



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

Bilfinger Industrial Services Inc. - Tech Team

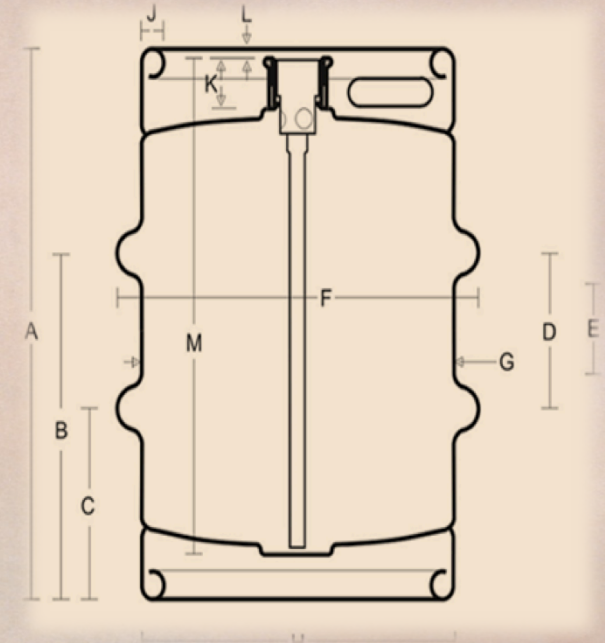
Renee Benson

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Presentation Outline

- **Introduce the BA's keg performance guidelines**
- **Discuss research and methodology**
- **Overview of key aspects**
- **Respond to questions**



Background

In early 2013, the Brewers Association retained Bilfinger Industrial Services to develop keg performance guidelines for use by all U.S. brewing industry stakeholders.

What the guidelines ARE:

- **Best practices and minimum requirements shared from beer industry stakeholders**
- **Designed to raise and maintain keg integrity for North America**

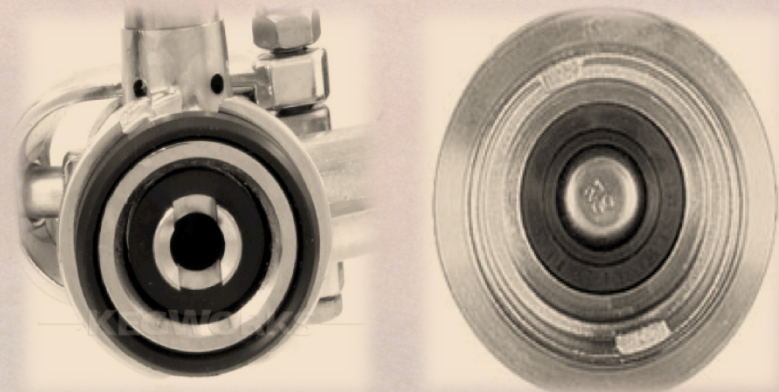
What the guidelines are NOT:

- **Regulations**
- **Standards**
- **Statutes**
- **Codes**



Guideline Purpose

- To provide manufacturers and commercial users a guideline of minimum quality recommendations for:
 - Refillable kegs equipped with D-System valves
 - Single use kegs ... filled once and not returned
- To facilitate safe operation of kegs and their components throughout the brewing industry network
- To foster positive communication among all beer industry stakeholders



Rigors of Trade

Keg manufacturing protocols should satisfy the rigors of trade as prescribed whether produced from metal, plastic, or any combination of materials. Rigors of trade for:

