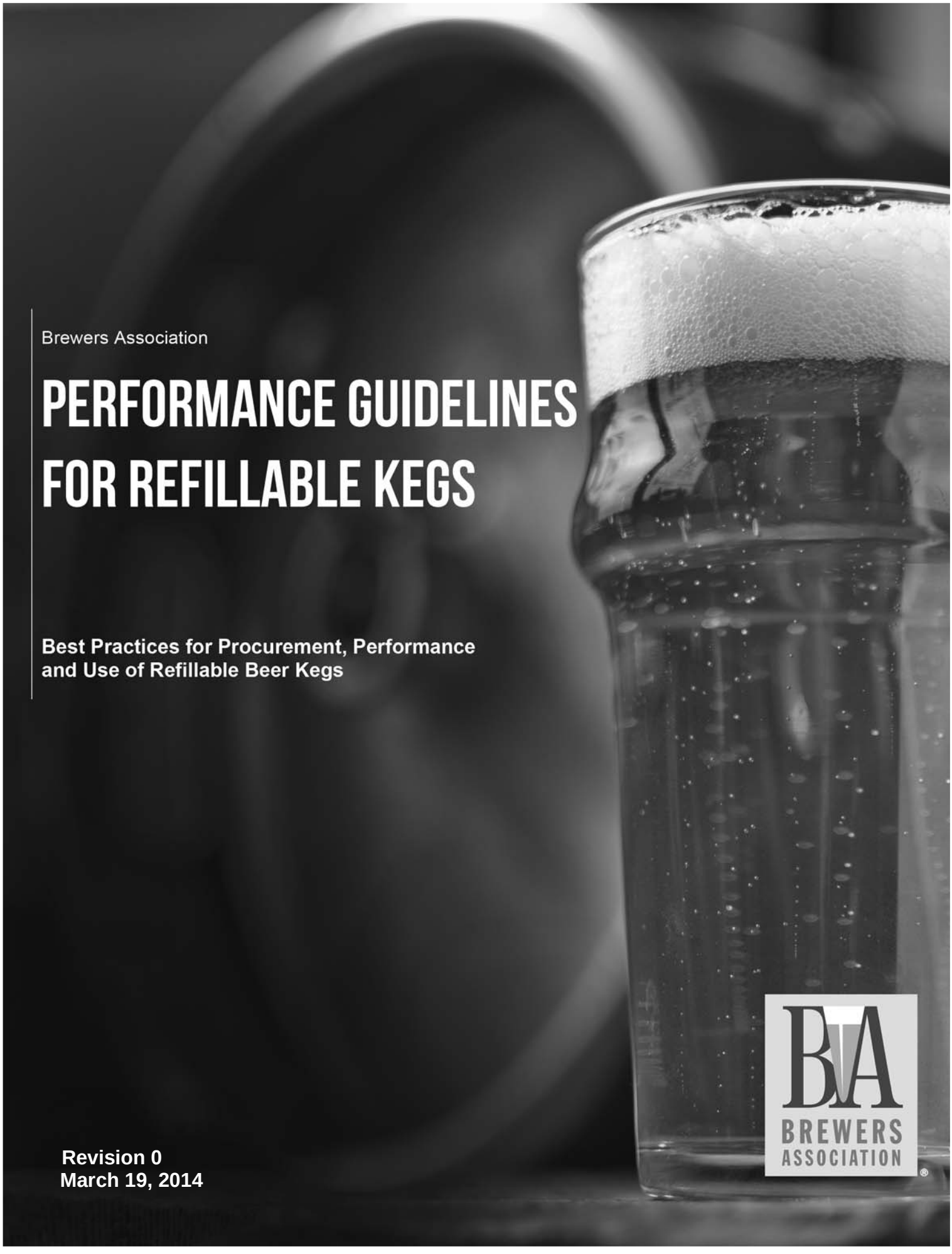


Brewers Association

PERFORMANCE GUIDELINES FOR REFILLABLE KEGS

Best Practices for Procurement, Performance and Use of Refillable Beer Kegs

BREWERS ASSOCIATION

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1. INTRODUCTION

1.1 The following information refers to refillable single valve beer kegs and is an industry recommendation to ensure beer keg quality and address best practices in the procurement, performance, and usage of beer kegs in North America.

1.2 This document summarizes industry accepted and recommended best practice guidance and is not intended to be used as a strict specification or standard. The brewer may address specific needs and refine these guidelines as appropriate in a written practice for themselves and for their suppliers. It is the brewer's responsibility to be familiar with and to maintain compliance with all federal, state, and local statutes and regulations and additionally those of other countries where a brewer chooses to export.

1.3 This guideline applies to all new, used, or reconditioned refillable kegs, irrespective of their material composition (whether steel, plastic or combination), and focuses on kegs using the D valve system based upon the broad use by North American brewers.

1.4 The separate Performance Guideline for Single Use Kegs covers industry recommendations for single use beer kegs.

1.5 The sources for information contained below are current best practices and recommendations from brewers and suppliers, regulations and standards, and governing bodies.

1.6 Federal, state, and local statutes and regulations shall take precedent over this guideline.

1.7 Brewers Association would like to thank the suppliers, vendors, technical experts, and brewers who participated and who have engaged throughout the guideline development process. Stakeholder support to continue to refine and improve this document is greatly appreciated.

1.8 The Brewers Association would like to extend its gratitude to the subject experts at Bilfinger Industrial Services Inc., Terry Stead, Renee Benson and Wendell Perkins for their expertise and dedication to the creation and development of the Performance Guidelines for Refillable Beer Kegs.

1.9 Graphics, figures and images in this document are courtesy of BFBI, Brewers Association Draught Quality Manual, DSI, IDD, KHS, Kross Brewery, MicroMatic, Soverign Keg and Tosca.

2. KEY FINDINGS

2.1 When a keg is in service or for any test performed, whether kegs are full, partial empty or pressurized, they should fail safe in all events. Fail safe criteria means no fragments and no ejection of components; vent of liquid or gas contents only without propulsion of the keg, valve, or any portion thereof. Fail safe applies at all times including failure when keg is in service.

2.2 Keg and component manufacturers should produce to and comply with specifications and technical drawing dimensional targets and tolerances, capacities, materials of construction, processes and procedures. All refillable keg manufacturing protocols should satisfy the rigors of trade as prescribed whether produced from metal, plastic, or any combination of materials.

2.3 The rigors of trade for refillable kegs encompass the continuous repeated cycle of keg washing, filling, shock and vibration of transport, manual and mechanical handling including drops and impacts during moves and storage, pressurization and dispense, empty storage under variable temperature conditions, additional handling, return transport, emptying, and complete re-wash with various chemicals, temperatures and pressures.

2.4 Standard industry practice for Maximum Allowable Working Pressure (MAWP) is 60 psig, the maximum pressure at which a keg should be allowed to operate. It represents the maximum gauge pressure that could develop in a keg absent venting or external cooling of the keg. This is the worst case condition for normal service. The MAWP must never exceed the Design Pressure.

2.5 Design Pressure is the maximum gauge pressure a keg is designed to withstand before rupture. Industry experience is that a refillable keg, to satisfy rigors of trade, should have a minimum design pressure of 300 psig. This provides a safety margin of at least 5 times the MAWP.

2.6 To prevent keg rupture, use a pressure regulator and relief device with any pressure source to which a keg is connected, (such as CO_2, steam, air, etc.). Filling and dispense systems should be set and checked regularly to maintain a pressure lower than the weakest component.

2.7 Kegs should be cleaned before each use per established industry methods with good manufacturing practices in a safe manner. There is no defined “typical washing” procedure for all applications. Thus, keg compatibility should be verified in partnership with the keg washing system vendor to provide the optimum washing sequence and maintain keg quality.

2.8 Kegs should be filled per established industry methods with good manufacturing practices in a safe manner. Keg compatibility should be verified in partnership with the keg filling system vendor to provide the optimum filling sequence to maintain keg and beer quality.

3. PURPOSE

3.1 To provide manufacturers and commercial users of single-valve refillable kegs (SVKs), generally sized from 20 liters (5.16 gallon) to 60 liters (15.5 gallon) and equipped with D-System valves, a guideline of minimum quality recommendations.
3.2 To facilitate the safe operation of kegs and their components throughout the brewing industry network.
3.3 To maintain positive communication between all involved parties.

4. PURCHASING OR PROCUREMENT

4.1 The intent of the following imperatives is important to establish understanding between supplier and end user from the beginning of the purchase relationship. Brewers need to understand the manufacturer's warranty offered on keg and keg components. All aspects need to be considered for present time usage and future requirements as growth continues within the brewery.
4.2 Consistent quality should be maintained from lot to lot.
4.3 It is recommended that keg manufacturers and sales representatives for the same provide detailed drawings and technical performance information for the specific product they represent.
4.4 It is recommended that all materials conform to the specifications of construction as detailed by the technical drawing and specification or contractual documents.
4.5 It is recommended that materials should be traceable to point of origin.
4.6 All product contact materials used in the keg system should comply with applicable FDA regulations, Title 21 CFR 177, for primary food contact. The keg and spear supplier should make available a copy of such certification. Stainless steel beer contact surfaces should be made of food safe AISI 304 or AISI 316 stainless steel.
4.7 It is recommended that keg systems be fit for purpose as defined by the brewer and the distribution life cycle to which the product will be subjected. A brewer should understand the distribution and dispensing environment to which the keg will be subjected and select a keg system that will withstand the rigors of trade.
4.8 For lease pool kegs, individual brewers should recognize that their keg cleaning, filling, processing and handling influences subsequent brewers' successful usage of those kegs.
4.9 It is recommended that for refillable kegs, the keg system supports industrial washing where all product contact surfaces are effectively exposed to washing agents and rinse water and do not retain or attract microbial growth nor retain residues of washing agents.
4.10 It is recommended that brewers understand their beer properties such as gas volume, pH, flavor components, solids, and the potential risk of dispense conditions and ingredient interaction with the keg system being considered.
4.11 It is recommended that new or reconditioned kegs at purchase are clean and free of contaminants both internally and externally.
4.12 It is recommended that new or reconditioned kegs at purchase should have no flavor, odor or physical impact on beverage products.
4.13 It is recommended that purchased beer kegs are only used for storing and dispensing beer. It is not recommended that beer kegs be used for storage of chemicals or other potential contaminants (such as pesticides) as they may interact with the interior surface of the keg and leave behind leachable residue or degrade the interior surface treatment.

5. PERFORMANCE

5.1 Performance on Failure

5.1.1 At all times during any test performed, and during all times when kegs are in service, whether kegs are full, partially empty, empty and at any pressure, they should fail safe in all events. Fail safe criteria means no fragments and no ejection of components; vent of liquid or gas contents only without propulsion of the keg, valve, or any portion thereof. Fail safe as such is not limited to testing, but applies at all times including failure when keg is in service.

5.2 Dimensional Requirements and Functionality

5.2.1 It is recommended that component manufacturers produce to and comply with technical drawing dimensional targets and tolerances, capacities, and materials of construction. Dimensional stability allows for constancy in volume.

5.2.2 It is recommended that component manufacturers produce to and comply with specifications for procedures, processes and protocols for bonding, welding, assembly and construction.

5.2.3 It is recommended that component manufacturers be able to provide technical drawings that represent the finished product being purchased; tooling and assembly drawings can be provided for reference.

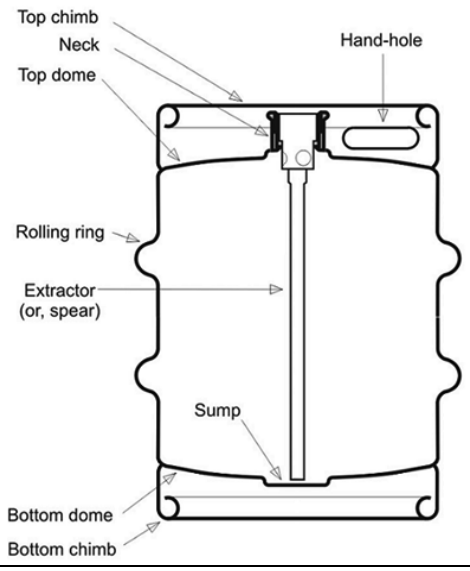
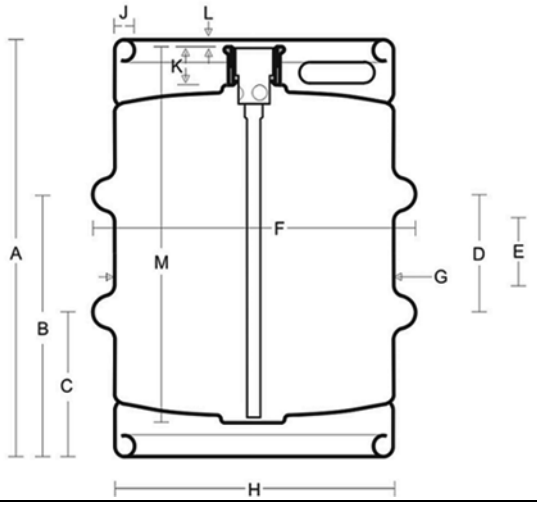
5.2.4 All drawings remain the property of the originator—whether the drawing is created by a brewer, a keg leasing company, or the keg/component manufacturer—unless ownership is modified by contract or other legal provision. These should be considered as confidential unless otherwise agreed.

5.2.5 It is recommended that component manufacturers acknowledge that all technical drawings should include a title block that contains at a minimum: drawing originator's corporation name, a drawing title or description, a unique alphanumeric reference such as a drawing number, an issue date, and a revision alphanumeric character and a revision log.

5.2.6 All parties should recognize that any change to the information on the drawing should have a written agreement between the brewer and the keg/component manufacturer, and should result in a modification to the drawing and the title block.

5.2.7 It is recommended that component manufacturers recognize that any revision to the title block should identify the change in the unique reference, the date of the change, the description of the change, and the new version.

5.2.8 Minimum recommended dimensional information is described below. These should provide for brewers to consistently and effectively process their kegs through washing, filling, distribution, and dispensing.

