Brew Prep Day and Brew Day Operations with your Forgeworks Brewhouse

This very detailed procedure is provided courtesy of Elliot Bell, our friend and Head Brewer at the Colorado Boy Brewery, here in Ridgway, CO.

Note: This is a general guideline, as there are many other methodologies that may be applicable. Some of the specific volumes outlined are related to a 7bbl system.

The original Colorado Boy Brewery in Ridgway, Colorado, was founded by craft brewing consultant, author and well known speaker, Tom Hennessy. Ridgway's Colorado boy is home to Forgework's very first Kettle. It was Tom Hennessy that convinced Bennett Forgework's owner, Tom Bennett to begin a stainless steel division of the company, focused on the Craft Brewing Industry.

Later, Tom Hennessy opened a second location of Colorado Boy, 25 miles North of Ridgway, in Montrose Colorado, which has a full 7bbl brewhouse from Forgeworks. Tom Hennessy also founded the Craft Beer Immersion Course, where brewing and cellaring day operations are taught in detail, as well as best business practices of the front of the house. This is a private three-day course designed for a head brewer and business manager (2-3 attendees). Recently, a third Colorado Boy has been added, called the Colorado Boy Depot, which primarily serves as beer production support for the original Ridgway location, and a new taproom/restaurant in Ouray, called the Colorado Boy Southwest. The Depot location is right next door to Bennett Forgeworks, and is equipped with a Forgeworks 7bbl Brewhouse.

Consider investing in the private training offered in the Immersion Course, and come out to Ridgway to brew on our 7bbl brewhouse and tour the Bennett Forgeworks fabrication facility. You will be right at the gateway to the stunning San Juan Mountains, with endless options for outdoor activities in the mountains, including fishing, jeep touring, mountain biking, hiking, back country ski touring, climbing (ice and rock), canyoneering, and drinking cold craft beer. Visit the Articles page on the Forgeworks website for an extensive list of our area attractions, including lodging.

https://www.coloradoboy.com/immersion

So you are starting a brewery, which will be a challenging journey of obstacles, risk, and an enjoyment that brings you right back to very reason you set out on this path. Take a look at Tom Hennessy's story on the Colorado Boy, and be prepared to be inspired.
https://infusion5.com/beyondthegallery/tom-hennessy/

Brew Prep Day:

Fill the brew kettle with enough water for strike and sparge water (approx. 290-305 gallons for a 7 bbl batch, depending on the recipe). Heat kettle water to about 180F to drive off any chlorine and also pre-heat the strike water for tomorrow's brew. [Note: if your city water contains chloro-ammine you will have to actively filter the water to remove this compound.] Next, turn off the kettle burner and close the steam stack slide gate to prevent excess heat from escaping overnight. Then, weigh out all the grain you will need for brew day.

It is assumed that the fermentation tank has already been cleaned with a PBW cleaning cycle: Normally, after beer is transferred into a bright tank the fermentation tank should be cleaned the same day with 20 gallons of 140-150F hot water and a pint glass full of PBW alkali cleaner added to the hot water for a half-hour cleaning cycle (CIP). Make sure to leave one port open (the sample port for example) during the CIP loop to act as a vacuum break, otherwise you could damage the tank as the PBW solution cools and forms a partial vacuum. Then the fermenter, brew pump, and hoses are rinsed out thoroughly with clean tap water, and hoses are hung up to dry.

The heat exchanger and oxygen stone assembly are normally filled or "packed" with PBW solution from the previous brew day and CIP cleaning cycle. On brew prep day the heat exchanger and oxygen stone assembly are flushed with 20-30 gallons of clean warm water, which is pumped from a clean holding tank using the brew house pump at full throttle through the heat exchanger and into the brewery drain. Then the [cleaned and rinsed] fermentation tank, brewery pump, and heat exchanger are connected in series with transfer hoses; and a CIP cycle is done with sanitizing solution (15-20 gallons of room temp water and about 8 liquid ounces of Sani-Clean sanitizer) for a 10 minute cycle. [Note: Make sure to purge the oxygen stone with sanitizing solution by simply opening the side valve attached to the O2 inlet and allowing sanitizer to back-flush out of the O2 stone assembly during the 10 minute cycle]. Also on the fermentation tank, make sure the racking arm and its associated butterfly valve are also sanitized inside and out. The "transfer tee" is also put into place on the fermenter's bottom valve and sanitized for tomorrow's brew.

