

Create a control narrative for beer brewing including concrete setpoints and ranges.

Title: Beer Brewing Control Narrative

1. Introduction:

This control narrative outlines the essential parameters and setpoints for beer brewing. The goal is to ensure a consistent, high-quality product while maintaining a safe and efficient operation. The narrative focuses on six key areas: milling, mashing, lautering, boiling, fermentation, and conditioning.

2. Milling:

Objective: Grind malted barley into grist while maintaining an appropriate particle size distribution for optimal mashing. Setpoints:

Mill gap: 0.8-1.2 mm (adjustable based on malt variety)

3. Mashing:

Objective: Extract fermentable sugars from the grist by maintaining appropriate temperature and pH ranges. Setpoints:

- Mash-in temperature: 62-67°C (144-153°F)
- Mash rest temperature: 63-68°C (145-155°F) for 60 minutes
- Mash-out temperature: 76°C (169°F)
- pH: 5.2-5.6
- 4. Lautering: Objective: Separate the sweet wort from the spent grains through a

5. Boiling:

combination of recirculation and sparging. Setpoints: Mash bed depth: 30-40 cm (12-16 inches)

- Recirculation rate: 1-2 L/min (0.26-0.53 gal/min) for 15-30 minutes
- Sparge temperature: 76-78°C (169-172°F)
- Sparge rate: 1-3 L/min (0.26-0.79 gal/min) to maintain 2.5-5 cm (1-2 inches) of
- liquid above the grain bed Runoff gravity: 2-4° Plato

Objective: Sterilize wort, coagulate proteins, extract hop bitterness and aroma,

- Setpoints:

Boil duration: 60-90 minutes

and concentrate sugars.

- Bittering hop addition: Start of boil
- Flavor hop addition: 15-30 minutes before end of boil
- Aroma hop addition: 0-5 minutes before end of boil Whirlpool duration: 15-20 minutes
- Objective: Convert fermentable sugars into alcohol and CO2 using yeast, while

6. Fermentation:

maintaining appropriate temperature and pressure. Setpoints:

Lager yeast fermentation temperature: 10-15°C (50-59°F)

Ale yeast fermentation temperature: 18-22°C (64-72°F)

- Fermentation pressure: 0.5-1.5 bar (7-22 psi)
- Diacetyl rest (lagers only): Raise temperature to 18°C (64°F) for 48 hours once
- fermentation is 75% complete 7. Conditioning:
- Objective: Mature and clarify the beer by allowing yeast to settle and flavors to

develop. Setpoints:

 Ale conditioning temperature: 12-15°C (54-59°F) for 2-4 weeks • Lager conditioning temperature: 0-4°C (32-39°F) for 4-8 weeks

- CO2 volumes: 2.0-3.0 (adjustable based on beer style)
- Following these setpoints and ranges will ensure a controlled and consistent beer

brewing process, leading to a high-quality final product.



Create a detailed explanation of the Lautering process (Section 4). Include the

equipment and instrumentation needed. Provide a list of the steps to execute.



## wort from the spent grains after mashing. It consists of two main sub-processes: recirculation and sparging. Recirculation helps to clarify the wort, while sparging

Lautering Process Explanation

rinses the remaining sugars from the grain bed. Proper lautering ensures optimal sugar extraction and wort quality. Equipment and Instrumentation: 1. Lauter Tun: A large vessel with a false bottom or slotted manifold to hold the

Lautering is a critical step in the beer brewing process that separates the sweet

grain bed while allowing the wort to pass through. 2. Mash Paddle or Rake: A tool used for stirring the mash to prevent clumping and

ensure even sparging.

lautering.

minutes.

3. Hot Liquor Tank (HLT): A tank for storing and heating water used in the sparging process.

4. Pumps: Used for recirculating and transferring wort and sparge water.

6. Temperature sensors: To measure and maintain the temperature of the sparge water.

5. Flow meters: To monitor and control the flow rates of wort and sparge water.

- 7. pH meter: To monitor the pH of the wort. 8. Refractometer or hydrometer: To measure the sugar content of the wort during
- 1. Transfer the mash to the lauter tun and create an even grain bed. The grain bed

Steps to Execute Lautering Process:

30-40 cm or 12-16 inches). 2. Begin the recirculation process by slowly pumping wort from the bottom of the

acts as a natural filter, so it's essential to maintain a consistent depth (usually

- lauter tun and returning it to the top. The recirculation rate should be 1-2 L/min (0.26-0.53 gal/min). This step helps to clarify the wort by allowing any small particles to settle within the grain bed. Recirculation typically takes 15-30
- 3. Monitor the clarity of the wort during recirculation. Once the wort runs clear, proceed to the sparging process. 4. Gradually add heated sparge water from the hot liquor tank to the top of the

grain bed. The sparge water temperature should be maintained between 76-

- 78°C (169-172°F). 5. Control the sparge rate at 1-3 L/min (0.26-0.79 gal/min) and try to maintain a liquid level of 2.5-5 cm (1-2 inches) above the grain bed. This prevents the grain bed from compacting and ensures even rinsing of the grains.
- using a refractometer or hydrometer. Continue sparging until the runoff gravity drops to 2-4° Plato, at which point most fermentable sugars have been extracted. 7. Carefully monitor the pH of the wort throughout the lautering process. It

6. Collect the runoff wort in a separate vessel while monitoring the sugar content

should remain within the range of 5.2-5.6. A pH outside this range can result in poor extraction efficiency and undesired flavors in the final beer. 8. Once the lautering process is complete, transfer the collected wort to the

boiling kettle for the next phase of the brewing process.

By carefully following these steps and maintaining the appropriate setpoints, the lautering process will ensure optimal sugar extraction and high-quality wort for the subsequent boiling step.





