

# Beverage Systems

Gas Mixing Specialists

## Beverage Systems

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## Who are Beverage Systems?

We are apart of BSL Gas Technologies Ltd, that design and manufacture **Beer and Beverage Dispense** gas mixing systems and solutions. We sell our equipment **Worldwide** and to many different companies.

**BSL** are one of the leading suppliers of **Gas Mixing, Gas Control and Gas Analysis** systems and solutions.

This document will explain some of our equipment commonly used for dispensing beverages. We will also give you valuable information on the **Beer Dispense Industry**.

## Mixing Gases for Beer Dispense



- ◊ Why do we care about beer presentation?
- ◊ What does mixed gas do for beer ?
- ◊ What should the correct gas mix be?
- ◊ Why a BSL Gas Mixer is just perfect for you?

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# Why do we care about beer presentation?

Whilst traditional brewing is an art, using science and a lot of experimentation, for the most part we are brewing to create a perfect drink for the consumers. It is nice we like it, but importantly the drinker has to love it. Love it because you are trying to encourage them to be loyal to your brand and your products. Consumers want the exact same experience every time. With a highly branded product like Guinness for example, it has to be dark, bitter and creamy with a 19mm head. It is a strong image, but if it does not look, smell, taste and act the same every time, no matter where and when, the experience is not the same, brand image is damaged.

For the people running pubs and responsible for dispensing and presenting the beer products there are advantages too. Serving a good pint to a discerning drinker will encourage loyalty to their establishment. There are other advantages too. For the cost minded publican, using mixed gas to present the perfect pint means that they will reduce waste. They will reduce waste in fobbing and foaming of their beers. They will reduce wasted beer, they will reduce the amount of wasted gas, all of which will make them more efficient. They will serve a better pint, more effectively and it will be at less cost to them.



So for the Brewer it is not a big decision. All the time taken to perfect the beer so carefully brewed is not wasted beyond the Brewery. It gives the brewer the opportunity to put in controls to make sure the product is maintained in the keg in an as brewed condition and controls to ensure it is dispensed exactly how it should be. Perfectly, each and every time.

**Who cares about beer presentation? We all do, everyone involved in the chain from brewer to the publican to the drinker benefits when presentation is consistent. Quality is perceived and products are viewed as premium products!**

# What does using mixed gas do for your Beer ?

There are some clear situations where mixed gas should be used for dispensing Beer to avoid disaster.

- ◆ If you are serving a beer that has nitrogen brewed in it or added to it. For example: Guinness is a good example of this style.
- ◆ If you are serving beer at a pressure over the balance point for that beer. In other words you need to dispense at a higher pressure than the beer desires, in which case you will over-carbonate it.
- ◆ For 'nitro' beers, CO<sub>2</sub> gas alone will allow the nitrogen to come out of the beer and nitrogen alone will allow the CO<sub>2</sub> gas to come out of the beer. So to keep the beer in balance the correct mix of CO<sub>2</sub> and N<sub>2</sub> is required.

The higher the N<sub>2</sub> content in the brewed beer the more N<sub>2</sub> needed in the mix used to keep and dispense it.

For non 'nitro' beers there is a different situation. All beers have an as brewed CO<sub>2</sub> content, quoted in volumes or grams per litre. This level is selected by the brewer, and it has an effect on taste and appearance. The correct gas mix will keep the balance of the beer. The CO<sub>2</sub> part of the mix will help maintain the as brewed volumes and the nitrogen part of the mix will help provide the pressure necessary to dispense it. By looking at the dispense temperature and the dispense pressure an appropriate mix of CO<sub>2</sub> and N<sub>2</sub> gases is selected.



## What does using mixed gas do for your beer?

- ◆ It will keep your nitro beers correctly carbonated and nitrogenous.
- ◆ It will keep your normally carbonated beers correctly carbonated, despite the length of time they remain on tap.
- ◆ It will prevent beers from going flat over time
- ◆ It will prevent beers from over-carbonation
- ◆ It will prevent unnecessarily wasted beer
- ◆ It will prevent unnecessarily wasted dispense gases
- ◆ It can reduce fobbing problems associated with temperature fluctuations

**What mixed gas does best is to keep the beer in the same condition it was brewed in and intended to be from the time it is brewed to the moment it is presented to the consumer.**

# What should the correct gas mix be?

## How to choose the correct gas mix for your beers...

The main factors you need to consider when finding the correct mix are...

- ◆ The as brewed CO<sub>2</sub> content of your beer
- ◆ Your correct cellar storage temperatures
- ◆ The dispense pressure required for your beers

The CO<sub>2</sub> content is the level of CO<sub>2</sub> dissolved in the Beer when brewed. It is the choice of the brewer, but similar styles of beer share similar CO<sub>2</sub> contents. Some approximated examples are below.

- ◆ Nitro beers                    1.1 to 1.4 volumes
- ◆ British beers                2.2 to 2.4 volumes
- ◆ Craft beers and lagers      2.4 to 2.5 volumes
- ◆ Lagers generally            2.6 to 2.8 volumes
- ◆ European style beers       3.0 volumes

The temperature is the temperature of the cellar or keg storage facility. These do vary of course, otherwise it would not be an important factor, however some properties of CO<sub>2</sub> gas in relation to water make a temperature of 3.3°C or 38°F an ideal storage temperature for carbonated products. In practice a keg of beer should be placed in the cellar for a period of time to allow it to acclimatise.

The pressure is the pressure of dispensing gases needed to move the beer from the keg, reliably to the point of dispense, taking into account the distance to be travelled and the equipment the beer has to travel through to get to the beer glass. These factors are mostly dictated by the Brewer for each of their products, plus other factors like which taps and tap heads that are used to pour the beer finally into the glass.

