Guide to Washing Kegs with D-System Valves

There are a wide variety of conditions encountered by kegs in today's market. Each may involve their own special set of cleaning requirements, which will be a combination of the equipment, process programming, and chemicals used. There are also a wide variety of machines available for keg users of every scale. It is our strong recommendation that keg users should view the purchase of one of these machines as an essential part of their quality and safety programs for draft packaging.

This should not be considered a comprehensive set of instructions, or the advice of Micro Matic regarding keg washing, which is not our area of expertise. These are simply some critical considerations for the design or purchase of a keg washer.

By whatever means, keg cleaning must include specific sequential steps, which are covered below under **Common Steps and QA/Safety Considerations**

Overview of common methods/equipment

1. **Fully Manual**, by removal of the spear from the keg in order to clean. This method is **not** recommended for the following reasons:
   a. Frequent removal of the circlips, as is necessary for this, results in excess and premature wear to the groove in the keg neck and the body of the keg spear. This results in a less reliable, less safe fit of the double circlip as the groove becomes worn or damaged.
   b. Frequent removal and reinstallation of the spear increases the likelihood of an accidental misalignment and the potential for an unsafe condition.
   c. Spears are designed to be cleaned with the valves in the open position as a part of a normal Clean-in-Place (CIP) process in the keg; they may not be cleaned properly by manual methods. Further, the 2-inch opening in the keg neck does not provide good access for manual internal cleaning of the keg.
   d. Poor ergonomics of filling upright, draining by inverting the keg multiple times by personnel for each step of process means potential for injury. This process of "soak" cleaning also provides little or no mechanical cleaning action and is likely to yield poor results.
   e. Increased cost of cleaning and maintenance due to increased labor costs and the need to replace the circlip with a new one every time it is removed. This is a critical safety requirement.

2. **Manually Operated Recirculating CIP Keg Washer**. These use a pump(s) to recirculate cleaning solution(s) from a temperature-controlled reservoir to the keg and return, along with pumped or line-pressure rinse water and sanitizer solution. Cleaning solution(s) enters the keg through the liquid side of a specialized wash/fill coupler[1] with the keg inverted so that the keg spear acts as the wash wand. Solutions are drained out of the gas side of the wash coupler and

returned to the solution reservoir (cleaning solutions) or to drain (rinse and sanitizer). Cycles are controlled by manual activation of inlet and outlet valves for each function. These systems are a popular choice among very low volume producers who are seeking a lower cost alternative that still utilizes the built-in cleaning functions of the keg spear and the mechanical cleaning action provided by recirculation, but they are problematic at best and not highly recommended. Some drawbacks to consider when choosing these systems include:

   a. There are many movements to be performed in very specific sequences, all critically timed, to perform all the steps involved in a full wash cycle (see examples below).
   b. Thorough training, clearly written SOPs and a high degree of diligence for operators are critical to safe and effective cleaning of kegs on these systems, since the operator controls all critical functions and timing. Imprecise operation can result in inconsistent and inadequate cleaning, rinsing, sanitation and CO2 purge.
   c. These units, particularly those of a “home-made” nature, often lack the necessary “low flow” pump cycle for proper spear and valve cleaning. (See Common steps and QA/Safety Considerations step 10a, below)

3. **Semi-Automatic Recirculating CIP Keg Washer**. These combine the features of the manually operated CIP setup above with PLC controls to automate the switching of valves for different cleaning steps. These may also include the use of wet/dry sensors, pressure transducers, flow meters or other automation to ensure proper completion of each step and consistently complete drainage of the keg between each step. These may include more than one cleaning solution in addition to a chemical sanitizer. They have the following advantages:
   a. Automation of the cycle processes allows for consistent completion of the cleaning cycles
   b. Additional features can provide even greater protection from failures at Critical Control Points (CCPs).

