How To Brew
Edition 2.1 Update

by John J. Palmer
June 01, 2002

Defenestrative Publishing Co.
PO Box 1781
Monrovia, CA 91017
Email: john@howtobrew.com

This update pertains to How To Brew, 2nd Edition

Library of Congress Card Number: 00-109877

ISBN–0-9710579-0-7

Purpose of Update:

The first printing of any hardcopy always results in the inclusion of several typos which serve to amuse the reader and/or provoke insight to the topic at hand. Unfortunately I didn't use that kind, but made use of redundant definite articles, retained place-holders, and a few mis-spelled words instead.

As I worked through the text to fix those errors, I noticed some phrasings that were unclear and other instances where I had neglected to mention the seemingly obvious. Fortunately, several of you were kind enough to point them out to me. I was able to make these changes without changing the page flow in most cases.

Finally, there were two additions that I just had to make–an IBU nomograph and the inclusion of batch sparging calculations to complement the no-sparge section. These additions are the primary reason for this update, because it is information that should have been included from the beginning and it doesn't warrant having to buy a new edition.

Front Matter

Title Page, publisher's information

Reason for Change: Email address changed.

Was: john@defenestrativepublishing.com

Is: john@howtobrew.com

Acknowledgements, p. §5, third paragraph

Reason for Change: Two names needed to be added to list.

Was: I would like to thank my friends Norm Pyle and Martin Lodahl for a lot of help and advice in preparing this book—they provided the impetus and early reviews that I needed to get this project off the ground. Many thanks also to Jim Liddil, Glenn Tinseth, Maribeth Raines, Steve Alexander, Chris White, Rob Moline, Patrick Weix, Don Put, Dave Draper, AJ Delange, Laurel Maney, Jim Busch, George and Laurie Fix, Jeff Donovan, Guy Gregory, Brian Kern, Dan Listermann, and Jeff Renner for contributing their knowledge to the Sanitization, Hops, Yeast, Water, Malts, Mashing, Lautering, and Recipe chapters.

Is: I would like to thank my friends Norm Pyle and Martin Lodahl for a lot of help and advice in preparing this book—they provided the impetus and early reviews that I needed to get this project off the ground. Many thanks also to Jim Liddil, Glenn Tinseth, Maribeth Raines, Steve Alexander, Dave Logsdon, Chris White, Rob Moline, Patrick Weix, Don Put, Dave Draper, AJ Delange, Laurel Maney, Jim Busch, George and Laurie Fix, Jeff Donovan, Guy Gregory, Brian Kern, Ken Schwartz, Dan Listermann, and Jeff Renner for contributing their knowledge to the Sanitization, Hops, Yeast, Water, Malts, Mashing, Lautering, and Recipe chapters.

Section 1—Brewing With Malt Extract

Chapter 1—A Crash Course in Brewing

Chapter 1, p. 13, third paragraph

Reason for Change: Error in sugar weights.

Was: 3. Prepare your priming sugar. We add a priming solution just before bottling to provide carbonation to the beer in the bottle. Boil ¾ cup (6 oz by weight) of corn sugar or ⅔ cup (5 oz by weight) of table sugar in two cups of water. Cover the pan and allow it to cool.

Is: 3. Prepare your priming sugar. We add a priming solution just before bottling to provide carbonation to the beer in the bottle. Boil ¾ cup (4 oz by weight) of corn sugar or ⅔ cup (3.8 oz by weight) of table sugar in two cups of water. Cover the pan and allow it to cool.

Chapter 2—Brewing Preparations

Chapter 2, p. 22, Percarbonates

Reason for Change: Improve information on percarbonate-based cleaners.

Was: **Percarbonates** Sodium percarbonate is sodium carbonate (i.e., Arm and Hammer Super Washing Soda) reacted with hydrogen peroxide and it effectively removes gunk from all types of brewing equipment. They are very effective at dissolving brewing deposits and rinse easily. Several products (e.g. B-Brite, One-Step and Powder Brewery Wash) are approved by the FDA as cleaners in food-manufacturing facilities. The hydrogen peroxide does provide some degree of sanitization, but it is better to rely on them only as cleaners. Use these cleaners according to the manufacturer's instructions, but generally use one tablespoon per gallon (4 ml per liter) and rinse after cleaning.

In my opinion, percarbonate-based cleaners are the best choice for equipment cleaning, and Powder Brewery Wash (PBW) from Five Star Chemicals, Inc. is the best of them. PBW combines sodium metasilicate with the percarbonate in a stable form which increases its effectivity and prevents the corrosion of metals like copper and aluminum that strong alkaline solutions can cause.

Is: Percarbonates Sodium percarbonate is sodium carbonate (i.e., Arm and Hammer Super Washing Soda) reacted with hydrogen peroxide and it is a very effective cleaner for all types of brewing equipment. It rinses easily. Several products containing percarbonates (e.g. Straight-A, Powder Brewery Wash, B-Brite, and One-Step) are approved by the FDA as cleaners in food-manufacturing facilities. One Step is labeled as a light cleaner and final rinse agent, and produces hydrogen peroxide in solution. Hydrogen peroxide will effectively sanitize surfaces and containers which are already clean. As with all sanitizers, the effectiveness of hydrogen peroxide as a sanitizing agent is compromised by organic soil. Use these cleaners according to the manufacturer's instructions, but generally use one tablespoon per gallon (4 ml per liter) and rinse after cleaning.