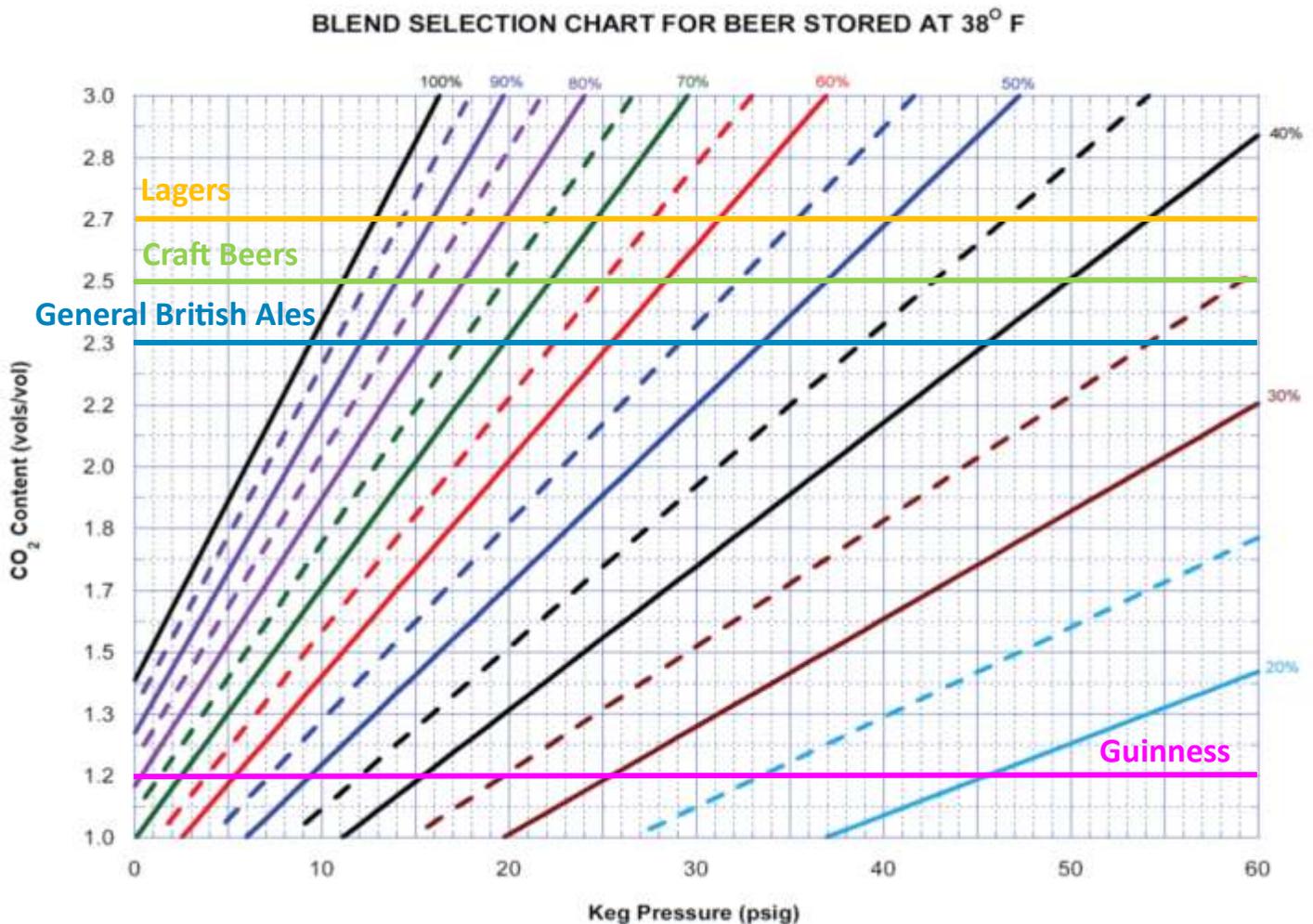
There is scope to play with these variables a little to achieve what you finally want to achieve with your range of products. And often there will be a need for two or more different blends which is easily catered for with the BSL Cellar-Mix gas mixing panels. For example a low CO<sub>2</sub> mix for a nitro beer and a high CO<sub>2</sub> mix for a lager and sometimes maybe something in between too. None of this is a problem of course, because all three mixes can come from single BSL mixing panels fed with CO<sub>2</sub> and N<sub>2</sub>.

**The correct mix is the one that takes into account your beer, the storage temperature and the dispense pressure you need for your products.**

# What should the correct gas mix be?

## How to choose the correct gas mix for your beers?

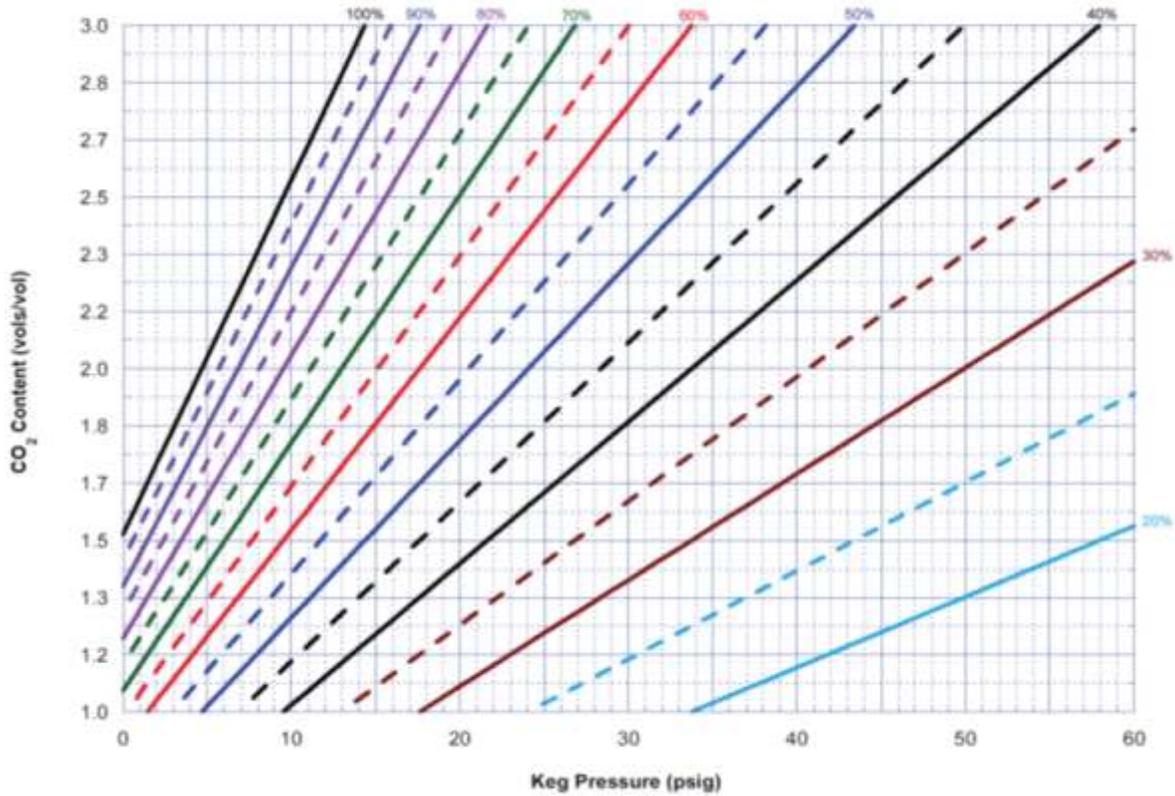
To make things simple, please see below a typical selection chart for 38°F / 3.3°C. Nitrogenised products will appear at one end of the spectrum as they have a low CO<sub>2</sub> content comparably and a high nitrogen gas content. Mixed gas is trying to keep the Nitrogen in solution. Highly carbonated products will appear at the other end of the spectrum. Here the issue is not to over carbonate the beer.



