yeast.

Sulfury—Burnt match or rubber, rotten egg, rotten cabbage, garlic. These flavors may result from spoilage organisms or from beer that needs more time to mature. (You'll usually be able to tell the difference.)

Meaty/brothy (autolyzed yeast)—While this can contribute to the umami of a well-aged old ale or barleywine (which have enough stuffing to balance the meatiness), this is a sign of broken down yeast. Usually these flavors will be accompanied by other oxidative flavors indicating old beer. If a beer strongly exhibits this character, look at the yeast sediment in the bottle—it will probably look like big flakes that don't stick well to the bottom of the bottle.

Skunky (mercaptan)—Some people recognize this as pleasant, but only because they were taught to like Heineken/Corona for these characters. It results from breakdown of hop compounds brought about by sunlight or fluorescent light (light-struck). Keep the bottles cold and dark!

Wet paper/cardboard, stale (oxidation)—This character comes from oxidation. All beer will eventually show at least some of this character as it ages, so you can't really stop it from happening. Serve beer while it's in date.

Buttery/movie popcorn (diacetyl)—While this is acceptable in some English styles as a result of yeasts that settle quickly, this is usually a technical brewing flaw. It can also show up in draught beer served from dirty beer lines.

Cooked/creamed corn, cooked cabbage (dimethyl sulfide, or DMS)—While acceptable at low levels in some styles (like pils), this is usually seen as a technical brewing flaw arising in beers made with very pale malt where the wort was not brewed vigorously or chilled quickly.

Green apple (acetaldehyde)—Green apples? Green beer. This is usually a sign that a beer was not allowed to mature sufficiently before the yeast was crashed out/removed.

ADVANCED **BEER FLAWS**

Astringent/husky; medicinal/band aid—This is usually from technical errors during mashing, or from beer made with particularly alkaline (the opposite of acidic) water. Medicinal flavors can also result from the overuse of sanitizers in the brewhouse (or in your glass).

Goaty—If yeast is left in contact with finished beer at warm temperatures for a long time, a family of fatty acids can be excreted, resulting in flavors also found in goat's milk.

Banana—While desirable in some styles (especially Bavarian Weizen), banana esters in the isoamyl acetate family can be produced as byproducts of yeast under adverse or conditions that are too warm for the particular strain.

Metallic/iron—Can be from old brewing equipment or very hard untreated water used for brewing. But I've found that it usually comes from bottling lines and is concentrated on the lip of the bottle (pour the beer into a glass).

For further reading, here is a great, friendly doc: http://morebeer.com/public/pdf/off_flavor.pdf

ADVANCED
EVALUATING BEER

Content contributed by Andrew VanTil, Imperial Beverage

FACTORS THAT AFFECT HOW WE TASTE BEER

Environment & Glassware

Outside the glass—Several things can affect how a beer tastes. These include the temperature of the room, whether or not there are strong smells in the room, the brightness and quality of lighting, and how clean the table is on which the beer is being served. On tap, beer's flavor is dramatically impacted by how clean the draught system is from which the beer is poured.

The beer glass—Beer will taste best if served fresh and poured correctly in a clean glass that's appropriate for the beer style. Different styles of beer call for different types of glassware. Beer drank right from the bottle won't have nearly as much aroma as it will if poured into a glass; and the bottle itself could make the beer taste metallic. Soaps or oils left behind in a dirty glass will kill the head on a beer and make it taste flat and lifeless. Glassware that was sanitized or just rinsed in tap water could make the beer smell like chlorine.

Inside the glass—Beer is ready to drink when it leaves the brewery, and beer flavor is almost always at its best when the beer is fresh. As time goes on, hop flavor and aroma fades, flavors from malt tend to oxidize in to cardboard-like flavors, and additional fermentations can take place, souring the beer. Heat and air can accelerate these processes. UV light exposed to beer bottles (or to your glass of beer on the patio) will make your beer taste skunky. Also, the temperature of the beer affects how it tastes. Over-chilling the beer will mask its true flavors and mouthfeel. Beer that is too warm will also exhibit a different balance of flavors and aromas as well.

Behavioral Factors

Biology affects how we taste beer. Women tend to be more sensitive tasters than men. Many people have different levels of sensitivity to particular tastes, flavors and aromas.

Behavioral Factors

Smoking, spicy or salty foods, the time of day, and how many beers a taster has already consumed can all affect his or her perception of how a beer tastes. Experience also matters—even though there are biological differences in sensitivity to taste and flavor, disciplined tasters will learn to pick out nuance and subtlety in beer with practice.

"Several things can affect how a beer tastes. These include the temperature of the room, whether or not there are strong smells in the room, the brightness and quality of lighting, and how clean the table is on which the beer is being served."

ADVANCED **EVALUATING BEER**

> **As time goes on, hop flavor and aroma fades, flavors from malt tend to oxidize in to cardboard-like flavors, and additional fermentations can take place, souring the beer. Heat and air can accelerate these processes.**

EVALUATING BEER

Appearance

First, look at the beer. When appreciating or evaluating beer, appearance matters and gives you information about what you're tasting. Is the beer turbid and cloudy or crystal clear? What color is it? Is the head thick and creamy or light like a meringue? Is it bright and effervescent or fairly still?

Aroma

Next, swirl the glass. Get your nose close to the beer (but don't stick it in the head). Take short sniffs (think of a bloodhound). Beer has hundreds of aromas that come from malt, hops, alcohols, and all of the other byproducts of yeast fermentation. Do you smell fruit? If so, is it tropical, citrus, berry, orchard fruit? What about caramel notes or roasted aromas? What about spicy or earthy elements? Grass, wood, pine, hay?

Taste and Flavor

Now (finally), put the glass to your lips and taste. Don't swallow it right away—swirl it around in your mouth and see what you can pick out. Flavor is mostly a function of the olfactory (nose), so a beer's flavor will likely confirm what you noticed in the aroma. Taste is more a function of the palate—sweet, salty, sour, bitter, umami, and fat tastes that are perceived by the thousands of taste buds on the tongue.

Feel

While the beer is still in your mouth, think about how it feels. Proteins and sugars contribute to a sense of body and weight in the mouth. Alcohol can give you a warming sensation and make the beer feel slick in the mouth. Astringency from roasted malts can give the mouth a drying sensation. Carbonation can give you a prickly refreshing feeling or it can make the beer feel soft and creamy in the mouth. Yeast from unfiltered beer can make the beer feel different in the mouth.

Finish

After you swallow, think about what you still taste. Does what you still taste beg you to taste more or rinse your mouth out with water? Despite what beer commercials have tried to teach us, well-made beer should continue to develop and have some taste quality even after you've swallowed it. Hop bitterness especially becomes important in the finish. Higher alcohol beers can have a great finish that lasts for minutes.

> **Taste is more a function of the palate—sweet, salty, sour, bitter, umami, and fat tastes that are perceived by the thousands of taste buds on the tongue.**

Evaluating Beer:

- **Appearance**
- **Aroma**
- **Taste and Flavor**
- **Feel**
- **Finish**

ADVANCED

WHAT IS CRAFT BEER?

Content contributed by Anne Drummond & Andrew VanTil, Imperial Beverage

Material contained in this document applies to multiple course levels. Reference your syllabus to determine specific areas of study.

Certainly, we could wax poetic on the intricacies of craft beer, craft breweries and brewers. But none could do so quite as succinctly as the Brewers Association (BA), created as "a passionate voice for craft brewers".

The Brewers Association is an organization of brewers, for brewers, and by brewers. Their membership is comprised of more than 2,500 US breweries, 30,000 members of the American Homebrewers Association, members of the allied trade, beer wholesalers, individuals, other associate members and the Brewers Association staff. With the purpose of promoting and protecting small and independent American brewers, their craft beers and community of brewing enthusiasts, the Brewers Association has a rich history.

BREWERS ASSOCIATION TIMELINE

Directly from the website of the organization, the following represents its historical timeline, as told by the staff of the BA:

1942
The Small Brewers Committee, a precursor to the Brewers Association of America, first meets at Palmer House in Chicago to discuss raw materials supply and other common issues of small brewers. One early issue the committee fought for was supplies of tin for crowns to seal beer bottles.

1976
The Brewers Association of America secures a small brewers tax differential on the first 60,000 barrels for brewers under 2 million barrels per year.

1978
Charlie Papazian and Charlie Matzen form the American Homebrewers Association in Boulder, CO with the publication of the first issue of Zymurgy magazine, announcing the new organization, publicizing the federal legalization of homebrewing and calling for entries in the first AHA National Homebrew Competition.

1982
The Great American Beer Festival debuts at the Harvest House in Boulder, CO.

1983
The Association of Brewers is organized to include the American Homebrewers Association and the Institute for Brewing and Fermentation Studies to assist the emerging microbrewery movement in US.

2005
The Association of Brewers and the Brewers' Association of America merge to form the Brewers Association.

2009
1,595 American craft brewers produce just under 9.1 million barrels of beer, as craft brewers continue steady growth and beer drinkers turn toward more flavorful craft-brewed beers from small and independent breweries.

This group, the obvious expert organization on the topic, describes what it means to be a craft beer brewery, or be defined as craft beer.

AN AMERICAN CRAFT BREWER IS SMALL, INDEPENDENT & TRADITIONAL

Small: Annual production consists of 6 million barrels of beer or less. Beer production is attributed to a brewer according to the rules of alternating proprietorships. Flavored malt beverages are not considered beer for purposes of this definition.

Independent: Less than 25% of the craft brewery is owned or controlled (or equivalent economic interest) by an alcoholic beverage industry member who is not themselves a craft brewer.

Traditional: A brewer who has either an all-malt flagship (the beer that represents the greatest volume among that brewer's brands) or has at least 50% of its volume in either all-malt beers or in beers that use adjuncts to enhance rather than lighten flavor.

The following are some characteristics of craft beer and craft brewers:

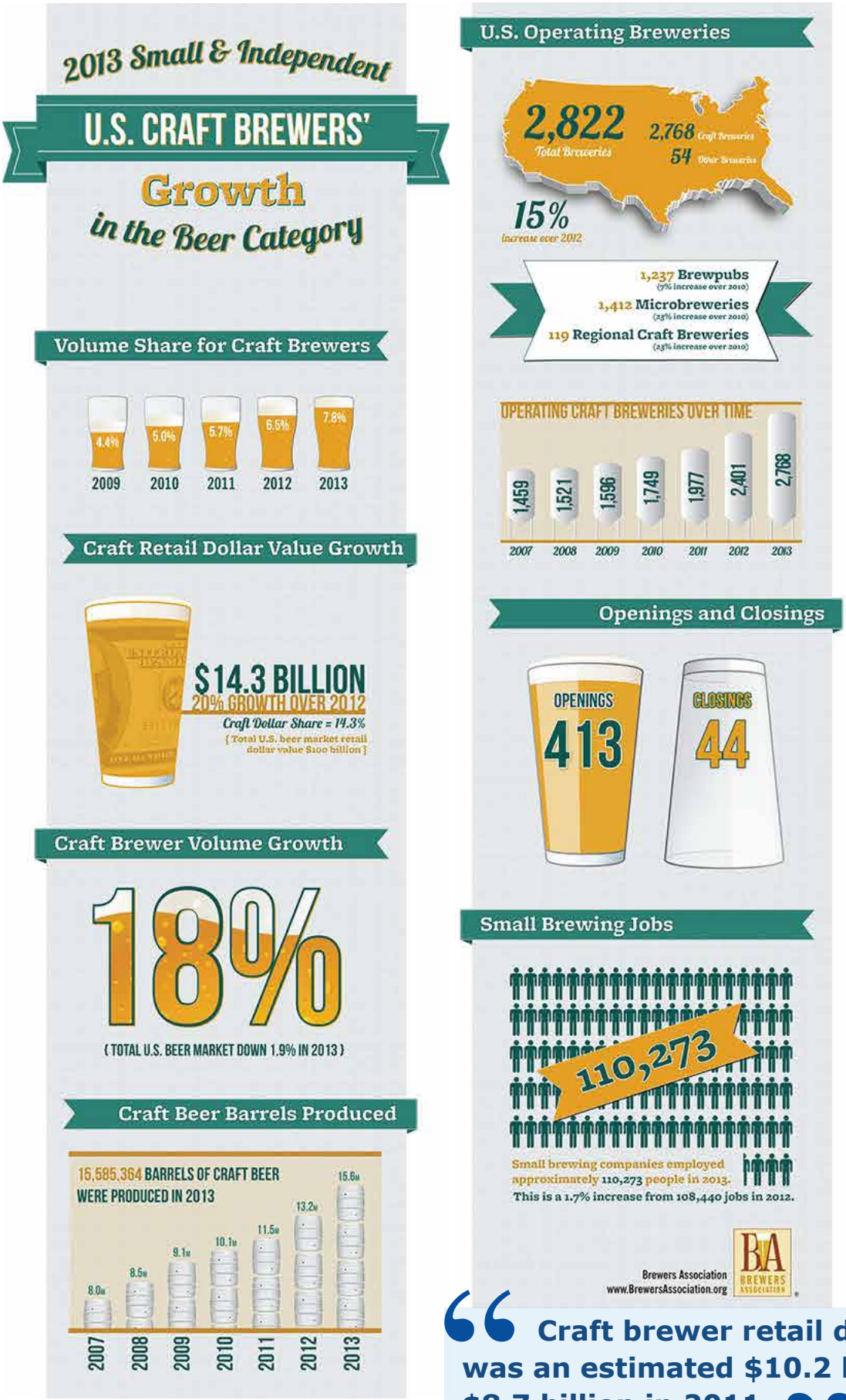
- Craft brewers are small brewers.
- The hallmark of craft beer and craft brewers is innovation. Craft brewers interpret historic styles with unique twists and develop new styles that have no precedent.
- Craft beer is generally made with traditional ingredients like malted barley; interesting and sometimes non-traditional ingredients are often added for distinctiveness.
- Craft brewers tend to be very involved in their communities through philanthropy, product donations, volunteerism, and sponsorship of events.
- Craft brewers have distinctive, individualistic approaches to connecting with their customers.
- Craft brewers maintain integrity by what they brew and their general independence, free from a substantial interest by a non-craft brewer.
- The majority of Americans live within ten miles of a craft brewer.