- **Single use kegs**



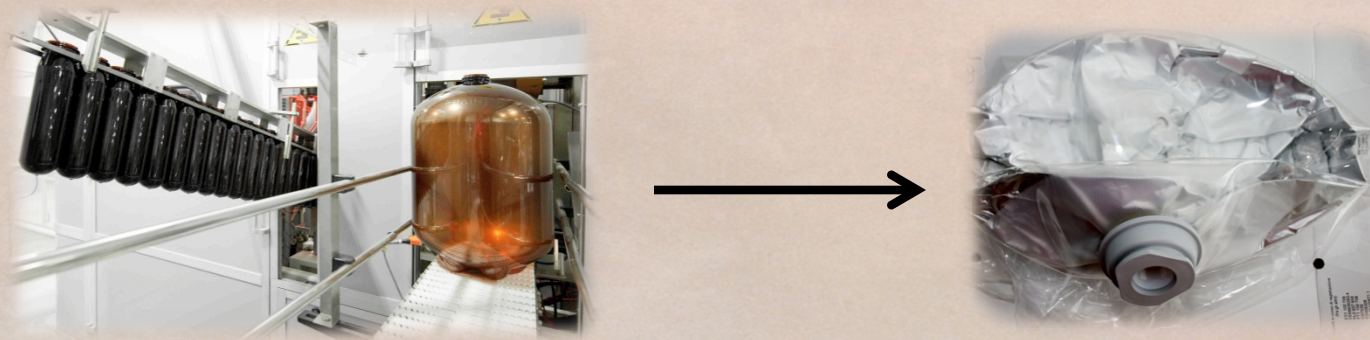
- **Refillable kegs**



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Single use kegs include empty storage under variable temperature and humidity conditions, shock and vibration of transport when empty and full, manual and mechanical handling including drops and impacts during moves and storage, pressurization and dispense, depressurization, final handling and disposal





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Refillable kegs also encompass the continuous repeated cycle of keg washing, empty storage under variable temperature conditions, additional handling, return transport, emptying, and complete re-wash with various chemicals, temperatures and pressures

Keg Safety

Performance on Failure

- During all times when a keg is in service or for any test performed, 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; venting of liquid or gas contents only, without propulsion of the keg, valve, or any portion thereof



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To prevent keg rupture, use a pressure regulator and relief device with any pressure source to which a keg is connected such as CO₂, steam, air, etc.

- **Filling and dispense systems should be set and checked regularly to maintain a pressure lower than the weakest component**

Project Process Framework

- Participant identification
 - Keg and keg component manufacturers
 - Keg cleaning and filling equipment suppliers
 - Brewers
- Regulatory identification and standards review
 - Australia, Germany, United Kingdom, United States
- Industry organization identification
 - ISBT, ASBC, ASME, ISTA, DOT, ASTM
- Data collection
- Data analysis
- Framework development
- Draft development
- Draft review
 - by keg and equipment suppliers, brewers, legal, and organizations
- Stakeholder feedback
- Finalization
- Guideline as a business tool



Resource Identification

Participant identification

- Teamed with the BA technical committee to coordinate participation
- Invited representative large, medium, and small to participate in information sharing and guideline review
- Reached out to and collaborated with:
 - Global keg and keg component suppliers (US, Europe, Asia).
 - Keg cleaning and filling equipment suppliers
 - Lease keg pool suppliers
 - Chemical wash reagent companies
 - Keg recondition and repair companies
 - Subject matter experts:
 - Gas blending technologies
 - Metallurgy
 - Analytical instrumentation
 - Pressure vessels