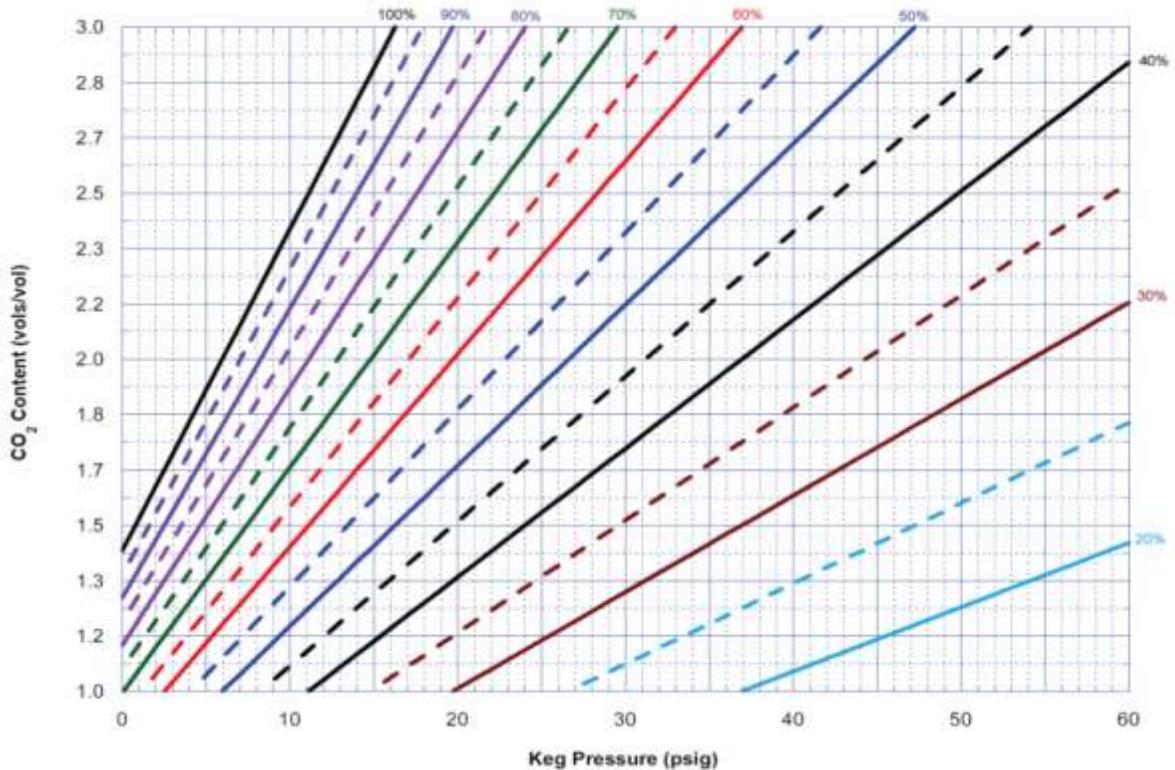
This chart is repeated and detailed for a number of different temperatures. Have a look at them to find the approximate best mixed gas ratio for your products.