In my opinion, percarbonate-based cleaners are the best choice for equipment cleaning, and Straight-A from Logic, Inc. and Powder Brewery Wash (PBW) from Five Star Chemicals, Inc. are the best of them. These products combine sodium metasilicate with the percarbonate in a stable form which increases its effectivity and prevents the corrosion of metals (like copper and aluminum) that strong alkaline solutions can cause.

Chapter 3—Malt Extract and Beer Kits

(none)

Chapter 4—Water for Extract Brewing

(none)

Chapter 5—Hops

Chapter 5, p. 52, middle of paragraph

Reason for Change: Wording is too rigid and potentially mis-leading.

Was: It is important for hop suppliers to pack hops in oxygen barrier bags and keep them cold to preserve the freshness and potency. Hops that have been stored warm and/or in non-barrier (thin) plastic bags can easily lose 50% of their bitterness potential in a few months. Most plastics are oxygen permeable; so when buying hops at a homebrew supply store, check to see if the hops are stored in a cooler or freezer and if they are stored in oxygen barrier containers. If you can smell the hops when you open the cooler door, then the hop aroma is leaking out through the packaging and they are not well protected from oxygen. Depending on the stock turnover of the shop, you might be better off ordering from a mail order hop supplier. Check homebrewing magazines for mail order suppliers that use oxygen barrier packaging.

Is: It is beneficial if hop suppliers pack hops in oxygen barrier bags and keep them cold to preserve the freshness and potency. Hops that have been stored warm and/or in non-barrier (thin) plastic bags can easily lose 50% of their bitterness potential in a few months. Most plastics are oxygen permeable; so when buying hops at a homebrew supply store, check to see if the hops are stored in a cooler or freezer and if they are stored in oxygen barrier containers. If you can smell the hops when you open the cooler door, then the hop aroma is leaking out through the packaging and they are not well protected from oxygen. If the stock turnover in the brewshop is high, non-optimum storage conditions may not be a problem. Ask the shop owner if you have any concerns.

Chapter 5, p. 63, Addition to last paragraph

Reason for Change: Clarification of Boil Gravity Adjustment.

Was: It is the gravity of the boil (1.080) that is used in figuring the utilization. As you will see in the next section, hop utilization decreases with increasing wort gravity. A higher concentration of sugars makes it more difficult for the isomerized alpha acids to dissolve.

Is: It is the gravity of the boil (1.080) that is used in figuring the utilization. As you will see in the next section, hop utilization decreases with increasing wort gravity. A higher concentration of sugars makes it more difficult for the isomerized alpha acids to dissolve. I use the initial boil gravity in my utilization calculation; others have suggested that the average boil gravity should be used. (The average being a function of how much volume will be boiled away during the boiling time.) This gets rather complicated with multiple additions, so I just use the initial boil gravity to be conservative. The difference is small—overestimating the total bitterness by 1-3 IBUs.

Chapter 5, p. 65, first sentence of first paragraph after equations

Reason for Change: Decimal error in .000125.

Was: The numbers 1.65 and 0.00125 in f(G) were empirically derived to fit the boil gravity (Gb) analysis data.

Is: The numbers *1.65* and *0.000125* in f(G) were empirically derived to fit the boil gravity (Gb) analysis data.