4. **Fully Automated Keg Washers with wash-probe type valve interface**. These offer all the benefits of the semi-automatic keg washers above, without the need to manually couple and uncouple the kegs. They typically use a keg neck centering mechanism and wash and/or fill probe(s) to engage the inverted keg, open the keg valves and connect to the supply and return piping. It should be noted that the wash/fill probes and centering devices on these machines must be properly designed[2] and maintained or they can result in high rates and severity of damage to keg valves. Some features may include:
   a. External keg washing stations
   b. Residual pressure pre-check before cleaning commences helps to ID and segregate “leaker” kegs.
   c. Conveyance of the keg from one station to another for different stages of the wash and/or fill process.
   d. A fill station with flow metering to ensure kegs are not over- or under-filled.
   e. Weigh check and foam/leak detection to confirm proper fill and seal.
   f. Saturated Steam for sanitation and oxygen exclusion.
   g. Enhanced automation to ensure proper safety and ergonomics; also quality checks at each stage.

Common steps and QA/Safety Considerations

1. Manual or mechanical external washing should clean the exterior of the keg and valve-well thoroughly to remove old markings, stickers, soils and clear any foreign objects from the valve-well.

2. External keg washing solutions should not exceed 160°F to avoid baking soils onto the interior walls of the keg or the spear.[3]

3. Kegs are turned upside down for washing. Pre-rinse, followed by cleaning solution(s) enters through the liquid side of the keg valve and drains through the gas side.

4. The rack on the machine should be designed to allow kegs to be inverted and placed securely for cleaning, while minimizing strain and discomfort to the operator.

5. All process supply or drain lines must be properly secured so they cannot come loose and spray cleaning solution, water, sanitizer, or steam on the operator in the event of unanticipated line failure, gas pressure release or over-pressurization.

6. All lines must be rated for the temperature, pressure and chemical composition of the cleaning/sanitizing solutions. Braided poly line of some sort is common. Braided stainless steel line covers can add another layer of protection. Unreinforced tubing is NOT an appropriate alternative for this application.

7. Kegs need to be purged of ullage (residual product), and if you use a caustic (sodium hydroxide) wash solution, they also need to be purged with clean air[4] or nitrogen[5] to remove remnant CO_2, which neutralizes caustic solutions and creates a vacuum in the vessel being cleaned. Many keg washers are equipped to remove small quantities of ullage but are not designed to remove larger amounts. It is best to remove larger quantities of ullage manually before placing kegs on the keg washer. This also prevents technicians from lifting excessively heavy kegs onto the machine.

8. Purge must be followed by a pre-rinse to remove loose soils. Typically, cool/warm city water or recycled wash-rinse solution is used. As in step 1, it is important not to overheat proteins, making them harder to remove.

9. Pre-rinse must be fully purged, typically using clean (sometimes sterile)[4] compressed air.

10. Wash cycle.
    a. Times and temperatures are dependent on the chemicals used, the soils that are present, and the limitations of the seals in the keg valve. This is best discussed with a chemical supplier who is familiar with food service applications and the need to prevent or mitigate calcium oxalate (beer stone, C_2CaO_4) deposits. On this and all cycles it's extremely important not to exceed keg valve manufacturers' product warranty guidelines, which will prematurely degrade rubber parts and void their warranty[6].

10. (Wash Cycle continued)

  b. During the wash cycle, the solution needs flow sufficient to wash the inside of the keg shell (38-45 PSIG at pump outlet)[7]. It is also necessary to have a period of low-flow cleaning where the solution cascades down the outside of the spear to wash the spear and the valve assembly, the hardest part of the keg to clean. This is most easily achieved by using a variable speed-controlled pump.

  c. During most cycles it is best to have drainage capacity that matches incoming flow to avoid pooling of cleaning solutions or rinse water in the bottom of the kegs. Sometimes this is achieved by injecting a stream of air into the cleaning solution to build a slight positive pressure and encourage good drainage.

  c. Poor drainage can result in pressure buildup, which may trigger the machine to reject the keg. This over-pressure rejection is important to prevent advancement to the next cycle if the keg is not fully purged and can help to identify kegs with failing valves.

  d. A valve cleaning soak cycle during which solution can pool in the bottom of the keg around the valve body can also be beneficial. In this case the outlet valve closes briefly near the end of the wash cycle while the inlet valve remains open.