# What should the correct gas mix be?

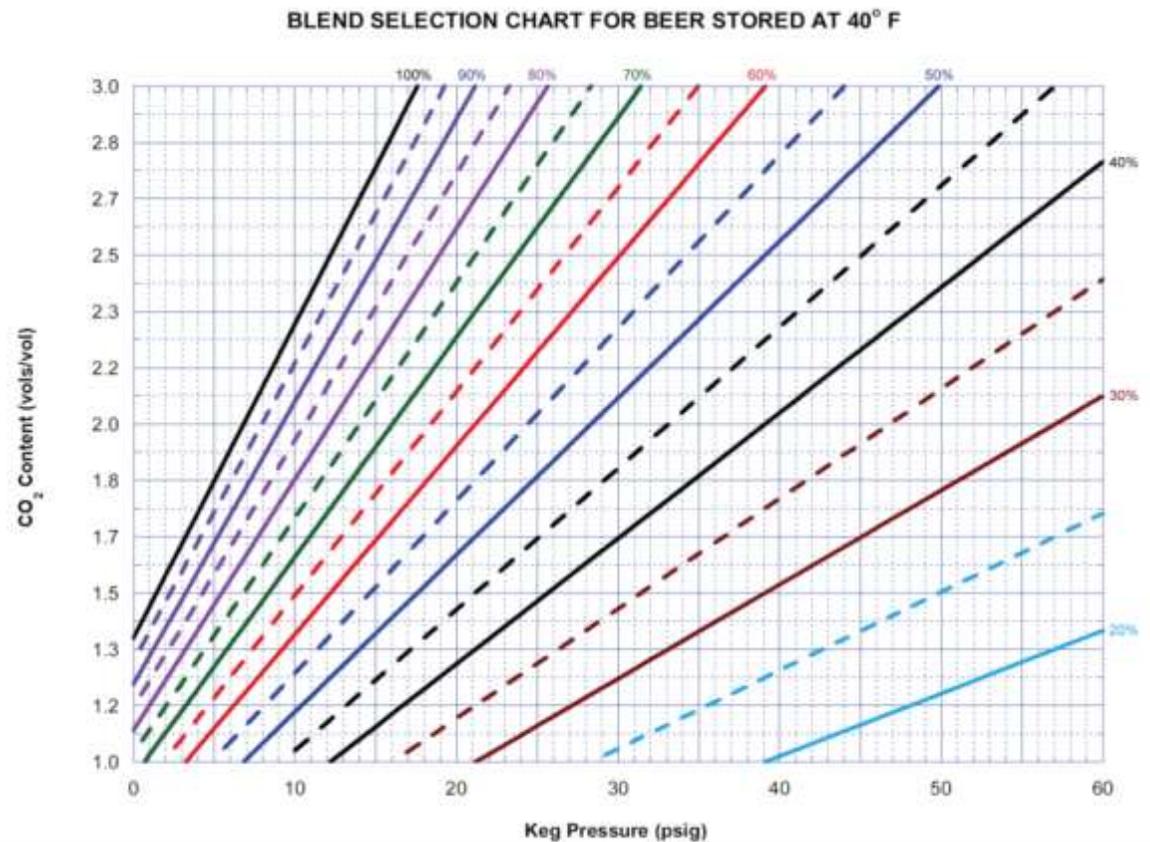
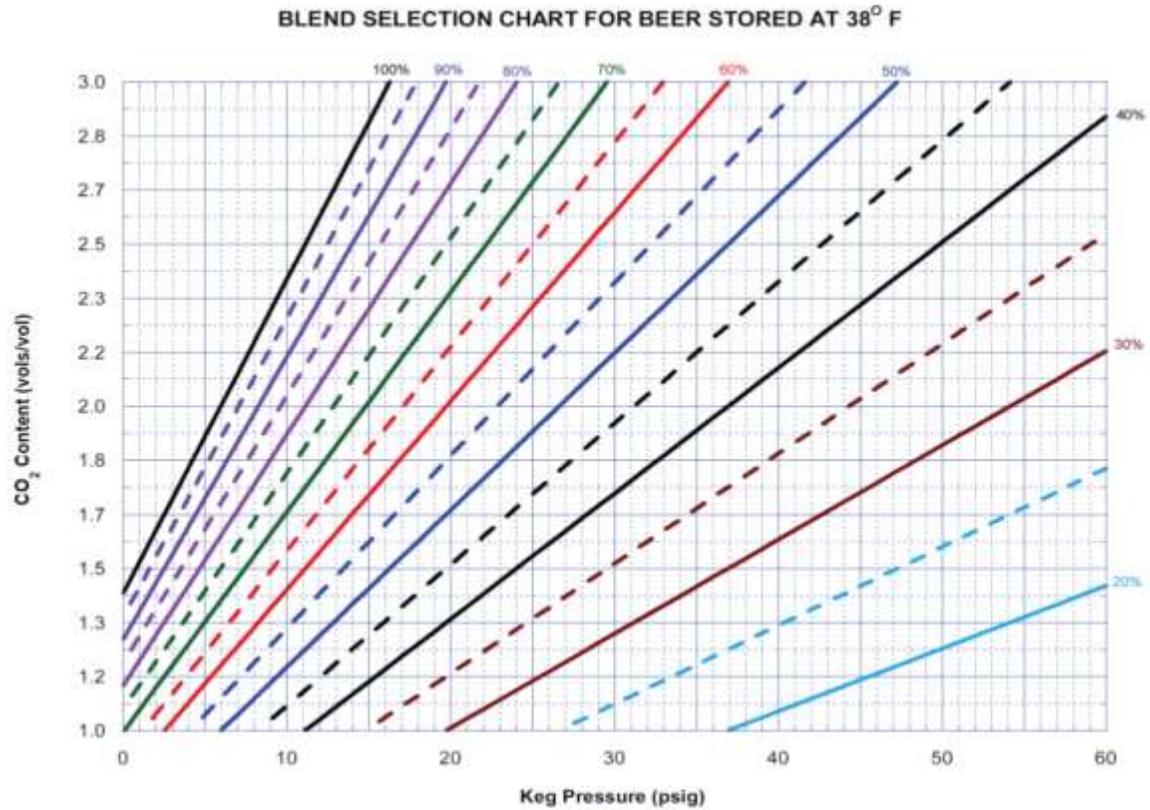
BLEND SELECTION CHART FOR BEER STORED AT 35° F