Sanitizing solution can be left overnight in the fermenter, heat exchanger, and oxygen stone assembly. One of the longer (approx. 15 ft.) transfer hoses may be kept clean overnight by simply connecting the two hose ends together with a tri-clamp, leaving the sanitizing fluid inside the hose. This clean hose will serve to connect the heat exchanger and O2 assembly to the "transfer tee" of the fermentation tank on brew day. Use TC end caps (aka blinds) to cap off the transfer tee on the fermenter. Also, cap off the heat exchanger and O2 stone assembly with TC end caps to keep them clean (filled with sanitizing solution) overnight. Rinse the sanitizer out of the brewery pump after the sanitation cycle is completed. The brew pump will be used on brew day during mash-in and does not require sanitizer in it during that process. [Note: the brew house vs. the fermentation area can be considered "hot side" vs. "cold side" in terms of sanitation requirements. What I mean is, the brew kettle and mash tun are fine as long as they are physically clean; the wort will be boiled for an hour (plus). So, it is not necessary to sanitize the mash tun or brew kettle. However, any equipment on the heat exchanger and fermentation side of the brewery should be rinsed, PBW'd, rinsed, sanitized, and prayed over with furrowed brow until nearly all

bacteria are extinct!] Also, keep the brew house clean and remove grain dust that builds up on surfaces and tanks because this can contribute to bacterial contamination that will bugger your beer.

Brew Day:

Yeast Preparation: If you're using new yeast from BSI (or another supplier) bring this out of cold storage, then add the test tube of the supplied yeast nutrient into the yeast container (use disposable nitrile gloves during this procedure). Slightly crack open the cap on the yeast container to vent. Allow the yeast slurry to come up to room temperature for about 3 hours in the morning while you are brewing. Place the yeast container in a clean environment, away from grain dust. If you are using your stock house yeast that you have already harvested from a previous brew, we'll add that later in the brew day; just keep it in cold storage for now at about 38F.

Assuming that you heated the kettle water to about 180F the night before the brew (to remove chlorine and preheat the water) the kettle likely dropped in temp to around 160F overnight. Now bring the kettle water back up to 164-165F. [Note: 165F is a good temperature for your strike water if you are milling your own grain and using a grist hydrator; but if you are using pre-milled grain and dumping it into the mash tun you may need a slightly higher strike water temperature (166F-170F) to achieve a final mash temperature of 150 -152 F. The reason for a slightly higher strike water temp on pre-milled grain is simply because you will be stirring the grist more vigorously to mix the water and grain vs. simply using a grist hydrator to do the job; and the extra stirring will release more heat from the mash. Before you mash-in add the appropriate amount of phosphoric acid into the total kettle water to amend the pH of the water. Whirlpool the acid in the kettle to mix it for about 5 minutes. [Note: Light beers like a Blonde may need slightly more phosphoric acid; dark beers like porters and stouts do not need any acid addition. Darker, roasted malts will automatically bring down the pH to lower levels. Each individual beer recipe will require a different quantity of phosphoric acid to hit its target pH in the mash tun based on the type and quantity of grain used. It does not take much: 50-180 grams of phosphoric acid. The target pH of the mash when all the grain and water are mixed in is 5.2-5.3 pH.

Use a sight tube or other means to find the initial volume of total water in the brew kettle and write this on the brew log data sheet. Subtract the amount of water you will need for strike water going into the mash (based on your spread sheet information /recipe formulation). This will tell you how much water to use before shutting off the strike water that is being transferred from the kettle.