Minimum Keg Component Dimensions for Sizes 20L – 60L	
	
A = Overall Height B = Top rolling ring to floor C = Bottom rolling ring to floor D = Rolling ring centers E = Length of body between rolling rings F = Diameter over rolling rings	G = Outside diameter between rolling rings H = Outside chime diameter J = Diameter of chime bead K = Height of neck L = Neck to chime clearance M = Internal height top of neck to bottom of sump

5.2.8.1 General keg dimensions for compatibility with cleaning and filling equipment as well as for general fit for retail dispense systems, walk-in coolers, kegerators, and keg boxes. Detailed dimensions to be provided by supplier.



5.2.8.1.1 Keg neck OD at Flange = 2.499” +/- 0.004”

5.2.8.1.2 Depth from finish top skirt (chime) to top of neck = 0.34” +/-0.06

5.2.9 General D-System spear dimensions for compatibility with kegs and couplers for dispensing. Detailed dimensions to be provided by supplier.



D-System Valve and Spear Assembly



D-System Threaded Valve

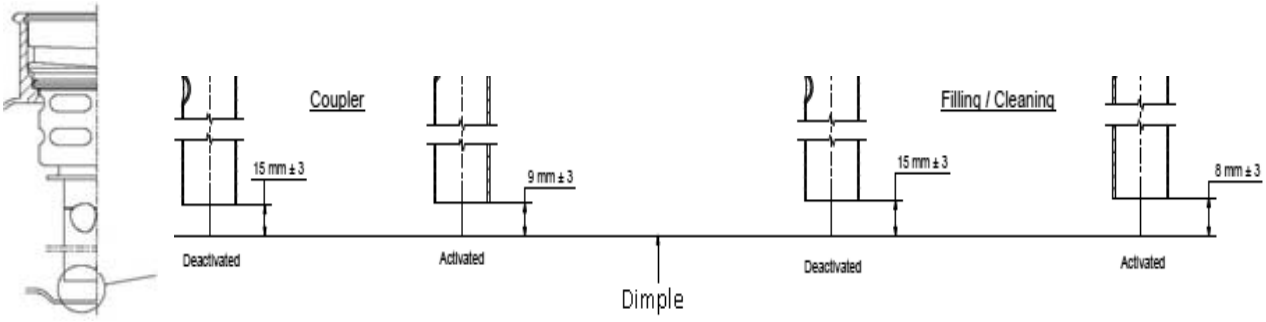


D-System Drop-In Valve with Retaining Ring

5.2.9.1.1 Maximum OD of valve = 1.976+/-0.004”

5.2.9.1.2 Distance from end of extractor tube to bottom of keg (sump) = (8+/- 3mm) with valve open for filling/cleaning.

5.2.9.1.3 Distance from end of extractor tube to bottom of keg (sump) = (9+/- 3mm) with valve open for dispensing.



Proper keg function requires design alignment between the keg, spear, and wash system vendors. The sump (dimple) facilitates the maximum dispense amount of beer from the keg. More importantly, dimensional tolerances of the keg design with valve and spear assembly are critical for complete and effective keg wash. The end of the spear tube should be in the sump, but not so close to the bottom dome as to restrict flow of rinse water and detergents.

5.2.9.1.4 It is recommended that extractor tubes incorporate a device to prevent an extractor tube ejecting from a keg under pressure.

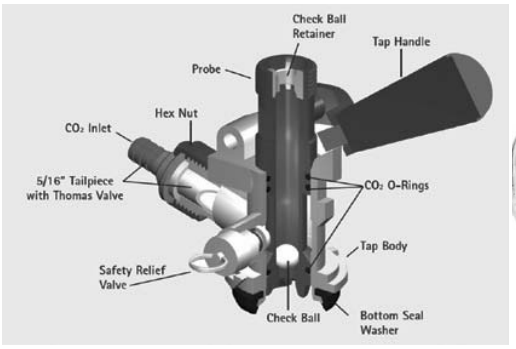
5.2.9.1.5 Integrity of the extractor safety system is achieved through combination of the correct dimensional fit of the extractor tube with the keg neck, and is designed to:

5.2.9.1.5.1 Not eject from a pressurized keg up to a pressure of 6 bar should an attempt be made to (improperly) remove the extractor tube while the keg is pressurized.

5.2.9.1.5.2 To actively reduce the keg pressure while being demounted.

5.2.9.1.6 It is recommended that treaded stainless steel extractor tubes for stainless steel kegs be mounted with a minimum application torque of 540in-lbs (61Nm). Check with the manufacturer where material or construction may specify otherwise.

5.2.10 General D-System coupler dimensions. Detailed dimensions to be provided by supplier.



D-System Coupler Cross Section



D-System Coupler

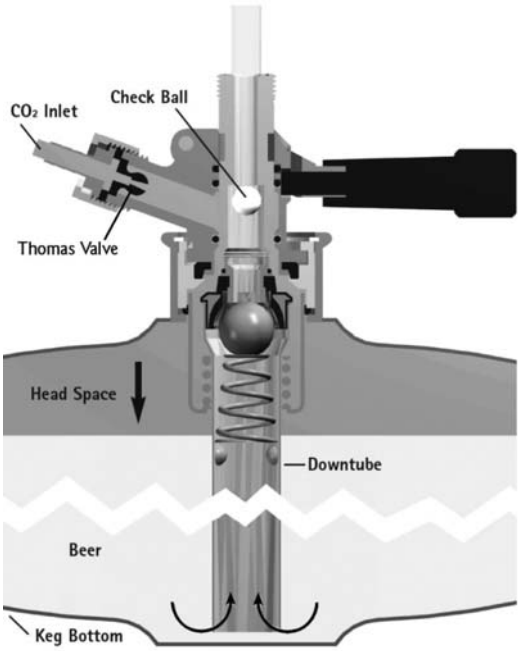


D-System Valve

5.2.10.1.1 Gas Port = 3/8” OD Barb to fit 5/16” ID flexible pressure tubing

5.2.10.1.2 Beer Port = 7/8” – 14 Thread per inch

5.2.10.1.3 Coupler should incorporate hygienic design with a high-capacity pressure relief valve as an integral part of the coupler body. When functioning properly with other relief devices in the system, it should prevent the keg from reaching pressure in excess of the recommended working pressure. Coupler also allows ability to relieve pressure for troubleshooting dispense problems.



5.3 Physical Characteristics

5.3.1 Weight and volume are as critical as physical dimensions.

5.3.1.1 Suppliers should specify keg target volume (capacity) and overflow volume with and without the spear valve. Containers should show no permanent change in volume when exposed to pressures up to 90psig.

5.3.1.2 Consistent keg weight is necessary for tare weight to confirm fill weight and unitized truckload weight.

5.3.2 It is recommended that all containers are visually inspected both internally and externally. It is the manufacturers responsibly to validate that:

5.3.2.1 There are no sharp edges or other irregularities on the keg including at hand holes, drain holes, welds, neck, chime, etc.

5.3.2.2 The inside and outside surfaces of kegs and spears are smooth and free of defects or imperfections that may harbor microbes, inhibit thorough washing, or affect filling and dispensing, including but not limited to cracks, crevices, pinholes, oxidized (sugared) material, and / or irregular weld ripples.

5.3.3 It is recommended that all product-contact surfaces, including those of welds, should have a clean-cut surface finish of no greater than 1.6µm Ra after final treatment.

5.3.3.1 Product-contact surfaces should be free from porosity, inclusions, micro-cavities, tears or laps which might harbor micro-organisms or shield them from the keg cleaning processes.

5.3.4 Interior and exterior surfaces should be decontaminated to remove any oil, grease, release agents, and foreign matter.

5.3.5 Recommended treatments and processes include but are not limited to pickling, electropolishing, and passivation. The following are recommended methods for pickling and passivation.

5.3.5.1 ASTM A 967, Chemical Passivation Treatments for Stainless Steel Parts

5.3.5.2 ASTM A 380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems

5.3.5.3 Federal Specification QQ-P-35C, Passivation Treatments for Corrosion Resistant Steels

5.3.5.4 ASTM B 912, Passivation of Stainless Steels Using Electropolishing

5.3.6 It is recommended that interior and exterior surfaces of a keg be resistant to acids, caustics, oxidizers, and other reagents applied at various concentrations, temperatures, pressures, and durations as part of the cleaning, disinfecting, and sterilizing process.

5.3.6.1 It is recommended to limit exposure of chemicals containing chlorine as these degrade the surface treatment of stainless steel kegs or stainless keg components.

5.3.6.2 Examples of typical washing agents are Sodium Hydroxide, Sodium Hypochlorite, 8-Hydroxyquinoline, Nitric Acid, Phosphoric Acid, Chlorine Dioxide, and others.

5.3.6.3 Temperature, concentration, and exposure limits outside of the washing agent's manufacturer's recommendation may damage stainless steel.

5.4 Fitness and Function Testing

5.4.1 Manufacturers should provide new kegs pre-pressurized with either oil-free air or inert gas such as carbon dioxide/nitrogen between 15-30psig.

5.4.2 Performance testing should be conducted by manufacturers and/or independent laboratories according to parameters agreed between the brewer and the manufacturer.

5.4.2.1 Manufacturers should provide a certificate of compliance or certificate of analysis demonstrating performance to specifications by lot.

5.4.3 The objective of the recommended testing is to reconstruct the environmental conditions that a keg should experience in its lifecycle. Understanding how the keg performs under the recommended conditions should identify risks that a brewer should consider when selecting a keg system. These tests may not demonstrate performance under the most extreme conditions, but rather more typical stress challenge conditions from rigors of trade.

5.4.4 It is recommended that testing represent environmental conditions (both maximum and minimum) experienced in brewery production, warehousing, distribution/handling, and basic intended use.

5.4.5 It is recommended that all testing be conducted at controlled temperature(s) and each test should include a significant time component to realistically emulate the service life cycle of a keg.

5.4.5.1 Life cycle for refillable kegs should be 10 to 30 years (60 to 180 cycles). For refillable kegs the rigors of trade include a continuous repeated cycle of keg filling, shock and vibration of transport, manual and mechanical handling including drops and impacts during moves and storage, pressurization and dispense, empty storage under variable temperature conditions, additional handling, return transport, emptying, and complete re-wash with various chemicals, temperatures and pressures. Manufacturers may offer recommendations for handling and maintenance to maximize service life.

5.4.6 It is recommended that all tests be conducted in a location safe for attending operators.

5.4.7 It is recommended that keg testing operators should be shielded/protected against the possible event of any breakaway components/fragments which may occur during the testing process.

5.4.8 It is recommended that proper personal protective equipment (PPE) be worn.

5.4.9 There are two types of pressure test procedures required to validate keg system performance.

5.4.9.1 Design pressure testing should be performed at the design stage, or any design revision thereafter. This would include any change in materials or material supplier, material thickness or keg geometry which may alter container integrity or its performance. This testing may include pneumatic and hydraulic burst to failure. Pneumatic testing to failure can be extremely violent and dangerous.

5.4.9.2 Proof pressure testing should be performed during production, to ensure the specifications agreed upon by the manufacturer and the brewer/buyer are maintained.

5.4.9.2.1 Proof test pressure to be a minimum of 1.5 times the Maximum Allowable Working Pressure.

5.4.9.2.2 Proof testing is recommended to be performed on all kegs. A validated quality assurance program may allow for testing on a sampling basis at a frequency agreed to by the brewer/ buyer and the keg manufacturer.

5.4.10 The following pressure conditions represent rigors of trade for refillable keg performance:

5.4.10.1 Empty new keg pressurization indicates that the keg with an installed valve does not leak. The recommended pressure using CO_2 or clean oil free air is 15-30psig at 72°F.

5.4.10.2 Washing and filling pressure may range from -5psig to +58psig for up to 120 seconds dependent upon the system process. The negative pressure (vacuum condition) may exist where steam sterilization of the keg cools and condenses. It is recommended that brewers have a maintenance and calibration program for their washing/filling system.

5.4.10.3 Normal Service Conditions include the full cycle of usage including emptying, washing, filling, distribution, dispensing, return and storage of (full, partially full and empty) at (refrigerated or ambient conditions). It does not include deliberate abuse such as subjecting the closed keg to fire.

5.4.10.4 Normal Operating Pressure for a beer keg is the gauge pressure inside of a beer keg under normal usage. This includes a range of pressures as the keg is washed, filled stored, dispensed and returned. These pressures will vary with the type and style of beer and the environmental conditions to which the keg is subjected. Normal Operating Pressure should never exceed the Maximum Allowable Working Pressure.

5.4.10.5 Maximum Allowable Working Pressure, MAWP, (also referred to as the maximum safe working pressure or the maximum allowable operating pressure) is the maximum pressure at which a keg should be allowed to operate. It represents the maximum gauge pressure that could develop in a keg absent venting, or external cooling of the keg. This is the worst

case condition for normal service. The approximate pressure of a full keg of 2.9 gas volume beer at 100°F is 60psig. The Maximum Allowable Working Pressure must never exceed the Design Pressure. The standard U.S. industry practice for MAWP is 60 psig. U.S. refillable kegs are commonly marked with a warning that the container will rupture if pressurized above 60 psig.

5.4.10.6 Design Pressure is the maximum gauge pressure a keg is designed to withstand before rupture. Based on industry experience to satisfy rigors of trade, a minimum design pressure of 300 psig is recommended for refillable kegs. This provides a safety margin of at least 5 times the maximum allowable working pressure. The predominance of refillable kegs exceeds this safety margin. A safety margin of 10X is not uncommon.

5.4.10.7 Safety Margin is the amount by which the Design Pressure exceeds the Maximum Allowable Working Pressure. Safety margin is expressed as a multiplier. The safety margin multiplier is applied to satisfy keg durability for the rigors of trade.

5.4.10.8 It is recommended that a pressure relief device, such as a burst disc, be included in the keg design. The relief device should activate above the MAWP and must not exceed the design pressure.