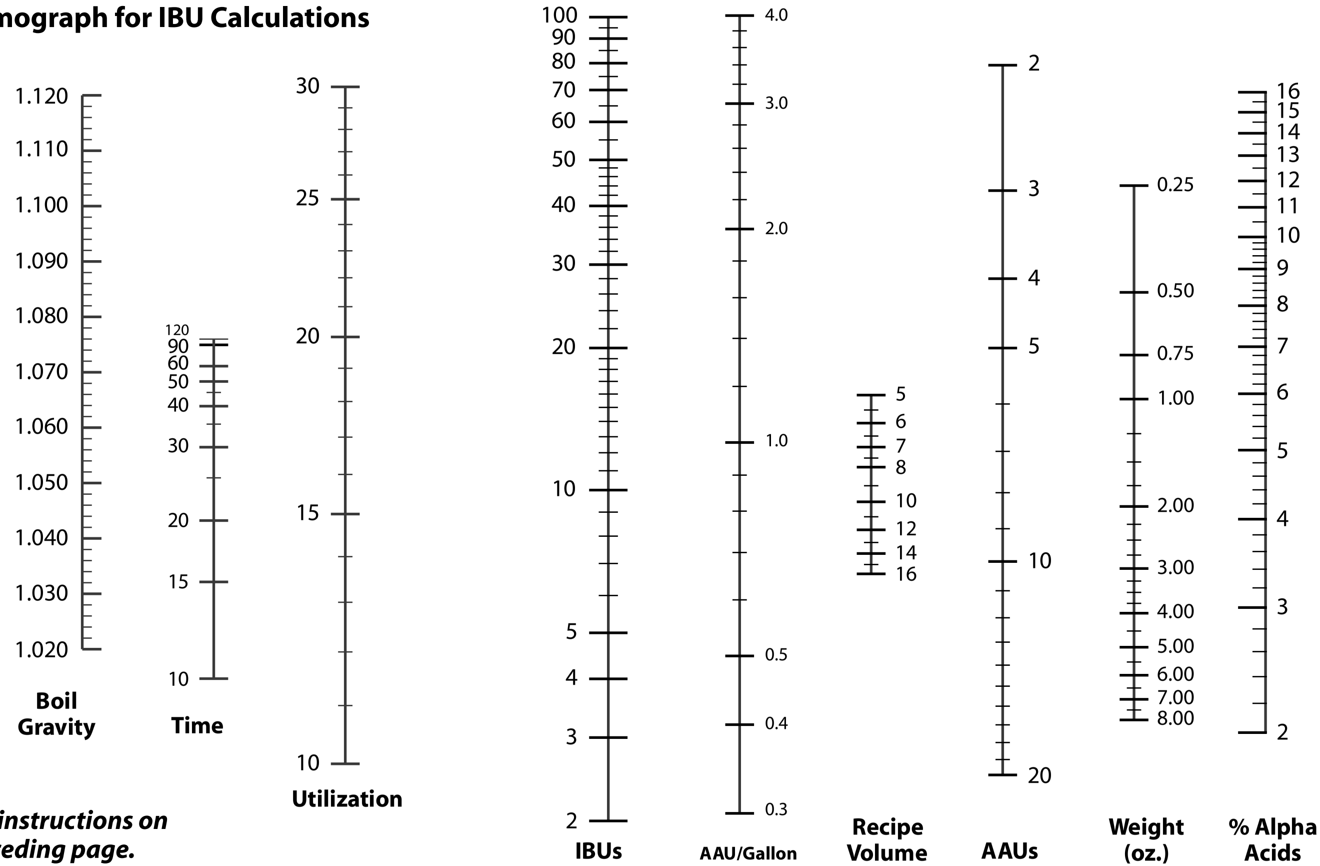
Chapter 5, p. 65 and 66, Addition of IBU Nomograph

Reason for Change: Adding IBU Nomograph and instructions because it's useful.

Is: IBU Nomograph for Hop Additions ***(next page)***

To use the nomograph, start on the right and draw a straight line from the *%Alpha Acids* of your hop, through the *Weight* of the addition, to arrive at the *AAUs* for that addition. Next, draw a line from the *AAUs* through the *Recipe Volume* to arrive at the *AAUs/gallon*. Now move to the left hand side of the chart and draw a line from your *Boil Gravity*, through your *Boil Time*, to determine the *Utilization*. Finally, draw a line through the points from the *Utilization* and *AAUs/gallon* lines to determine the *IBUs* of that hop addition.

Nomograph for IBU Calculations



See instructions on preceding page.

Chapter 6—Yeast

Chapter 6, p. 74, Lager Yeast, American Lager, third sentence

Reason for Change: Clarification.

Was: Some strains have an almost green-apple tartness.

Is: Some cultivars have an almost green-apple tartness.

Chapter 6, p. 79, last sentence of second paragraph

Reason for Change: Clarification of risk.

Was: This way the escaping carbon dioxide will be able to vent without exposing the starter to the air.

Is: This way the escaping carbon dioxide will be able to vent without exposing the starter to airborne bacteria.

Chapter 7—Boiling and Cooling

Chapter 7, p. 89, Recipe for Cincinnati Pale Ale

Reason for Change: Fixing typo for consistency.

Was: 3 lbs. Amber dry malt extract

Is: 2 lbs. Amber dry malt extract

Chapter 8—Fermentation

(none)

Chapter 9—Fermenting Your First Batch

(none)

Chapter 10—What is Different for Brewing Lager Beer?

Chapter 10, p. 120, Lower Temperatures, fifth sentence

Reason for Change: Explanation of "other compounds."

Was: In addition to producing fewer byproducts during the primary phase, the yeast uses the long conditioning phase to finish residual sugars and metabolize other compounds that may give rise to off-flavors and aromas.

Is: In addition to producing fewer byproducts during the primary phase, the yeast uses the long conditioning phase to finish residual sugars and metabolize other compounds like diacetyl and acetaldehyde that would otherwise give rise to off-flavors and aromas.

Chapter 10, p. 121, second paragraph, second to last sentence

Reason for Change: Clarification of autolysis smell and taste.

Was: At a minimum, a beer that has experienced autolysis will have a burnt rubber taste and smell and will probably be undrinkable.

Is: At a minimum, a beer that has experienced autolysis will have a strong yeasty taste, or perhaps a burnt rubber smell and taste, and will probably be undrinkable.

Chapter 10, p. 123, Lager Fermentation Guidelines,

Reason for Change: Adding equivalent temperatures in degrees Celsius.

