

Balancing a Direct Draw Draft Beer System

Overview

Introduction A Direct Draw Beer Dispensing System is a self contained, thermostatically controlled refrigeration unit, in which one or more kegs of beer are stored at an optimum temperature of 38° F. This system is equipped with beer dispensing hardware and 3/16" inside diameter (I.D.) beer line that can be used exclusively between the keg coupler and faucet.

A Direct Draw Beer System may be contained within a walk-in cooler, a commercial keg box, or within a kegerator or converted refrigerator. These units are available for purchase commercially and for home use. The information that follows will describe the process and procedures to successfully balance any Direct Draw Beer System.

Purpose The purpose of this document is to define what a balanced beer system is, and introduce the reader to the components that make up a direct draw draft beer system. Additionally, this document will explain the procedure and illustrate the calculations required to properly balance this type of beer system.

What is a Balanced System

Three Objectives of a Balanced System Balancing a Direct Draw Draft Beer System involves calculations and measurements to meet three main objectives:

1. Protecting the integrity of the beer
2. Eliminating waste
3. Acquiring an industry standard flow rate of approximately 128 ounces per minute or approximately 1 gallon a minute.

Success in meeting these objectives depends on balancing two separate pressures:

- Applied gauge pressure
- Restriction pressure.

! System balance does not have to entail calculations reserved for rocket science. Acquiring accurate measurements and using simple math will be sufficient.

Balancing Two Pressures

Balancing Gauge and Restriction Pressure

There are two distinct pressures in a draft beer system.

- Gauge Pressure, is the actual pounds per square inch gauge (PSIG) pressure of 100% CO₂ applied to the keg. This propels (pushes) the beer through the system. The volumes of CO₂ in the beer and its temperature determine PSIG. A domestic lager with 2.6 CO₂ volumes at 38° F requires 14 PSIG @ sea level to maintain product CO₂ levels while eliminating foam issues.
- Restriction is defined as the pounds per square inch pressure (PSI) of resistance the beer encounters as it flows through the system. This Restriction comes from three sources:
 1. System Hardware
 2. Gravity
 3. Beer tubing

Each variable has a known PSI value and is measurable. When identified and accumulated, this total restriction value works to oppose the gauge pressure.

When these two pressures are equal, a flow rate of approximately 128 ounces per minute is acquired, creating a balanced system.

An example would be a draft beer system that requires 14 PSIG applied pressure to the keg with restriction consisting of hardware, beer tubing and gravity that amount to 14 PSI. The beer is pushed through the system with the same amount of resistance it encounters along the way resulting in approximately 128 oz. / min.

Restriction Sources

System Hardware

The hardware components in a draft beer system consist of tailpieces, unions, faucets, shanks, couplers, and more. All of these components restrict the beer as it passes through. Most pieces impart so little restriction that they can be ignored.

One piece of hardware that cannot be ignored is a shank and tube assembly that is utilized in the towers of some Kegerators. It consists of ¼" outside diameter stainless tubing with threads on one end that protrudes down the tower into the refrigerated box itself. The beer line with fittings is easily attached to these threads. When this shank is present, beer encounters 3 PSI of restriction and must be included in the restriction calculations.

Restriction Sources (continued)

Gravity

Gravity is referred to as either vertical lift or drop. The faucet is either above or below the bottom of the keg.

The easiest method of measuring is to visualize two horizontal planes in the system, one at the faucet and the other at the bottom of the keg, then the vertical distance between them. This vertical distance is measured in feet and has a PSI value of .45 per foot. This is rounded to .5 PSI for ease of calculating.

A typical direct draw system has a vertical lift distance between these two planes of approximately four feet thus 2 PSI of restriction in gravity. ($4 \times .5 = 2$)

Beer Tubing

Since it is easily cut to length, beer tubing is the restriction component utilized to balance the system after hardware and gravity are determined.

Vinyl beer tubing with a 3/16" inside diameter (I.D.) has 3 PSI of restriction per foot and is used exclusively in direct draw systems.

Note - Kegs positioned in a walk-in cooler where the calculated length of 3/16" beer tubing will not be long enough to reach between the coupler and faucet is considered a remote system, and more advanced balance principles apply.

Practice Balancing a Direct Draw System

Establish the Applied Gauge Pressure

The first step to balancing a beer system is to establish the applied gas pressure gauge (PSIG) of 100% CO₂ required to propel and maintain the beers carbonation to the brewers' specification. This is based on the beer's CO₂ volumes and the temperature of the beer.

! Refer to the brewer's specifications for specific CO₂ volumes.

Note – Correct for altitude by adding one pound of PSI gauge pressure for every 2000' above sea level.

Practice Balancing a Direct Draw System (continued)

Identify the Restriction Sources

For example - a 2.6 volume beer at 38° F requires 14 PSIG to maintain the product's carbonation, and eliminate any foam issues.

This system has 4' of vertical lift and no shank with tube assembly.

To balance this system to 128 oz. / min. flow rate, the applied pressure must be balanced with 14 PSI of hardware, gravity and beer line restriction.

CO2 Volume	2.5 Volumes
Beer Storage Temperature	38° F

Calculations:

Gauge Pressure		14 PSI
Hardware	Shank with Tube N/A	- 0
Gravity	4' x .5	<u>-2</u>
Restriction to be made up with vinyl beer tubing		12PSI

Beer Tubing Length	$12/3 = 4'$ of 3/16"ID vinyl beer tubing
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Calculate the Length of Beer Tubing

The example above requires 12 PSI of restriction to be made from a length of 3/16" vinyl tubing. To calculate the length of line needed simply divide the restriction required (12 PSI) by the pounds of restriction per foot of tubing (3 lbs/foot)

$12 / 3 = 4$ feet of 3/16 ID vinyl beer tubing.

Example 2

System Specifications

CO2 Volume	2.8 Volumes
Beer Storage Temperature	38° F

Calculations:

Gauge Pressure		16 PSI
Hardware	Shank with Tube	- 3
Gravity	4' x .5	<u>-2</u>
Restriction to be made up with vinyl beer tubing		11PSI

Beer Tubing Length	$11/3 = 3' 8"$ of 3/16" ID vinyl beer tubing
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! 4 inches of 3/16 ID tubing has 1 PSI of restriction

Beer Temperature and CO₂ Content

Determining PSIG to the Keg

Beer temperature and CO₂ volumes determine ideal gauge pressure, (PSIG) to the keg.

! Gauge pressure should never be adjusted to control the beer flow rate.

Balancing a system correctly eliminates unnecessary regulator adjustment, and helps guard against other problems associated with Direct Draw Beer Systems. Balancing a System results in a manageable flow rate, and maintains a product's integrity. Waste is reduced, profits are increased and beer is enjoyed as the brewer intended.