5.4.10.9 In all cases the dispensing system should be equipped with a pressure regulator and pressure relief valve(s) set below the MAWP.

5.4.10.10 Keg Proof Pressure is 1.5 times the maximum allowable working pressure at 72°F for 30 seconds. Kegs should withstand this pressure without deformation.

5.4.11 The following table provides an overview interpreted from national standards and guidelines.

Standard or Guideline Document	Maximum Allowable Working Pressure	Design Pressure (Minimum)	Relief Pressure (Maximum)	Proof Pressure	Keg Size
BA Guideline Refillable	60 psig	300 psig	≤2/3 Design Pressure	1.5 x MAWP	Up to 60 L
Germany DIN 6647-1	3 bar (43.5 psig)	60 bar (870 psig)	45 bar (652 psig)	-	Up to 50L
Australia AS2971	.5 MPa (72.5 psig)	2.2 MPa (319 psig)	Optional .5 MPa (72.5 psig)	.75 MPa (109 psig)	-
UK BFBi S. Steel	4.14 bar (60 psig)	75 bar (1102 psig)	Optional 40 +/- 5 barg Per DIN 6647-1	6.21 bar (90 psig)	100L

5.4.12 The following temperature conditions represent rigors of trade for refillable keg performance

5.4.12.1 Washing and Sterilization temperature range: ambient to 287°F (dry saturated steam).

5.4.12.2 Refrigerated storage temperature range: 30°F to 48°F

5.4.12.3 Outdoor storage temperature range: -20°F to 120°F (140°F in direct sunlight)

5.4.13 Recommended tests to verify keg system physical performance. Proper PPE and safety protocols should be established before commencing with any testing.

5.4.13.1 Drop/Impact testing for Refillable Kegs - ASTM D5276-92, Test Method 001

5.4.13.2 Horizontal Impact Testing - ASTM D4003-92, Test Method 002

5.4.13.3 Pressure testing - Proof at Design Stage, Test Method 003

5.4.13.4 Pressure testing - Ongoing to max expected pressure, Test Method 004

5.4.13.5 Valve Leak testing - Ongoing before filling, Test Method 005

5.4.13.6 Neck deflection testing, Test Method 006

5.4.13.7 Compression testing - ASTM D4577, ASTM D642
5.4.13.8 Corrosion/Salt spray - ASTM 117, Test Method 007
5.4.13.9 Shock Impact Testing - ASTM D880-92
5.4.13.10 Mechanical-Shock Fragility of Product - ASTM D3332-92
5.4.13.11 Rapid Pressure Determination - ASTM D3070-00
5.4.13.12 Test Methods for Measuring Adhesion by Tape Test ASTM D3359

5.4.14 It is recommended that prior to purchase of a keg system, that analytical and organoleptic testing be performed to determine if there are any changes in flavor, odor, or color of beer regardless of the materials of construction of the keg system.

5.4.15 Comprehensive testing for product package interaction should involve all product contact surfaces of the keg components.

5.4.16 Compatibility Testing

5.4.16.1 The purpose of compatibility testing is to understand the properties of the keg and beer by analyzing the interaction process that occurs between them. This interaction could be migration of keg packaging materials such as polymers, additives, or metals into the beer. It also could be permeation of substances from the environment through the keg packaging materials into the beer such as oxygen or permeation of a substance from the beer into the keg packaging material such as aromatic compounds. Testing measures the effects and interactions of different types of packaging, beer, and environmental conditions. Recommended tests to verify beverage and keg system compatibility:

5.4.16.2 Ferrous (Iron) pickup = ≤ 20-60ppb Fe after 60 days with beer at 40-45°F

5.4.16.2.1 ASBC Methods of Analysis, online. Beer Method-18. Iron. Approved (A1958, B1974, C1992). American Society of Brewing Chemists, St. Paul, MN, U.S.A. doi: 10.1094/ASBCMethod-Beer18

5.4.16.3 Volatile organic compound (VOC) pickup

5.4.16.3.1 ASBC Methods of Analysis, online. Sensory Analysis Method 9. Threshold of Added Substances-Ascending Methods of Limits Test (international Method). Approved 2011. American Society of Brewing Chemists, St. Paul, MN, U.S.A. doi: 10.1094/ASBC Method-Sensory Analysis 9.

5.4.16.3.2 Gas chromatography-mass spectrometry

5.4.16.4 Flavor Scalping

5.4.16.4.1 Gas chromatography-mass spectrometry

5.4.16.4.2 ASBC Methods of Analysis, online. Sensory Analysis Method-7. Triangular Test (International Method). Approved (2011). American Society of Brewing Chemists, St. Paul, MN, U.S.A. doi: 10.1094/ASBCMethod-Sensory Analysis 7

5.4.16.5 Oxygen transmission

5.4.16.5.1 F1927 Standard Test Method for Determination of Oxygen Gas Transmission Rate, Permeability and Permeance at Controlled Relative Humidity Through Barrier Materials Using a Coulometric Detector

5.4.16.6 CO_2 permeation

5.4.16.6.1 ASTM F1115 - Standard Test Method for Determining the Carbon Dioxide Loss of Beverage Containers

5.4.16.6.2 ASTM F2476 - Test Method for the Determination of Carbon Dioxide Gas Transmission Rate (Co 2TR) Through Barrier Materials Using An Infrared Detector

5.4.16.7 UV and visible light degradation

5.4.16.7.1 ASTM D5208-09 "Standard Practice for Fluorescent Ultraviolet (UV) Exposure of Photodegradable Plastics"

5.4.16.7.2 ASTM D5071-06 "Standard Practice for Exposure of Photodegradable Plastics in a Xenon Arc Apparatus"

5.4.16.7.3 ASTM D4329-05 "Standard Practice for Fluorescent UV Exposure of Plastics"

5.4.16.8 Organoleptic analysis (sensory panel)
5.4.16.8.1 ASBC Methods of Analysis, online. Sensory Analysis Method-7. Triangular Test (International Method). Approved (2011). American Society of Brewing Chemists, St. Paul, MN, U.S.A. doi: 10.1094/ASBCMethod-Sensory Analysis 7
5.4.16.9 Color concentration and change
5.4.16.9.1 ASBC Methods of Analysis, online. Beer Method 10. Color. Approved A1958, B1958, C2002. American Society of Brewing Chemists, St. Paul, MN, U.S.A. doi: 10.1094/ASBCMethod-Beer10
5.4.16.9.2 Colorimeter (L*, a*, b*)
5.4.16.10 Oil lubricant residue
5.4.16.10.1 Camphor Oil test
5.4.16.11 Product flavor and freshness stability
5.4.16.11.1 ASBC Methods of Analysis, online. Sensory Analysis Method 6. Paired Comparison Test (International Method). Approved 2011. American Society of Brewing Chemists, St. Paul, MN, U.S.A. doi: 10.1094/ASBCMethod-Sensory Analysis 6.
5.4.16.11.2 ASBC Methods of Analysis, online. Sensory Analysis Method 8. Duo-Trio Test (International Method). Approved 2011. American Society of Brewing Chemists, St. Paul, MN, U.S.A. doi: 10.1094/ASBCMethod-Sensory Analysis 9.
5.4.16.11.3 Gas chromatography-mass spectrometry
5.4.16.12 Microbiological analysis
5.4.16.12.1 ASBC Methods of Analysis, online. Microbiological Control Method 1. Aseptic Sampling. Approved A2011, B2011, C2011, D2011, E2011, F2011. American Society of Brewing Chemists, St. Paul, MN, U.S.A. doi: 10.1094/ASBCMethod-Microbiological Control 1
5.4.16.12.2 ASBC Methods of Analysis, online. Microbiological Control Method 2. Detection of Microorganisms. Approved A2011, B2011, C2011. American Society of Brewing Chemists, St. Paul, MN, U.S.A. doi: 10.1094/ASBCMethod-Microbiological Control 2
5.4.16.13 Allergens
5.4.16.13.1 ASBC Methods of Analysis, online. Beer Method 49. Determination of Gluten Using the R5 Competitive ELISA Method. Approved 2013. American Society of Brewing Chemists, St. Paul, MN, U.S.A. doi: 10.1094/ASBCMethod-Beer 49. (Note as of March, 2014, The Alcohol & Tobacco Tax & Trade Bureau has not recognized the R5 Competitive ELISA Method as a reliable method for testing for gluten in fermented foods.)
5.4.16.14 CO_2 Purity. Refer to International Society of Beverage Technologists, ISBT.

6. REGULATORY AND SAFETY

6.1 Regulatory

6.1.1 Refer to the Alcohol and Tobacco Tax and Trade Bureau website, TTB.gov/beer, for a complete listing of requirements regarding:
6.1.1.1 Permits
6.1.1.2 Regulations and Statues
6.1.1.3 Labeling
6.1.1.4 Taxes
6.1.2 Regarding keg and keg component suppliers, the following is recommended at a minimum:
6.1.2.1 Suppliers should comply with Current Good Manufacturing Practices (21CFR) and the applicable Food Safety requirements and all applicable state and local food laws and regulations.

6.1.2.2 Suppliers should maintain total material traceability throughout their processes and maintain load integrity / security with documented load seals in accordance with the Public Health Security and Bioterrorism Act of 2002 and the Food Security Guidelines (March 2003).

6.1.2.3 Suppliers should maintain accurate test methods, recipes of all component parts of the keg making process as well as regulatory approvals, and MSDS sheets for each component part. Supplier should furnish these upon request.

6.1.2.4 Supplier should require a Certificate of Analysis document for all raw materials used.

6.1.2.5 All packaging materials and components should comply with the limited Heavy Metal content, as detailed in US legislation Coalition of Northeastern Governors (CONEG) Heavy Metal regulations.

6.1.2.6 Suppliers should maintain documentation of recycled content used in production.

6.2 Safety

6.2.1 It is recommended that all keg components and equipment that interact with keg assemblies (such as kegs, spears, valves, taps, carbon dioxide tanks, nitrogen tanks, washing and filling equipment) be equipped with safety devices to mitigate risk of injury or damage to individuals and equipment. Spears (extractor tubes) should incorporate a device to prevent a spear from ejecting from a keg under pressure. Altering, circumventing, or destroying safety features of any of these components are not recommended.

6.2.2 Removal of or tampering with a keg valve for purposes of introducing any ingredient (such as dry hops, wood chips, etc.) is never appropriate. Only finished beer should ever be introduced into a keg. Utilize alternate methods for flavoring beer prior to keg filling that do not jeopardize refillable keg integrity or personal safety. This method also eliminates product safety risk where foreign matter retained in a keg is subsequently exposed to caustic chemical wash and contaminates the next beer filling. Example images below show damage to a valve as a result of a hop sock within a keg.





6.2.3 It is recommended that all systems to which a keg can be connected, whether commercial or "homemade" that use pressurized air, carbon dioxide, water, steam, etc., should have a pressure regulator and pressure relief valve. These should be set, checked regularly, and maintained for relief at a pressure lower than the weakest component.

6.2.4 Pressure, temperature, volume, flow settings of the wash/fill processing equipment should be maintained according to those established and proven by the qualified OEM.

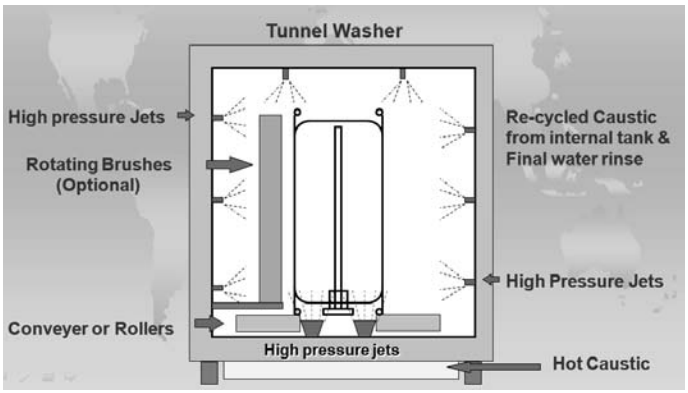
6.2.5 Under the OSH Act, employers are responsible for providing a safe and healthful workplace. Employers should comply with all applicable OSHA standards. Employers should also comply with the General Duty Clause of the OSH Act, which requires employers to keep their workplace free of serious recognized hazards.

7. KEG WASHING

7.1 Kegs should be cleaned per established industry methods with good manufacturing practices in a fail safe manner. There is no defined “typical washing” procedure for all applications. Thus, keg compatibility should be verified in partnership with the keg washing system vendor to provide the optimum washing sequence, and maintain keg quality. Failure to do so may cause damage to the keg, damage to the equipment, or injury.

7.2 It is important to establish the correct washing and rinsing, volumes, temperatures, and velocities to achieve effective washing and rinsing. When using steam to sterilize kegs, make sure the steam is saturated (not dry) and that the contact time and temperature are sufficient to destroy beer spoilage organisms (typically starting at 275°F for 1 minute). Using steam presents a risk of creating a vacuum within the keg and as such can negate the cleaning and sterilization that has been performed prior to the vacuum. Steam sterilization requires that the wash process removes all beer solids so they do not remain and become baked on (beer stone deposit) leading to foaming and microbiological issues. A more detailed overview of keg washing can be found in the appendix.

7.3 The first stage in keg washing is cleaning the external areas of the keg. The keg outside may be washed manually or in a tunnel arrangment as shown.



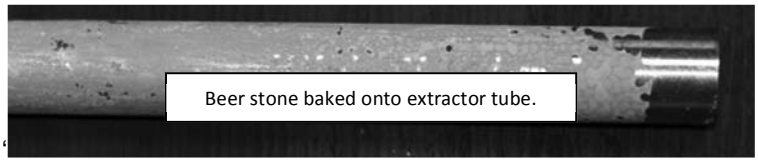
7.4 It is recommended that keg and equipment compatibility be verified in partnership with the chemical (cleaning agent) supplier to confirm there is no negative package chemical interaction. Failure to do so may cause damage to the keg, damage to the equipment, or injury.