Was: (Fahrenheit only)

Is:
- The temperature difference between the primary phase and the lager phase should be 10-15°F (5-8°C).
- Nominal lagering times are 3-4 weeks at 45°F (7°C), 5-6 weeks at 40°F (4°C), or 7-8 weeks at 35°F (2°C).

Chapter 11—Priming and Bottling

(none)

Section 2—Brewing With Extract and Specialty Grain

Chapter 12—What is Malted Grain

(none)

Chapter 13—Steeping Specialty Grains

(none)

Section 3—All-Grain Brewing

Chapter 14—How the Mash Works

Chapter 14, p. 168, The Acid Rest, 2nd paragraph, first three sentences

Reason for Change: General clarification on role of phytase.

Was: Pale lager malt is rich in phytin, an organic phosphate containing calcium and magnesium. Phytase breaks down phytin into insoluble calcium and magnesium phosphates and phytic acid. The process lowers the pH by removing the ion buffers and producing this weak acid.

Is: Malted barley is rich in phytin, an organic phosphate containing calcium and magnesium. Phytase breaks down phytin into insoluble calcium and magnesium phosphates and myo-inositol–a vitamin. The process lowers the pH by removing the phosphate ion buffers and producing weak acids.

Chapter 15—Understanding the Mash pH

Chapter 15, p. 184, Residual Alkalinity and Mash pH, add new last sentence

Reason for Change: Clarification of alkalinity neutralization mechanism.

Add: This chemical reaction does not require enzyme activity or an acid rest.

Chapter 15, p. 189, Using Salts for Brewing Water Adjustment, 4th paragraph

Reason for Change: Add another example of brewing software.

Was: There is a software program called "Promash" at www.promash.com that is very handy for these types of calculations as well as all types of mashing and recipe calculations.

Is: There are several brewing software programs that are very handy for these types of water calculations as well as all types of mashing and recipe calculations. Two examples are *Promash* at *www.promash.com*, and *Strangebrew* at *www.strangebrew.ca*. The functionality of these brewing applications have been thoroughly reviewed and I can assure you that they are comprehensive and easy to use.

Chapter 16—The Methods of Mashing

(none)

Chapter 17—Getting the Wort Out

Chapter 17, p. 199, Batch Sparging

Reason for Change: General clarification.

Was: **Batch Sparging** This method is a U.S. homebrewing practice where the full volume of sparge water is mixed into the mash, usually involving the larger rectangular chest coolers. The grain bed is allowed to settle, re-circulated for clarity, and then the wort is drained off. You can use more than one batch of water if you need to. This method differs from the English method in that the mash is not held for any significant time at the saccharification temperature before draining.

Is: **Batch Sparging** This method is a U.S. homebrewing practice where large volumes of sparge water are added to the mash all-at-once, instead of gradually, and is more often used with the larger rectangular chest coolers. The grain bed is allowed to settle, re-circulated for clarity, and then the wort is drained off. Usually two or sometimes three sparges are combined to create the wort. It is less efficient than continuous sparging (you will use 10-15% more grain than a standard recipe), but it is convenient. This method differs from the English method in that the different runnings are combined to produce a single beer. Batch and no-sparge brewing will be described fully at the end of *Chapter 18–Brewing Your First All-Grain Beer*.

Chapter 17, p. 200, A Good Crush Means Good Lautering, last sentence of third paragraph

Reason for Change: Address change.

Was: ...and the Brewtek Mill–Brewer's Resource, Camarillo, CA.

Is: ...and the Brewtek Mill–Brewer's Resource, Lake Forest, CA.

Chapter 17, p. 201, Getting the Most From the Grainbed, first paragraph, second sentence

Reason for Change: Double negative.

Was: If the grainbed is very shallow, from lautering too little grain in too large a tun, then the filter bed will be inadequate, the wort won't not clear, and you will probably get hazy beer.

Is: If the grainbed is very shallow, from lautering too little grain in too large a tun, then the filter bed will be inadequate, the wort won't clear, and you will probably get hazy beer.

Chapter 17, p. 203, second paragraph, second sentence

Reason for Change: Add another example.

Was: Ready-made false bottoms (e.g. Phil's Phalse Bottom—Listermann Mfg.) are available for some coolers, but you can also build a slotted pipe manifold for just a few dollars.

Is: Ready-made false bottoms (e.g. Phil's Phalse Bottom—Listermann Mfg., and the Fermentap false bottom) are available for some coolers, but you can also build a slotted pipe manifold for just a few dollars.

Chapter 17, p. 203, fourth paragraph, first sentence

Reason for Change: General clarification.

Was: Manifolds are less likely to compact the mash and cause a stuck sparge at high flow rates during lautering.

Is: Manifolds are less likely to compact the mash and cause a stuck sparge at high flow rates during lautering, due to having less open drain area. But overall, their efficiency is only a few percent less than a false bottom.

Chapter 18—Brewing Your First All-Grain Beer

Chapter 18, p. 211, Figure 96 Caption

Reason for Change: Adding another example to end of caption.

Add: You can also fill another cooler with your sparge water and drain it to your lauter tun. Many brewers do it this way.

Chapter 18, p. 212, Step 5, last sentence.

Reason for Change: Add citation.