BLEND SELECTION CHART FOR BEER STORED AT 38° F

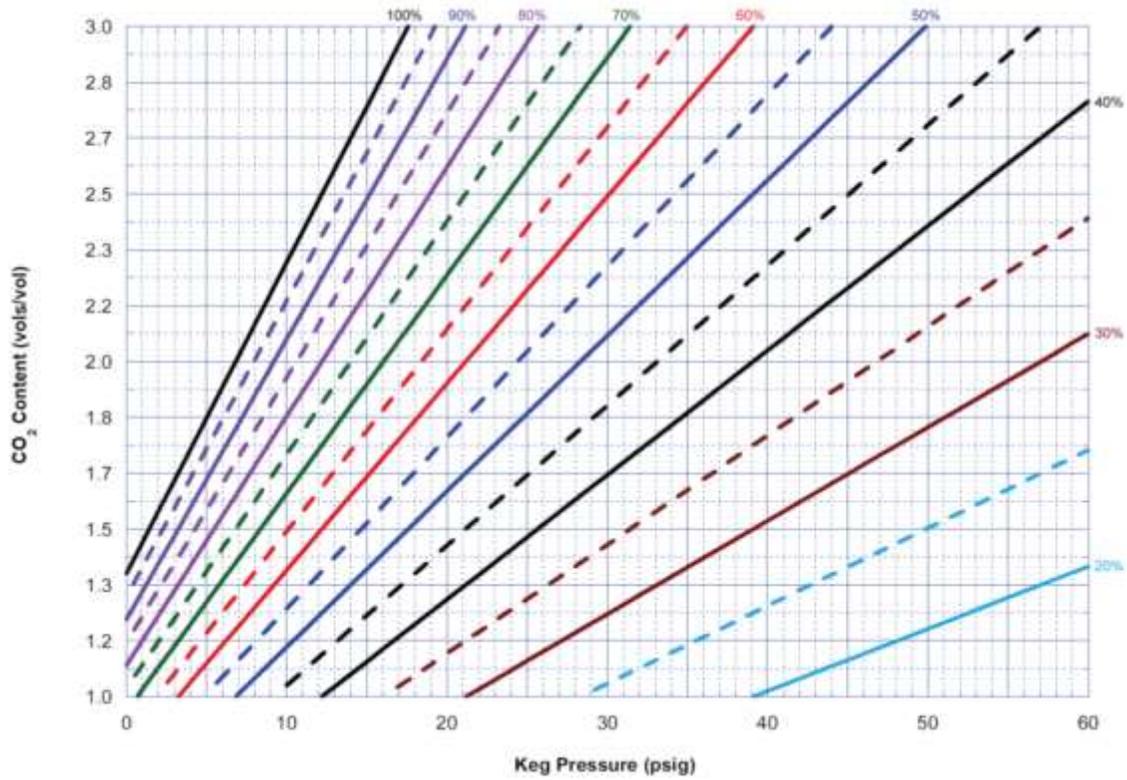


# What should the correct gas mix be?

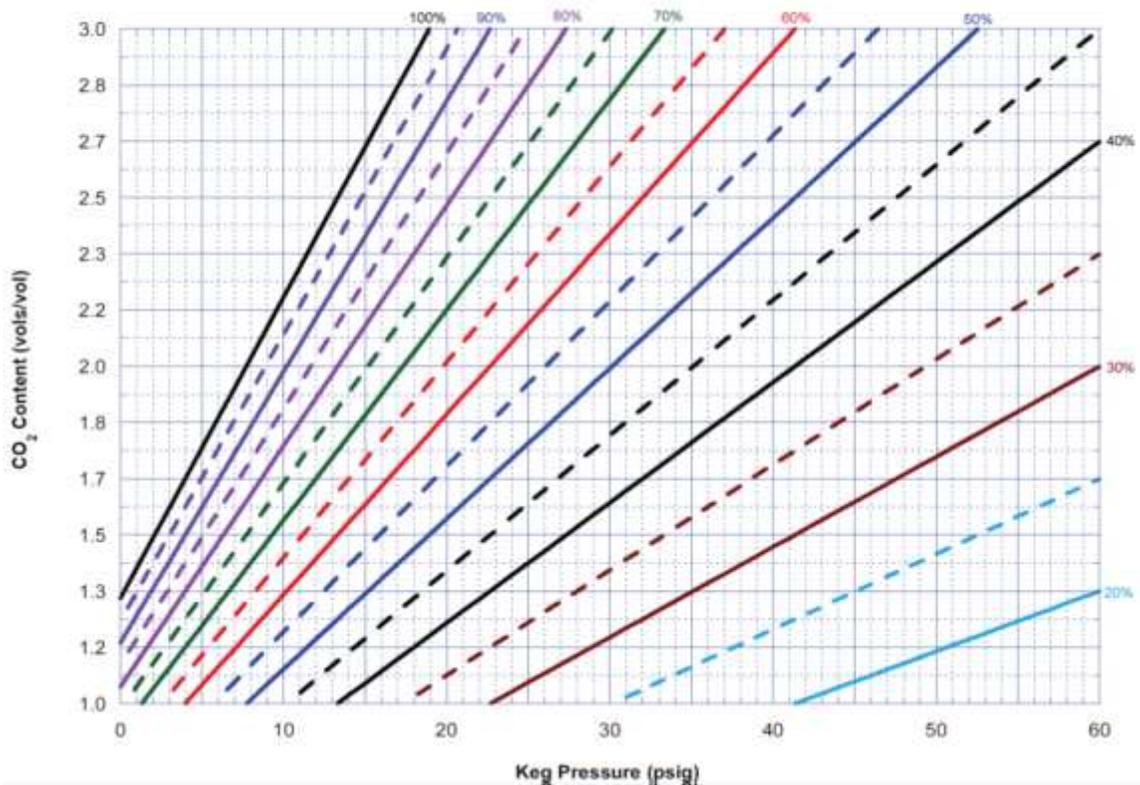


# What should the correct gas mix be?

BLEND SELECTION CHART FOR BEER STORED AT 40° F

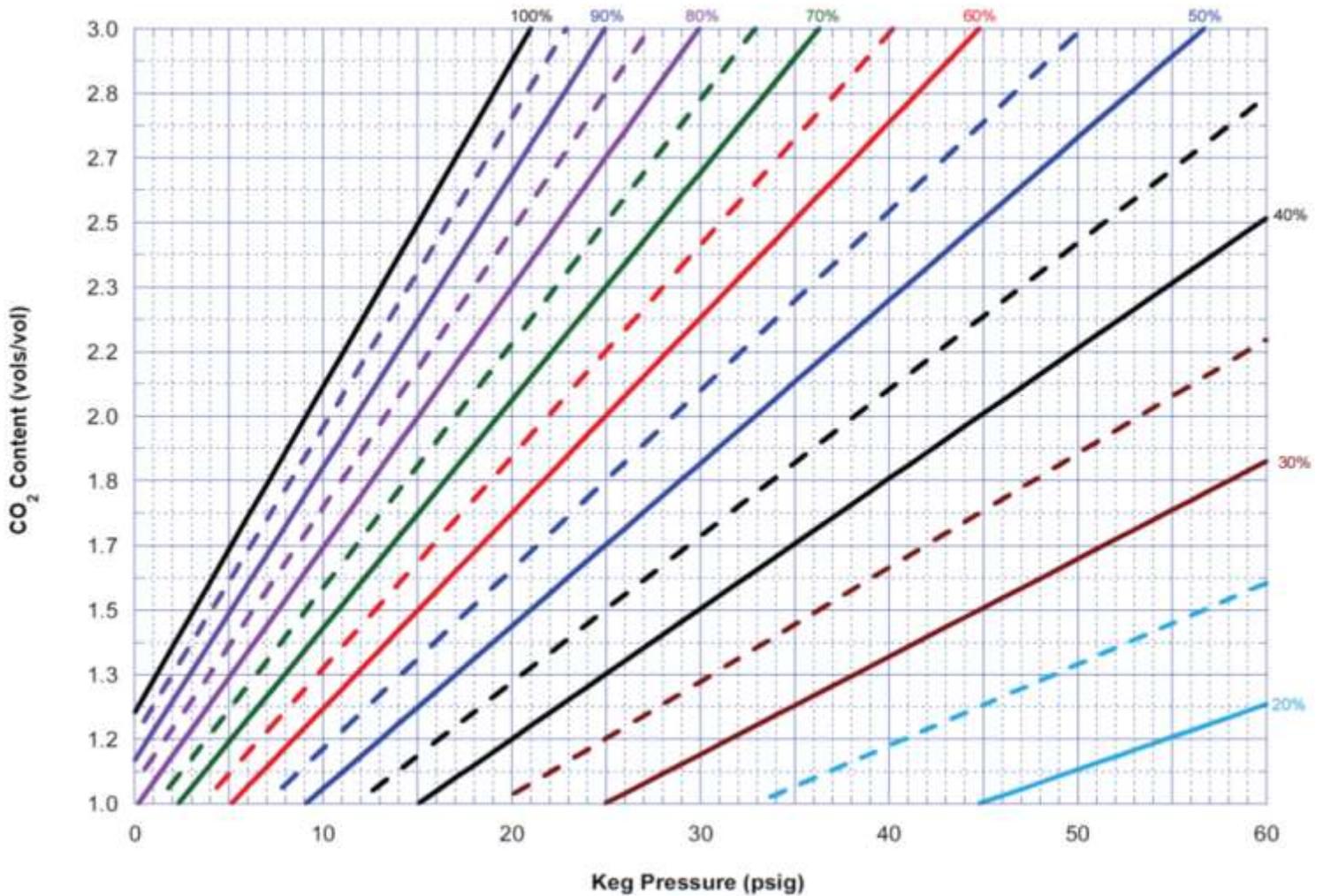


BLEND SELECTION CHART FOR BEER STORED AT 42° F



# What should the correct gas mix be?

BLEND SELECTION CHART FOR BEER STORED AT 45° F



# Why our Gas Mixer just perfect for Beer Dispense?

## What are the sources of gas available?

It is clear that for various reasons mixed gas is really helpful and beneficial to everyone involved in the beer drinking chain. Looking just at mixed gas sources there are only two options. You purchase mixed gases in gas cylinders or you make mixed gas yourselves using simple gas sources.

**We know it is better to use our Gas Mixers and produce mixed gas yourself, below we will explain some of the reasons why.**

## Costs of gas -

- ◆ This is actually a really easy one to compare. By using our Gas Mixer you will have the opportunity to purchase 100% CO<sub>2</sub> and 100% N<sub>2</sub> gases and then to mix them yourselves.
- ◆ The cost of these pure and simple gases are much less than the cost of premixed gases in cylinders.
- ◆ CO<sub>2</sub> gas in cylinder is a liquid, so you get a much greater volume of CO<sub>2</sub> gas as a pure supply than you do when it is pre-mixed.
- ◆ You will pay cylinder rental and delivery costs too. With pure gases you will need fewer deliveries as you are holding more volumes of gas yourselves. Since you have fewer, more effective cylinders with pure gases, you will be paying less for cylinder gas rental too.