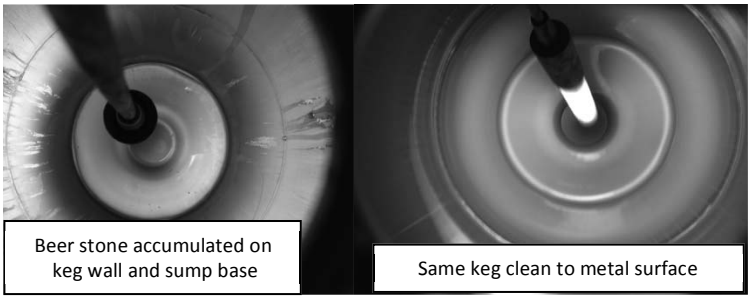
7.4.1 Brewers should work with their cleaning agent supplier to understand the temperatures and concentrations that allow their chemicals to perform effectively based on their beer type, water source, and cleaning system.

7.4.2 Third party consultants are available who provide monitoring of cleaning, disinfection, sterilization, and filling of kegs who can analyze a brewers washing and filling process to address issues or provide verification of cleaning and filling process capability.

7.5 If the spear/valve system requires decoupling for interior surface inspection and washing, it is important that the brewer only use the authorized decoupling device. Never use any implement, tool, or apparatus not recommended by the spear manufacturer as it can expose the operator to unsafe conditions that could result in injury or death.

7.6 It is recommended that brewers set up a routine inspection cycle, not only for the exterior of the keg system, but also for the interior surfaces to ensure beer quality and keg integrity.





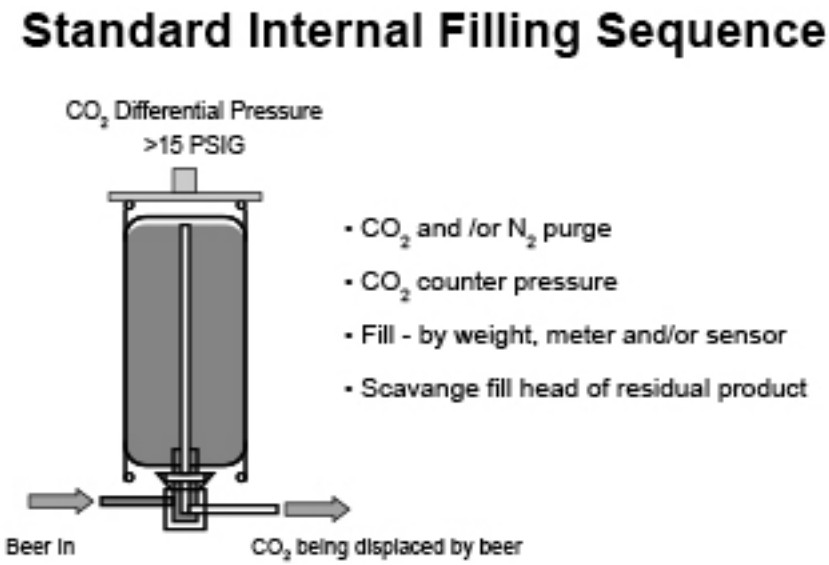
7.7 It is recommended that keg washing systems have containment features in the event of a chemical leakage or washing solution release in the plant environment.
7.8 It is recommended that keg washing systems have an enclosure that protects employees from chemicals or hot water spray in the event of keg disengagement from equipment or keg failure.
7.9 When changing keg suppliers or adding a new type of keg to the brewer's pool, not only should the washing/filling system vendor be involved, but also the chemical supply company should be engaged in validating the washing program applicability to each keg type. Validation may include effluent sampling, swabbing, dye testing, visual inspection, or sensory (tasting) to ensure beer quality.

8. KEG FILLING

8.1 Kegs should be filled per established industry methods with good manufacturing practices in a fail safe manner. It is recommended that keg compatibility be verified in partnership with the keg filling system vendor. Working with the keg filling system vendor to provide the optimum filling sequence should maintain keg and beer quality. Failure to do so may cause damage to the keg, damage to equipment, or injury.
8.2 It is important to establish the correct filling, volumes, temperatures, and velocities to achieve effective filling. A more detailed overview of keg filling can be found in the appendix.
8.3 Brewers should comply with all federal, state, and local regulations on net weight/volume for label claim.
8.4 Proper keg head space should be established for each keg design based on label claim volume, the keg manufacturers direction, filling method, and beer type. Flood Filling (overflowing container) during filling process is not recommended.
8.5 It is recommended for brewers to avoid pressures above 30psig at the end of filling. Post pressuring kegs with N_2 to nitrogenize (sometimes referred to as nitrogenate), CO_2 to carbonate or mixed gas to alter levels after filling is never recommended.
8.6 Keg valve removal is for quality control inspection and maintenance of the keg and valve only. Disengagement of the valve/spear assembly for filling is not recommended. Only beer should be within a keg
8.7 No objectionable odors should be near the filling location to protect beer quality.
8.8 Kegs should be filled in an inverted position. Additional information on filling can be found in the appendix.

8.8.1 Where upright filling is practiced, beer flow introduced into the keg via the spear tube is slower due to the small cross sectional area of the inner sections of the valve over that of the outer gas ring valve. Upright filling is more likely to overfill a keg unless some form of accurate metering or filling by weight system is used. This condition creates a hydraulic pressure in the keg and can lead to dispensing problems if the hydraulic pressure of the beer is too high leading to foam or wild beer when the keg is first tapped. Overfill with limited headspace also renders the keg susceptible to damage from thermal hydraulic expansion, from freeze and/or heat, as well as pressure surge from drop impact (water hammer effect).

8.8.2 Inverted filling can be more challenging because the valve spear tube is approximately 5mm (0.2 inches) from the bottom of the keg. Beer should exit through the spear tube and immediately shut off the beer supply on any automatically controlled filler even without a metering device. Inverted filling through the keg valve gas port is faster but initially more turbulent than upright filling. Some equipment manufacturers overcome this problem by introducing various methods of variable flow filling and counter pressure control.



9. PLANT QUALITY CONTROL PROCEDURES

9.1 The following is a recommended series of procedures that a quality manager might wish to use to verify correct keg equipment operation and to ensure that kegs are being washed and filled within specification. Sample collection and analysis can also be performed by an independent laboratory for any of the following checks.

9.1.1 Detergent tank titration checks:

9.1.1.1 It is recommended that this system is not used as a CIP system for your product mains and beer filling heads. Cross contamination is a risk.

9.1.1.2 Detergent tank(s) titration checks, should be made prior to start-up and at least twice during each 8 hour operating shift. The frequency can be adjusted to meet the quality department's requirement.

9.1.1.3 Many adverse effects to the keg, valve, and machinery can be induced when operating above certain temperature and concentration levels. Running a system at higher temperatures and concentrations to compensate for other deficiencies in the systems operation is problematic. For example, utilizing chlorinated caustic solutions above 150°F may cause hydrolyzation and severe damage to stainless steel equipment and kegs.

9.1.2 Keg water carry-over and titration checks:

9.1.2.1 After the keg has completed the wash sequence(s), the keg should be allowed to continue through the sterilizing sequence and then rejected (stopped), immediately prior to commencing the racking (filling) head(s) sequence(s). When the keg is retrieved at the discharge point of the machine, the keg can be cooled down by placing a cold water hose over the outer surfaces (if steam is used).

9.1.2.2 A coupler is then used to tap the keg. The keg should be inverted to remove the contents via the CO_2 port of the coupler by allowing the keg to drain or forcing the contents out with air or CO_2. The condensate or rinse residuals in a 50 to 60 liter keg should measure between 40 to 80 ml. A maximum allowable limit should be 100 ml.

9.1.2.3 If the condensate carryover is 100 ml or more, the keg system should be checked together with that of the steam quality and relevant steam main condensate traps to ensure that excessive condensate is not present.

9.1.2.4 The condensate obtained from the keg can be titrated to ensure that there is no acid and/or alkali carry-over from the wash head(s). This check should be carried out once a day for each machine or as required by quality control.

9.1.2.5 For this check, the pH of the steam condensate supplied to the keg line should be a known factor if steam is used for purging.

9.1.3 Keg condensate or sanitizer carryover:

9.1.3.1 Another keg is used to do a similar check after it has been allowed to complete the sequences through the racker head(s) up to the point of immediately prior to starting the beer filling sequence. The keg sequence is stopped and the keg rejected immediately prior to starting the beer filling sequence. The keg is removed from the system after discharging from the machine. When checking for the quantity of condensate or sanitizer residuals present in the keg, it should be less than 50 ml. This check should be carried out once a day for each machine or as required by quality control.

9.1.4 Microbiological checks to the keg:

9.1.4.1 Methods vary slightly. The main objective is to ensure sampling consistency is maintained, i.e. having introduced the sterile liquid into the keg, each keg should be rotated a set number of times to ensure all surfaces have been covered equally before it is extracted. A known quantity should always go into the keg and a known quantity should always be extracted, filtered and plated. This procedure should be carried out at a frequency that provides confidence on bio-reduction practices.

9.1.4.2 The following procedure demonstrates an approach to check for microbial integrity. Introduce a liter of sterile liquid, preferably beer, into an empty keg via a sterilized keg valve and "funnel" coupler. The keg should be rotated a three times to ensure all surfaces have been covered equally. Remove 500ml of the sterile liquid into a sterile flask. Split the sample into three 100ml samples via Millipore type membranes, plate and incubate the membranes on agar suitable for aerobic and anaerobic organisms.

9.1.5 After a Clean-In-Place (CIP) sequence:

9.1.5.1 After the CIP sequence, the beer process mains, bright beer tank (BBT) and/or sterile beer tank (SBT) and racker connection head(s), can be swabbed and checked for visual cleanliness to ensure that the cleaning operation frequencies are effective and adequate. This should be carried out at least once a week.

9.1.5.2 CIP Velocity: It is critical to control flow rates in pipes to provide turbulent flow and scouring action to clean surfaces. Turbulent flow is generated at flow velocities above 1.5 meter/second. There is no benefit in increasing the velocity past 2.1 meter/second, as diminishing benefits are realized in energy use and effluent are the only result.

Pipesize	Min CIP Velocity (1.5m/sec)	Ideal CIP Velocity (1.8m/sec)	Max CIP Velocity (2.1m/sec)
1.0″	2.8 m^3/hr.	3.3 m^3/hr.	3.9 m^3/hr.
1.5″	6.3 m^3/hr.	7.5 m^3/hr.	8.7 m^3/hr.
2.0″	11.1 m^3/hr.	13.3 m^3/hr.	15.6 m^3/hr.
2.5″	17.4 m^3/hr.	20.8 m^3/hr.	24.3 m^3/hr.
3.0″	25.0 m^3/hr.	30.0 m^3/hr.	35.0 m^3/hr.

9.1.6 Beer microbiological stability sampling:

9.1.6.1 Samples are taken from the BBT and/or SBT and keg at a frequency directed by the brewery quality department. A suitable stability test is to set aside a keg of beer from the keg line after filling and "forcing" the contents by leaving the keg in an environment of 70°F (21°C). Taste, odor and clarity tests can then be taken after 72 hours and at regular duration as desired to satisfy quality control standards.

9.1.7 Keg pressure sampling:

9.1.7.1 A keg filled with beer should be removed from the keg line and allowed to stand for 5 to 10 minutes. A "pressure test" coupler is connected to the keg after being sterilized along with the keg neck. Pressure in the keg should be approximately 75% of the counter pressure used during the latter part of the filling sequence. Deviation from target should be investigated.

9.1.7.2 The residual pressure in the keg after filling will indicate that the keg CO_2/N_2 in solution is going to be maintained. If the pressure in the keg is above that of the filling counter pressure, then it is highly probable that the keg was overfilled and creating a hydraulic pressure within the keg. When filling kegs upright or in the inverted position against a "back-up" probe, this hydraulic pressure condition will be common.

10. STORAGE, HANDLING, TRANSPORTATION, AND RETURN

10.1 Storage

10.1.1 Prior to usage, it is recommended that kegs be stored in accordance with commercially accepted practices and regulations.

10.1.2 It is recommended that brewers utilize a FIFO (first in, first out) program for kegs. Returned kegs that may be expected to be held in inventory for a prolonged period should be cleaned prior to storage.

10.1.3 No objectionable odors should be allowed in the keg storage areas or keg transport vehicle.

10.1.4 It is recommended that the keg storage facility be clean and free of dust/debris and have an insect and pest prevention system.

10.1.5 Manufacturers should complete performance testing to ensure keg and spear assembly withstand static warehousing conditions and temperatures to satisfy brewer needs. Refer to testing section for recommended testing procedures.

10.1.6 It is recommended that manufacturers test and validate keg stability for outdoor storage. Refer to testing section for recommended testing procedures. Freezing conditions are not recommended for full keg storage.

10.2 Handling and Transportation

10.2.1 Any packaging materials used during the transport or storage of empty kegs for delivery, including pallets, dunnage, etc. should not adversely affect the desirable physical properties of the keg system or the brewer's product.

10.2.2 It is recommended that brewers have manufacturers complete performance testing to ensure the keg and spear assembly withstand supply chain distribution safely and without damage. Refer to testing section for recommended testing procedures.

10.2.3 It is recommended that brewers test and validate keg stability for typical handling and drops from route trucks. Refer to testing section for recommended testing procedures.

10.2.4 Brewers should inspect all kegs for damage. Suspect kegs should be sent out for repair or recondition.

10.3 Keg Return

10.3.1 It is recommended that brewers establish protocols and procedures with their distributor for returning kegs in an agreed manner.

10.3.2 It is recommended that brewers refer to the "Code of Keg Conduct – Best Practices for Keg Users" which covers roles for beer industry stakeholders.