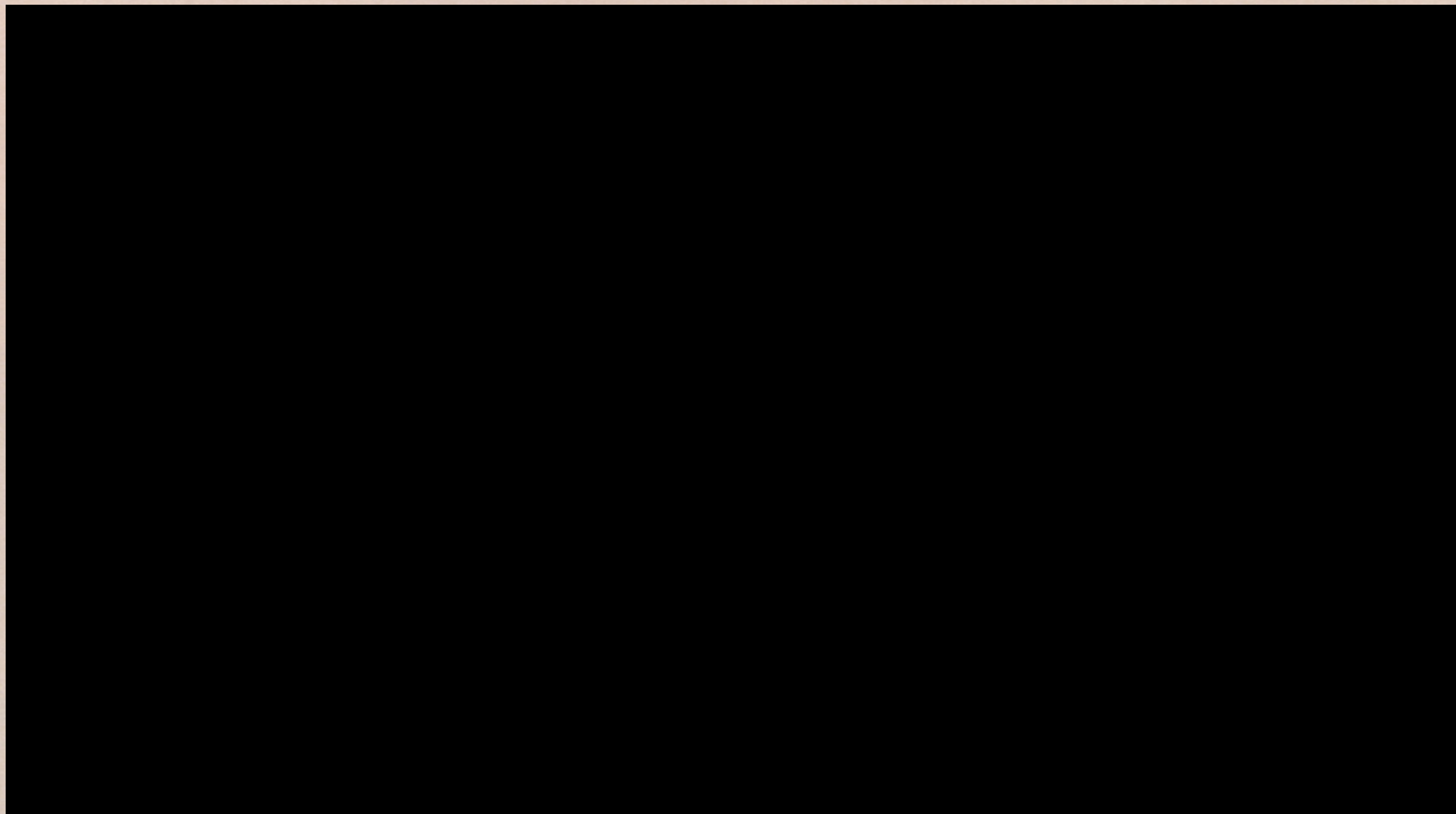


Resource Identification

Regulatory identification and standards review

- United States
 - American Society of Mechanical Engineers (ASME)
- United Kingdom
 - Brewing, Food & Beverage Industry Suppliers Association (BFBI)
- Germany
 - Deutsches Institut für Normung (DIN)
- Australia
 - Standards Australia Committee (SA)

Pressure Energy



ASME Code

- **ASME Boiler and Pressure Vessel Code VIII Division 1: Rules for Construction of Pressure Vessels**
 - “Division 1 provides requirements applicable to the design, fabrication, inspection, testing, and certification of pressure vessels operating at either internal or external pressures exceeding 15 psig.”

“This pressure may be obtained from an external source ... or from a direct or indirect source”
- **Neither kegs nor beer are directly referenced in ASME VIII**
 - **Kegs meet the criteria of a pressure vessel**

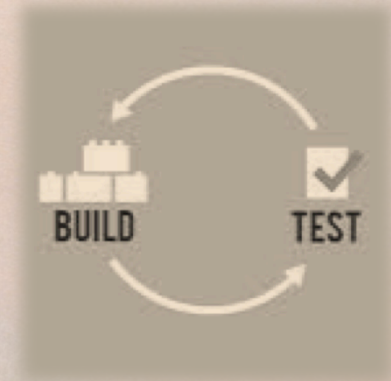
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- Neither kegs nor beer are directly referenced in ASME VIII
 - Kegs meet the criteria of a pressure vessel
- **ASME has no record of exemption for beer kegs in ASME VIII**
 - **No enforcement has been identified**
- **The National Board of Boiler and Pressure Vessel Inspectors provides synopses of state exemptions for pressure vessels by volume, temperature, pressure, diameter, and dimensions**

Resource Identification

Industry organization identification

- International Society of Brewing Technologists (ISBT)
- American Society of Brewing Chemists (ASBC)
- American Society of Mechanical Engineers (ASME)
- International Safe Transit Association (ISTA)
- Department of Transportation (DOT)
- American Society for Testing and Materials (ASTM)
- American Welding Society Standards (AWS)
- Others



Data Collection and Analysis

- Survey
- Phone interview
- Face to face meeting
- Site visit
- Internet
- Published material
- Email correspondence
- Forum network
- Calculations
- Peer and expert review



Framework Development

- Defined separate guidelines for refillable and single use
 - Material of construction, whether metal, polymer or combination
- Established volume range: 15 to 60 liter
- Aligned on sections to include in guideline