PERTINENT BEER SALES & GROWTH STATISTICS IN THE UNITED STATES

- Craft brewers currently provide an estimated 108,440 jobs in the U.S., including serving staff in brewpubs.
- Growth of the craft brewing industry in 2012 was 15% by volume and 17% by dollars compared to growth in 2011 of 13% by volume and 15% by dollars.
- Craft brewers sold an estimated 13,235,917 barrels* of beer in 2012, up from 11,467,337 in 2011.
- The craft brewing sales share in 2012 was 6.5% by volume and 10.2% by dollars.
- Craft brewer retail dollar value in 2012 was an estimated $10.2 billion, up from $8.7 billion in 2011.
- As of March 18, 2013, the Brewers Association is aware of 409 brewery openings in 2012 (310 microbreweries and 99 brewpubs) and 43 brewery closings (18 microbreweries and 25 brewpubs).
- 2,347 craft breweries operated for some or all of 2012, comprised of 1,132 brewpubs, 1,118 microbreweries and 97 regional craft breweries.

OTHER U.S. BREWING INDUSTRY FACTS

- Overall U.S. beer sales were up an estimated 0.9% by volume in 2012.
- Imported beer sales were up 1% in 2012 and up 1% in 2011.
- Overall U.S. beer sales were approximately 200,028,520 barrels and imported beer sales were 27,712,665 barrels in 2012.
- 2,403 total breweries operated for some or all of 2012, the highest total since the 1880s.



SMALL

Annual production of 6 million barrels of beer or less. Beer production is attributed to a brewer according to the rules of alternating proprietorships. Flavored malt beverages are not considered beer for purposes of this definition.

INDEPENDENT

Less than 25% of the craft brewery is owned or controlled (or equivalent economic interest) by an alcoholic beverage industry member who is not themselves a craft brewer.

TRADITIONAL

A brewer who has either an all malt flagship (the beer which represents the greatest volume among that brewers brands) or has at least 50% of its volume in either all malt beers or in beers that use adjuncts to enhance rather than lighten flavor.

"Craft brewer retail dollar value in 2011 was an estimated $10.2 billion, up from $8.7 billion in 2011."

ADVANCED
MARKET SEGMENTS OF THE CRAFT BEER INDUSTRY

Content contributed by Anne Drummond & Andrew Van Til, Imperial Beverage

The craft beer industry is defined by four distinct markets: brewpubs, microbreweries, regional craft breweries, and contract brewing companies.

MICROBREWERY

A brewery that produces less than 15,000 barrels (17,600 hectoliters) of beer per year with 75% or more of its beer sold off-site. Microbreweries sell to the public by one or more of the following methods: the traditional three-tier system (brewer to wholesaler to retailer to consumer); the two-tier system (brewer acting as wholesaler to retailer to consumer); and, directly to the consumer through carryouts and/or on-site tap-room or restaurant sales.

BREWPUB

A restaurant-brewery that sells 25% or more of its beer on site. The beer is brewed primarily for sale in the restaurant and bar. The beer is often dispensed directly from the brewery's storage tanks. Where allowed by law, brewpubs often sell beer "to go" and /or distribute to off site accounts. Note: BA re-categorizes a company as a microbrewery if its off-site (distributed) beer sales exceed 75%.

CONTRACT BREWING COMPANY

A business that hires another brewery to produce its beer. It can also be a brewery that hires another brewery to produce additional beer. The contract brewing company handles marketing, sales, and distribution of its beer, while generally leaving the brewing and packaging to its producer-brewery (which, confusingly, is also sometimes referred to as a contract brewery).

REGIONAL BREWERY

A brewery with an annual beer production of between 15,000 and 6,000,000 barrels.

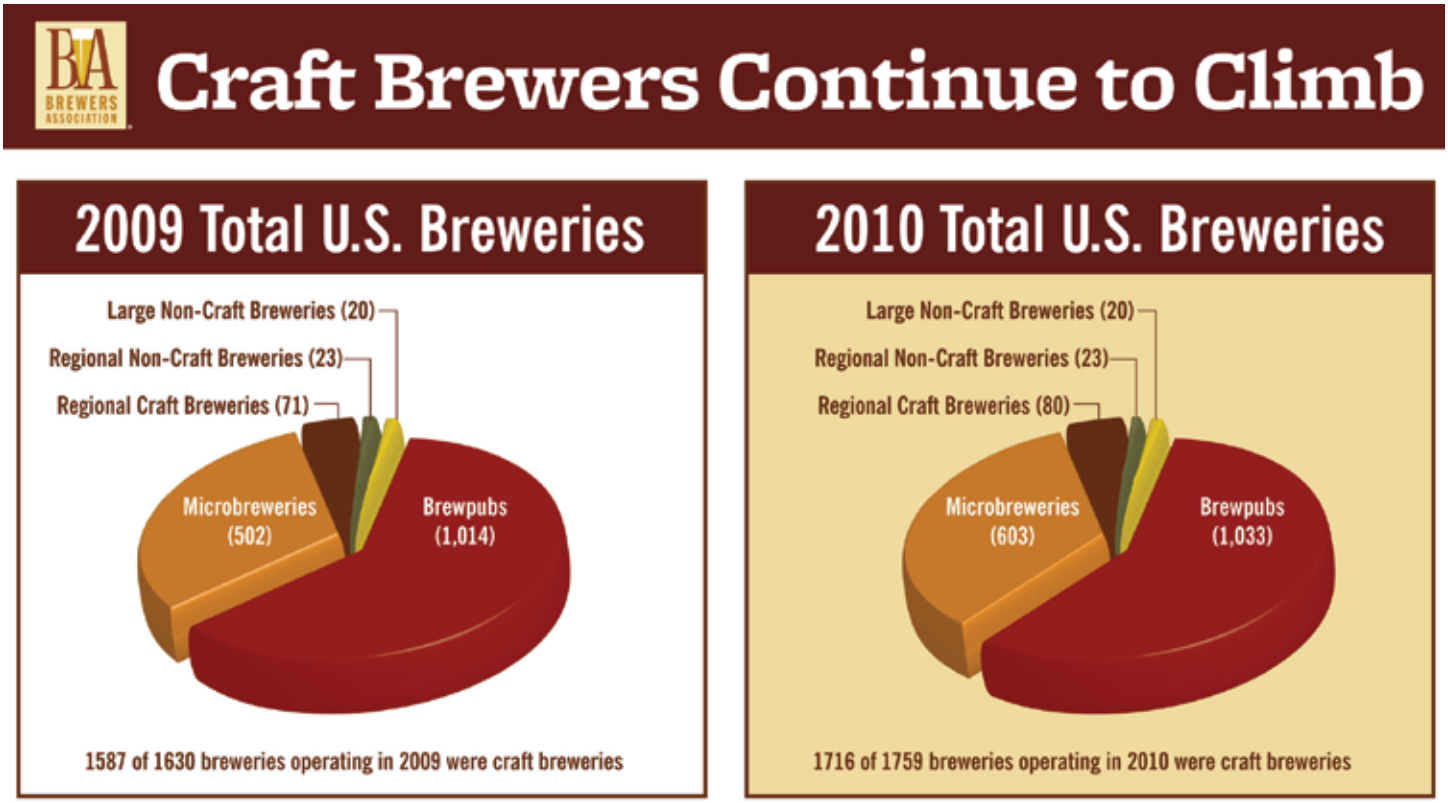
REGIONAL CRAFT BREWERY

An independent regional brewery who has either an all malt flagship or has at least 50% of it's volume in either all malt beers or in beers which use adjuncts to enhance rather than lighten flavor.

LARGE BREWERY

A brewery with an annual beer production over 6,000,000 barrels.

> **The craft beer industry is defined by four distinct markets: brewpubs, microbreweries, regional craft breweries, and contract brewing companies.**



> **Large Brewery: A brewery with an annual beer production over 6,000,000 barrels.**

ADVANCED HISTORY

Content contributed by Andrew VanTil, Imperial Beverage

IMPORTANT FIGURES IN AMERICA

Important figures in America's Craft Brewing Renaissance are many. Among them are the few listed below. These we consider to have been most influential, or to have generated such a catalyst for change in the industry that they were worth calling out. These are people who inspired generations of homebrewers, craft beer drinkers, enthusiasts, and small brewers to help launch what craft has become in America today.

Charlie Papazian is the current President of the Brewer's Association. He founded the American Homebrewers Association with the first issue of the magazine Zymurgy and the first National Homebrew Competition in 1979, bringing awareness to the recent national legalization of homebrewing. His book The Complete Joy of Homebrewing and its subsequent editions were for a long time the only widely available books that provided detailed information about how to make beer at home. He is also credited as instrumental in the founding of the Association of Brewers, the Great American Beer Festival, the Brewers Association, and The World Beer Cup.

Ken Grossman cofounded Sierra Nevada Brewing Company in 1979. It has become the 7th largest brewery and 2nd largest craft brewery in the United States. First released in 1980, Sierra Nevada Pale Ale has come to be recognized as the benchmark for the American Pale Ale style, and it is the 2nd best selling craft beer in the US.

Fritz Maytag purchased 51% of Anchor Brewing Company in 1965. The San Francisco brewery had survived from the 19th century gold rush era but had been struggling in recent years. After becoming sole owner in 1969, he began bottling Steam Beer, hoping to revive the style that the brewery made before Prohibition. In the mid 1970's he launched Anchor Porter and Liberty Ale (a hoppy pale ale) which at the time were styles not available anywhere in the US.

Bert Grant was a beer industry veteran, having taken his first job as a taster at 16. After working for several large regional breweries in Canada and the US, he came to Yakima Washington to build two hop processing plants. In 1982 he founded Yakima Malting and Brewing Co., also known as Grant's Brewery Pub. This is recognized as the first brewpub in the US since Prohibition. His IPA was also likely the first to be marketed as such since the demise of Ballantine IPA.

REINHEITSGEBOT

The Reinheitsgebot is commonly known in English as the Beer Purity Law. Originally instituted in Bavaria as an official law in 1516, it mandated that only barley, hops, and water (yeast was not understood at the time and has been added to revisions of the law) may be used as ingredients for beer. The law provided a model that spread throughout Germany until it was officially recognized as state law in 1871. A form of it exists today in Germany under Section 9 Amendment of the Provisional Beer Law of 1993.

Many reasons likely contributed to the original formation of the law. The nobility wanted to protect other grains like wheat and rye for use as flour for affordable bread. It also may have wanted to ensure a sufficient quantity of wheat for use in its own house breweries. The law also provided a vehicle for beer taxation—barley and hops were regulated at the time while many other ingredients were not. Finally, it prevented the use of ingredients that were of lesser quality (or even poisonous) in beer. Because of this last reason, the Reinheitsgebot is recognized as the oldest surviving consumer protection law in the world.

“Many reasons likely contributed to the original formation of the law. The nobility wanted to protect other grains like wheat and rye for use as flour for affordable bread. It also may have wanted to ensure a sufficient quantity of wheat for use in its own house breweries.”