10.3.3 Returning requirements for brewers to consider:

10.3.3.1 Defect isolation and marking system

10.3.3.2 Stray/foreign keg isolation

10.3.3.3 Single size/style on a pallet

10.3.3.4 Full kegs on bottom of pallet

10.3.3.5 Depressurize or drain kegs as appropriate

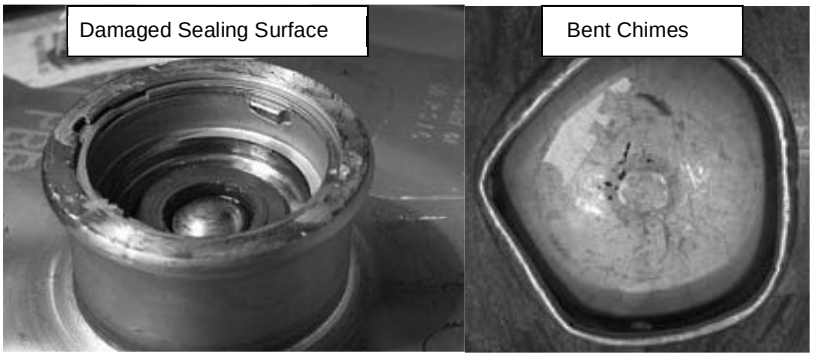
10.3.3.6 Vertical or upright position for shipping

10.3.3.7 Stretch wrapped unit load

10.3.3.8 Removal of debris, stickers, or attachments

11. DISPENSING

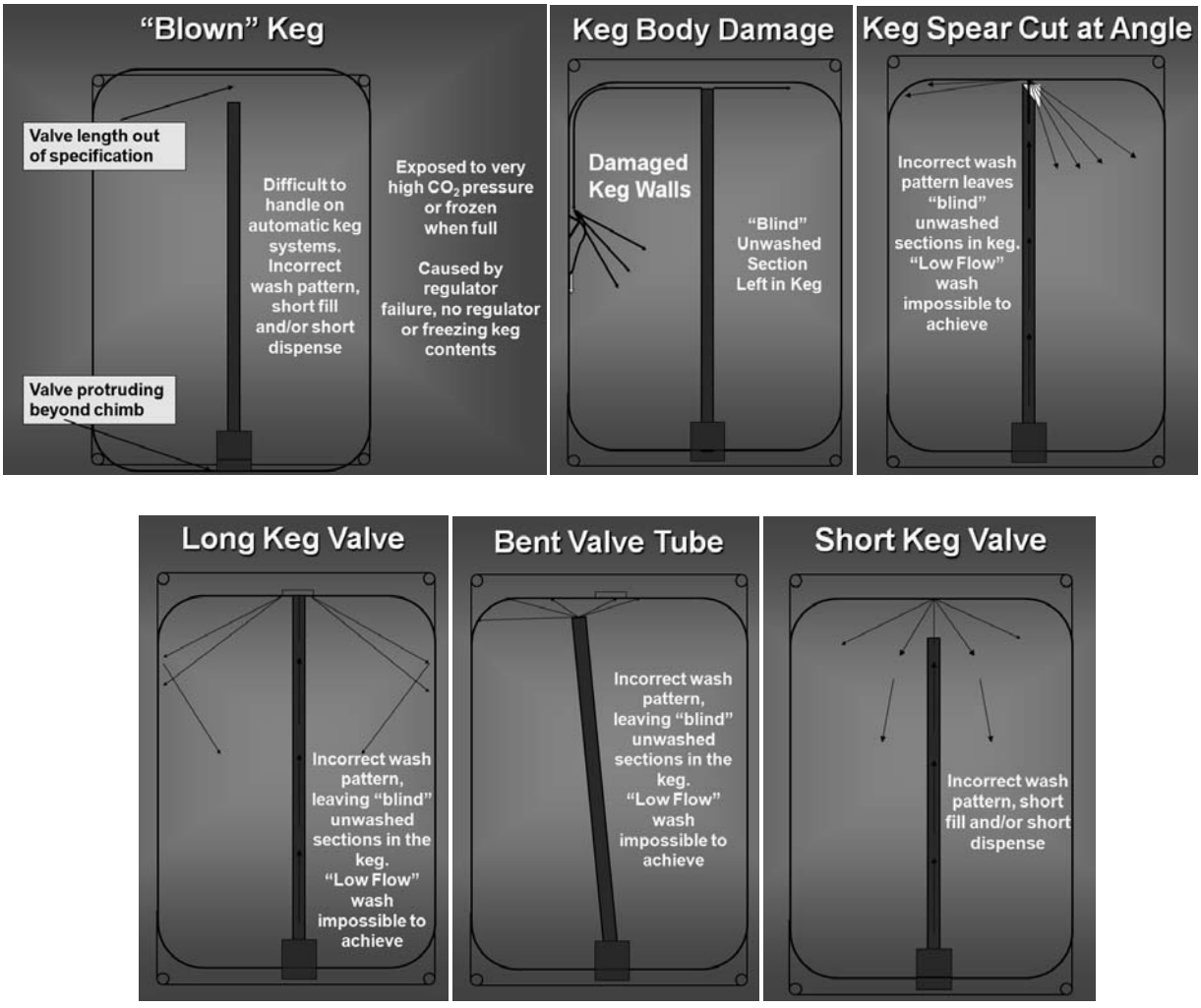
11.1 Keg assemblies should be capable of being maintained fail safe in all events. Inspect keg and valve for physical defects or damage before attaching to dispense equipment.



11.2 It is recommended that retailers verify maximum dispensing pressures. These should be clearly marked/identified on the keg. Direct contact to the manufacturer should be made if this is not provided.
11.3 Be cautioned utilizing picnic pumps that do not have pressure relief system. Pressures can exceed 45psig from this manual pump.
11.4 It is recommended that retailers make sure all regulators and pressure relieve valves are maintained and calibrated regularly per manufacturer's directions.
11.5 It is recommended that retailers make sure all carbon dioxide and or nitrogen gas tanks are maintained and located according to local municipality requirements.

12. REPAIR AND RECONDITIONING

12.1 It is recommended that brewers establish a preventive maintenance program for their keg pool to include protocols and procedures to identify the need to repair or service a keg and/or spear assembly.
12.2 It is recommended that kegs be inspected for physical defects or damage before entering into the washing process. Below are images of some common keg and spear defects and their consequences.



12.3 It is recommended that brewer's utilize industry recognized and qualified companies with expertise in keg and/or valve repair and refurbishment. Refer to the appendix for a supplier guideline in mounting, dismounting and servicing of spears.

12.4 Repair and reconditioning companies should be responsible for utilizing quality procedures that assure conformance to the brewers keg and spear specification. The following are the services a repair company should provide.

12.4.1 Restore kegs to specification.

12.4.2 Capacity dents removed on keg body including the bottom pan.

12.4.3 Inspect valve and rebuild or place, if needed, to specification.

12.4.4 Wash keg internally and externally.

12.4.5 Inspect keg interior and ensure it is clean to metal and that all beer contact area welds are passivated.

12.4.6 Straighten bent necks and assure top dome is to manufacture design strength, typically 800 pounds minimum vertical load pressure for stainless steel.

12.4.7 For threaded valves, apply torque to specified value.

12.4.8 Chimes repaired with proper curl.

12.4.9 Repaired keg pressurized with clean air to 30psi to ensure vessel integrity.

12.4.10 Mark keg with repair date.

12.5 It is recommended that as part of the repair sequence, kegs be pickled, passivated, and pressure tested before returning to the brewer.

13. Keg Decommissioning

13.1 When safety is identified as an issue and repair and recondition is not an option, it is recommended that brewers have protocols and procedures for determining the need to remove a keg or spear assembly from the production stream and decommission them to prevent reentry into the keg pool system.

13.2 It is recommended that brewers utilize qualified recycle/reclaim providers to protect against reentry of an unsafe keg into the brewery system.

13.3 Kegs should never be disposed in a pressurized state.

14. GLOSSARY

14.1 **Acid Washing**: Acid cleaners are used in beer stone and water stone removal. Phosphoric acid-based blends are typically safe for most materials whereas some acids could react with system components.

14.2 **Beer**: The term beer means beer, ale, porter, stout, and other similar fermented beverages (including sake or similar products) of any name or description containing one-half of 1 percent or more of alcohol by volume, brewed or produced from malt, wholly or in part, or from any substitute thereof.

14.3 **Beer Stone**: Calcium oxalate, a mineral deposit that forms slowly on a surface from beer and is very difficult to remove.

14.4 **Brewer**: Any entity which brews beer for sale.

14.5 **Burst Disc/Pressure Relief Disc**: A single use, non-reclosing, pressure relief device which opens at a predetermined differential pressure to relieve pressure. It is used as a safety device to allow a controlled release of pressure at or below the design pressure of the keg to prevent an uncontrolled rupture of the keg. Inscribed into the keg, the opening of the burst disc causes the keg to become scrap.

14.6 **Relief Pressure (Burst Disc Set Pressure)**: The nominal pressure at which a relief valve or burst disc actuates. The actual opening pressure will be within a specified tolerance.

14.7 **Caustic Washing**: Sodium hydroxide – a high pH chemical used in cleaning solutions that will react with organic deposits.

14.8 **Chimb: or Chime**: The projecting edge or rim of a keg or cask.

14.9 **Coupler**: A connector valve separate from and compatible with a keg valve for controlling the introduction of gas into a keg and the release of beer out of a keg during dispense.

14.10 **D-System**: One of several versions of keg coupler styles available. The D-System is the common industry standard in N. America. The D-System is often referred to as Sankey D.

14.11 **Design Pressure**: The maximum gauge pressure a keg is designed to withstand before rupture.

14.12 **Design Pressure Testing**: Testing conducted at the design stage or any design revision for the purpose of validating the keg design pressure. Design revision includes any change in materials or material supplier, material thickness or keg geometry which may alter container integrity or its ability to satisfy the rigors of trade.

14.13 **Electropolishing**: An electrochemical process that removes material from a metal surface. It is used to polish, passivate, and deburr metal parts.

14.14 **Fail Safe**: For the purposes of this document fail safe means no fragments and no ejection of components; vent of liquid or gas contents only without propulsion of the keg, valve, or any portion thereof. Fail safe applies at all times.

14.15 **Flavor Scalping**: Term used to describe the loss of quality of a packaged beverage due to either its volatile flavors being absorbed by the packaging or the beverage absorbing undesirable flavors from its packaging.

14.16 **Keg**: For the purposes of this document will be known as a small container/barrel constructed of stainless steel, aluminum, plastic or a combination of those materials. Wooden kegs are not addressed in this guideline.

14.17 **Maximum Allowable Working Pressure** (MAWP) (also referred to as the maximum safe working pressure or the maximum allowable operating pressure): The maximum pressure at which a keg should be allowed to operate. It represents the maximum gauge pressure that could develop in a keg absent venting, or external cooling of the keg. This is the worst case condition for normal service. The Maximum Allowable Working Pressure must never exceed the Design Pressure. The standard industry practice for MAWP is 60 psig. U.S. refillable kegs are commonly marked with a warning that the container will rupture if pressurized above 60 psig.

14.18 **Nitrogenize (sometimes referred to as nitrogenate)**: To infuse nitrogen gas into beer.

14.19 **Normal Operating Pressure**: Normal Operating Pressure for a beer keg is the gauge pressure inside of a beer keg under normal usage. This includes a range of pressures as the keg is washed, filled

stored, dispensed and returned. These pressures will vary with the type and style of beer and the environmental conditions to which the keg is subjected. Normal Operating Pressure should never exceed the Maximum Allowable Working Pressure.

14.20 **Normal Service Conditions**: Normal Service Conditions include the full cycle of usage including emptying, washing, filling, distribution, dispensing, return and storage of (full, partially full and empty) at (refrigerated or ambient conditions). Normal service conditions include the Rigors of Trade. It does not include deliberate abuse such as subjecting the closed keg to fire.

14.21 **Passivation**: The generation of the passive chromium-oxide film that protects stainless steel. The passive film requires about 24 hours to achieve maximum effectiveness.

14.22 **Pickling**: Restores the corrosion resistance of the surface by removing any surface contamination as well as any embedded iron in the steel and is normally used for new kegs.

14.23 **Pressure Relief Valve**: Reclosing pressure relief device to provide instant response to an increase in pressure at a predetermined differential pressure. Relief valves are set below the design pressure of the pressurized item and sized to prevent the pressurized item being over pressured.

14.24 **Proof Pressure Testing:** Pressure testing of each keg at manufacturing to verify pressure carrying capacity.

14.25 **PSIG**: Pounds per square inch, gauge. A measure of gas pressure against the atmospheric pressure, typically seen on gas regulator gauges. Since atmospheric pressure varies with altitude, the gauge pressure must be adjusted with altitude.

14.26 **Ra** (roughness average) **value**: Ra is a measure of the surface profile. Ra is typically expressed in micro-meters or micro-inches.

14.27 **Refillable Keg**: Kegs designed for multiple returns for washing, filling, warehousing and distribution.

14.28 **Regulator**: A gas control valve that delivers a set gas pressure regardless of tank pressure. There may be a primary regulator on the gas source and a secondary regulator at the gas connection for each keg.

14.29 **Rigors of Trade**: For refillable kegs the continuous repeated cycle of keg washing, filling, shock and vibration of transport, manual and mechanical handling including drops and impacts during moves and storage, pressurization and dispense, empty storage under variable temperature conditions, additional handling, return transport, emptying, and complete re-wash with various chemicals, temperatures and pressures.

14.30 **Safety Margin**: Safety Margin is the amount by which the Design Pressure exceeds the Maximum Allowable Working Pressure. It is usually expressed as a multiplier, i.e. 5X, 10X.

14.31 **Sanitary Welding**: The process of joining material by welding where the finished product contact surfaces can be consistently cleaned to meet the requirements of food grade products.

14.32 **Single Use Keg**: A keg that is designed to be filled once and is not returned for refill.

14.33 **Spear**: An extractor tube that extends from the keg valve to bottom of the keg body.

14.34 **Tap**: The connector from the draught system to the keg, more commonly referred to as the coupler.

14.35 **Valve**: A self-closing valve that is opened by a coupler when the keg is cleaned, filled, or tapped. It has one or two valves that control liquid and gas flow in and out of the keg.