Was: See Figure 99.

Is: See Figures 98 and 99.

Chapter 18, p. 213, Figure 98 title

Reason for Change: Mis-numbered.

Was: Figure 98.

Is: Figure 99.

Chapter 18, p. 213, Figure 99 title

Reason for Change: Mis-numbered.

Was: Figure 99.

Is: Figure 100

Chapter 18, p. 220-224, Batch Sparge and No-sparge Brewing

Reason for Change: Added Batch Sparge procedure and re-worked introduction material.

Is:

Batch and No-Sparge Brewing

In between the first and second editions of this book, I finally got on the bandwagon with a couple of methods that several of my friends have been using for years: batch sparge and no-sparge brewing. These mashing and lautering methods use 10-25% more grain than a standard recipe (continuous sparge) to produce a larger mash that does not have to be closely monitored during the lauter.

Towards the end of the continuous sparging process, as the gravity of the runnings falls to 1.008, the mash pH rises to about 6 as the sugars are extracted and the buffering effect of the malt/wort is replaced by water. This rise in mash pH tends to extract greater proportions of tannins, polyphenols, and silicates into the wort which have a dulling effect on the taste. Batch sparging with a standard recipe grainbill can exacerbate this effect because the majority of the buffering capability is drained away before adding the second sparge volume. Therefore the grainbills for batch sparge and no-sparge brewing need to be scaled up to make up for inefficiencies that might otherwise lead to a rise in pH and off-flavors. These methods can produce a richer, smoother tasting wort with the same gravity as a standard recipe, but use a simpler lautering process that is more robust and pH stable.

So why doesn't everyone use these methods if they're so great? Because continuous sparging methods are more economical for commercial breweries and usually work just fine for homebrewing as well. Everyone learns about continuous sparging first and most all-grain recipes you will see (such as those in brewing magazines) are based on the efficiency of this method. That's why I used it for your first all-grain batch—better to start with the basics, then build from there. Using the batch or no-sparge method uses more grain and increases the size of the mash tun you need.

For example, here is a comparison of the standard 5 gallon recipe (continuous sparging) and the batch sparge and no-sparge recipes for the Tittabawassee Brown Ale you brewed for your first all-grain batch:

Grainbill	Standard	Batch	No-sparge
pale ale malt	7 lbs.	7.6 lbs.	8.5 lbs.
crystal 60 malt	1 lbs.	1.1 lbs.	1.25 lbs.
chocolate malt	.25 lbs.	.3 lbs.	.5 lbs.
Total weight	8.25 lbs	9.0 lbs.	10.25 lbs.
Total mash volume	3.75 gal	4.9 gal.	8 gal.

Each method produces the same 6 gallons of 1.041 wort. The obvious difference is the size of the mash: 4.9 for batch sparge and 8 gallons for no-sparge, versus 3.75 gallons for the continuous sparge. You will probably need a bigger mash tun for these methods.

Batch Sparge Recipe Calculations:

Batch sparging works best when two sparge volumes of the same size are combined to create the wort. To keep the process simple, we want the first sparge volume to be what we get when we simply drain the mash. To do this, we need to calculate the optimum mash ratio that will give us that volume, including the water that will be absorbed by the grain. Then the batch sparge brewing process becomes as easy as conducting the mash, draining the first runnings to the boiling kettle, adding an equal volume of sparge water back to the mash, draining again, and boiling!

First, let's define the terms in the equations:

Inputs:

- OG: Standard recipe original gravity (just the points part i.e. 1.0<u>49</u>).
- Gr: Standard recipe grainbill (total pounds).
- Vr: Standard recipe batch size (e.g., 5 gallons).
- Vb: Standard recipe boil volume (e.g., 6 gallons).

Calculation Coefficients:

- k: Water-retention coefficient (0.5 quart per pound)

Outputs:

- W: Batch sparge water volume (quarts).
- Rb: Batch sparge mash ratio (quarts/lb.).
- S: Scale-up factor for grainbill.
- Gb: Batch sparge grainbill (total pounds).
- Vm: Volume of water for the mash (quarts).
- BG: Boil gravity (points).
- BG_1: Gravity of the first runnings (points).
- BG_2: Gravity of the second runnings (points).
- Vt: Total volume of the mash (quarts).

1. Decide how many gallons of wort you will boil to achieve your recipe volume and thus your sparge volume (e.g. Vb = 6 gallons).
   $W = Vb/2$ *(3 gallons i.e., 12 quarts)*

2. Calculate the optimum batch sparge mash ratio.
   $Rb = (Vb + (Vb^2 + 2k \cdot Vb \cdot Gr)^{1/2})/Gr$ *(1.85 qts/lb.)*

3. Calculate the scale-up factor.
   $S = 1/(1 - k^2/Rb^2)$ *(1.08)*

4. Calculate the batch sparge grainbill.
   $Gb = S \cdot Gr$ *(8.9 or ~9.0 lbs.)*

5. Calculate the volume of water for the mash.
   $Vm = Rb \cdot Gb = W + k \cdot Gb$ *(16.6 quarts)*

6. Calculate the gravity of the first runnings.
   $BG_1 = 4 \cdot S \cdot Vr \cdot OG/Vm$ *(1.064)*

7. Calculate the gravity of the second runnings.
   $BG_2 = 4 \cdot Vr \cdot OG \cdot (k/Rb) \cdot (1 - (k/Rb))/(Gr \cdot (Rb - k))$ *(1.017)*