- ◆ With our Gas Mixer you can have a number of different mixes available from a single wall mounted unit, without increasing the unit cost of the gas you use. With premixed gas cylinders you will have more deliveries again and more cylinder rental costs again.
- ◆ Our Gas Mixer will give you the exact mix you need, no compromises, so you will expect to eliminate the fobbing waste we mentioned earlier. Whereas, pre-mixed cylinders are always a compromise, which means there will always be some wasted beer and gas, which means pouring money away.
- ◆ The moderate initial cost of our Gas Mixer will very quickly be covered by the savings you make in gas costs.
- ◆ And once paid for, the system will continue to save you money on gas use.



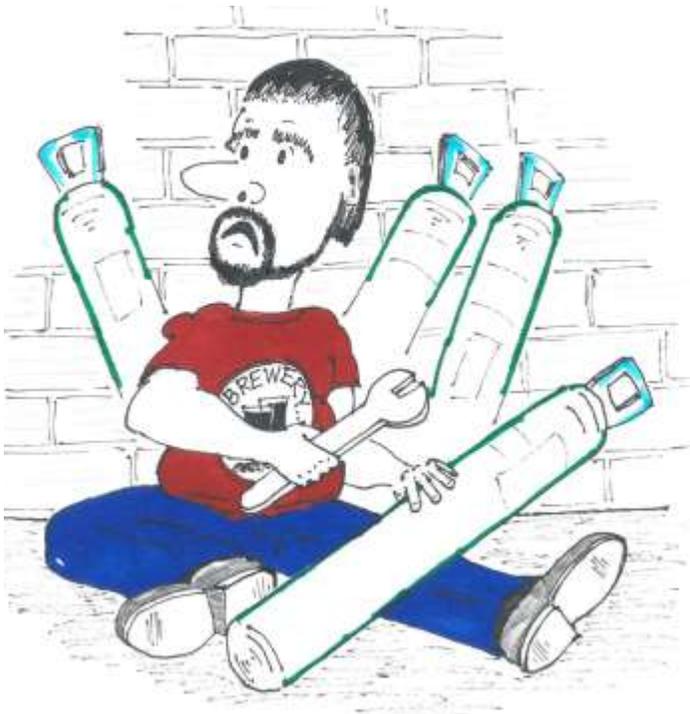
**Have a wrestle with your gas costs.  
You will be really surprised at how much money you will save!**

# Why our Gas Mixer just perfect for Beer Dispense?

## What are the sources of gas available?

**Suitability of the solution.** This is another really simple comparison. By using a BSL Gas Mixer you will have the most accurate, reliable and convenient solution for obtaining mixed gas.

- ◆ The convenience and availability of pure gases as CO<sub>2</sub> and N<sub>2</sub> is much better than pre-mixed gases in cylinder. Every country of the World has them available and most have them available in good clean, repeatable quality for Food grade purposes. And they need to be Food grade of course because beer is food.
- ◆ The range of gases available in a pre-mixed format is limited, the Gas Mixer is not limited, you can have pretty much whatever mixed gases you want and you can have as many as you want all at the same time.