MONASTIC BREWS: TRAPPIST VS. ABBEY

Several breweries in Europe bottle products sporting labels with lovely images of monasteries or jolly monks hefting chalices of frothy ale. Some of these brews are actually still made in monasteries, while others are made by a brewery simply wishing to pay homage to its history or even simply are of the town from which it hails. This stems from the fact that many monastic orders follow the Rule of Saint Benedict. Part of this rule admonishes monks to “live by the work of their hands”. Because of this, monasteries that observe the rule do not depend on charity for subsistence—they support themselves by producing goods for sale like cheese, clothing, bread, and of course, beer. Before the French Revolution, most monasteries brewed their own beer. Since the end of World War II, there have been very few brewing monasteries left.

Despite this, the monastic tradition in brewing is still strong in Belgium, where many of its Trappist and abbey ales are world famous. But when talking about such beers, many apply the terms “Trappist” and “abbey” interchangeably to refer to beers made by monasteries or as a family of beer styles. However, there are some important differences between the two.

“Despite this, the monastic tradition in brewing is still strong in Belgium, where many of its Trappist and abbey ales are world famous. But when talking about such beers, many apply the terms “Trappist” and “abbey” interchangeably to refer to beers made by monasteries or as a family of beer styles. However, there are some important differences between the two.”

There are six breweries in Belgium and one in the Netherlands that are located on the property of a Trappist monastery. The Trappists are a particular order that strictly observes the Rule of Saint Benedict. Their beers tend to be relatively strong ales that employ sugar in the kettle and are bottle conditioned, but they are NOT, in and of themselves, a beer style category. Because of the high quality of the beers these monasteries produce, some secular breweries began to make beers and pass them off as Trappist. Since 1997, the brewing Trappists began to use a seal of authenticity on their labels to combat this. The seal guarantees that the beer is made within the walls of the monastery, that the monastic community controls production, and that the profits from beer sales primarily support the monastery or social services. These monasteries are (with their beer brands):

Abbey of St. Benedict (Achel)
Abbey of Notre Dame de Scourmont (Chimay)
Abbey of Notre Dame d'Orval (Orval)
Abbey of Notre Dame de St. Remy (Rochefort)
Abbey of Our Lady of the Sacred Heart (Westmalle)
Abbey of St. Sixtus (Westvleteren)
Abbey of Our Lady of Koningshoeven (La Trappe and other labels)
in the Netherlands

Abbey ales are NOT brewed inside the walls of a monastery (there is one exception where a secular brewery is located at a monastery), and they are typically made by breweries that are not owned by an abbey. They may be produced by secular breweries and named after local churches, historical monasteries, or even completely fictional abbeys, or they may have a licensing agreement with an existing abbey wherein a portion of profits go to the abbey.

While the terms "Trappist" and "abbey" do not refer to specific beer styles, some of the individual Trappist beers became popular enough that brewers of abbey ales have emulated them. As a result, these similar beers have come to be recognized as beer styles. These styles include Dubbel, Tripel, and Quadrupel (see style section for more details).

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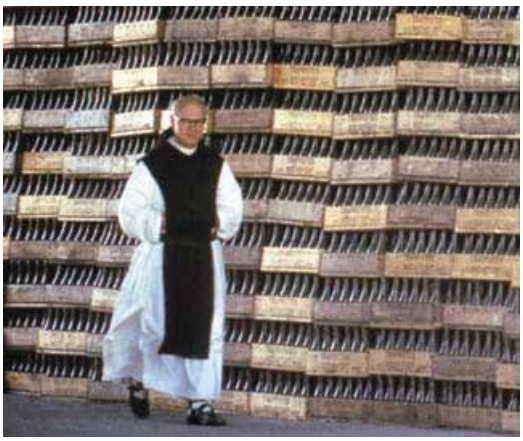


ADVANCED
OFF PREMISE BEER

Content contributed by Jenny Parker, Imperial Beverage

Below are some steps to "raise the bar" at your retail store:

Learn proper merchandising techniques so that you will be able to effectively display beverages. This includes rotating the stock so that the older product is sold first, assembling cardboard promotional displays (ALWAYS include pricing for a successful display), and stacking merchandise into specific patterns that are visually appealing. The best space in a cooler door is the space "on the handle" and also in the "eye to thigh" height range.

Know how to practice good housekeeping skills when you become a beverage merchandiser by cleaning shelves, rearranging displays and replacing damaged or defective product on a consistent basis (always rotate first in first out).

Understand all safety standards when handling and merchandising beverages. This type of merchandise can be extremely heavy, especially when handled in bulk quantities, and can present a safety hazard to both you and others around you. Know proper lifting techniques to avoid injury, such as lifting with your legs, not your back.

Be professional and courteous around customers and store employees. You may be interacting with customers during the course of the day, and may be expected to handle requests and special orders. Providing good customer service is a must!

> **"The best space in a cooler door is the space "on the handle" and also in the "eye to thigh" height range. Always rotate first in first out."**

ADVANCED
ON PREMISE BEER SERVICE

Content contributed by Jenny Parker, Imperial Beverage

Walk into nearly any establishment that serves beer these days and you're likely to find draught beer for sale. Of course, you find well-known brands served through familiar taps, but these days you'll also see fancy options like nitro beers and even some bars with highly carbonated German Weissbier and also English-style "cask" ales. Glassware varies from run-of-the-mill pints to shapely half-liters and diminutive snifters with every possible shape and size in between.

PROPER BEER SERVICE

If sold in a bottle, a craft beer should be poured at the table by the server into a properly-sized, room-temperature glass. It is smart for the server to present the craft beer to the customer in a manor somewhat similar to a bottle of wine. These are world-class artisan beers and benefit from being handled with care and respect. (If sold from draught, see below for proper pouring techniques.)

The server presents the bottle (while still holding it) and addresses the customer by restating the name of the beer that was just ordered. After the customer has a moment to see the label clearly, the server opens the bottle and pours the beer. Repeat this procedure with each customer at the table who ordered a beer. As in wine service, the bottle-opening ritual can add a bit more pizzazz to the service/sale and builds the tip. Hearing the "popshh" of the bottle cap lifting followed by the "sszzz" of the pouring truly adds another welcomed dimension to the customer's craft beer experience. Provide each server with a nice bottle opener, if you decide to do table-side opening.

The glass—think wine service here—should never be filled to the brim with beer, but should have ample space for at least a finger or two of foamy head. (A few beer styles that do not really have a head, such as English ales served on cask, but pretty much any bottled craft beer should.) Tilt the glass and start pouring a little beer down the side of the glass to get a feel for its foaminess. Then turn the glass straight up as the beer is now poured into the middle of the glass at a rate sufficient to create an appropriate head, but not so quickly as to create a big foam up. Adjust the pouring rate to bring the beer level up to where you want it. It is fine to have a little foam protruding above the rim of the glass.

To hold a whole bottle, you probably need a 14 oz. glass for a 12 oz. beer. Of course it is perfectly fine to use a smaller glass, filling it appropriately and leaving the rest of the bottle contents for the customer (or server) to pour later. Draught beer also needs its head space, so size your portions/glassware accordingly. Smaller glasses, like a 10-oz. one, are great when serving guests out of a larger bottle, such as a 22-oz. or a 750 ml. It is okay to treat a large bottle of cold or chilled craft beer the same way you treat a bottle of white wine, like placing it in a chiller sleeve on the table. By leaving the bottle at the table, customers can enjoy reading the often interesting details printed on the beer label.

"The server presents the bottle (while still holding it) and addresses the customer by restating the name of the beer that was just ordered. After the customer has a moment to see the label clearly, the server opens the bottle and pours the beer."

CHECK ITS TEMPERATURE

For maximum enjoyment a craft beer should be served at its proper temperature. Craft beers are more demanding about their serving temperatures than are American macro-brews, which pretty much all want to be icy cold. Craft beers need to warmer, with lighter styles served cold but not iced and heavier, richer styles served at cool cellar temperatures. See the Temperature Guideline article below for more information.

GOOD HEAD IS A GOOD THING

Some beers styles have more carbonation or effervescence (hefeweizen, Belgian ales) and will foam up more easily. Some beer styles have thick creamy heads and others have lighter, fine ones. Some are crisp white; others are tan. They are each beautiful in their own way. The foaming action actually disburses the beer's great aromas into the air so they can more easily be smelled. In these ways, head plays a very important role in craft beer appreciation. In your restaurant, every craft beer head should be a good head.

Producing a good head requires the glassware to be beer-clean with no oil, grease, detergent or sanitizer residues. Wiping or polishing a glass with a towel does not make it beer-clean, only proper washing, rinsing, and storage do. Even a small amount of grease, oil or cleaning product residue can kill a head in seconds. See below for more information on a "Beer-Clean Glass".

It's also a good practice to spritz/mist the inside of the glass quickly with fresh water just before filling it. This will help ensure the formation and retention of a proper foamy head, which is so important to thorough craft beer enjoyment.

GLASSWARE STYLES ABOUND

Craft beer styles come with a wide array of glassware styles and shapes. It is very nice, but not totally necessary, to have at least a few different glassware styles for your primary craft beer categories. One glass type to avoid is the common straight-sloped-sided bar pint glass, as it does not really complement any particular beer style and is much too common for premium beer service. Find a glass with an elegance equal to the high-quality beers it will hold. Different sized, clear glasses with some type of bowl or fluted shapes are best for beer appreciation. You can even use wine glasses successfully. Recommendations on craft beer glassware can be found in the Beer Glassware section below

Silkscreened beer branded glassware is popular and looks great in a beer specialty bar but might be considered a bit too promotional for a fine dining restaurant. And Michigan law actually prohibits a restaurant from pouring beer into a logoed glass.

> **"The foaming action actually disburses the beer's great aromas into the air so they can more easily be smelled."**

CRAFT BEER SERVICE TIPS

- Servers who show a little flair with the craft beer service ritual add the fine dining experience to their guests and also add to the gratuity.
- Ensure that the beer's temperature is correct for its style before it is brought to the table.
- Always serve a bottled beer with a glass. The guest should never have to ask for a glass.
- Never frost or cold-chill a glass used for craft beer service.
- Craft beers do not have twist-off caps. A good beer opener is worth its weight in gold.
- Encourage guests to share a bottle of beer, as they do bottled wine, by offering more selections in 22-oz and 750-ml bottles.
- Craft beer glassware should be consistent in quality with your wine glassware.

> **For maximum enjoyment a craft beer should be served at its proper temperature.**

COLD STORAGE & PROPER CHILLING OF KEGS BEFORE SERVING

To ensure fresh flavor and ease of dispense, draught beer should remain at or slightly below 38°F throughout distribution, warehousing and delivery. Brewers and distributors use refrigerated storage for draught beer. In warm climates or long routes, they may also use insulating blankets or refrigerated delivery trucks to minimize temperature increases during shipping.

At retail, even a few degrees increase above the ideal maximum of 38°F can create pouring problems, especially excessive foaming. Ideally all draught beer delivered to retail will be stored cold until served.

Accounts that lack cold storage for their entire inventory of draught beer should allow adequate chilling time for recently refrigerated kegs in order to avoid problems in dispensing. In a similar vein, recently arrived kegs should be allowed adequate chilling time as they usually warm to some degree during delivery. In order to avoid problems in dispensing, every keg must be at or below 38°F while being served.

To help ensure that your kegs are properly chilled before serving, the chart below provides a guide to the time needed to properly chill a keg to 38°F from a given starting temperature. Note that even kegs that "feel cold" (e.g., 44°F) may need to chill overnight in order to ensure proper dispense.

START TEMP	TIME TO 38° F
50° F	25 hours
48° F	23.5 hours
46° F	21 hours
44° F	18 hours
40° F	7 hours
38° F	0 hours

> **At retail, even a few degrees increase above the ideal maximum of 38°F can create pouring problems, especially excessive foaming. Ideally all draught beer delivered to retail will be stored cold until served.**

TEMPERATURE GUIDELINES

Most Americans are used to drinking their beers at very cold temperatures, but these icy temperatures harm the enjoyment of craft beer. While lighter-styled craft beers should be served cold, it is not necessary or wise to serve them icy cold. Just as too cold a temperature dulls a fine white wine, it has the same effect on a fine craft beer. This is especially important for beer that is served with a meal.

Some of the beer temperature confusion comes from the popular North American light beers and macro-brewed lagers that are designed to taste best at 38° F. Accordingly, much of the US beer refrigeration equipment is designed to hold beer at 34-38° F. In contrast, lighter styles of craft beer taste their best a bit warmer than that and are also more tolerant of warmer serving temperature variations. To test this, try a craft-brewed helles lager and a macro-brewed light beer side-by-side, first at 38° F. and then at 48° F. See which one tastes best as it warms. When served with food, lighter-styled craft beers taste better at 43° to 45° F.