11. All wash solution must be purged from the keg at the end of each wash cycle. This is recovered to the wash solution reservoir which is fitted with a heater to maintain correct solution temperature. Because of gradual dilution and accumulated soil load in these reservoirs, it is important to test the cleaning solution regularly by titration or instrument, and to drain and fully flush the reservoir at regular intervals. When relying on conductivity probes to monitor NaOH (caustic) solutions, it is important to confirm those readings periodically with a titration test. The carbonates generated when NaOH is neutralized by exposure to CO2 will create a false positive in a conductivity test, resulting in the solution being weaker than it the conductivity makes it appear to be.

12. The primary wash cycle may be followed with a secondary wash cycle using the same or a different chemical solution. Most typical is to follow an alkaline wash cycle with an acid wash cycle. Alternatively, on machines with only a single wash cycle and reservoir, some breweries follow a protocol of washing kegs using caustic solution for a few weeks, alternated with a week of washing kegs using acid solution – the intent being that over time every keg gets cleaned with acid solution 1-2x per year.

13. Follow the wash cycles with a rinse cycle or cycles, again utilizing a low flow cycle to rinse the spear. Determining the necessary length of rinse may be done by testing rinse water with pH strips or inline pH metering to make sure no residual caustic or acid remains. It is critical to product integrity and consumer safety that a thorough rinse is assured.

14. Sanitize with saturated steam, which sanitizes using the latent heat released as the steam condenses, while also purging oxygen from the keg prior to using CO_2 to purge the steam and condensate, and pressurizing for fill.

15. Alternative sanitation methods include:

    a. Sanitizing with an appropriate solution of an EPA approved “no-rinse” sanitizer, purging all air with CO_2 and pressurizing to the level needed for your filling system. The specifics should be discussed with a chemical supplier. Sanitizer solution should be sent to drain, not to a recirculation reservoir upon purging from the keg, unless the manufacturer’s label specifically approves it for re-use. Even then, Good Manufacturing Practice (GMP) generally discourages re-use of any sanitizer, especially for no-rinse applications.

    b. Sanitizing with hot water by pumping 190° F water into the keg and holding for 100 seconds, followed by a purge and pressurization with CO2. This requires far more time, water and energy than is required for steam or chemical sanitizing and is generally considered less reliable as well[8].

The key point in all of this is safety - yours and your customers. It is critical that each step is completed properly and consistently. This is particularly challenging in manually operated systems where a successful outcome is reliant on a well-trained and attentive operator. However, even the most highly engineered automated machines need frequent monitoring and periodic adjustments.

Footnotes

1. Micro Matic part #7485-CC (with shut-off valves) or 7485-CCLS (without shut-off valves)
2. Design consultation and technical drawings are available from Micro Matic.
3. Andy Brewer, “Keg Line Operations,” in Ray Kilmovitz and KarlOcker, ed., *Beer Packaging* (St. Paul, MN: Master Brewers Association of the Americas, 2014), 350
4. Brewer, 354
5. Purging the air from a keg using CO_2 fully can be challenging for breweries who are not first displacing the air with steam or hot water. Some breweries using chemical sanitizers have reported good results using nitrogen to purge the CO_2 from their kegs rather than using air. This adds some cost but lowers the risk of high dissolved oxygen levels in the packaged beer and eliminates the need for multiple CO_2 purge cycles to effectively purge oxygen from the keg.
6. Per Micro Matic’s warranty conditions:
    a. If steam is used, it may not exceed 135° C (275° F), and the time must be limited to 2 minutes
    b. Neither Alkaline nor Acid cleaners may exceed a 3% solution, temperatures above 80° C (176° F), or contact times longer than 10 minutes
    c. Use of novel cleaning chemicals should always be cleared with Micro Matic for compatibility with valve materials. Typical cleaning chemicals include Caustic (NaOH) and phosphoric, nitric and citric acids. Peroxyacetic Acid (PAA) is probably the most commonly used chemical sanitizer.
7. Brewer, 353
8. Brewer, 357