- ◆ The accuracy of some of the sources of pre-mixed gas in cylinders is variable, the Gas Mixer is precise. There are inherent issues when mixing gases in cylinders in a pre-mixed format and the more CO<sub>2</sub> you have in the mix, the more difficult the mixing becomes. The Gas Mixer is much more reliable and accurate day to day.
- ◆ Pre-mixed gas cylinders need some agitation and settling time before they finally begin to give you the mix that you need. The Gas Mixer is good to go immediately you have the supply of pure gases.
- ◆ Changing lots of cylinders can be a nuisance, especially at busy times. The premixed gas cylinder route will mean that you will have to make more cylinder changes. With a Gas Mixer, you will be changing cylinders, especially CO<sub>2</sub> gas much less often.
- ◆ Changing lots of different cylinders can be complex and messy, especially for those not trained greatly in how to do it and how to do it safely. The Gas mixer and pure cylinder route greatly reduces complexity and the risk that someone might connect up the wrong gas to the wrong products. That risk is greatly reduced when using pure gases, it is simpler and has less room for error.

- ◆ The more gas mixes you need in your cellar, the more cylinders you will have and the more space you will take up. The Gas Mixer itself is wall mounted, it needs fewer cylinders to feed it and will therefore take up less of the valuable floor space.
- ◆ The Gas Mixer gives larger or out of the way pubs the opportunity to consider making their own Nitrogen, with the use of a Nitrogen Generator and pure CO<sub>2</sub> gas.

**Pre-mixed gas in cylinders can be a part solution for some, using our Gas Mixer with pure gases is much more suitable, cheaper, more reliable, more accurate by design, much more flexible and will give you many more options.**

# What other useful products do we have for dispense experts?



## Beer Check Gas Analyser

This is a very useful hand held device which will perform a number of functions, but primarily is a very effective way to measure the CO<sub>2</sub> content of a mixed gas line from one of our Gas Mixing panels or Gas Blenders. It is a 0 to 100% CO<sub>2</sub> in N<sub>2</sub> ultrasonic measuring device which is very reliable over time. Battery operated it is very transportable and is quick to use and respond. These units can also be used to measure the CO<sub>2</sub> mixtures coming from nitrogen generator systems and with an added pressure and flow adaptor they can be used to confirm the mixtures in pre-mixed gas cylinders. Mostly they are used to fault find in pubs, when things are not going as they should. **Would one of these units help you?**

## CO<sub>2</sub> Gas Filtration

We have a range of filters to offer for cleaning the gases, especially CO<sub>2</sub> gas which is great at picking up and making impurities as it is moved around. The best location for a CO<sub>2</sub> gas filter is immediately after the pressure regulator for the CO<sub>2</sub> supply and immediately before it enters the first piece of equipment in the cellar. Often this will be the BSL Gas Mixer, or a nitrogen generator if one is present. The filters we suggest have an effective pore size of 0.01 micron and an quoted efficiency of 99.97%.



## In-Line Leak Detector

This is actually a very clever simple little device which is used to qualify and quantify the size of gas leaks in your cellar. You may think this is not important but actually it can be very helpful. Leaks are waste of course and wasted gas is wasted money, so this device is a simple way of checking your system at the end of each day to see if you are throwing money into the atmosphere. Where you have nitrogen generators the leak detector is very useful indeed, because the leak will be partly stored nitrogen which means your generator will be working harder than is necessary, consuming power as it does so.

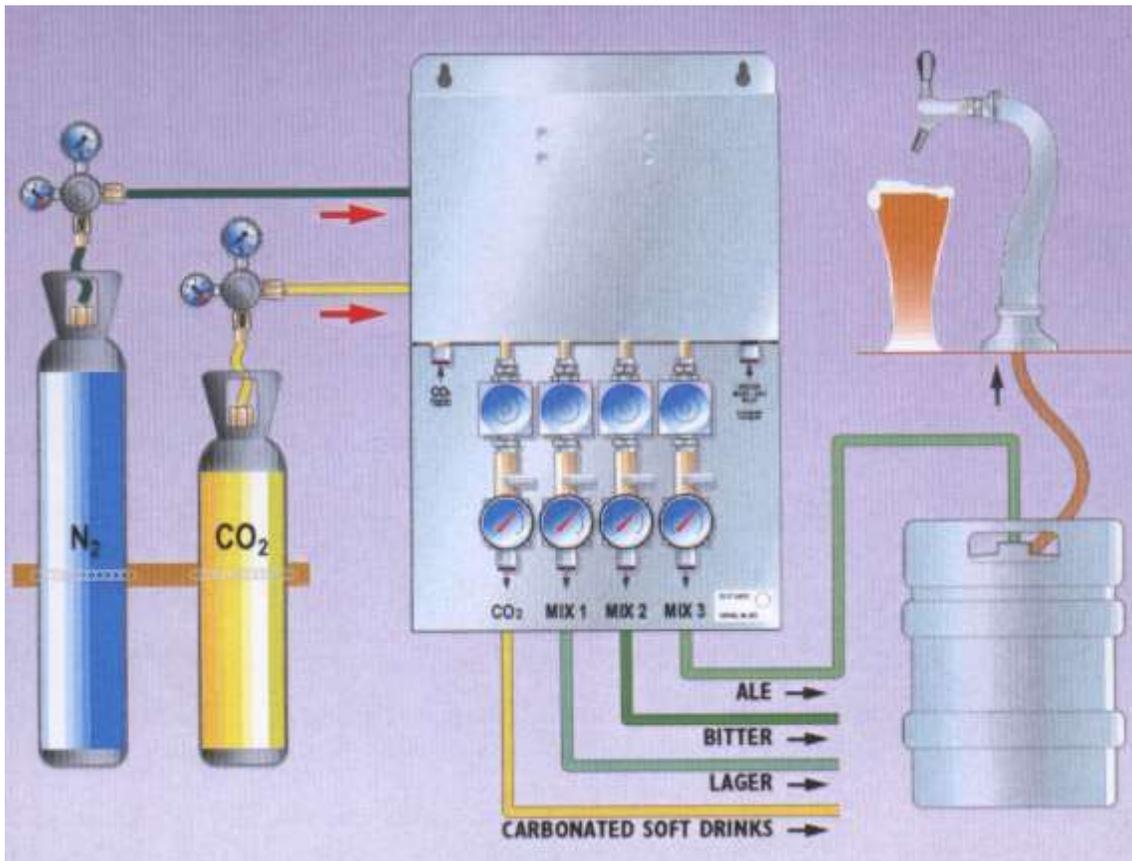
**There are lots of places that gas can leak from...**

**Which products will be useful to you?  
Mixing Panels can be designed and built to suit your particular requirements.**

# What does a typical simple mixed gas installation look like?

**A typical mixed gas installation with our Gas Mixer looks as simple as below.**

CO<sub>2</sub> gas will most likely be delivered in a CO<sub>2</sub> gas cylinder or maybe a liquid mini-bulk supply tank. The supply gas pressure will be regulated down for the gas mixing panel which is normally looking for about 5 bar g of pressure for Beer and protected with pressure relief valves.