8. Verify the combined boil gravity and recipe gravity.
   $BG = (BG_1 + BG_2)/2$ and $OG = BG \cdot Vb/Vr$ *(1.040 and 1.049)*

9. Calculate the total batch sparge mash volume (quarts). The volume of 1 pound of dry grain, when mashed at 1 quart per pound, has a volume of 42 fluid ounces (1.3125 quarts or .328 gallons). Higher ratios only add the additional water volume.

   $Vt = Gb(1.3125 + (Rb - 1))$ *(19.5 qts. i.e., 4.9 gallons)*

No-Sparge Recipe Calculations:

Here is how to calculate a no-sparge version from a standard recipe, such as those given in *Chapter 19.* These calculations combine the scaling-up of the grainbill with a three step infusion mash method that makes the whole process more manageable.

Inputs:

- OG: Standard recipe original gravity (just the points part i.e. 1.049).
- Gr: Standard recipe grainbill (total pounds).
- Vr: Standard recipe batch size (e.g. 5 gallons).
- Vb: Standard recipe boil volume (e.g. 6 gallons).

Calculation Coefficients:

- k: Water-retention coefficient (0.5 quart per pound)
- Rr: Standard recipe conversion rest mash ratio (e.g., 2 quarts/lb.)

Outputs:

S: Scale-up factor for grainbill.

Gn: No-sparge grainbill (total pounds).

BG: No-sparge boil gravity (points).

Rn: No-sparge final mash ratio (quarts/lb.).

Wn: No-sparge total water volume (quarts).

Wmo: Mashout water volume (quarts).

Vt: No-sparge total mash volume. (quarts).

1. Decide how many gallons of wort you will boil to achieve your recipe volume (e.g., Vb = 6 gallons).

2. Calculate the scale-up factor.

S = 4•Vb/(4•Vb – k•Gr) *(1.2)*

3. Calculate the no-sparge grainbill.

Gn = S•Gr *(9.96 lbs.† See Below)*

4. Calculate the no-sparge boil gravity.

BG = OG•Vr/Vb *(1.041)*

5. Calculate the no-sparge mash ratio.

Rn = (4•Vb + k•Gn)/Gn *(2.84 (qts/lb)*

6. Calculate the total no-sparge water volume (quarts).

Wn = Gn•Rn = 4•Vb + k•Gn *(29.1 qts.)*

7. Calculate the volume of water you will use for mashout (quarts).

Wmo = Gn(Rn-Rr) or Wn – infusions *(8.6 qts.)*

8. Calculate the total no-sparge mash volume (quarts).

Vt = Gn(1.3125 + (Rn – 1)) *(32.3 qts i.e., 8 gallons)*

No-Sparge Multiple Infusion Mash Procedure

1. From the no-sparge recipe equations, we have determined that the scale-up factor for the Tittabawassee Brown Ale is 1.2. Applying the scale-up factor to each malt gives us:

Grainbill	Standard	No-sparge
pale ale malt	7 lbs.	8.5 lbs.†
crystal 60 malt	1 lbs.	1.25 lbs.†
chocolate malt	.25 lbs.	.5 lbs.†
Total weight	8.25 lbs	10.25 lbs.
Total mash volume	3.75 gal	8 gal.

†When scaling up the individual malts, you can round up to the nearest quarter pound to make weighing easier.

2. From Chapter 16, we can calculate the infusions for dough-in and conversion, based on the new grainbill of 10.25 lbs.

Dough-in Infusion

Target temperature:	104°F
Dough-in infusion ratio:	1 quart/lb.
Infusion water temperature	111°F
Infusion volume:	10.25 quarts

Conversion Infusion

Water volume of mash is:	10.25 quarts
Target temperature:	154°F
Infusion water temperature:	210°F
Infusion volume:	10 quarts
Total water volume	20.25 quarts

3. At this point we have a rather ordinary mash of 10.25 lbs in 20.25 quarts of water, i.e., a mash ratio of about 2 qts/lb. The total volume of this mash is about 6 gallons. Now we will calculate how much water we need to add to make up the total no-sparge water volume (Wn) and use it for a mashout infusion.

$$Wn = 4(Vb + kGn) = 29.125 \text{ quarts}$$

$$Wmo = Wn - \text{infusions} = 29.125 - 20.25 = 8.875 \text{ or } 9 \text{ quarts}$$

4. At first glance, you might say "just add 9 more quarts and call it good" but we really don't want to push the mashout temperature over 170°F. So, we want to calculate the infusion temperature that will give us a final mash temperature of 170°F (max). From Chapter 16, we can re-arrange the infusion equation to find the infusion temperature.

$$Tw = (T2 - T1)(.2G + Wm)/Wa + T2$$

$$Tw = (170 - 154)(.2 \cdot 10.25 + 20.25)/9 + 170 = 209.6 \text{ or } 210°F$$

In this case, using our usual infusion water temperature of 210°F, we don't need to worry about increasing the potential for tannin extraction. However, if we were going to collect 7 gallons instead of 6, which would mean infusing 13 quarts instead of 9, the temperature of the infusion would need to be reduced to 198°F.