More fully-flavored craft beer styles should be served somewhat warmer still. Like elegant red wines that are best served at cool cellar temperature, full-flavored beer styles need a chill but not a cold. Also be careful not to serve full-flavored beers (or red wines for that matter) at room temperature. Typical room temperature (72° F) is much too warm for all but a couple of craft beer styles. Use the Temperature Guidelines below or consult a beer temperature service guide like the one linked here from Ratebeer.com for more detailed information.

(TEMPERATURE GUIDELINES CON'T)

Since all beers will warm up after they are poured, you can figure this factor into your refrigerator temperature settings. Information provided by Anheuser Busch states that a room-temperature, rinsed, thin-shell glass will raise the temperature of beer by about 2 degrees. A heavy glass chalice or mug increases the beer's temperature by around 4° to 6° F.

Food refrigeration equipment is kept too cold for craft beer. Public health agencies recommend a food storage temperature of 36° to 38° F. Don't store your craft beer there unless you have a way to warm it up before serving.

Craft Beer Storage Temperature Guidelines

For proper craft beer service three separate bottle-cooling spaces are recommended. Conveniently, two of these double up nicely with wine. The temperature recommendations have been set to assure an optimum serving temperature, accounting for a 2° F glass warming factor. Think of the three categories as:

- Cold , 41° F (5° C)
- Chilled, 46° F (8° C)
- Cellar, 55° F (13° C)

Cold – This is where you will keep your lightest styles of craft beer. These include American microbrewed lagers, German helles lager, American wheat beer, hefeweizen, summer seasonal beers, sweet fruit-flavored lambics, Belgian-style wit (white ale), and Kölsch.
Chilled – This workhorse category keeps your Pale, Amber, Blonde, & Golden ales; stout; porter; dunkel, dark wheat beer; European-style pilsner; Tripel; dark sour ales; and gueuze. This cooler doubles for your white wines.
Cellar – Cool cellar temperature (like those in a true, unheated in-ground cellar or cave) is where you keep your cask-conditioned English ales & bitter, India Pale Ales & Double IPAs, most things labeled Imperial, dark Abbey beers, Dubbel, barleywine, Baltic porter, bock and doppelbock. This cellar-temperature cooler doubles for your red wines.

Don't depend solely on the cooler's thermostat dial markings or digital read out; use a calibrated refrigerator thermometer to monitor the beer cooler temperature. In this energy-waste-conscious environment, keeping your thermostat at optimum temperature, and not a degree colder, is good for your bank account.

Test your beer service temperatures with customers and see where your customers prefer them to be. With so many styles of craft beer available today, it is difficult to know exactly where a beer will taste its best. It may take a little trial and error to decide which of the three temperature categories is right for a specific beer.

What about the macro-brews?

North American macro-brewed lagers and lights (Bud-Miller-Coors), require colder storage temperatures than craft beer. Should you decide to continue selling them, they should be kept in an icy cold refrigerator set to 35–38° F. This is especially true for kegs of their draught beer.

Cool craft beer, like wine, good for business

In summary, people tend to prefer their light American macro lagers at 38-40° F because this is the temperature at which they are designed to taste their best. Craft beers, on the other hand, definitely taste better at warmer temperatures. Contemporary craft beers are often based on traditional beer styles that did not depend on modern refrigeration equipment. Craft beers open up and show off their taste complexities at more moderate temperatures. Think of craft beer much like you think of wine. It has very similar temperature requirements — and the requirements are quite different from those of generic light beer and macro-brewed lagers.

As is true in so many areas of restaurant management, paying attention to the little things leads to increased customer satisfaction. Paying proper attention to craft beer storage temperature is yet another avenue to positively differentiate your establishment from the competition. Your customers will recognize and appreciate this little thing that means so much to beer appreciation.

BEER-CLEAN GLASS

How clean is beer-clean? Pretty darned clean.

How important is beer-clean to craft beer service in a restaurant? The Brewers Association (BA) states that a "perfectly poured beer requires a properly cleaned glass", and we agree.

Here are some of the issues caused by non-beer-clean glassware and their various bad residues.
- A beer flattened from a big initial foam up that knocks most of the carbonation out of a poured beer.
- A headless beer from a film or grease residue that attacks the beer's effervescence causing it to disappear.
- A bad odor or taste caused by something left on the glass from improper cleaning or added to the glass by improper handling.
- A gag response when the drinker discovers the lipstick on the rim of the glass is not his.

Some tips beyond proper washing and rinsing include:
- Dry glassware away from sinks, dirty dishes, and food preparation areas.
- Do not wipe dry or polish glassware with towels–they can actually transfer aroma or films to the glass. A properly washed and rinsed glass does not require wiping. It's best to air dry or heat dry in an automatic glass washer.
- Air dry and store glassware upside down in clean stainless steel baskets or hanging by their feet in overhead racks.
- Remind bar and wait staff that aromas can easily be transferred to a glass by an employee who has recently applied a perfumed hand cream.

Beer-clean is a higher standard than many people realize, but it's not hard to achieve. It just takes commitment to a system. For step-by-step instructions to the beer clean process, see below for the Brewers Association guide on the topic.

Having beer-clean glassware is yet another way to differentiate your establishment from the competition. It's a little thing that will be very appreciated by your beer drinking customers.

CRAFT BEER GLASSWARE

For the casual- or fine-dining restaurant the selection of craft beer glassware is important, but it need not be difficult. As rule of thumb, craft beer glassware simply needs some of the same consideration you give your wine glassware.

Just as restaurants commonly keep three or more distinct types of wine glasses—for reds, whites and sparkling—you will likewise want to use at least three distinct types of beer glasses, plus possibly use one wine glass type you likely already have. Craft beer glassware should generally match the elegance of your wine glassware.

A curved-in shape such as this 14 oz. Libbey Teardrop makes a great all-purpose craft beer glass. About 7" tall, it provides the elegant look that is similar to wine glassware.

Another all-purpose option, the stemmed Anchor Excellency Pilsner comes in 12-oz. and 14-oz. Elegant shape.

This Libbey Catalina 14 oz. footed pilsner is a good glass for any craft-brewed pilsner, hefeweizen, or lager. Its nice slightly curved-in top gives it a particularly classy look.

(CRAFT BEER GLASSWARE CON'T)

14-oz.all-purpose glass. Can be used equally well with lager/pilsner, lighter ales (pale, blonde, golden, amber, red), stouts, bitter, porter and wheat beer. Best for normal-strength beers. An elegant footed or short-stemmed glass works great here, but so does a classic pilsner. Look for a style that has a bit of a curved-in top, which helps with beer appreciation. A 14-oz. glass will hold a whole 12-oz. bottle and give decent head space. Footed/stemmed glassware also adds the convenience of compatibility with hanging racks. Always select clear glass, never colored, frosted, or tinted.

This Stolzle "Berlin Beer" glass from Anchor Hocking is a worthy example of the tulip shape the is essential for craft beer sales in restaurants. Its 13.75 oz. size will find multiple uses among flavorful Belgian-styles, Imperials, and aromatic beers.

- 12- or 13-oz. footed tulip or snifter. Used for more fragrant, richly aromatic beers, like big-hopped double IPAs, saison, dark sour beers, thick and rich baltic porters and imperial stouts, abbey beers, doppelbocks, barrel-aged beers, smoked beers and barley wine. Makes a beautiful presentation. Holds up to an 8 oz. pour and provides ample head and vapor space. It's shape allows the drinker to warm it with the hand, which is perfect for the type of beers recommended for this glass style. It's fine to use a glass that is smaller in size than a standard bottle of beer since 6 oz makes a nice serving of stronger-alcohol (10%–12%), richly aromatic beers.
- 6- or 9-oz. Champagne flute or white wine glass. Used for fruit lambics, gueuze, eisbock, wild ales, Berliner weisse cocktails, and any festive specialty beer you feel deserves it. (A white wine glass can also be used in a pinch in place of the beer tulip above.)
- 10-oz tumbler. A chunky facet-sided glass or classy flat-bottomed crystal tumbler is the prefect look for serving a wide variety of craft beers in smaller portions. It provides a contrast to the more elegant footed and stemmed glassware styles. These are nice to use with bottles of craft beer that are shared among two or more customers at a table.

Optional but nice:

- 12-oz. Goblet or chalice. Traditional for abbey-style beers, dubbel, tripel and all Trappist beers.
- 20-oz. or larger Wheat beer glass. These are tall, often with a large bell at the top. Designed to collect the thick frothy head created by pouring a well-made Hefeweizen.
- 7-oz. Stange. A small, thin straight-sided cylinder glass traditionally used for Kolsch, but also great for any lighter-styled summer ale and even a bock.

CHARACTERISTICS OF A GOOD BEER GLASS

A beer tulip is the glass best suited to richly flavored and highly aromatic beers. It should be a clear glass so the beer's color shows through. Craft beers range in color from light gold to amber to copper to brown to almost black. Some craft beers are crystal clear, others are opaque, while still others are cloudy. A clear glass allows all the color variances to be seen and appreciated.

Somewhat bowl shaped, with room for the aromas to collect. When first poured the releasing effervescence delivers all beer's fragrance up to the nose. But once the beer is half consumed, a bit of a bowl shaped glass will help collect the vapors and allow the beer to be better appreciated.

Larger than the amount of liquid beer poured into it. For instance, a 12-oz glass should never have more than 10- or 11-oz. of beer poured into it to leave room for the formation of a proper head. Richly-flavored aromatic beers poured into a tulip glass benefit from even more head room to allow for both a head and some aroma collection space. Never fill a glass to the brim with liquid beer. Here again, in the concept of proper glass filling, you will notice some similarity to wine service.

Beer-clean so it encourages formation and retention of a nice head. Beer-clean

(CRAFT BEER GLASSWARE CON'T)

is not a characteristic of the glass so much as it is a characteristic of the handling of it. Beer-clean is described in another article in Craft Beer Restaurant.

Non-frosted (preferably room temperature) so it doesn't freeze out the flavors of a craft beer that tastes better a bit warmer.

A classy look whether that is elegant classic crystal that matches your wine glassware, or funky, clunky contemporary, or clean, crisp modern lines. Beer glassware should match the style and personality of your restaurant.

One style to avoid-
As a fine-dining restaurant you should avoid the sloped, flat-sided mixing-glass style that is so common as the bar pint in beer bars, corner taverns and pool halls. While it is very durable, its shape is not particularly conducive to beer appreciation.

GLASSWARE CLEANING

A perfectly poured beer requires a properly cleaned glass. As a starting point, glassware must be free of visible soil and marks. A beer-clean glass is also free of foam-killing residues and lingering aromatics such as sanitizer.

A freshly cleaned glass should be used for every pour. We recommend that accounts never refill a used glass.

Two systems deliver effective beer glass cleaning:
1. Manual cleaning in the three-tub sink, or
2. Dedicated automatic glass washers.

Each approach requires specific techniques and a certain degree of discipline. Let's look at what's involved with each one.

Manual or Hand Cleaning in the Three-Tub Sink

1. Clean sinks and work area prior to starting to remove any chemicals, oils or grease from other cleaning activities.

2. Empty residual liquid from the glass to a drain. Glasses should NOT be emptied into the cleaning water as it will dilute the cleaning solutions.

3. Clean the glass in hot water and suitable detergent. Detergent must not be fat- or oil-based. Detergents suitable for beer glass cleaning are available through restaurant and bar suppliers.

4. Scrub the glass with cleaning brushes to remove film, lipstick and other residue. Rotate the glass on the brushes to scrub all interior and exterior surfaces. Be sure to clean the bottom of the glass.

5. Rinse glass bottom/butt down in cold water. Water for the rinse should not be stagnant but should be continually refreshed via an overflow tube. If time permits, a double dunk is recommended and preferred.

6. Sanitize in third sink filled with hot water and an appropriate sanitizer. Sanitizers typically contain chlorine so check the pH and chlorine content of the sanitizing bath periodically to maintain proper conditions. Water temperature should be at a minimum 90ºF. Chlorine concentration should be 100 ppm or at the required local health department concentration.

Automatic glass washing machines

- Dedicate this machine to cleaning bar and beer glassware only. Do not subject it to food or dairy product residue.
- Use correct detergent, sanitizer and rinse agents in properly metered amounts.
- Check concentrations once each day using kits or follow detergent and sanitizer supplier recommendations.
- Use water temperatures of 130º to 140ºF. High temperature machines designed to operate at 180ºF can be used without additional chemical sanitizers. Please check your health department for local requirements.
- Maintain the machine to assure good water flow through the system including free flow through each nozzle and washer arm.
- Regularly service the machine based on the manufacturer's or installer's guidelines.