Guideline Table of Contents

Refillable Kegs - Table of Contents

1. Introduction
2. Key Findings
3. Purpose
4. Purchasing or Procurement
5. Performance
6. Regulatory and Safety
7. Keg Washing
8. Keg Filling
9. Plant Quality Control Procedures
10. Storage, Handling, Transportation,
and Return
11. Dispensing
12. Repair and Reconditioning
13. Keg Decommissioning
14. Glossary
15. Sources
16. Appendix

Single Use Kegs - Table of Contents

1. Introduction
2. Key Findings
3. Purpose
4. Purchasing or Procurement
5. Performance
6. Regulatory and Safety
7. Keg Filling
8. Keg & Plant Quality Control
Procedures
9. Storage, Handling, and
Transportation
10. Dispensing
11. Keg Decommissioning
12. Glossary
13. Sources
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Draft Development, Review and Feedback

Draft and review cycle utilizing:

- Brewers
- Keg and keg component manufacturers
- Keg cleaning and filling equipment manufacturers
- Keg recondition and repair companies
- Peers and subject matter experts
- Technical committee
- Trade organizations
- Legal

Pressures

Normal Operating Pressure

- Normal Operating Pressure for a beer keg is the gauge pressure inside of a beer keg under normal usage
 - Includes a range of pressures as the keg is washed, filled stored, dispensed and returned
 - 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

Pressures

Maximum Allowable Working Pressure (MAWP)

- **MAWP is the maximum pressure at which a keg should be allowed to operate**
- **MAWP represents the maximum gauge pressure that could develop in a keg absent venting, or external cooling of the keg**
 - **Worst case condition for normal service**
 - **MAWP must never exceed the Design Pressure**

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 - MAWP must never exceed the Design Pressure
- **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**
 - **Approximate pressure of a full keg of 2.9 gas volume beer at 100°F is 60 psig**

Pressures

Design Pressure

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- Based on industry experience to satisfy rigors of trade, a minimum design pressure of 300 psig is recommended for refillable kegs
 - Provides a safety margin of at least 5 times the maximum allowable working pressure
 - Predominance of refillable kegs exceeds this safety margin
 - A safety margin of 10X is not uncommon

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 - A safety margin of 10X is not uncommon
- For single use kegs the design pressure is recommended to be 2.5 times the maximum allowable working pressure

Pressures

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

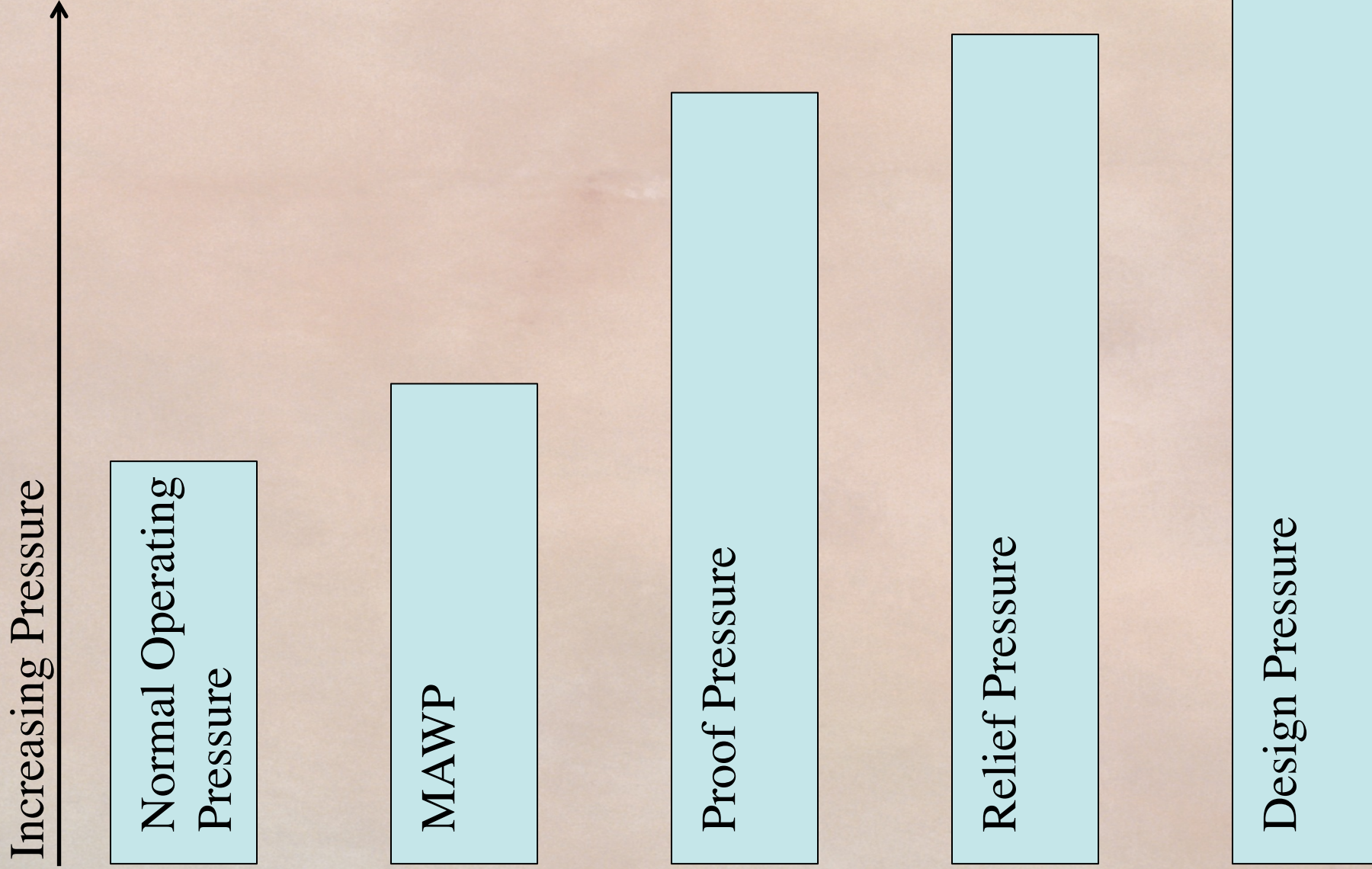
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 - 72°F for 30 seconds
 - Kegs should withstand this pressure without deformation