5. Yes, there are a few calculations involved and it's a lot bigger mash, but it does simplify things to add all the water to the mash, recirculate, and drain it to start your boil. No worrying about the pH and gravity of the final runnings, no worrying about whether you will hit your target gravity—this process is robust. And if you want to simplify the calculations aspect, then putting the equations into a spreadsheet or using a brewing software program like Promash or Strangebrew will make it easy.

Section 4—Recipes, Experimentation, and Troubleshooting

Chapter 19—Some of My Favorite Styles and Recipes

Chapter 19, p. 234, British Pale Ale Style Guidelines

Reason for Change: Didn't proofread very well.

	Substyle	OG	FG	IBUs	Color
Was:	Burton Ale	1.046-65	1.049-65	1.011-20	6-14
Is:	Burton Ale	1.046-65	1.011-20	30-65	6-14

Chapter 19, p. 239, American Pale Ale Style Guidelines

Reason for Change: Didn't proofread very well.

	Substyle	OG	FG	IBUs	Color
Was:	American Pale Ale	1.050-75	1.012-16	40-60+	8-14
	American Amber Ale	1.050-75	1.012-16	40-60+	8-14
Is:	American Pale Ale	1.045-56	1.010-15	20-40	4-11
	American Amber Ale	1.045-56	1.010-15	20-40	11-18

Chapter 19, p. 241, Brown Ale Style Guidelines

Reason for Change: Didn't proofread very well.

	Substyle	OG	FG	IBUs	Color
Was:	American Brown Ale	1.040-55	1.010-15	25-45	15-22
Is:	American Brown Ale	1.040-60	1.010-17	25-60	15-22

Chapter 19, p. 245, Stout Style Guidelines

Reason for Change: Didn't proofread very well.

	Substyle	OG	FG	IBUs	Color
Was:	Russian Imperial Stout	1.075-95+	1.018-30+	50-90+	35+
Is:	Russian Imperial Stout	1.075-95+	1.018-30+	50-90+	20-40

Chapter 19, p. 255, Bock Style Guidelines

Reason for Change: Didn't proofread very well.

Was:

Substyle	OG	FG	IBUs	Color
Traditional Bock	1.064-72	1.013-20	20-35	12-30
Doppelbock	1.073-120	1.018-30	20-40	14-30

Commercial	Example:
India Pale Ale	Einbecker Mai Ur-Bock

Is:

Substyle	OG	FG	IBUs	Color
Traditional Bock	1.064-72	1.013-20	20-35	14-30
Doppelbock	1.073-120	1.018-30	20-40	12-30

Commercial	Example:
Traditional Bock	Einbecker Mai Ur-Bock

Chapter 19, p. 257, Vienna Style Guidelines

Reason for Change: Didn't proofread very well.

	Style	OG	FG	IBUs	Color
Was:	Vienna	1.064-72	1.013-20	20-35	12-30
Is:	Vienna	1.046-52	1.010-14	18-30	8-12

Chapter 20—Developing Your Own Recipes

(none)

Chapter 21—Is My Beer Ruined?

Chapter 21, p. 274, Symptom: Vinegar Smell, Cause 2

Reason for Change: Poor advice.

Was: Cause 2: Wild Yeast and Bacteria Two other bugs are also common, Brettanomyces and Pediococcus. One man's garbage can be another man's gold, though. These two cultures and Lacto bacteria are actually essential to the Belgian Lambic beer styles. Under any other circumstances, beers that taste like Lambics would be thrown out instead of being carefully nurtured and blended over a two year period. Lambic beers have a pronounced tartness with fruity overtones. I have it on good authority that once you acquire the taste, they are very good. Until you acquire the taste however, you might as well throw it out. Brettanomyces is supposed to smell like horse sweat or a horse blanket. Raise your hand if you know what a horse smells like. From sweat, I mean. Anyone? I think Brett smells like leather, myself.
Cure: Be meticulous in your sanitation, or find someone from Belgium to drink it.

Is:

Cause 2: Wild Yeast and Bacteria Two other bugs are also common, Brettanomyces and Pediococcus. Brettanomyces is supposed to smell like horse sweat or a horse blanket. Raise your hand if you know what a horse smells like. From sweat, I mean. Anyone? I think Brett smells like leather, myself. Pediococcus can produce diacetyl and acidic aromas and flavors.

One man's garbage can be another man's gold, though. These two cultures and Lacto bacteria are actually essential to the Belgian Lambic beer styles. Under any other circumstances, beers that taste like Lambics would be discarded instead of being carefully nurtured and blended over a two year period. Lambic beers have a pronounced tartness with fruity overtones. This type of beer is very refreshing and is excellent with heavy food.

Cure: Be meticulous in your sanitation, or investigate Lambic brewing.