Handling Clean Glassware

- Keep glassware clean and odor free after washing.
- Air-dry glassware. Drying glasses with a towel can leave lint and may transmit germs and odors.
- Dry and store glasses in a stainless-steel wire basket to provide maximum air circulation. Similar deeply corrugated baskets or surfaces also work.
- Do not dry or store glassware on a towel, a rubber drain pad or other smooth surface, as they can transfer odors to the glass and slow the drying process.
- Store glassware in an area free of odors, smoke, grease or dust.
- Store chilled glasses in a separate refrigerator away from food products such as meat, fish, cheese or onions as they can impart an odor to the glasses.
- Store beer glasses dry in a chiller. Never use a freezer. Chill glasses at 36° – 40ºF.

TESTING FOR "BEER-CLEAN" GLASS

Beer poured to a beer-clean glass forms a proper head and creates residual lacing as the beer is consumed. After cleaning, you can test your glasses for beer clean status using three different techniques: sheeting, the salt test and lacing. Let's review each technique.

- Sheeting Test: Dip the glass in water. If the glass is clean, water evenly coats the glass when lifted out of the water. If the glass still has an invisible film, water will break up into droplets on the inside surface.

- Salt Test: Salt sprinkled on the interior of a wet glass will adhere evenly to the clean surface, but will not adhere to the parts that still contain a greasy film. Poorly cleaned glasses show an uneven distribution of salt.

- Lacing Test: Fill the glass with beer. If the glass is clean, foam will adhere to the inside of the glass in parallel rings after each sip, forming a lacing pattern. If not properly cleaned, foam will adhere in a random pattern, or may not adhere at all.

Sheeting Test

Salt Test

Lacing Test

(GERMAN PILSNER CON'T)

Comments: Drier and crisper than a Bohemian Pilsener with a bitterness that tends to linger more in the aftertaste due to higher attenuation and higher-sulfate water. Lighter in body and color, and with higher carbonation than a Bohemian Pilsener. Modern examples of German Pilsners tend to become paler in color, drier in finish, and more bitter as you move from South to North in Germany.

History: A copy of Bohemian Pilsener adapted to brewing conditions in Germany.

Ingredients: Pilsner malt, German hop varieties (especially noble varieties such as Hallertauer, Tettnanger and Spalt for taste and aroma), medium sulfate water, German lager yeast.

Benchmark Brewery:
Bitburger: The brewery was originally founded in 1817 and first brewed its prized Pilsner in 1883. During the Second World War the town of Bitburg and the brewery were nearly destroyed. 1945 the brewery was rebuilt and production resumed. The growth of the brewery continued and by 1975 was in its sixth generation of management and export to other countries such as Italy in 1976 and the United States in 1978.

Benchmark Beers:

- **Bitburger Premium Pils:** A traditional German Pilsner brewed in accordance with the German Purity Law. Dry and crisp with pronounced hoppiness and slightly bitter character. One of the top three best selling beers in Germany.
- **Victory Prima Pils:** An American version of the traditional German Pils style. Prima Pils has been critically acclaimed (94 points Wine Advocate), has won countless awards and has gained the reputation as one of the best Pilsners in the world. Heaps of hops give this pale lager a bracing, herbal bite over layers of soft and smooth malt flavor. This refreshing combination of tastes makes Prima a classy quencher in the tradition of the great pilsners of Europe. www.victorybeer.com
http://youtube/NWikacsFgHo

> **"German Pilsner: Clean, no fruity esters, no diacetyl."**

SCHWARZBIER

Aroma: Low to moderate malt, with low aromatic sweetness and/or hints of roast malt often apparent. The malt can be clean and neutral or rich and Munich-like, and may have a hint of caramel. The roast can be coffee-like but should never be burnt. A low noble hop aroma is optional. Clean lager yeast character (light sulfur possible) with no fruity esters or diacetyl.

Appearance: Medium to very dark brown in color, often with deep ruby to garnet highlights, yet almost never truly black. Very clear. Large, persistent, tan-colored head.

Flavor: Light to moderate malt flavor, which can have a clean, neutral character to a rich, sweet, Munich-like intensity. Light to moderate roasted malt flavors can give a bitter-chocolate palate that lasts into the finish, but which are never burnt. Medium-low to medium bitterness, which can last into the finish. Light to moderate noble hop flavor. Clean lager character with no fruity esters or diacetyl. Aftertaste tends to dry out slowly and linger, featuring hop bitterness with a complementary but subtle roastiness in the background. Some residual sweetness is acceptable but not required.

Mouthfeel: Medium-light to medium body. Moderate to moderately high carbonation. Smooth. No harshness or astringency, despite the use of dark, roasted malts.

(SCHWARZBIER CON'T)

Overall Impression: A dark German lager that balances roasted yet smooth malt flavors with moderate hop bitterness.

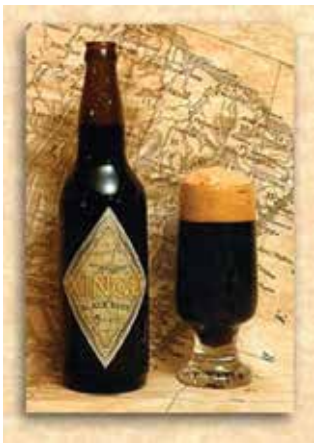
Comments: In comparison with a Munich Dunkel, usually darker in color, drier on the palate and with a noticeable (but not high) roasted malt edge to balance the malt base. While sometimes called a "black Pils," the beer is rarely that dark; don't expect strongly roasted, porter-like flavors.

History: A regional specialty from southern Thuringen and northern Franconia in Germany, and probably a variant of the Munich Dunkel style.

Ingredients: German Munich malt and Pilsner malts for the base, supplemented by a small amount of roasted malts (such as Carafa) for the dark color and subtle roast flavors. Noble-type German hop varieties and clean German lager yeasts are preferred.

Benchmark Brewery:
Kostritzer: Mentioned in records as far back as 1543, the Kostritzer Schwarzbierbrauerei is located in Germany in the town of Bad Kostritz. The brewery was has been owned by the Bitburger Brauerei since 1991 and it is one of the oldest producers of Schwarzbier in Germany. For more on the brewing process of Kostritzer http://www.koestritzer.de/en/brauerei/brauprozess/

Benchmark Beers:
• **Kostritzer Shwarzbier Black Lager:** nearly opaque in color with a light, refreshing body. Exhibiting roasted malt character with chocolate and coffee notes similar to a stout but with a much lighter mouthfeel. A smooth easy drinking dark lager.
• **Xingu Black Beer:** Brewed in the city of Toledo, state of Paraná, Brazil. A two time Gold Medal winner as the best dark lager in the world by The Beverage Testing Institute, the roasted malts give this beer its coffee, molasses and licorice aromas and flavors. A smooth, silky texture and a rich yet mild finish. www.xingubeer.com



ADVANCED
TASTING BEER

Content contributed by Andrew VanTil, Imperial Beverage

SENSE OF TASTE

"Flavor" is the overall package of sensation that we get from the combination of olfaction from our sense of smell, taste (sometimes called gustation) from the taste buds in our mouth, and other sensations like texture, temperature, astringency, and chemical coolness and piquance (heat or spice). Here we'll focus specifically on the sense of taste.

Humans have roughly 10,000 taste buds. Taste buds contain cells that react with certain chemicals as they pass by (when we eat or drink). When this happens, signals are sent to our brains and we perceive the five basic tastes of sweet, salty, sour, bitter, and umami. Recent research suggests that there may be other primary tastes like fatty (which we don't have to worry about here because beer is fat-free) and metallic, but there is not yet universal agreement to this end.

Most taste buds are on the tongue, but some can also be found in the cheeks, on the lips, and on the soft and hard palate. On the tongue, they are localized in three areas. On the front two thirds, there is a concentration of buds that appears to be equally sensitive to all five tastes. Across the back, there is a band of buds that many believe to be especially sensitive to bitter and umami, and toward the back along the sides of the tongue are patches of buds that seem to be especially sensitive to sour.

So... how does any of this relate to what we taste in beer?

"Flavor is the overall package of sensation that we get from the combination of olfaction from our sense of smell, taste (sometimes called gustation) from the taste buds in our mouth, and other sensations like texture, temperature, astringency, and chemical coolness and piquance (heat or spice). Here we'll focus specifically on the sense of taste."

SWEET

The taste of sweetness comes from different kinds of sugars dissolved on our tongues. Different types of sugars taste sweeter than others. Fructose is the sweetest of all naturally occurring sugars, and is around 10 times sweeter than lactose. Malt used to make beer is typically richest in maltose and maltotriose. While these are readily fermentable by most yeasts that brewers use, in most cases there is some that is left unfermented; almost all beer has residual sugar in varying degrees. This depends on a number of factors including the types of malt (and other sugar sources) used, mashing procedures, original gravity of the wort, the yeast type, strain, and health, and the conditions of fermentation. Brewers can control many of these factors to target residual sugar in beer. Residual sugar coupled with alcohol, temperature, and other aromatic and mineral elements contributes to an overall impression of sweetness in beer. Depending on the beer style and the brewer's intent, these elements balance elements of body, bitterness, and acids, in the beer.

SALTY

Dissolved salts in food create an electric charge that we experience as saltiness. While this is primarily the case with sodium chloride (table salt), potassium, calcium, magnesium, and ammonium salts can also trigger impressions of saltiness, but the taste can tend toward alkaline or bitter. While (with the exception of the Leipsiger Gose style) most beers don't taste overtly salty, water used for brewing usually has a degree of mineral content that includes some concentrations of salts. Some of these salts will give beer a background note of saltiness or impressions of other tastes and sensations. Brewers themselves also typically add salts to water used for brewing in order to hit targets of acidity in the mash, satisfy mineral demands for healthy yeast growth, and to modify taste profile in the beer.

“Similar to saltiness, our tongues detect the hydrogen component in dissolved acids, and experience a sour taste.”

SOUR

Sourness is how we sense acidity in food. Similar to saltiness, our tongues detect the hydrogen component in dissolved acids, and experience a sour taste. All beer is inherently acidic when compared to water, but we wouldn't say that most beer styles are obviously sour. The acidity of beer generally serves to refresh the palate and balance elements of sweetness and bitterness. The carbonation of beer also contributes to impressions of sourness as carbonic acid is in equilibrium with carbon dioxide dissolved in liquids. This too, helps provide a balancing effect with other flavor components in beer.

Of course, we do know that some beer styles are intentionally and obviously sour. This is generally from the activity of wild yeasts and bacteria that produce as byproducts lactic and acetic acids, or from the use of other ingredients in brewing like fruits that have natural acidity. Historically, beer soured to an extent by wild yeast and bacteria was a major part of beer flavor, as it was not in the last 200 years that our understanding of yeast and microbiology eventually led to the use in brewing of sanitary fermentations with monocultures of yeast.

“Umami is typically found in foods like ripe tomatoes, seaweed, mushrooms, meat, shellfish, and dairy products, particularly when foods have been fermented or aged (think soy and fish sauce, Parmigiano-Reggiano cheese).”

UMAMI

The literal translation of the Japanese word umami is “good flavor” or “deliciousness,” but other more descriptive translations like “savory,” “meaty,” or “brothy,” have been used. Umami is typically found in foods like ripe tomatoes, seaweed, mushrooms, meat, shellfish, and dairy products, particularly when foods have been fermented or aged (think soy and fish sauce, Parmigiano-Reggiano cheese). The taste of umami is described as a mouth-watering fullness in the mouth. While it can be enhanced by balancing saltiness and sweetness, umami itself cannot be produced simply from a combination of other tastes.

Its existence was suspected by some chefs and scientists late in the 19th and early 20th centuries. In 1908, Japanese chemist Kikunae Ikeda identified the brown crystals left behind from evaporated seaweed soup as glutamic acid (an amino acid—one of the building blocks of proteins). Umami is now widely accepted as a basic taste as the taste bud receptors for glutamate and a few other similar structures have been identified.

In most beers, umami plays a minor role, as the main source for it in most beers is the breakdown of yeast cells or autolysis. In most beers, this would generally be seen as a flaw and would likely be

(UMAMI CON'T)

accompanied by unpleasant oxidized flavors. However, in beers that can withstand or even be enhanced by aging on yeast, umami components accompanying autolysis can result in an experience of roundness and fullness on the palate and is sometimes described as "bready" or "toasty." This can be further enhanced by considering food pairings with other foods that display umami.

See also http://www.npr.org/templates/story/story.php?storyId=15819485 – a great audio story about umami—recommended for beginner level.

> **"In most beers, umami plays a minor role, as the main source for it in most beers is the breakdown of yeast cells or autolysis."**

ADVANCED

BEER INGREDIENTS

Content contributed by Andrew VanTil, Imperial Beverage

MALT



1. What is it?
Malting is the process where a grain seed is steeped in warm water, causing it to sprout, and then dried under controlled conditions. This process initiates the growth cycle for a seed. Enzymes begin to break starches down into sugars and proteins down into amino acids that the plant would have needed to grow; the maltster then stops the process by drying the grain. This locks up those resources and preserves them for use by the brewer.