14.36 **Vendor**: A person or supplier company that provides equipment or packaging components for sale.

15. SOURCES

15.1 United States Department of Labor. Occupational Safety & Health Administration, Beverage Delivery Ergonomics. Washington DC, http://www.osha.gov/law-regs.html
15.2 "Designation: D880 - 92 (Reapproved 2008)." ASTM International. N.p.. www.astm.org
15.3 Code of Federal Regulations CFR Title 26, Subtitle E, Chapter 51, Subchapter A, Part I, Subpart D, Section 5052. http://www.gpo.gov
15.4 Code of Federal Regulations CFR Title 27, Chapter 1, Subchapter A, Part 25, Subpart J, Section 23.141. http://www.gpo.gov
15.5 American Welding Society Standards, AWS D18.1 http://www.aws.org
15.6 Alcohol and Tobacco Tax and Trade Bureau (TTB), U.S.Department of the Treasury. http://www.TTB.gov/beer
15.7 Brewing, Food, & Beverage Industry (BFBi), Standards for the Design /Manufacture/Performance /Purchasing of Keg Beer Containers http://www.bfbi.org.uk
15.8 American Society for Testing and Materials (ASTM) http://www.astm.org
15.9 American Society of Mechanical Engineers (ASME) http://www.asme.org
15.10 Deutsches Institut fur Normung (DIN) 6647-1, 6647-2, 6647-4 http://www.din.de
15.11 Australian Standard Serially Produced Pressure Vessels AS 2971-2007 http://www.standards.org.au
15.12 International Safe Transit Association (ISTA) http://www.ista.org
15.13 Coalition of Northeastern Governors (CONEG) http://coneg.org
15.14 ASTM A 967, Chemical Passivation Treatments for Stainless Steel Parts www.astm.org
15.15 ASTM A 380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems www.astm.org
15.16 Federal Specification QQ-P-35C, Passivation Treatments for Corrosion Resistant Steels www.gsa.gov
15.17 ASTM B 912, Passivation of Stainless Steels Using Electropolishing www.astm.org
15.18 Brewers Association, Code of Keg Conduct. www.kegreturn.com
15.19 ASBC – Methods of Analysis www.asbcnet.org
15.20 Nickel Development Institute (NiDI), Cleaning and Descaling Stainless Steels (9001) http://www.nickelinstitute.org
15.21 Brewers Association, Draught Beer Quality Manual, www.draughtquality.org

16. APPENDIX

Performance testing should be conducted by manufacturers and/or independent laboratories according to parameters agreed between the brewer and the manufacturer.

16.1 Test Method 001 Drop/Impact Test Method for Refillable Kegs
16.2 Test Method 002 Keg Horizontal Drop/Impact Test Method
16.3 Test Method 003 Design Pressure Test Method
16.4 Test Method 004 Proof Pressure Test Method
16.5 Test Method 005 Valve Leak Test Method
16.6 Test Method 006 Keg Neck Deflection Test Method
16.7 Test Method 007 Keg Corrosion / Salt Test Method
16.8 Valve Detailed Description
16.9 Inspection and Reconditioning of Valves
16.10 Washing System Detailed Description
16.11 Filling System Detailed Description
16.12 Keg Return Repatriation Code-of-Conduct
16.13 Stainless Steel Keg Welding Recommendations

Test Method 001 Keg Drop/Impact Test Method For Refillable Kegs

Scope: The purpose of this document is to provide guidance on drop/impact testing on pressurized and/or non-pressurized beer kegs. This guide is for kegs 20L to 60L. This test method does not address all of the safety concerns. It is the responsibility of the user of this method to establish appropriate safety practices.

Purpose: Determine if the keg is fit for use.

Material Components Required for Testing:

1. Test Keg and corresponding components
2. Water
3. Thermometer
4. Valve
5. Measuring Device (i.e. tape measure and ruler/caliper)
6. Pressure Gauge
7. Lifting / Tilting apparatus (i.e. a sling)
8. Dropping Surface: 1 inch thick steel plate on concrete

Procedure:

Test 1: Top Chime on hand hole drop

1. Fill keg completely with 40°F water and 15PSIG at least 99.5% full
2. Measure the following. (See diagram below)
    a. Top Inside Diameter
    b. 90° from first measurement Inside Diameter
    c. Distance between top of Chime to Neck at midpoint of spear
3. Lift filled keg to a height of 4 feet (1.2 meters)
4. Tilt keg to an angle of (45°/50°)
5. Utilizing a release mechanism, drop keg onto steel plate on the top chime on hand hole
6. Re-measure the following locations on the keg
    a. Point of impact – Inside Diameter
    b. Perpendicular to point of impact Inside Diameter
    c. Distance between top of Chime to Neck at midpoint of spear
7. Repeat drop two (2) additional times for a total of three (3) drops for this test
8. Measure after every drop.

Passing criteria for Test 1:

Any change in measurement must meet the following to be deemed a success for test 1.
Measurement a is less than or equal to 0.708” (18mm)
Measurement b is less than or equal to 0.0787” (2mm)
Measurement c is less than or equal to 0.1968” (5mm)
No bursting and no leakage

Test 2: Perpendicular to hand hole drop

1. Fill keg completely with 40°F water and 15PSIG at least 99.5% full
2. Measure the following.
    a. Top Inside Diameter
    b. 90° from first measurement Inside Diameter
    c. Distance between top of Chime to Neck at midpoint of spear
3. Lift filled keg to a height of 4 feet (1.2 meters)
4. Tilt keg to an angle of (45°/50°)
5. Utilizing a release mechanism, drop keg onto steel plate at a location perpendicular to hand hole
6. Re-measure the following locations on the keg

a. Point of impact – Inside Diameter
b. Perpendicular to point of impact Inside Diameter
c. Distance between top of Chime to Neck at midpoint of spear

7. Repeat drop two (2) additional times for a total of three (3) drops for this test
8. Measure after every drop.

Passing criteria for Test 2: (See diagram below)

Any change in measurement must meet the following to be deemed a success for test 2.
Measurement a is less than or equal to 0.708" (18mm)
Measurement b is less than or equal to 0.0787" (2mm)
Measurement c is less than or equal to 0.1968" (5mm)
No bursting and no leakage

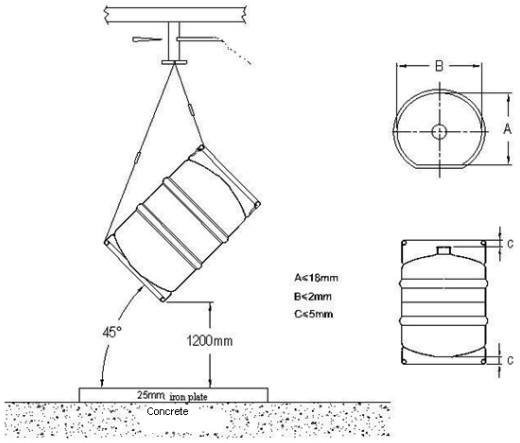
Test 3: Bottom chime/butt weld drop

1. Fill keg completely with 40°F water and 15 PSIG at least 99.5% full
2. Measure the following. (See diagram below)
   a. Top Inside Diameter
   b. 90° from first measurement Inside Diameter
   c. Distance between top of Chime to Neck at midpoint of spear
3. Lift filled keg to a height of 4 feet (1.2 meters)
4. Tilt keg to an angle of (45°/50°)
5. Utilizing a release mechanism, drop keg onto steel plate at a location perpendicular to hand hole
6. Re-measure the following locations on the keg
   a. Point of impact – Inside Diameter
   b. Perpendicular to point of impact Inside Diameter
   c. Distance between top of Chime to Neck at midpoint of spear
7. Repeat drop two (2) additional times for a total of three (3) drops for this test
8. Measure after every drop.

Passing criteria for Test 3:

Any change in measurement must meet the following to be deemed a success for test 3.
Measurement a is less than or equal to 0.708" (18mm)
Measurement b is less than or equal to 0.0787" (2mm)
Measurement c is less than or equal to 0.1968" (5mm)
No bursting and no leakage

Summary: Summarize the test results and finalize the report.



Test Method 002 Keg Horizontal Drop/Impact Test Method For Refillable Kegs

Scope: The purpose of this document is to provide guidance on drop/impact testing on pressurized and/or non-pressurized beer kegs. This guide is for kegs 20L to 60L. This test method does not address all of the safety concerns. It is the responsibility of the user of this method to establish appropriate safety practices.

Purpose: Determine if the keg is fit for use.

Material Components Required for Testing:

1. Test Keg and corresponding components
2. Water
3. Thermometer
4. Valve
5. Measuring Device (i.e. tape measure and ruler/caliper)
6. Pressure Gauge
7. Lifting / Tilting apparatus (i.e. a sling)
8. Dropping Surface: 1 inch thick steel plate on concrete

Procedure:

Test: Horizontal Chime Impact Drop

1. Fill keg completely with 40°F water and 15PSI at least 99.5% full
2. Measure the following. (See diagram below)
    a. Outer Diameter of each chime at A1 and A2 (See Diagram)
    b. 90° from first measurement at A1 and A2 Outside Diameter
3. Lift filled keg to a height of 4 feet (1.2 meters)
4. Tilt keg to an angle of 90° from floor
5. Utilizing a release mechanism, drop keg onto steel plate on keg side
6. Re-measure the following locations on the keg
    a. Point of impact – Outside Diameter A1 and A2
    b. Perpendicular to point of impact at A1 and A2 Outside Diameter
7. Repeat drop two (2) additional times for a total of three (3) drops for this test
8. Measure after every drop.

Passing criteria for Test:

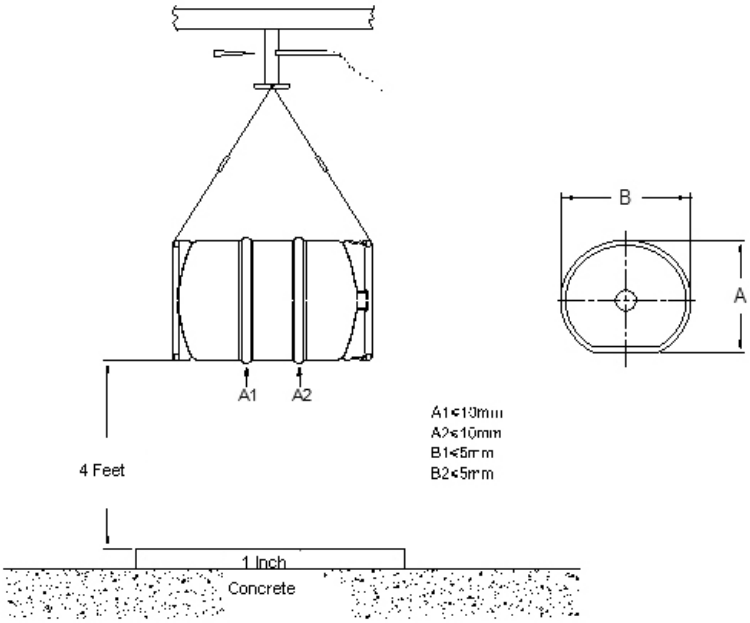
Any change in measurement must meet the following to be deemed a success for test 1.

Measurement a is less than 0.3937” (10mm)

Measurement b is less than 0.1968” (5mm)

No bursting and no leakage

Summary: Summarize the test results and finalize the report.



Test Method 003 Design Pressure Test Method

Scope: Pressure performance of new keg designs or modifications of a keg design including process changes, material changes and sourcing.

(This test method does not address all of the safety concerns. It is the responsibility of the user of this method to establish appropriate safety practices.)

Purpose: To verify that the keg design can withstand the design pressure and fail safely upon rupture with no fragmentation.

Material Components Required:

1. Test Kegs without a pressure relief device and corresponding components.
2. Test Kegs with pressure relief devices and corresponding components.
3. Water
4. Thermometer
5. Valve
6. Hydraulic Pump
7. Measuring Device (i.e. tape measure and ruler/caliper)
8. Pressure Gauge
9. Timing Device (i.e. clock, stop watch, etc.)

Procedure:

1. Conduct the following test on kegs with and without pressure relief devices.
2. Heat soak fill water and keg to a standard test temperature of 68°F (20°C).
3. Fill keg completely with water.
4. Allow the water to come up to the ambient temperature of the test cell.
4. Fit valve and connect hydraulic pump.
5. Measure keg diameter in three places along keg wall at predetermined distances marked on the keg.
6. Measure overall height of keg from base to top of coupler.
7. Apply pressure to keg using hydraulic pump and bring to 30psig.
8. Measure deflection at 30 seconds, 3 minutes, 5 minutes, 1 hour, 3 hours, 8 hours, 24 hours. 3.5 days.
9. Monitor results and determine if further testing is required.
10. Increase the pressure to 60psig and measure at the same time intervals as listed in point 9 above.
11. After 7 days at 60psig (MAWP), increase the pressure to 90psig. Hold for 28 hours.
12. Increase pressure gradually until keg ruptures.
13. Select a new keg and repeat test at 104°F (40°C)
14. Record date, time, temperature, and rupture pressure.
15. Analyze test results
16. Finalize test report

Passing criteria for Test:

Kegs must be capable of withstanding the design pressure for 28 hours without evidence of permanent deformation and fail safely with no fragmentation at rupture or vent pressure.

Summary: Summarize the test results and finalize the report.

Test Method 004 Proof Pressure Test Method for Refillable Kegs

Scope: Proof pressure testing of keg and testing of keg resistance to permanent deformation due to pressurization.

(*This test method does not address all of the safety concerns associated with this test. It is the responsibility of the user of this method to establish appropriate safety practices.)*

Purpose: Determine if the keg is fit for use regarding pressure resistance.