Chapter 21, p. 279, Diacetyl, middle of paragraph

Reason for Change: Minor clarification.

Was: Diacetyl can be the result of the normal fermentation process or the result of a bacterial infection.

Is: Diacetyl can be the result of the normal fermentation process or the result of a bacterial infection, such as pediococcus.

Section 5—Appendices

Appendix A—Using Hydrometers

(none)

Appendix B—Brewing Metallurgy

(none)

Appendix C—Building Wort Chillers

Appendix C, p. 307, second paragraph, second sentence.

Reason for Change: Add clarifying sentence.

Was: The advantages of an immersion chiller are that it is easily sanitized by placing it in the boil and will cool the wort before it is poured into the fermenter. Make sure the chiller is clean before you put it into the wort.

Is: The advantages of an immersion chiller are that it is easily sanitized by placing it in the boil and will cool the wort before it is poured into the fermenter. This allows you to separate the wort from the cold break. Make sure the chiller is clean before you put it into the wort.

Appendix C, p. 307, Counterflow Chillers, first paragraph, third sentence.

Reason for Change: General clarification.

Was: The drawbacks are keeping the inside of the chiller clean between batches and preventing hops and break material in the kettle from clogging the intake.

Is: The drawbacks are that the cold break is carried into the fermentor with the wort, keeping the inside of the chiller clean between batches, and preventing hops and hot break material in the kettle from clogging the intake.

Appendix D—Building a Mash/Lauter Tun

Appendix D, p. 325, Building Copper Pipe Manifolds, first paragraph, figure citations

Reason for Change: Wrong figures cited.

Was: See Figure 167. ... Figure 168 illustrates this issue for a rectangular cooler.

Is: See Figure 173. ... Figure 174 illustrates this issue for a rectangular cooler.

Appendix E—Metric Conversions

Appendix E, p. 338, Gravity Conversion Table, 9th line

Reason for Change: Typo.

	Specific Gravity	°Plato
Was:	1.024	5.1
Is:	1.024	6.1

Appendix F—Recommended Reading

Appendix F, page 340, Books

Reason For Change: Addition.

Is: Beer Captured—Mark and Tess Szamatulski

Maltose Press, 2001
This is a very special recipe book. Mark and Tess are brewshop owners and spent years choosing and developing homebrew recipes for classic beers in 150 styles from around the world. The recipes in this book are especially detailed and the brewing methods are explained very well. Want to really impress your friends with your beer? Then get this book.

Appendix F, p. 341, Books

Reason for Change: Addition.

Is: The Brewers Companion—by Randy Mosher

Alephenalia Publications, 1995
Randy is a highly technical yet clear-spoken brewer who likes to answer the question: "What if...?" He has filled this book with charts and tables that answer that question, no matter what the topic. This is an extremely useful book for the all grain brewer.

Appendix F, p. 344, Internet Resources

Reason for Change: Additions.

Is: StrangeBrew Brewing Software—www.strangebrew.ca

Strangebrew is a Windows OS application that is another superb resource for designing and saving recipes. It has an easy to use interface and the ability to export recipes as XML. It does IBU calculations, gravity calculations, water calculations, mash calculations, plus competition forms and bottle labels. Recipes from other users are available at the StrangeBrew website along with technical support and a discusion board. It is available as a download from the website for a 30 day free trial before registering.

The Beer Judge Certification Program website—www.bjcp.org
Years ago a group dedicated brewers and judges set out to control their own destiny for the benefit of the hobby and beer in general, and the Beer Judge Certification Program was born. This nonprofit organization is dedicated to promoting beer literacy, the appreciation of real beer, and to recognize beer tasting and evaluation skills via a comprehensive examination.

All the current beer style guidelines and descriptions are maintaind online as .pdf files. This is an excellent resource for advancing brewers who would like to enter their beers in competitions or study to become part of the program.

Appendix F, p. 344, Internet Resources

Reason for Change: Updating my site info because I dropped the extra domain.

Was:

How To Brew—www.howtobrew.com
Home of the online edition of the book, sponsured by the Real Beer Page. This edition features color graphics and search capability. If you would like to print out a color copy of the nomographs or a copy of the tables, this is the place to get them.

Palmer House Brewery and Smithy—www.realbeer.com/jjpalmer
My homepage where you can find other beer and brewing articles, links, and instructions for making chainmail armor.

The Defenestrative Publishing Co.—www.defenestrativepublishing.com
This site covers the business end of the book, and is probably the best spot to look for notices of any errata or updates that I feel are necessary.

Is:

How To Brew—www.howtobrew.com
Home of the online edition of the book, sponsored by the Real Beer Page. This edition features color graphics and search capability. If you would like to print out a color copy of the nomographs or a copy of the tables, this is the place to get them.

Palmer House Brewery and Smithy—www.realbeer.com/jjpalmer
My homepage where you can find other beer and brewing articles, links, and instructions for making chainmail armor.

The Defenestrative Publishing Co.—www.realbeer.com/jjpalmer/ordering.html
This site covers the business end of the book, and is probably the best spot to look for notices of any errata or updates to the hardcopy that I feel are necessary.