Now we are ready to mash-in. Attach a sight tube on the brew kettle to monitor water volume. Reconfigure the [heat resistant] brew hoses to go from the bottom of the kettle into the brew pump, then from the pump outlet to another hot hose and up to the grist hydrator (or just connect the pump outlet to the bottom TC fitting of the mash tun if you do not have a grist hydrator and are using pre-milled grain). [Note: "Under-letting" the false bottom screen with water to cover it is important; otherwise you can get a stuck mash from having a trapped air pocket underneath the screen. Weird hydraulics!] When you have 2 inches (4-6" if you are using pre-milled malts) of strike water above the false floor screen, and you are using a mill, you are ready for Grist. Turn on the mill and auger. Supply enough water to the grist hydrator to wet the grist. If using a flow meter, this may be approximately ¼ bbl per minute of flow. To achieve the right mash-in flow, use your brewer's paddle and catch samples below the hydrador. It should be wet, but not really really wet, and not somewhat dry

Side note on pre-milled malts: If you are using pre-milled malts from your supplier start adding your malt after you have about 4-6" of water over your false bottom screens. The enzymes in barley (developed during the actual malting process) are temperature and pH sensitive. You do not want to overheat the enzymes during the mashing-in phase because this can denature them, limiting their ability to convert starches into sugars. So keep the thickness of the mash to slightly thinner than oatmeal consistency while you are mashing in. Too much hot strike water added while you are mashing-in could elevate the temperature beyond the enzyme's "happy zone". 1 ½ quarts of water per pound of grain is a good target ratio.

If you're using a grist hydrator start milling your base malts first then add specialty malts, but leave a bag of 2-row base malt at the end of the mash to purge out any specialty malts left inside the auger that may affect your next brew. Turn off the strike water when you get down to the pre-determined volume from your brew log sheet calculation. If you are using gypsum (calcium sulfate) dump in your predetermined amount into the mash and stir thoroughly. Check the temperature and pH of the mash. 150-152 F is the magic mash temp; but if the mash temp is over 152 F, I would lower it by adding a half gallon of cold water and stirring it in. In general, you don't want to get close to 155 F for a mash temperature because you may extract more unfermentable sugars in the mash that will carry over into the finished beer, making it too sweet for the style.

5.2-5.3 is a good target pH for the mash. If the mash pH is too high (over about 5.5pH) you can lower it by adding about 20-30 grams of phosphoric acid to a pint of water then adding it directly into the mash and doing a good deep stir. When measuring the pH pull up the grist with a paddle and move the pH probe slowly in the grist to get an accurate reading. Don't just measure the pH of the water on top of the mash or you'll get a [false] high reading. Close the lid on mash tun and set timer for 30-60 minutes. Starch conversion usually only takes about 30 minutes with properly modified malts. Write down the mash start time on brew log sheet. Side note: Calibrate the pH meter about every 3-6 months to keep it accurate, and keep the pH probe [tip] capped with electrode storage solution when not in use.

Once all of the strike water has been pumped into the mash tun, heat the remaining water in the kettle to about 178F (this will be your sparge water). When the water in the kettle reaches the correct temperature shut off the kettle burner and transfer the sparge water into the hot liquor tank (HLT). The HLT itself should absorb some of the heat, such that when you actually sparge the temperature should be 170 F coming directly out of the sparge arm over the grain bed.

Once water is transferred to the HLT and the brew kettle is empty set up the mash tun for vorlafing (recirculating the wort). All modern Forgworks Mash Tuns are equipped with a Vorlauf diffuser plate that fans the wort over the grain bed. If your Forgeworks Mash Tun is pre 2018, then you can prepare for the vorlauf in one of the following two ways. Connect two 90 fittings together and fasten these to the inside of the mash tun (top TC fitting) pointed against the inner wall of the mash tun, the air gap being about 3/8" away from the mash tun wall, so that you don't splash the wort excessively and get hot-side aeration. Or, a better way to Vorlaf is to arrange a piping scenario that slowly admits 2-3 gallons a minute of wort to the surface of the grain bed somewhere towards the center of the grain bed. The wort can be directed onto a 4-6" diameter stainless dispersion plate so that it spreads out evenly over the surface of the grain bed without aerating it excessively. This way you set up the whole grain bed as a filtration medium instead of just dumping wort down the side wall of the mash tun.