Material Components Required for Testing:

1. Complete manufactured keg
2. Valve or quick connect
3. Clean, oil free plant air
4. Measuring Device (i.e. tape measure, ruler/caliper, go/no go gauge)
5. Pressure Gauge
6. Timing Device (i.e. clock or stop watch)

Procedure:

1. Measure keg diameter in three places along keg wall at predetermined distances.
2. Measure overall height of keg from base to top of neck.
3. Apply pressure to keg and bring to 90psig and hold for 30 seconds.
4. Relieve the pressure.
5. Re-measure keg diameters and heights.
6. Record data.
7. Analyze test results
8. Finalize test report

Passing criteria for Test:

Kegs must be capable of holding a minimum internal pressure of 90 PSIG without leaking or permanent deformation.

Summary: Summarize the test results and finalize the report.

Test Method 005 Keg Neck Deflection Test Method for Refillable Kegs

Scope: The purpose of this document is to test the Neck of the keg. This guide is for kegs 20L to 60L. The tests in this document are intended to confirm keg Neck strength through static, dynamic and compression testing.

Purpose: This is one component of keg testing in assisting to determine if the keg is fit for use.

Material Components Required for Testing:

1. Test Keg and corresponding components
2. Valve
3. Measuring Device (i.e. tape measure and ruler/caliper)
4. Pressure Gauge
5. Lifting / Tilting apparatus (i.e. a sling)
6. Inflexible Bar minimum of 3.28 feet (1,000 mm) in length
7. Fitting
8. Weights/Loads 22 lbs, 55 lbs
9. Hydraulic pump
10. Ram on a beam

Procedure:

Lateral (Static) Test:
1. Place keg horizontally
2. Attach fitting to bar
3. Insert bar and affix to the neck of the keg while maintaining keg stillness
4. Place a 55 lb (25kg) weight/load on the bar 3.94" (100mm) from the neck of the keg.
5. Have load rest on bar for a minimum of 2 seconds then move the load another 3.94" (100mm) away from the keg neck for 2 seconds.
6. Continue moving load for the entire length of the bar.
7. Remove load
8. Measure the deflection of the bar at the 3.28 foot (1,000mm) marker.

Passing criteria for Lateral (Static) Test:
Bar deflection must not exceed .787" (20mm) from its position before the load was applied.

Lateral (Dynamic) Test:
1. Place keg horizontally
2. Attach fitting to bar
3. Insert bar and affix to the neck of the keg while maintaining keg stillness
4. Place a 22 lb (10kg) weight/load on the bar 11.81" (300mm) from the neck of the keg.
5. Have load rest on bar for a minimum of 2 seconds then move the load another 11.81" (300mm) away from the keg neck for 2 seconds.
6. Continue moving load for the entire length of the bar.
7. Remove load.
8. Measure the deflection of the bar at the 3.28 foot (1,000mm) marker.

Passing criteria for Lateral (Dynamic) Test:
Bar deflection must not exceed 1.181" (30mm) from its position before the load was applied.

Axial Test:

1. Using a hydraulic pump and ram on a beam
2. Gradually increase load vertically downwards on the center of the neck.

3. Document the amount of downward deflection at the following intervals 2,500N, 5,000N, 7,000N, 7,500N and failure.

Passing criteria for Axial Test:
The top dome must be capable of withstanding a force of 7.5KN with no permanent deformation when the load is removed.

Neck Test Form

KEG Neck Test Measurement				
No.	Item		Specification	Remark
1	Deflection	Concentricity to keg body	≤2°	
		Parallel to keg body	≤10mm	
2	Displacement Deflection against Vertical Downward Force	Vertical downward force of 2500N	0mm	
		Vertical downward force of 5000N	≤1.5mm	
		Vertical downward force of 7000N	≤4mm	
		Max. force to collapse	≥7500N	
3	Static Neck Deflection	25KG load be suspended, from 100mm to 800mm, keep 2s	≤15mm	
4	Dynamic Neck Deflection	300mm, 10KG load drop from 350mm height	≤30mm	

Summary: Summarize the test results and finalize the report.

Test Method 006 Keg Corrosion / Salt Test Method

Scope: The purpose of this document is to provide guidance on drop/impact testing on pressurized and/or non-pressurized beer kegs. This guide is for kegs 20L to 60L. This test method does not address all of the safety concerns. It is the responsibility of the user of this method to establish appropriate safety practices.

Purpose: Determine if the keg is fit for use.

Material Components Required for Testing:

1. Atomized nozzles
2. Non-metallic chamber
3. Salt solution reservoir
4. Compressed Air Supply
5. Controllable heating capabilities
6. NaCl
7. Distilled Water

Procedure:

1. Create a salt solution of 4 lbs of NaCl and 80 lbs of distilled water
2. After thorough cleaning of a salt spray chamber enclose salt solution in reservoir
3. Create a salt solution fog displacing 12.4 sq. in. of horizontal collection area
4. This needs to spray .3 - .5 ml of solution per hour within keg.
5. The spray nozzle(s) should be directed so that none of the spray will directly on the test specimen
6. Dispense salt solution for 24 hours.
7. Test is complete after 24 hours
8. Do not reuse any sprayed salt solution/fog
9. Test one keg at a time

Passing criteria for Test:

Inspect keg for any visual appearance of rust, pass on no visual appearance of rust.

Summary: Summarize the test results and finalize the report.

Sankey Valve Systems Detailed Description

Below are Sankey type valves and the associated coupler bottom (base) profiles. The reference valves and couplers have a one-to-one relationship and are not interchangeable. The images below show the visual differences between the Sankey valve system types.

Valves Couplers



A Valve and A Coupler

D Valve and D Coupler

G Valve and G Coupler

M Valve and M Coupler

S Valve and S Coupler

U Valve and U Coupler

Inspection and Reconditioning of Valves

MicroMatic and DSI D-System valve service manuals



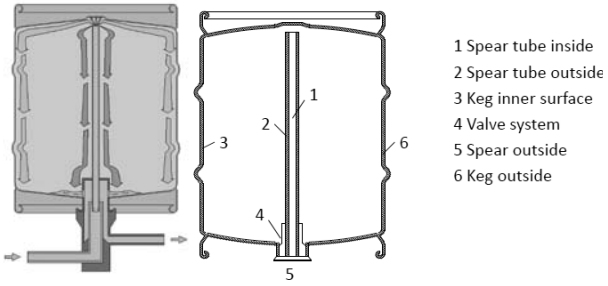
RS-D Service Manual.pdf



Mounting Instruction D Type.pdf

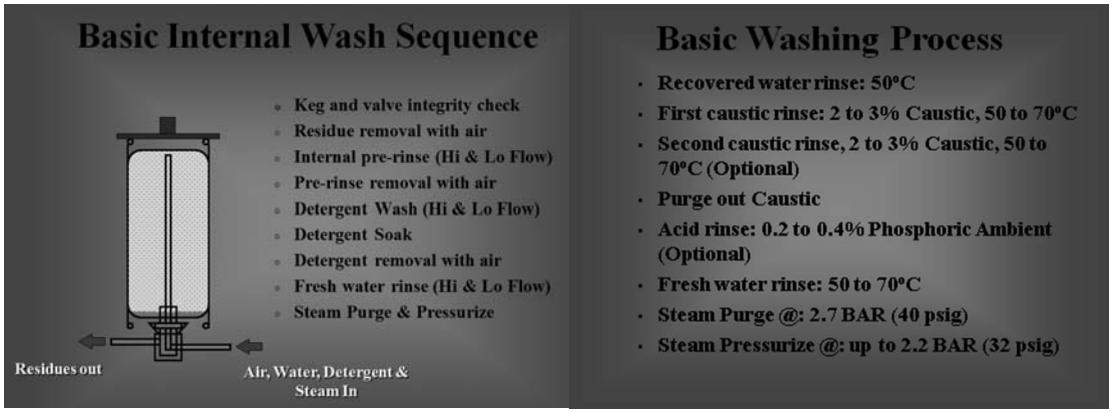
Washing System Detailed Description

Washing kegs has many variants influenced by the valve style, shape of the keg, and the product attributes. Assembled kegs are always washed upside down.



Proper keg washing is carried out where the wash medium is forced up the inside of the spear tube under regulated pressures and flows to ensure that it cascades over the outer surface of the valve spear tube and down the internal walls of the keg.

It's important to establish the correct washing and rinsing, volumes, temperatures, and velocities to achieve effective washing and rinsing. There are many variations to single valve keg washing cycles; however, the following basic process sequence is commonly used in breweries worldwide.



AIR ASSISTED DE-ULLAGE — To purge the KEG of residual product and CO_2 and/or N_2. After de-ullage purging the KEG can be pressurized to 2 BAR (30 PSIG) and a pressure loss check carried out.

WARM WATER PRE-RINSE — Ambient to 50ºC (122ºF) fresh or recovered water used to rinse out any remaining residual product.

AIR PURGE — To purge the KEG of rinse water and remaining residual product.

HOT CAUSTIC WASH — 50º to 70ºC (122 to 160ºF), 2% v/v caustic wash to loosen, breakdown and remove proteinaceous materials from the keg inner surfaces. Soak included where organic materials in the keg are difficult to remove. For example, where kegs have been air dispensed with picnic pumps and the residual product has oxidized and/or mold colonies have formed, also high yeast loading in unfiltered beers.

AIR PURGE — To purge the keg and recover the caustic to a holding tank where it is reheated and titration monitored and adjusted.

ACID WASH — Depending on product and process water hardness, a phosphoric acid wash (0.2 to 0.4% v/v at 50º to 70ºC (122 to 158ºF)) may be employed after the caustic wash to help prevent calcium precipitants and beer stone from building up on inner surfaces.

AIR PURGE — To purge the keg and recover the acid to a holding tank where it is reheated and titration monitored and adjusted.

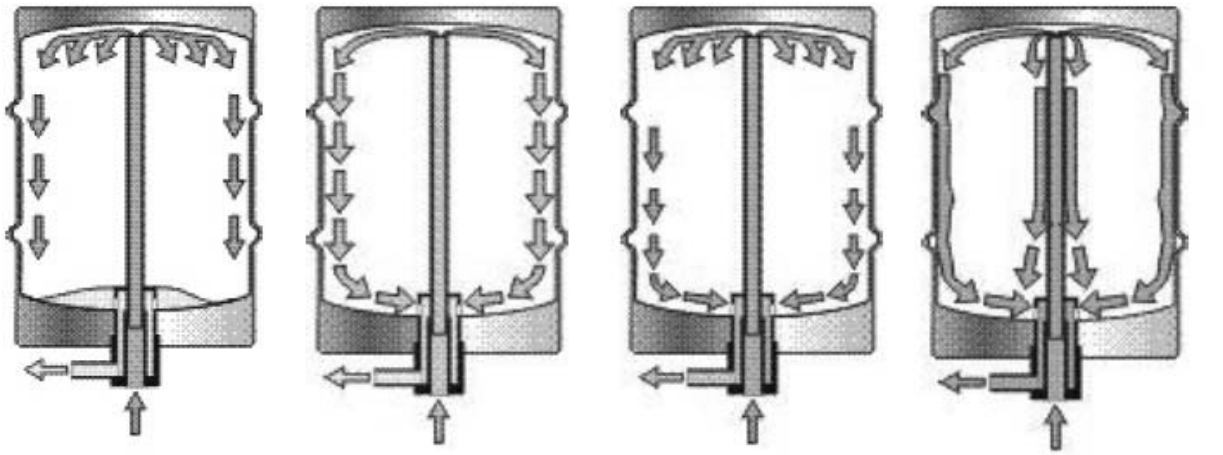
HOT WATER RINSE — 50º to 70ºC (122 to 158ºF), fresh water to remove acid residuals from the kegs inner surfaces.

STEAM PURGE — To purge the keg of the rinse water. This water is commonly recovered to a holding tank where it is then used as the pre-rinse for the next keg to be washed.

STEAM PRESSURIZATION — The steam pressure in the keg is raised to 1.0 and 2.2 BAR (20-32PSIG), to achieve a minimum sterilizing temperature of 110-135ºC (230-275ºF).

STERILIZE HOLD —The keg is held at sterilizing temperature for a pre-set time to achieve complete sterilization of the inner surfaces and valve components.