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 - 72°F for 30 seconds
 - Kegs should withstand this pressure without deformation
- **A pressure relief device is recommended, such as a burst disc, be included in the keg design**
 - Relief device should activate above the MAWP and must not exceed the design pressure
- **In all cases the dispensing system should be equipped with a pressure regulator and pressure relief valve(s) set below the MAWP**

Pressure Definition Relationships



Pressures

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 60L
Germany DIN 6647-1 Refillable	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 Refillable	4.14 bar (60 psig)	75 bar (1102 psig)	Optional 40 +/- 5 barg Per DIN 6647-1	6.21 bar (90 psig)	100L

Pressures

Standard or Guideline Document	Maximum Allowable Working Pressure	Design Pressure (Minimum)	Relief Pressure (Maximum)	Proof Pressure	Keg Size
BA Guideline Single Use	60 psig	1.5 X Pressure Relief Set Point	<5 X MAWP	1.5 X MAWP	Up to 40L
Germany DIN 6647-1 Refillable	3 bar (43.5 psig)	60 bar (870 psig)	45 bar (652 psig)	-	Up to 50L
Germany DIN 6647-4 Single Use	4 bar (58 psig)	1.5 X Pressure Relief Set Point	≤5 X MAWP	1.5 X MAWP	Up to 60L
Australia AS2971 Refillable	.5 MPa (72.5 psig)	2.2 MPa (319 psig)	Optional .5 MPa (72.5 psig)	.75 MPa (109 psig)	-
UK BFBi S. Steel Refillable	4.14 bar (60 psig)	75 bar (1102 psig)	Optional 40 +/- 5 barg Per DIN 6647-1	6.21 bar (90 psig)	100L



Guideline as a Business Tool

- To help ensure beer keg quality and address best practices in the procurement, performance, and usage of beer kegs in North America
- To use as a template and refine as appropriate to address specific business needs
- To establish understanding between supplier and brewer from the beginning of a purchase relationship
- To consider all aspects for present time usage and future requirements as growth continues within the brewery

The Guidelines can be found in the Business Tools Section of the site:

<http://www.brewersassociation.org/pages/business-tools/keg-guidelines>



Thank You!

- We appreciate the Brewers Association for their vision and facilitation of the guidelines.
- We would like to thank the suppliers, vendors, technical experts, and brewers who participated and have engaged throughout the guideline development process.
- Stakeholder support to continue to refine and improve this document is greatly appreciated.



Contact Information

Information and feedback to refine and improve the Performance Guidelines can be sent to technical@brewersassociation.org

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Questions



We will be available for additional questions and discussions immediately following the presentation at 2:30 PM in room 210.