It is highly recommended that you use a Grant for your vorlauf and your transfer to the Kettle. There are several reasons for this, one being that because you are gravity feeding into your Grant from the Mash Tun, there is no way you could accidentally pull a vacuum under the Mash Tun screen. It doesn not take much of a vacuum to damage the V-Wire Screen, so you have to be very careful here if you are not using a grant or a flowmeter at a target rate. Forgeworks Mash Tuns are equipped the Manometer Ports and Tube. This apparatus gives you a visual on the underscreen and above screen levels so you can monitor your vorlauf rate, and recognize if a vacuum is being created. The other is so you can get good eyes on the clarity of your wort. Forgeworks makes an awesome 20 Gallon Grant (and better yet, they also make a second version of that 20 gallon grant that is also a Keg Cleaner, Remote CIP Tank, and a Hop Back. You're going to recirculate the wort in the mash tun for 20-25 minutes until it clears. Place a stainless steel strainer on top of the grant opening to collect excess grist coming out of the mash tun. Place the grant next to the mash tun and hook up a 7/8" ID food grade, high temp hose to go from the bottom fitting of the mash tun into the grant; the wort will just gravity feed into the grant. Hook up a brewer's hot hose to go from the bottom TC fitting of the grant into the brew pump inlet, and another hot hose from the brew pump outlet to the top TC fitting on the mash tun where the wort enters the tun and is sent to the grain bed. Fill the grant with wort from the mash tun, and prime the brew pump with enough wort to remove air from the inlet hose and pump head assembly. Then start the pump and set up a slow flow rate (approximately 1/4 to 1/3 throttle opening on the pump's outlet valve) to gently circulate the wort in the mash tun for 20-25 minutes. [Note: It's a good idea to have a stainless steel ball valve on the brew pump and also the bottom outlet of the mash tun to obtain better flow control over the wort. Butterfly valves tend to drift open and can make precise flow control difficult.

When the wort clears in the grant (not cloudy or grainy) shut the pump off, close your valves, and reconfigure the hot hoses. We will now be sending wort directly into the brew kettle. Set up a brewer's hot hose to go from the brew pump outlet to the bottom port on the brew kettle. Also, set up another pump and hot hose to deliver sparge water from the H.L.T. to the sparge arm or ball inside the mash tun (unless you are simply gravity flowing from your HLT into your mash tun in which case you won't need this second pump!). Fill the grant with enough wort and prime the pump again, start the brew pump and slowly transfer wort into the brew kettle for about an hour and 15 minute transfer time. You'll have to adjust the flow rate coming out of the mash tun so it doesn't overflow the grant. [Note: Vorlafing will cause the grain bed to compact slightly. You'll now have about 8-10 inches of wort stratifying over the top of grain bed. Start sparging when the grain bed is visible. You can use your brew paddle to judge the depth of the grain bed if grist is floating on top. Just put the tip of the paddle in the grist and note when it feels compacted or dense. Keep about 1-3 inches of sparge water on top of the grain bed during the lautering/wort transfer process. Pay attention to the volume of wort going into the kettle vs. time; adjust pump flow rate if necessary. You want the wort transfer time to be about an hour and 15 minutes for proper extraction of the available sugars in the mash. Turn the kettle burner ON when the wort reaches about the 100 gallon mark. [Note: turning the burner on too early can scorch the wort.]

Eventually, the sparge water will run out, and the remainder will drain through the grain bed. You'll need to open up the bottom valve on the mash tun a little more as the liquid drains down through the grain bed (resulting in lower head pressure in the mash tun). During your first brews: Until you know your mash/brew house efficiency shut off the wort transfer into the kettle when you hit about 220 gallons (assuming your pre-boil target is about 250 gallons for a 7 bbl batch). Cool a wort sample to 70F and check gravity; compare it to your predicted [pre-boil] target gravity. If it looks good keep going with

the transfer. If the gravity looks low then stop the transfer and adjust the total grain bill for the next time that you brew that recipe. Once you reach your target [wort] volume inside the kettle, shut off the transfer process going into the kettle. Cool a wort sample and check gravity.

Now you have time to pitch the yeast into the fermentation tank while the kettle is coming up to a boil: First drain the sanitizer out of the fermenter from the day before, replace the [sanitized] racking arm and its butterfly valve back into its proper position and angle. Make sure that you set the thermostat on the fermenter to the proper fermentation temperature. With your brewery wash down hose and spray nozzle, blast any grain dust off off the fermenter door, then spray sanitizer all over the door and the door gasket area. Remove fermenter door and place it face down on a clean surface like a sanitized bucket rim. Inspect the inside floor of the fermenter and flush with a clean pitcher full of sanitizing solution if hop particles, etc. are present. [Note: sometimes there are small quantities of hop bits leftover from the heat exchanger that get deposited in the fermenter during the sanitation C.I.P. loop.]

