FORGEWORKS BREWHOUSE VESSELS

FUNCTION AND PRODUCTION FLOW

In a modern brewery, the "brewhouse" is comprised of the vessels that process fluids at high temperatures, sometimes referred to as the ‘hot side’ of a brewery. Afterwards, the unfermented beer, or wort, is sent to the ‘cold side’ of the brewery for fermentation or conditioning.

Forgeworks primarily fabricates a two-vessel brewhouse system where each tank performs several functions of the brewing process.

There are four processes in the production flow of a typical brewhouse:

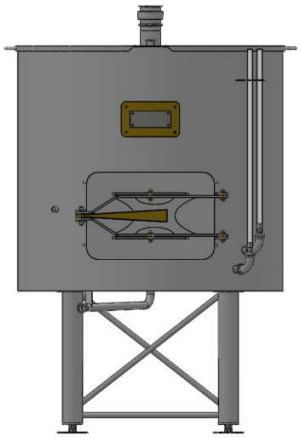
- **Mash** – Milled barley and adjunct grains, called grist, are combined with hot water (approx. 160 degrees) to produce an oatmeal-like solution called the mash
- **Lauter** – The sugar-rich liquid of mash (called wort) is separated from the grain in the mash by filtering the liquid through a metal screen. After filtration the wort is transferred to a boil kettle
- **Boil** – The wort is boiled usually for an hour, other ingredients like hops and herbs are added here
- **Whirlpool** – After the boil is finished the wort is recirculated in the boil kettle, creating a whirlpool effect which causes sediment to collect at the bottom of the tank

Large production breweries will often have a separate vessel for each of the four processes listed above. A Forgeworks brewhouse saves space and cost by combining processes into a **Mash/Lauter Vessel**, referred to as a Mash Tun, and a **Boil/Whirlpool Vessel,** referred to as a Kettle.

Key components of the Mash Tun

- The mash tun is equipped with a manway at the bottom of the tank to provide access for cleaning and disposal of the hundreds of pounds of spent grain
- A v-wire screen to filter the wort from the spent grain

- A thermowell port to monitor temperatures
- A drain to transfer fluid to the kettle for the boil
- The mash tun has no heating elements, burners or electronic equipment

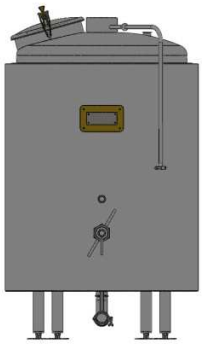


Key components of the Kettle

Kettle components are to be installed by a licensed HVAC professional/Electrician. Components may have been provided by Forgeworks, but not manufactured by Forgeworks. Some components required will need to be sourced by a licensed HVAC professional/Electrician.

- Heated by an indirect fire burner system or multiple electrical immersion heaters. Indirect fire systems utilize a Natural Gas Power Burner which blows a flame into a closed firing chamber
- Exhaust venting flange used to attach Class A Chimney parts, to route burner exhaust to the outside of the building
    - Exhaust venting, not provided by Forgeworks but required upon installation, is required of 8" Double Wall Class A Stainless Steel Chimney sections, with an inline draft controller
- Steam venting which vents steam produced during boiling. A Steam collar is attached to the dome lid of the kettle, and is to be married up with 8" Single Wall Stainless Steel chimney parts (not manufactured or supplied by Forgeworks)
- A Johnson A421 Temperature Controller to monitor and control the temperature of the liquid in the kettle (not manufactured by Forgeworks, but may have been included as part of a brewhouse package)
- An Emergency cut off switch within reasonable reach of the brewer during kettle operation (not manufactured or provided by, but recommended upon installation)
- Each Kettle is equipped with a 2" port on the dome lid that can be used to install a Foam Sensor switch to prevent an accidental boil-over. The Foam Sensor is to be purchased separately by the customer, should they want to install such safety equipment.

The Kettle is never subjected to internal pressure under normal working conditions. The steam produced during the boil is vented through an 8" Chimney at the top of the kettle, and is directed out of the building, separate from the fire chamber exhaust venting. If a Steam Stack Slide Gate was purchased as an accessory option for the kettle, use of this gate will not create an internal pressure condition, as the slide gate is not airtight. The kettle is not designed to be a pressure vessel, and it does not require pressure to operate.



Cold Side of the Brewery – Fermentation and Conditioning

After the Whirlpool process, the hot wort is transferred through a plate heat exchanger where it is cooled to between 50 and 70 degrees prior to fermentation. Forgeworks does not manufacture these heat exchangers but will often source these units for customers if they request. Once the wort is fully transferred into the Fermenter, the fermentation process begins, often referred to as the "Cold Side" of the brewing process.

Fermentation vessels, or fermenters, utilize a dimpled cooling jacket which refrigerates the beer by using a glycol chilling system (not manufactured or sourced by Forgeworks).

After the fermentation process, beer is transferred to a Bright Tank for conditioning, and may be directly connected to a draught system for serving in a tap room.

Fermentation and Bright Tanks are referred to as Cellaring Equipment, and this equipment may have or may not have been provided by Forgeworks.

All transfers of wort or fermented beer from one vessel to the other are performed by centrifugal pumps, which are not manufactured by Forgeworks but are sometimes sourced as a part of a brewhouse package.

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