Basic Wash Event Sequences are Shown as Follows (pages 40-41)

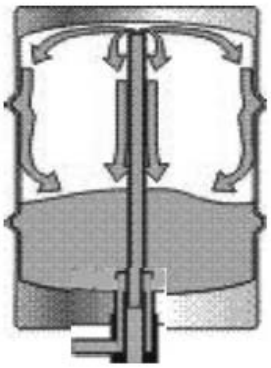


Residual Pressure Test: Residual and CO_2 Blow Out

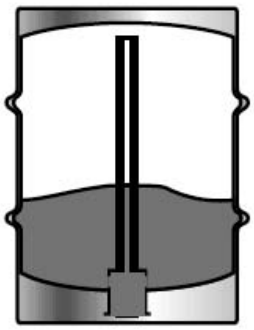
Pulsing Water Rinse

Water Blow Out with Sterile Air

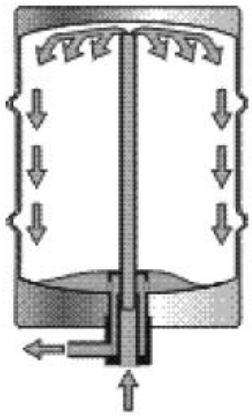
Pulsing Spraying of Caustic for Wall and Spear



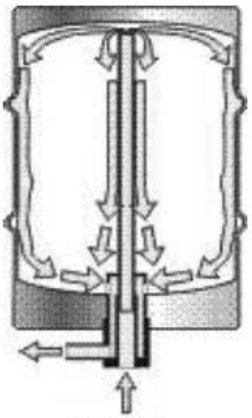
Caustic Filling



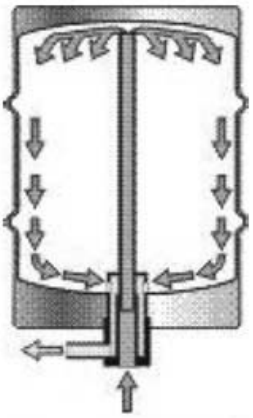
Caustic Soaking



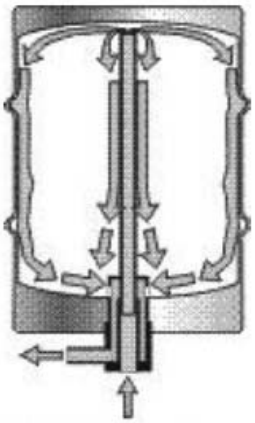
Blow Out Caustic with Sterile Air



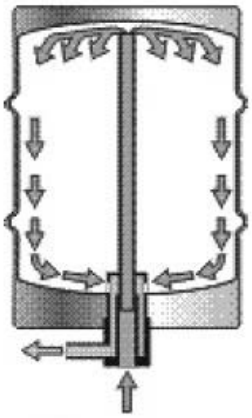
Pulsing Spraying of Acid



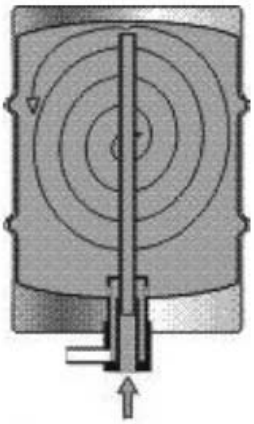
Blow Out of Acid with Sterile Air



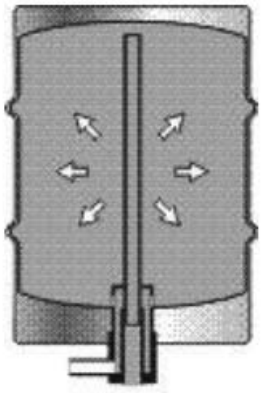
Pulsing Spraying of Hot Water



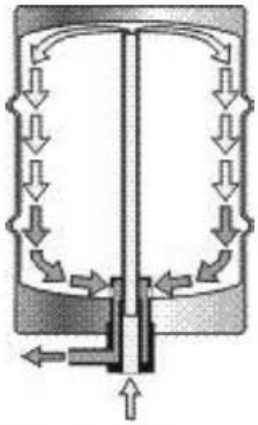
Blow Out Water with Steam



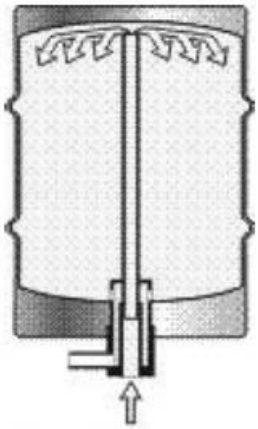
Steam Pressure Build-Up Pressure Control



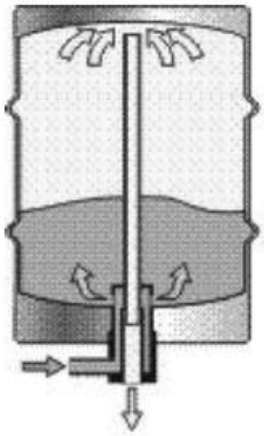
Active Steaming with Sterile Steam Press Test De-press



Blow Out Steam with CO_2



Counter-Pressurizing of CO_2 to Filling Pressure



Filling Process

Sequences as above are monitored by the keg washing, sterilizing and filling machine control system, typically a Process Logic Controller (PLC). The PLC receives input signals from, and operates in conjunction with, flow, temperature, pressure and interface sensing devices mounted into the system process pipe-work adjacent to the process head(s) to which the keg is connected.

Little is gained from using chemicals and rinse waters at titration levels and temperatures above those detailed. Many elastomer valve seal failures and precipitants present in kegs, such as calcium and beer stone are due to excessive levels of caustic and high temperatures. These levels are used in an effort to overcome other more serious problems in the washing and sterilizing process and sometimes machine design.

The streaming effect of the condensing steam will generally leave the outside of the spear tube clean and sterile when kegging filtered beers. Washing the outside of the spear tube by reducing the wash flow rate and allowing the wash medium to flow down the outside of the spear tube greatly improves quality when kegging unfiltered beers.

Equipment suppliers offer many variances of energy and water conservation packages to include:

Recovering pre-rinse water, passing it through a heat exchanger to heat up incoming fresh water and cool down effluent prior to disposal to drain. The effluent can also be used in the rinse section of an External Washer for kegs prior to disposal to drain.

Recovering the final rinse water and using it for the next keg pre-rinse.

Recovering the heated cooling water and using it as the final rinse water.

Installing the above conservation systems into a keg line can reduce the systems water consumption by 50% and the steam water heating consumption by up to 90%.

Filling System Detailed Description

A typical preparation and filling sequence for a stainless steel single valve keg is as follows:

STEAM STERILIZATION — The keg neck and filler connection head are sterilized prior to opening the keg valve.

STEAM PRESSURE RELIEF — The steam pressure in the keg is relieved to just above atmospheric pressure.

GAS PURGING —The keg is purged of steam and steam condensate with gas and in some instances the volume of condensate is monitored. This can be CO_2, N_2 or a mixture of both.

GAS PRESSURIZATION — The keg is pressurized with gas to a counter pressurization level that is dependent upon the method and rate of filling used, the beer temperature, and the volume and type of gas or gases in solution in the beer.

FILLING — Filling of the keg is achieved with a beer "overfill" monitoring system which can be combined with a metering system or a "fill by weight" system at the filling head.

GAS and/or WATER SCAVENGING — After filling, the keg valve is closed and the residual beer in the connection head of the machine is disposed to drain or a beer recovery system. The keg valve and neck are in some instances rinsed with sanitizing water prior to being released from the head.

Special attention to filling techniques, with a view to faster but quieter filling, greater fill accuracy and less product loss is a necessity. Automatic keg packaging lines include a beer boost pump (a pump between the beer buffer tank and the filler) fitted with a Variable Frequency Drive (VFD) to vary the pump output to match the varying demand of a multi-filling head keg line. Small automatic and semi-automatic keg lines will generally suffice with a "flat curve" constant speed pump to achieve the same near constant pressure requirement for good filling conditions.

All automatic and semi-automatic machines are fitted with a sensor in the outlet pipework of the filling head to stop the flow of beer when detected by the sensor. This indicates that the keg has been filled, or that there is leakage across the keg valve and the filling system connection head. Since kegs are designed to include head space this method may result in an overfilled condition. Issues with overfilling include the brewery giving away beer (loss), lack of head space so gas balance in the beer is not controlled, and over-pressure could occur with subsequent keg damage. The sensor should be a security supplement to controlled or metered flow.

Other methods of fill monitoring are recommended in addition to the outlet sensor to comply with "fill" regulatory requirements and product economy.

FILLING BY METER:

Beer fill metering used on single valve keg lines falls into four categories; Turbine, Volumetric, Magnetic Flow and Mass Flow metering.

TURBINE — Turbine meters have a rotor mounted between two bearings. As beer flows past this rotor it rotates. An induction sensor head mounted on the outer wall of the turbine housing senses the rotor blades rotating and produces a series of pulses. When the pulses reach a preset value, the beer valve on the filler and the keg valve are closed. Turbine meters are accurate to within 60ml. (2.0oz.) but can be susceptible to bearing damage during cleaning and sterilizing regimes.

VOLUMETRIC — The volumetric meter operates on a similar principle but instead of a turbine rotor it uses a rotary piston with three or four accurate volume chambers which have a typical accuracy of ± 100ml. (3.0 oz.). The volumetric meter is also susceptible to damage during cleaning and sterilizing regimes.

MAGNETIC — Magnetic flow meters do not suffer similar damage during cleaning and sterilizing since they have no moving parts and measurement is based on induction. Electronics enable high frequency coil excitation and the monitoring of variable flow conditions with improved accuracy and repeatability. Magnetic flow meters are consistently accurate to within 50ml. (1.6oz.).

MASS — The mass flow meter has all the advantages of the magnetic flow meter in so far as there are no moving parts in the flow stream. The mass flow meter measures changes in momentum related to the mass flow rate and has excellent fill repeatability and accuracy, but is rarely adopted due to a relatively high cost when compared to the other versions aforementioned.

FILLING BY WEIGHT:

Volumetric filling methods do not meet "fill" regulatory requirements. Therefore, brewers are required to measure the "fill" by weight. This in itself can be difficult when mixed populations of kegs of varying tare weights are used and the weighing takes place after the filling process.

To address this problem long term development has produced a series of semi-automatic and fully automatic filling machines that use the "Gravfill" system to tare weigh the keg immediately prior to filling and fill the keg by weight to within 0.02% repeatability.

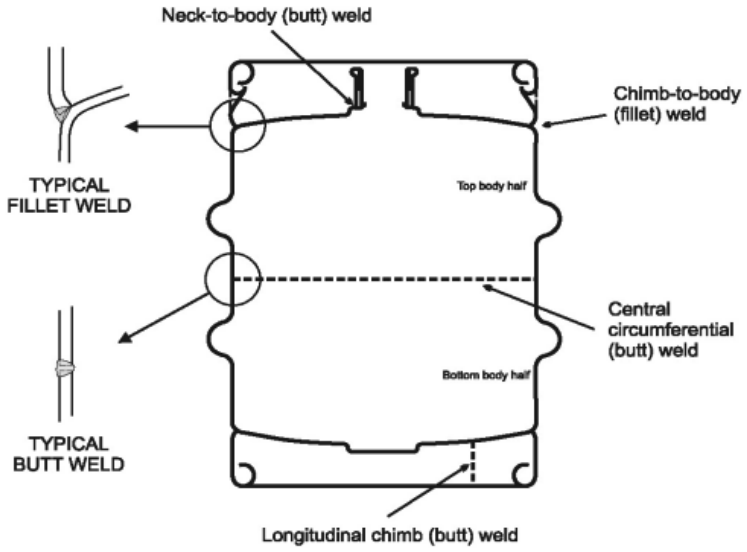
QUIET FILLING:

Another filling technique is "Quiet" or "Black" filling, where the keg is counter-pressurized to a pressure slightly below the beer supply pressure. As filling commences the gas pressure in the keg is slowly decreased until the desired differential pressure is reached. Although using more gas and taking longer to fill, the technique overcomes problems associated with filling nitrogenated beer.

Improved keg valve design and filling techniques have overcome many of the problems faced when filling a keg, with:

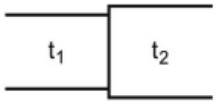
1. Beers at up to 10ºC (50ºF).
2. Nitrogenated beers.
3. High and low carbonated beers using the same filling profile, and;
4. Keeping product losses to a minimum.

Stainless Steel Keg Welding Recommendations

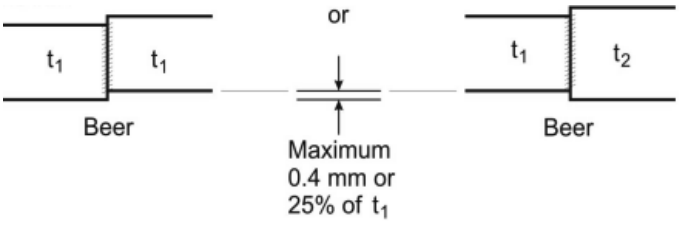


In a butt weld, the edges of two components are brought together and a weld is laid down (either from one side or sometimes from both sides) such that the weld material penetrates the full thickness of the joint. Examples of butt weld include the central circumferential weld joining the deep-drawn halves of a two-part container, the longitudinal center band weld and the dome-to-center band welds of a three-part container, the weld which joins the ends of a strip of material to create a tubular chimb.

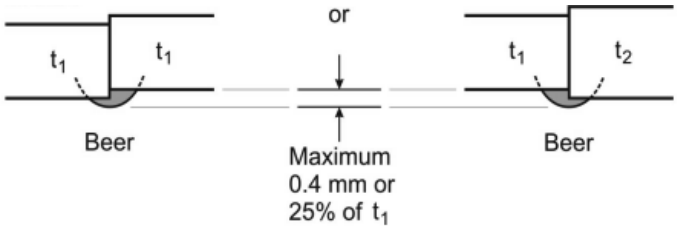
In butt welding, where two components are of different gauges at the point of contact, the thinner material should be positioned within the surfaces of the thicker.



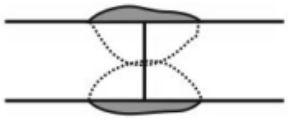
The maximum recommended step between butt weld surfaces exposed to beer at any point along the weld run should be 0.4mm or 25% of the gauge of the components at the point of contact (the thinner in the case of materials of two different gauges), whichever is the lesser. Where neither surface is exposed to beer (e.g. in the case of the shive bush outer weld), this limit should be applied to the outer surface.



The weld should penetrate for at least the full depth of the original area of contact of the two component parts as indicated on the diagram at all points along the weld run. Over penetration on the beer contact side should be no more than 0.4mm or 25% of the thinnest steel gauge.

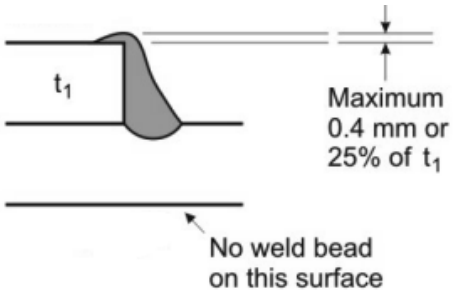


Where a weld is formed by two passes, one from each side of the joint, sample sectioning should demonstrate that weld beads meet or overlap,



In a fillet weld, one component is laid on top of another and a weld is run along its raw edge. The weld material is not intended to penetrate right through the thickness of the second component; it joins the two components with a wedge of weld metal. Examples of fillet welds are the chimb-to-body or chimb-to-dome welds.

In fillet welding, the weld run should fuse the full thickness of the attached component, and penetrate adequately into the parent material over the entire length of the weld run. Where the fillet weld will be in contact with beer (e.g. a patch, or inner shive, plate) the weld bead should not protrude above the surface of the attached plate by more than 0.4mm or 25% of the gauge of the attached plate, whichever is the lesser.



After any pickling there should be no weld bead standing above the opposite surface of the main plate from that onto which the fillet weld was made.