2. Why barley (and not wheat, spelt, sorghum, corn, etc.)?
While most cereal grains can be malted, brewers prefer barley for its husk, high starch content, high enzyme content, lower protein content, and relatively neutral flavor. Other grains, like wheat and rye, contribute unique flavors to beers as well, but even these beers are typically made with at least 30% barley malt.

3. Types of malt
Depending on the time and temperature of the drying process (kilning), malt products vary from very pale in color and light in flavor to black in color and intense in flavor.
Base malts—these are the lightest malts. Brewers typically use between 70-100% of these malts for all of their recipes.
Specialty malts—these are further processed through toasting, roasting, or caramelization. Brewers use these types of malts in smaller percentages because of their high flavor impact.

4. What does malt contribute?
Alcohol—malt starch is converted to sugars during the brewing process that are eventually fermented to alcohol (and CO_2). If more malt is used, then more alcohol will be in the finished beer.
Color—from pale straw to black, malt is the primary determinant for color in beer. Colors range from pale straw to black. Most American craft brewers use the Standard Reference Method (SRM) to describe beer color.
Body/sweetness—malt protein and unfermented starches and sugars are left behind in finished beer. These contribute a sense of weight in the mouth and a perception of sweetness/residual sugar on the palate.
Flavor—depending on the type and amounts of malts used, a wide variety of flavors results in finished beer. A few examples of beer flavors that come from malt use include grainy, roasted, cereal, burnt, coffee, molasses, toffee, raisiny, honeyed, nutty, chocolaty, pruny, dried fruit.

(MALT CON'T)

5. How is it used?

In the brewing process, malt is coarsely milled, separating the husk from the kernel without grinding the seed into flour. The grist is then mixed with warm water and held for a period of time. This is called the mash. During the mash, enzymes naturally in the malt will break down the starches into simple sugars suitable for fermentation. At the end of the mash, the sweet liquid, or wort, is drained off the spent grain and brought to a boil in the brew kettle. After the boil, the wort is cooled down so that yeast can be added to begin fermentation.

HOPS



1. What are they?

Hops are the greenish flowers of the humulus lupulus plant, which is a vigorous climbing vine in the nettle family, closely related to marijuana. Since the late 16th century, they've been almost universally used in beer production.

2. Why hops?

The bitterness provides a counterpoint to the rich sweet character of malt. Hops are also a natural preservative; historically, the use of hops allowed table beer to be drinkable for a few months rather than a few weeks.

3. Types of hops (varieties)

There are over 100 varieties of hops used by brewers. Much like wine grapes, each variety exhibits a particular flavor and aroma profile, but this profile is expressed differently depending on where it is grown. Some varieties are prized for their bittering potential and others for their aromatic oil content. Many hop varieties historically were grown in particular regions. Because of this, these varieties have come to be associated with particular beer styles.

Major regions and some associated varieties
UK—Kent Goldings, Fuggles
Germany—Hallertauer (Mittelfrüh), Spalter, Tettnanger, Hersbrucker
Czech Republic—Saaz
Poland—Lublin
Australia—Pride of Ringwood
New Zealand—Pacific Gem
US (esp. Yakima Valley)—Cascade, Centennial, Chinook, Columbus, Amarillo, Simcoe, Crystal, Mt. Hood, Liberty, Sterling, Santiam, Ahtanum, Summit, Citra, Warrior, Willamette

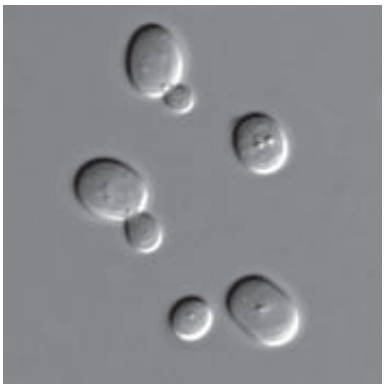
4. What do hops contribute?

Bitterness—the resins in hops become soluble after boiling, and the finished beer tastes bitter to balance the sweet malty tones.

(HOPS - What do hops contribute? CON'T)
Flavor/Aroma—the essential oils in hops contribute a spectrum of aromatic qualities. Some descriptors for hop flavors/aromas include floral—rose, geranium, lily, lavender; spicy—herbal, peppery, minty, eucalyptus, bay, sprucy, piney; earthy—grassy, hay, woody, cellar; fruity—citrus, tropical; pungent, catty.

5. How are they used?
Before brewers use them, hops are dried and sometimes ground and compressed into pellets. During the boil, brewers will add whole hop flowers or pellets at different times, depending on the desired effect. Hops added at the beginning of the boil will contribute bitterness, but the hop oils will largely boil off. To pack more hop flavor and aroma into a beer with little accompanying bitterness, brewers can add hops toward the end of the boil or even after fermentation (dry hopping). Un-dried hops used within a couple days of the annual harvest are known as wet hops or fresh hops.

YEAST


1. What is it?
Yeast is a single-celled organism in the fungus family. Saccharomyces Cerevisiae is the type of yeast known as brewer's yeast. It consumes sugar (from malt) and creates as waste products alcohol, carbon dioxide, and lots of other flavors that we know as beer (which we don't call a waste product).

2. Types of yeast
Lager (bottom fermenting)—these ferment beer more slowly at cooler temperatures than ale yeasts (40-60°F). Lagers need longer maturation time than ales because they take longer to reduce "green" flavors produced as a normal part of fermentation and because they produce sulfur flavors that the yeast needs time to reabsorb post fermentation. Lager yeasts tend to ferment beer drier than ales, and they don't produce as much fruity/spicy flavor as ale yeasts.
Ale (top fermenting)—these work vigorously at room temperature (60-80°F). They require less time to finish their fermentation cycle; beers made with ale yeasts may be ready to drink as soon as a week after brewing. Ales tend to finish a bit sweeter with more body and fruity flavors than lagers.

3. Yeast Strains
Brewers and beer aficionados spend a lot of time talking about yeast strains. We've talked about the two major types of brewer's yeast, but there are thousands of different strains within those two categories. While the basic metabolic action (yeast consuming sugar and yielding alcohol and CO_2 as waste products) is the same across all strains, individual strains also create flavor/aroma compounds as additional byproducts of fermentation (they also perform differently from each other in different brewery settings, which gives the brewer some flexibility in yeast selection to help his/her individual situation). While this is true for lager yeast strains, it is even truer for ale yeast strains.

Here are a few important categories of ale yeast strains:
American Ale yeasts—these tend to be fairly neutral in character, giving the brewer flexibility for use in several styles.
British Ale yeasts—fruitier than American ale yeasts, these tend to leave more residual sugar and body in the finished beer. They also settle out of the beer readily, making them a great choice for unfiltered and cask conditioned ales.
German wheat (weizen) yeasts—these yeasts leave a strong signature of phenolic spice (cloves) and fruity esters (banana, bubble gum) in the beer, and they tend to stay suspended in beer for a long time, which contributes to the cloudy character in unfiltered weissbiers.
Belgian Ale yeasts—This is a fairly broad category of yeasts, producing beers with a huge range of fruity, spicy, and earthy characters. They don't specifically exhibit clove/banana tones like weizen yeasts.

4. How Brewers Use Yeast
At the end of the brewing process, the brewer will mix or "pitch" a prescribed amount of yeast into the unfermented beer (wort) at a controlled temperature that ensures that the action of the yeast will be vigorous and begin quickly. Within a few hours, fermentation will be apparent as the brew becomes cloudy and foam builds on the surface. Depending on the type of yeast used, this will continue for one or more weeks until the yeast has multiplied and consumed the simpler sugars in the wort, producing what will become beer after additional maturation. For some very traditional styles, brewers will also rely on yeast and bacteria in the air or in the fermentation vessels (often wooden barrels) to naturally begin fermentation. Typically, such beers will be at least a bit sour but also quite complex.

WATER

1. What role does it play in beer?
Water makes up more than 90% of most types of beer, and it's also used as part of the production process in brewing, so the quality of the water used for brewing is really important. Apart from the actual H20 itself, trace minerals and elements in water are important for yeast health and can improve a beer's flavor.

2. Historical implications
Brewers throughout history have generally understood the importance of water quality, so it's no accident that many of the world's classic beer styles were developed in places with a particular type of water that turns out to have been well suited to that style. For example, London is famous for its dark ales. Even if the brewers at the time didn't understand it, it turns out that the carbonates in London's water were what rounded the bitter edges of the roasted malts used to make those beers.

3. Modern realities
Even though many breweries may still use the same artesian water source that they have for over a hundred years, most of the brewing world today has access to treated water from a municipal source. If desired, brewers can change that water to suit their needs through a combination of filtration, chlorine removal, and addition of minerals.

ADVANCED
DRAUGHT SYSTEMS

Material contained in this document applies to multiple course levels. Reference your syllabus to determine specific areas of study.

Content collected by Anne Drummond from sources (including Glastender of Saginaw, Mi, Brewers Association, and Kegworks)

All beer is not created equal, as you probably already know. Beer can taste very different—even the same brand and same style of beer—depending on how it is handled at the distributor and account levels. These elements of handling will affect the longevity of your beer.

A few elements are the enemy of beer. Light, temperature, and age are the biggest triggers. But offering beers on draught impacts the consumer experience, too.

Draught beer is always served in a glass, allowing the beer to agitate, release some of its aroma (esters.) This can result in a differing drinking experience for the consumer. Try them side by side! Because any location wants to best enhance the draught beer experience for their customer, they should consider the following points:

ROTATE STOCK

Draught beer is best served fresh. The kegs must be properly rotated, or the beer will lose its original taste and aroma. Always use the oldest beer first. Do not stock new deliveries in front or on top of kegs already in the cooler.

TEMPERATURE

Draught beer must be kept cold at all times. The optimum storing temperature is between 34° and 38°F. Temperatures above 45°F may cause the beer to turn sour and cloudy. A beer keg takes a long time to cool down, so they should never be stored outside of a cooler for any length of time. For example, a beer keg that is allowed to heat up to 44°F will take approximately 18 hours to cool down in a 36°F cooler. Always place keg beer in a cooler immediately upon delivery.

> **“A beer keg that is allowed to heat up to 44°F will take approximately 18 hours to cool down in a 36°F cooler.”**

It is best to store beer kegs in a cooler that is used exclusively for draft beer and not foods. Frequent opening of the cooler door can raise the beer temperature. Also, unpleasant food odors can affect the taste of the beer by penetrating the beer lines(and Kegs) over time.

Improper temperature is one of the most common causes of draft beer drawing problems. Draught beer is more likely to foam when the beer temperature is above 38°F. Temperatures lower that 28°F can cause the beer to freeze, which causes the beer to be cloudy and have an off taste. Once again, the optimum storing temperature is between 34° and 38°F.

> **“Temperatures lower that 28°F can cause the beer to freeze, which causes the beer to be cloudy and have an off taste.”**

PRESSURE

It is important to keep a constant and uniform level of pressure on the beer. Never turn off the CO_2 gas at night. You cannot save gas this way.

Is your regulator accurate? A sluggish needle, which falls downward when beer is drawn, will result in flat beer toward the end of the barrel. A creeping regulator, which creeps upward during idle periods, will result in wild or over-carbonated beer. If you suspect that your regulator is operating improperly, please contact the original installer or the factory.

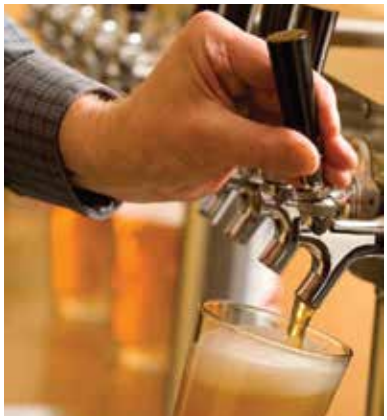
> **"A beer barrel at 38°F has an internal pressure of 12 to 16 P.S.I."**

COUNTER-PRESSURE

Since CO_2 is chemically the same as the natural carbonation in draft beer, pressurized CO_2 tanks are used to provide the pressure to a keg for dispensing. By maintaining the natural head pressure on the keg, the beer is prevented from going flat or becoming over carbonated. Most remote beer systems require the use of counter-pressure that is higher than the natural carbonation level of draft beer (a beer barrel at 38°F has an internal pressure of 12 to 16 P.S.I.). However, if the counter-pressure is provided by pure CO_2, the beer will over carbonate and foam, so a counter pressure system other than straight CO_2 is required.

The counter-pressure method may consist of blended nitrogen and CO_2 or mechanical beer pumps. Blended nitrogen and CO_2 comes pre-blended in a tank or is blended on site using a blender and a tank of pure nitrogen and a tank of pure CO_2. Blended nitrogen and CO_2 provides counter-pressure by mixing nitrogen and CO_2 to lower the CO_2 content in the overall pressure mixture, allowing system pressures placed on the kegs to be above 16 pounds without over carbonating the beer.