Let sanitizer drain out thoroughly, then close bottom fermenter valve. Pitch yeast into fermenter. If you are using yeast that you've previously harvested, then skim off the top layer of dead yeast with a clean and sanitized ladle and remove the layer of beer until you get down to the good yeast. The pitch rate is about 1.5 pints of yeast per barrel brewed. [Note: The stainless ladle that you use for pitching yeast should be cleaned with dish soap and soft sponge, then rinsed, then placed in a beaker full of boiling water (for about 5 minutes) and finally placed in a bucket of sanitizing solution for a minute or so before using it.]

If you are using a new batch of yeast from BSI or another supplier you can now add this yeast by simply (using disposable nitrile gloves) tightening the cap on the yeast container, shake vigorously, dump about half the yeast into the fermenter (with bottom valve closed on fermenter) then shake again to remove bottom yeast in the container, and dump again. After pitching the yeast into the fermenter, re-sanitize the door and gasket with a spray bottle and reattach door onto the fermenter.

Back to the kettle: When the wort comes to a boil write this time down on the brew log sheet. Set the lab timer for 20-30 minutes. No hops are added during this initial boil time. This is usually the time when trub is skimmed off the top of the wort. The trub contains tannins and proteins that should be skimmed off which will help head retention and beer clarity later on. CAUTION: if the wort in the kettle looks like it might boil over just turn the kettle burner OFF briefly to allow the foamy trub to settle, then skim off the remainder of the trub and turn kettle burner back ON.

I should interject here and say that this is a good time to start removing the spent grain from the mash tun. We use the clean mash tun to store excess hot water coming from the heat exchanger during final knockout to clean the kettle, heat exchanger, and any hoses that had wort in them. However, graining out the mash tun can take a while, so it might be better to skip this step until you are finished brewing to clean out the mash tun. Once the clock is ticking (boil start time) you need to do hop additions, set up for whirl pooling, set up the heat exchanger for the knockout, etc. You can simply use you're HLT or other tank to store hot water from the heat exchanger (with an overflow port/hose or diversion valve if necessary) and clean out the mash tun later in the day. Five Star Chemicals sells a nice brewer's cleaning brush you can use with a little dish soap to clean the mash tun after you've removed the grain. Checkout this link on the Forgeworks website, found under the FAQ's article. It talks about cleaning the mash tun and the deal with CIP with the Mash Tun's flat lid.

https://static1.squarespace.com/static/5a9e9942da02bcf47a068ed2/t/5ad8df5670a6ad0742ea093a/1524162391405/Reasoning+for+no+CIP+Feature+on+Flat.pdf

Back to the brew kettle: After the initial 20-30 minutes boil time, the first bittering hop is added and now it is 60 minutes until the end of the boil. Proceed with any other hop additions. Kettle finings such as Irish Moss or Five Star's "super moss" are added 15 minutes before end of the boil (just hydrate them 10-20 minutes before adding them to kettle). When boil time is completed, and any late addition hops are added the kettle burner is shut OFF. The pump and hot hoses can be configured now for the whirlpool. Hook one hot hose to the kettle bottom port; this attaches to the pump inlet. The pump outlet is attached via hot hose to the [middle] whirlpool port on the side of the kettle.

Start the whirlpool and pump for 10 minutes. Then turn off pump and let the wort rest for 10 minutes. This gives you time to set up the heat exchanger and oxygen tubing. The heat exchanger needs a source of cold city water supplied to the cold water inlet of the heat exchanger. The hot water outlet port from the heat exchanger can be connected with a hot hose to the [cleaned] mash tun or spare holding tank. Again, this hot water can be used later for cleaning the kettle and heat exchanger after the brew. The cleaned and sanitized transfer hose (stored from brew prep day) is then hooked up between the oxygen stone assembly of the heat exchanger and the "transfer tee" going into the fermenter. Also hook up a drain hose on the fermenter's "transfer tee" to divert the initial sanitizer in the lines and heat exchanger down the drain.