Mechanical beer pumps are another type of counter-pressure method. Pressurized CO_2 is used to actuate the mechanical diaphragm inside the beer pump; however the CO_2 does not come in to contact with the beer, thus eliminating the risk of over carbonation.



A BALANCED SYSTEM

A properly balanced system should provide at least some head (foam) on a glass of beer. A normal head can be up to one inch thick. While most bartenders tend to pour off the foam until there is virtually no head, at least some foam should be expected. Proper pouring techniques will help minimize excess foaming. It is also important to remember that frosty mugs cause the beer to foam more than normal, so this should be considered when system performance is being evaluated. Frosty mugs then kill head on beer. Since the sanitizer that is used is usually what is frozen.

Once a beer system is operating, there are really no adjustments that need to be made, unless a new brand of beer is introduced. In fact, adjusting the pressure regulators haphazardly creates more problems than it solves. Fluctuations in walk-in cooler or keg temperature are often the cause of temporary foaming problems. In these instances, adjusting the regulators will not help and will likely create problems later on when the temperature problem goes away. The best way to ensure proper system operation is to follow the regular maintenance schedule outlined in the operation manual.

(Source: GlasTender, Saginaw, MI)

CARING FOR YOUR DRAUGHT SYSTEM

Yeast and bacteria routinely enter draught systems where they feed on beer and attach to draught lines. Minerals also precipitate from beer, leaving deposits in lines and fixtures.

Within days of installing a brand new draught system, deposits begin to build up on the beer contact surfaces. Without proper cleaning, these deposits soon affect beer flavor and undermine the system's ability to pour quality beer.

Please note that all parts of these recommendations must be implemented in order to be effective. The proper cleaning solution strength won't be effective if the temperature is too cool or there is insufficient contact time with the lines. The lines themselves will remain vulnerable to rapid decline if faucets and couplers aren't hand-cleaned following the recommended procedures.

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CLEANING GUIDELINES

Many states require regular draught line cleaning, but all too often the methods used fall short of what is needed to actually maintain draught quality.

As a retailer, you may or may not clean your own draught lines, but you have a vested interest in making sure the cleaning is done properly. Clean lines make for quality draught beer that looks good, tastes great, and pours without waste. Simple checks like maintaining cleaning logs, and checking keg couplers for visible buildup will help to ensure your beer lines are being properly maintained and serviced.

CLEANING SAFETY

Line cleaning involves working with hazardous chemicals. The following precautions should be taken:

- Cleaning personnel should be well trained in handling hazardous chemicals.
- Personal protection equipment including rubber gloves and eye protection should be used whenever handling line cleaning chemicals.
- Cleaning solution suppliers offer Material Safety Data Sheets (MSDS) on their products. Cleaning personnel should have these sheets and follow their procedures while handling line cleaning chemicals.
- When diluting chemical concentrate, always add chemical to water and never add water to the chemical. Adding water to concentrated caustic chemical can cause a rapid increase in temperature, possible leading to violent and dangerous spattering or eruption of the chemical.

SYSTEM DESIGN AND CLEANLINESS

- Draught system designs should always strive for the shortest possible draw length to help reduce operating challenges and line cleaning costs. Foaming beer and other pouring problems waste beer in greater volumes as draw length increases. Line cleaning wastes beer equal to the volume of the beer

> **"Longer runs also place greater burdens on mechanical components, increasing repair and replacement costs."**

lines themselves. Longer runs also place greater burdens on mechanical components, increasing repair and replacement costs.

- Be sure to check with the manufacturers of the various components in any draught beer system to ensure that all components (line material, fittings, faucets, couplers, pneumatic pumps, fobs, etc.) are compatible with the cleaning methods and procedures you plan to use. The acceptable range of variables such as cleaning solution concentration, temperature, and pressure can vary by component and manufacturer.
- Large venues like stadiums, arenas, and casinos often combine very long draught runs with long periods of system inactivity that further complicate cleaning and maintenance. Additional maintenance costs eventually outweigh any perceived benefits of a longer system.

CLEANING FREQUENCY AND TASKS

Every two weeks (14 days)

- Draught lines should be cleaned with a caustic line-cleaning chemical following the procedures outlined herein.
- All faucets should be completely disassembled and cleaned.
- All keg couplers or tapping devices should be scrubbed clean.
- All FOB-stop devices (a.k.a. beer savers, foam detectors) should be cleaned in line, and cleaning solution vented out of the top.

Quarterly (every three months)

- Draught beer lines should be de-stoned with an acid line cleaning chemical or a strong chelator that is added to or part of the alkaline chemical formulation. (The DBQ working group is working with brewing industry researchers to complete further studies on line-cleaning chemistry, including additives such as EDTA.)
- All FOB-stop devices (a.k.a. beer savers, foam detectors) should be completely disassembled and hand-detailed (cleaned).
- All couplers should be completely disassembled and detailed.

> **"All FOB-stop devices (a.k.a. beer savers, foam detectors) should be completely disassembled and hand-detailed (cleaned). All couplers should be completely disassembled and detailed."**

TROUBLE SHOOTING

ISSUE	PROBABLE CAUSE	SOLUTION
Dispensed beer temperature is too warm (may result in excessive foaming)	A. Line chiller glycol tank is too warm. B. Walk-in cooler temperature is too warm. C. Line chiller is not running.	A. Glycol bath should be maintained between 28°F and 32°F. If it is warmer, adjust the thermostat to a colder setting. B. The walk-in cooler temperature should be maintained between 35°F and 40°F. Place a thermometer in a glass of water inside the walk-in cooler for two hours to check the temperature inside the walk-in. C. Check the line chiller power cord is plugged in or a circuit breaker is not blown.

No CO_2 pressure on beer system.	A. Empty CO_2 cylinder. B. CO_2 shutoff valve is closed at CO_2 cylinder. C. CO_2 shuttoff valves in lines loading to keg taps are closed. D. CO_2 regulators have been changed from their original settings. E. Leak in the CO_2 system.	A. Switch to new CO_2 tank supply. B. Open CO_2 shuttoff valve at CO_2 cylinder. C. Open CO_2 shuttoff valves in lines leading to the keg taps. D. The original beer system installer will set the regulators at the proper pressure to run your beer system. Contact the original installer if the original settings were not recorded. E. Find the leak and repair it.
Beer is sour or has an off taste.	A. Beer system needs to be cleaned and sanitized. B. Beer is spoiled due to inadequate walk-in cooler temperature. C. Different beers have been mixed in the same beer line.	A. Clean and sanitize the beer system or contact the local line cleaning contractor. B. Correct the walk-in cooler temperature problem, check line chiller operation, then clean and sanitize the beer system. C. Clean and sanitize the beer system before switching to a new beer supply.

For additional reading: Glastender Operation Manual & Draught Beer Quality Manual, Brewers Association

ADVANCED

BREWING BEER:

HOW BEER IS MADE

Material contained in this document applies to multiple course levels. Reference your syllabus to determine specific areas of study.

Contributed by Robert De La Rosa, II, with additional information sourced by Anne Drummond. Sources include SterkensBrew.be, alabev.com, WikiHow, Beer Advocate, Micro Matic, Beer in the Middles Ages and Renaissance, Brasserie-lancelot.com; Principles of Food, Beverage, and Labor Cost Controls, and Beer-pages.com.

WHAT IS BEER?

All beer is not created equal. However, every beer is made of the same four ingredients: water, hops, malted barley, and yeast. At its simplest, these four ingredients are combined through the brewing process to form beer. Sometimes other ingredients are used to enhance or achieve certain desired flavors in the beer. These ingredients can be such things as fruit, wheat, and spices, but in recent craft beer history, the sky is the limit. Some breweries have used ingredients that might be thought of as far fetched to create their desired flavors.

INGREDIENTS USED FOR BREWING

The basic ingredients of beer are water; a starch source, such as malted barley, able to be saccharified (converted to sugars) then fermented (converted into alcohol and carbon dioxide); a brewer's yeast to produce the fermentation; and a flavorings such as hops. A mixture of starch sources may be used, with a secondary starch source, such as maize (corn), rice or sugar, often being termed an adjunct, especially when used as a lower-cost substitute for malted barley. Less widely used starch sources include millet, sorghum and cassava root in Africa, and potato in Brazil, and agave in Mexico, among others. The amount of each starch source in a beer recipe is collectively called the grain bill.

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WATER

Beer is composed mostly of water. Regions have water with different mineral components; as a result, different regions were originally better suited to making certain types of beer, thus giving them a regional character. For example, Dublin has hard water well-suited to making stout, such as Guinness; while the Plzeň Region has soft water well-suited to making Pilsner (pale lager), such as Pilsner Urquell. The waters of Burton in England contain gypsum, which benefits making pale ale to such a degree that brewers of pale ales will add gypsum to the local water in a process known as Burtonisation.

STARCH SOURCE

The starch source in a beer provides the fermentable material and is a key determinant of the strength and flavor of the beer. The most common starch source used in beer is malted grain. Grain is malted by soaking it in water, allowing it to begin germination, and then drying the partially germinated grain in a kiln. Malting grain produces enzymes that convert starches in the grain into fermentable sugars. Different roasting times and temperatures are used to produce different colors of malt from the same grain. Darker malts will produce darker beers.

Nearly all beer includes barley malt as the majority of the starch. This is because its fibrous hull remains attached to the grain during threshing. After malting, barley is milled, which finally removes the hull, breaking it into large pieces. These pieces remain with the grain during the mash, and act as a filter bed during lautering, when sweet wort is separated from insoluble grain material. Other malted and unmalted grains (including wheat, rice, oats, and rye, and less frequently, corn and sorghum) may be used. In recent years, a few brewers have produced gluten-free beer, made with sorghum with no barley malt, for those who cannot consume gluten-containing grains like wheat, barley, and rye.

YEAST

Yeast is the microorganism that is responsible for fermentation in beer. Yeast metabolizes the sugars extracted from grains, which produces alcohol and carbon dioxide, and thereby turns wort into beer. In addition to fermenting the beer, yeast influences the character and flavor. The dominant types of yeast used to make beer are the top-fermenting Saccharomyces cerevisiae, which would typically be used to produce ales, and bottom-fermenting Saccharomyces uvarum, which typically be used to produce lagers. Brettanomyces ferments lambics, and Torulaspora delbrueckii ferments Bavarian weissbier. Before the role of yeast in fermentation was understood, fermentation involved wild or airborne yeasts. A few styles such as lambics rely on this method today, but most modern fermentation adds pure yeast cultures.

HOPS

Flavoring beer is the sole major commercial use of hops. The flower of the hop vine is used as a flavoring and preservative agent in nearly all beer made today. The flowers themselves are often called "hops". The first historical mention of the use of hops in beer was from 822 AD in monastery rules written by Adalhard the Elder, also known as Adalard of Corbie, though the date normally given for widespread cultivation of hops for use in beer is the thirteenth century. Before the thirteenth century, and until the sixteenth century (during which hops took over as the dominant flavorings) beer was flavored with other plants; for instance, Glechoma hederacea. Combinations of various aromatic herbs,

berries, and even ingredients like wormwood would be combined into a mixture known as gruit and used as hops are now used. Some beers today, such as Fraoch' by the Scottish Heather Ales Company and Cervoise Lancelot by the French Brasserie-Lancelot company, use plants other than hops for flavoring.

Hops contain several characteristics that brewers desire in beer. Hops contribute a bitterness that balances the sweetness of the malt; the bitterness of beers is measured on the International Bitterness Units scale. Hops contribute floral, citrus, and herbal aromas and flavors to beer. Hops have an antibiotic effect that favors the activity of brewer's yeast over less desirable microorganisms and aids in "head retention", the length of time that a foamy head created by carbonation will last. The acidity of hops is a preservative.

The flavor of the beer depends on many things, including the types of malt and hops used, other ingredients and the yeast variety. Getting the yeast right is essential as each variety has its own distinctive effect on the beer.

The process of making beer is known as brewing. A dedicated building for the making of beer is called a brewery, though beer can be made in the home and has been for much of its history. A company that makes beer is called either a brewery or a brewing company. Beer made on a domestic scale for non-commercial reasons is classified as home brewing regardless of where it is made, though most homebrewed beer is made in the home. Brewing beer is subject to legislation and taxation in developed countries, which from the late 19th century largely restricted brewing to a commercial operation onlyThe key ingredient in all beers is malted grain. Though this can be barley (most traditional), wheat or rye, the grain is allowed to germinate, then is dried and in some cases, roasted.