Once whirlpooling is complete and the wort is resting for 10 minutes, close the butterfly valve on the kettle's whirlpool side, close the brew pump's outlet valve, then take the hot hose attached to the pump outlet and connect this hose to the product or wort inlet side of the heat exchanger. Take final readings of kettle volume and final gravity of wort (after cooling the wort to 70F). Hook up the oxygen line to the oxygen stone assembly on the heat exchanger. Initially, the side drain valve on fermenter's "transfer tee" should be OPEN. Fermenter tank bottom valve is initially CLOSED during startup. Open all valves on the heat exchanger, wort inlet and outlet. Turn ON the cold tap water going into the heat exchanger. VERIFY that cold tap water is going through the heat exchanger BEFORE starting the transfer process, otherwise you will cook your yeast!! Water should be coming out of the heat exchanger; this water goes into a storage tank, clean mash tun, or simply directed towards the brewery drain. The brew house pump valve is initially closed at startup. The bottom kettle valve should be open.

With cold city water ON to the heat exchanger, start the brew house pump and slowly open its valve to about ¼ throttle to begin pushing wort through the heat exchanger. At the "transfer tee" of the fermenter, wait until all of the sanitizer has been flushed down the drain, then close the drain valve on the side of the "transfer tee" and open the main fermenter tank valve in one smooth motion. Adjust the brew house pump valve (and thus the flow rate) to obtain 68-70 F for the wort exiting the heat exchanger as it flows into the fermenter. [Note: Wort for lagers will be transferred at slightly lower temperatures.] Turn on the O2 and allow it to flow during the knockout at 4 liters per minute. Double check to make sure that you have set the fermenter's thermostat to the desired FERMENTATION temperature…not to crash temperature 38F!! That would be bad.

Continue the transfer. Keep an eye on the last bit of wort in the kettle. Shut off the brewery pump if it looks like any trub or crud will be sucked into the brew pump and heat exchanger. Shut off the pump

when the transfer ends, and shut off the O2. Close the brew pump valve temporarily so that wort does not back flow from the fermenter. Close the brew kettle bottom valve.

Purge the remaining wort out of hoses and heat exchanger by attaching a CO2 line (with it's own control valve and regulator set to about 15 psi) with a triclamp fitting to the hot hose going from the pump to the kettle. Once the CO2 line is connected, open the brew pump valve (no need to turn the pump on) and slowly open the CO2 control valve to force out the remaining wort into the fermenter. When you're done shut off the CO2 valve that you're pushing with, and CLOSE the bottom fermenter tank valve. Then open the drain valve on the "transfer tee" of the fermenter. You're done! Congratulations! Now for cleaning.

Push hot rinse water through all hoses and the heat exchanger. For now, the rinse water will go through the "transfer tee" and into the drain. A few minutes is enough time. Drain and spray out the kettle with hot water. Clean the kettle with a brewer's scrub brush and some dish soap, rinse again. Fill the kettle with about 20 gallons of hot water at about 120-140 F. Sprinkle in a pint glass full of PBW powder. Reconfigure the hoses to reverse flow through the wort side of the heat exchanger. This is done to backflush hops and contaminants out of the heat exchanger. So, coming from the kettle bottom port to the pump, then out of the pump into the O2 assembly, out of the heat exchanger (actually labeled wort inlet side) to all hoses connected together (those that had wort in them). Then finally, these hoses will attach to the kettle spray ball. Also, put the fermenter's "transfer tee" somewhere in the loop to clean it (close the side drain valve on transfer "tee" while CIP loop is running). Close the kettle's damper going to the steam vent. You may also need to pinch off the kettle's condensate drip tube temporarily so that fluid does not escape. Run the CIP loop for thirty minutes. The last 5 minutes, shut off the pump and remove the hose going to the spray ball; attach this hose to the whirl pool port and pump fluid through it for 5 minutes to clean it.

Pack the heat exchanger at the end of the CIP loop: partially close brew pump valve about half throttle to slow the flow rate. Shut off the butterfly valve on the heat exchanger at the point where PBW is exiting. After a few seconds, shut off the butterfly valve where PBW solution is entering the heat exchanger (O2 assembly side of the heat exchanger). PBW can stay in the heat exchanger and oxygen assembly until the next brew prep day. Rinse the remaining hoses with hot water and hang them up to dry. Spray out the kettle to remove PBW. Now pour yourself a beer!