Breweries generally buy prepared malt. In rare exceptions, breweries will germinate their own malt, but this is typically not a process that is done at the brewery itself. For an example of one that is, follow this link. http://rogue.com/beers/chatoe-good-chit.php

To further prepare the malt, it is crushed to break apart the grain kernels, increase their surface area, and separate the smaller pieces from the husks. The resulting grist is mixed with heated water in a vat called a "mash tun" for a process known as "mashing". During this process, natural enzymes within the malt break down much of the starch into sugars, which play a vital part in the fermentation process. Mashing usually takes 1 to 2 hours, and during this time various temperature rests (waiting periods) activate different enzymes depending upon the type of malt being used, its modification level, and the desires of the brewmaster.

These enzymes will convert the starches of the grains to fermentable sugars. The temperature of the mashing process is imperative. Too high a temperature or too short a resting period in the mashing can result in cloudy, low body, or high sugar beers that offer their yeasts difficulty in fermenting. This temperature will also dictate the body of the beer. Special care in the mashing process is imperative.

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“The activity of these enzymes convert the starches of the grains to dextrines and then to fermentable sugars such as maltose. A mash rest at 104 °F or 40 °C activates beta-glucanase, which breaks down gummy beta-glucans in the mash, making the sugars flow out more freely later in the process. A mash rest from 120 °F to 130 °F (49 °C to 55 °C) activates various proteinases, which break down proteins that might otherwise cause the beer to be hazy. But care is of the essence since the head on beer is also composed primarily of proteins, so too aggressive a protein rest can result in a beer that cannot hold a head. This rest is generally used only with undermodified (i.e. undermalted) malts which are popular in Germany and the Czech Republic, or non-malted grains such as corn and rice, which are widely used in North American beers. Finally, a mash rest temperature of 149 to 160 °F (65 to 71 °C) is used to convert the starches in the malt to sugar, which is then usable by the yeast later in the industrial brewing process. Doing the latter rest at the lower end of the range produces more low-order sugars which are more fermentable by the yeast. This in turn creates a beer lower in body and higher in alcohol. A rest closer to the higher end of the range creates more higher-order sugars which are less fermentable by the yeast, so a fuller-bodied beer with less alcohol is the result. Finally the mash temperature may be raised to 165 °F to 170 °F (about 75 °C) (known as a mashout) to deactivate enzymes.”

Additional water is then washed over the grains to extract additional sugars. This process is known as sparging.

After sparging, the mash is transfered to a lauter tun where the resulting liquid is strained from the grains in a process known as lautering. The lauter tun generally contains a manifold which acts as a strainer allowing for the separation of the liquid from the grain. At this point the liquid is known as wort. The wort is moved into a large tank where it is boiled with hops and sometimes other ingredients.

During boiling, water in the wort evaporates, but the sugars and other components of the wort remain, allowing more efficient use of the starch sources in the beer. Boiling also destroys any remaining enzymes left over from the mashing stage. Hops are added during boiling as a source of bitterness, flavor and aroma. Hops may be added at more than one point during the boil. The longer the hops are boiled, the more bitterness they contribute, but the less hop flavor and aroma remains in the beer.

After boiling, the hopped wort is now cooled, ready for the yeast. In some breweries, the hopped wort may pass through a hopback, which is a small vat filled with hops, to add aromatic hop flavoring and to act as a filter; but usually the hopped wort is simply cooled for the fermenter, where the yeast is added.

This is when the fermentation process begins. At this point, the wort has many qualities of the finished beer, but has yet to become alcoholic. The wort is then moved into a temperature controlled cylindrical-conical "fermenter" where yeast is added or "pitched" with it. The yeast converts the sugars from the malt into alcohol, carbon dioxide and other components through a process called fermentation or glycolysis. After a week to three weeks, the fresh (or "green") beer is cooled close to freezing temperature, yeast is purged and the beer is allowed to rest. After this conditioning for a week to several months, the beer is often filtered to remove remaining yeast and particulates. The "bright beer" is then ready for serving or packaging.

Fermentation is sometimes carried out in two stages, primary and secondary. Once most of the alcohol has been produced during primary fermentation, the beer is transferred to a new vessel and allowed a period of secondary fermentation. Secondary fermentation is used when the beer requires long storage before packaging or greater clarity. When the beer has fermented, it is packaged either into casks for cask ale or kegs, aluminum cans, or bottles for other sorts of beer.

MORE ON YEAST *(Source: Beer Advocate)*

Yeast are single-celled microorganisms that reproduce by budding. They are biologically classified as fungi and are responsible for converting fermentable sugars into alcohol and other byproducts. There are literally hundreds of varieties and strains of yeast. In the past, there were two types of beer yeast: ale yeast (the "top-fermenting" type, Saccharomyces cerevisiae) and lager yeast (the "bottom-fermenting" type, Saccharomyces uvarum, formerly known as Saccharomyces carlsbergensis). Today, as a result of recent reclassification of Saccharomyces species, both ale and lager yeast strains are considered to be members of S. cerevisiae.

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Top-Fermenting Yeast
Ale yeast strains are best used at temperatures ranging from 10 to 25°C, though some strains will not actively ferment below 12°C (33). Ale yeasts are generally regarded as top-fermenting yeasts since they rise to the surface during fermentation, creating a very thick, rich yeast head. That is why the term "top-fermenting" is associated with ale yeasts. Fermentation by ale yeasts at these relatively warmer temperatures produces a beer high in esters, which many regard as a distinctive character of ale beers.

Top-fermenting yeasts are used for brewing ales, porters, stouts, Altbier, Kölsch, and wheat beers.

Bottom-Fermenting Yeast
Lager yeast strains are best used at temperatures ranging from 7 to 15°C. At these temperatures, lager yeasts grow less rapidly than ale yeasts, and with less surface foam they tend to settle out to the bottom of the fermenter as fermentation nears completion. This is why they are often referred to as "bottom" yeasts. The final flavor of the beer will depend a great deal on the strain of lager yeast and the temperatures at which it was fermented.

Some of the lager styles made from bottom-fermenting yeasts are Pilsners, Dortmunders, Märzen, Bocks, and American malt liquors.

Spontaneous Fermentation
Beer that is exposed to the surrounding open air to allow natural/wild yeast and bacteria to literally infect the beer, are spontaneous fermented beers. One of the typical yeasts is the Brettanomyces Lambicus strain. Beers produced in this fashion are sour, non-filtered and inspired by the traditional lambics of the Zenne-region. This brewing method has been practiced for decades in the West Flanders region of Belgium.

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Byproducts of Yeast

Yeast impact the flavor and aroma of beer more than you might think. The flavor and aroma of beer is very complex, being derived from a vast array of components that arise from a number of sources. Not only do malt, hops, and water have an impact on flavor, so does the synthesis of yeast, which forms byproducts during fermentation and maturation. The most notable of these byproducts are, of course, ethanol (alcohol) and carbon dioxide (CO2); but in addition, a large number of other flavor compounds are produced such as:

- acetaldehyde (green apple aroma)
- diacetyl (taste or aroma of buttery, butterscotch)
- dimethyl sulfide (DMS) (taste or aroma of sweet corn, cooked veggies)
- clove (spicy character reminiscent of cloves)
- fruity / estery (flavour and aroma of bananas, strawberries, apples, or other fruit)
- medicinal (chemical or phenolic character)
- phenolic (flavour and aroma of medicine, plastic, Band-Aids, smoke, or cloves)
- solvent (reminiscent of acetone or lacquer thinner)
- sulfur (reminiscent of rotten eggs or burnt matches)

There are other yeast byproducts, and some of the listed can be both desired byproducts and/or undesired depending on the beer style or what the brewer was trying to achieve.

DID YOU KNOW?

There are four families of beers that are determined by the type of yeast used.

ALE
(top-fermenting yeasts)

Ale yeasts ferment at warmer temperatures between 15°C and 20°C (60°F to 68°F), and occasionally as high as 24°C (75°F). Pure ale yeasts form a foam on the surface of the fermenting beer, because of this they are often referred to as "top-fermenting" yeast - though there are some ale yeast strains that settle at the bottom. Ales are generally ready to drink within three weeks after the beginning of fermentation, however, some styles benefit from additional aging for several months or years. Ales range in color from very pale to black opaque.
Source: SterkensBrew.be

LAGER
(bottom-fermenting yeasts)

While the nature of yeast was not fully understood until Emil Hansen of the Carlsberg brewery in Denmark isolated a single yeast cell in the 1800s, brewers in Bavaria had for centuries been selecting these cold-fermenting Lager yeasts by storing or "Lagern" their beers in cold alpine caves. The process of natural selection meant that the wild yeasts that were most cold tolerant would be the ones that would remain actively fermenting in the beer that was stored in the caves. Some of these Bavarian yeasts were stolen and brought back to the Carlsberg brewery around the time that Hansen did his famous work. Lager yeast tends to collect at the bottom of the fermenter and is often referred to as "bottom-fermenting" yeast. It is a common misconception that all lagers are light in color: lagers can range from very light to deep black, just like ales.
Source: SterkensBrew.be

BEERS OF SPONTANEOUS FERMENTATION
(wild yeasts)

These beers are nowadays primarily only brewed around Brussels, Belgium. They are fermented by means of wild yeast strains that live in a part of the Zenne river which flows through Brussels. These beers are also called Lambic beers.
Source: SterkensBrew.be

BEERS OF MIXED ORIGIN

These beers are blends of spontaneous fermentation beers and ales or lagers or they are ales or lagers which are also fermented by wild yeasts.
Source: SterkensBrew.be

PASTEURIZING BEER *(Source: Micro Matic)*

The Pasteurization process is one that significantly changed the health of the world's population. Invented by Louis Pasteur, a French chemist and microbiologist, pasteurization is created by heating a liquid to a high temperature, destroying bacteria in that liquid that can be harmful. In the case of beer, pasteurization is used to stop the growth of the yeast that might remain in the beer after packaging. This process enables a can or bottle of beer to be stored at room temperature for periods of time (up to 120 days).

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Traditionally, in the US, only the beer in cans and bottles is pasteurized. The pasteurization process often occurs after the beer has been placed in the can or bottle and the package has been sealed. The process involves running the package through a hot water spray (approximately 140 degrees F) for two to three minutes.

Domestic draft beer is not normally pasteurized, and so it must be stored at 38 degrees F in order to prevent secondary fermentation from occurring in the keg. Imported draft beers are usually pasteurized, and so the kegs can be stored at room temperature without negatively affecting the beer. For proper serving, and to ensure an appealing taste the imported kegs of beer must be stored and served at 38 degrees.

Draft beer that is not pasteurized has a life 45-60 days. Draft beers that are pasteurized often have a life of 6 to 9 months. This enables the pasteurized draft beer to endure long shipping times.

The contents of non-pasteurized kegs that are used at special events or picnics, and stored outside during the event should not be served once the event has ended. Pasteurized kegs can be returned to the cooler, and the contents can be served at a later time.

Does pasteurizing draft beer impact the taste of the beer?
This is a question that has long been debated, and truly a matter of personal taste.

When a brew master wanted to demonstrate their prowess at brewing a quality beer, the true measure of the quality of that beer was how good it tasted right from the brewing vessel.

PRODUCTION AND TRADE AROUND THE WORLD

The Benedictine Weihenstephan Brewery in Bavaria, Germany, can trace its roots to the year 768, as a document from that year refers to a hop garden in the area paying a tithe to the monastery. The brewery was licensed by the City of Freising in 1040, and therefore is the oldest working brewery in the world.

The brewing industry is a global business, consisting of several dominant multinational companies and many thousands of smaller producers ranging from brewpubs to regional breweries.[39] More than 133 billion liters (35 billion gallons) are sold per year—producing total global revenues of $294.5 billion (£147.7 billion) as of 2006.

A microbrewery, or craft brewery, is a modern brewery which produces a limited amount of beer. In the US, the American Brewers Association defines a "craft brewery" as "small, independent and traditional", and gives a production size of less than 6,000,000 US beer barrels (700,000,000 L) a year and cannot be more than 24% owned by another alcoholic beverage company that is not itself a craft brewery (This means Goose Island and other breweries like it are no longer craft breweries due to ownership by MillerCoors or AB InBev) A brewpub is a type of microbrewery that incorporates a pub or other eating establishment.

SABMiller became the largest brewing company in the world when it acquired Royal Grolsch, brewer of Dutch premium beer brand Grolsch. InBev was the second-largest beer-producing company in the world and Anheuser-Busch held the third spot, but after the acquisition of Anheuser-Busch by InBev, the new Anheuser-Busch InBev company is currently the largest brewer in the world.

Brewing at home is subject to regulation and prohibition in many countries. Restrictions on homebrewing were lifted in the UK in 1963, Australia followed suit in 1972, and the USA in 1978, though individual states were allowed to pass their own laws limiting production.