N<sub>2</sub> gas will most likely be delivered in a nitrogen gas cylinder or maybe from a nitrogen generator or less common a nitrogen liquid mini-bulk tank. The supply gas pressure will be regulated down for the gas mixing panel which is normally looking for about 6 bar g of pressure and protected with pressure relief valves.

The mixer block is located inside our Gas Mixing Panel which also houses low pressure, outlet pressure regulators, isolation valves and each outlet has a further set of two safety pressure relief valves to protect the downstream equipment including the beer kegs

themselves. The mix is pre-set and tamperproof, but each outlet can be isolated or opened and the outlet pressure can be set for each situation. Standard panels come in many configurations. One through to four mixes out. CO<sub>2</sub> outlets for soft drinks at higher pressures and even nitrogen outlets for the dispensing of other products.

**Installations are generally very simple.  
The Gas Mixing Panel is right at the heart of the process.**

# What happens to gas pressure in a Beer Keg?

## What happens to gas pressure in a beer keg?

Keg gas pressure is the force of the gas molecules hitting the internal surfaces of a container. The amount of force they exert depends upon the number of molecules hitting the surfaces and the speed at which they hit those surfaces.

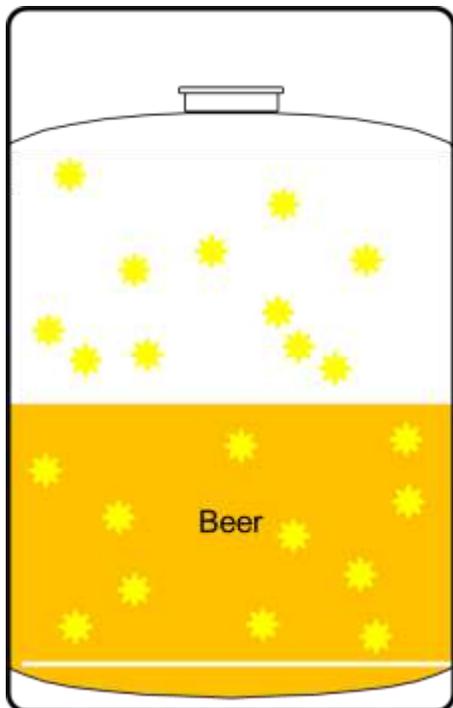
If a keg with gas in it is heated up, the gas molecules will move faster, hit the internal surfaces of the keg harder and more frequently, therefore exert more pressure. If the same keg is cooled, the gas molecules will move more slowly, hit the internal surfaces less hard and less frequently, therefore exert less internal pressure.

To change the internal pressure in the keg, we can change the temperature, we can change the gas space volume of the container by changing the number of gas molecules in the container.

**Gas Absorption**— Under normal equalised beer dispense conditions, gas molecules are constantly going in and out of solution in the beer. Gas molecules in the gas space hit the surface of the beer and dive in to solution. And at the same time dissolved gas molecules hit the surface and break out of solution.

**Gas Absorption and pressure**—If we increase the gas supply pressure in the keg, the gas molecules hit the surface of the liquid faster and more often than the gas molecules in solution. Initially more molecules are going into solution than are coming out of solution. This continues until molecules have become absorbed to a point that the same number of molecules exist in and out of solution. This point is equilibrium, where the same number of molecules are entering as leaving once again.

**Gas Absorption and Temperature**—With higher temperature, we get the dissolved molecules moving faster, hitting the surface more often and harder causing them to break out. With lower temperatures, the opposite is true, more gas molecules are kept in solution assuming the pressure remains constant. Warmer temperatures need more pressure to keep the same amount of gas in solution and in equilibrium.



**A Keg of Beer with CO<sub>2</sub> gas is in equilibrium when the number of CO<sub>2</sub> molecules dissolved in the beer is the same as the number not dissolved in the beer. This will remain the same all the time pressure and temperature are maintained.**

# What happens to gas pressure in a Beer Keg?

## What happens to gas pressure in a beer keg? Continued....

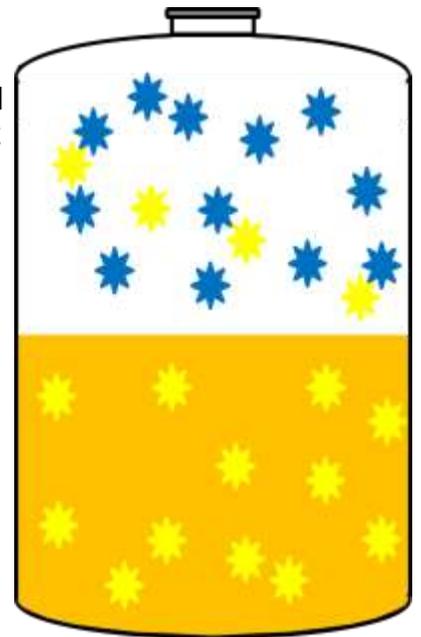
**Absolute Pressure**—We all live in or about 1 atmosphere of pressure which is approximately 14.7 psi or 1 bar or 1000mbar above a vacuum. Absolute pressure (PSIA) starts at a complete vacuum with no gas molecules present at all. Gauge pressure (PSIG) is always indicated from ambient, where the atmosphere changes with altitude a barometric pressure. For gas dissolved in beer it is necessary to think in terms of absolute (PSIA) pressure because to get all of the gas out of a liquid at normal temperatures it is necessary to expose it to a vacuum. For example a keg half full of beer and half full of CO<sub>2</sub> at 0 PSIG still has 14.7 PSIA worth of CO<sub>2</sub> molecules exerting force.

**Partial Pressures and Nitrogen**—If the keg is filled with more than one type of gas molecule, (N<sub>2</sub> and CO<sub>2</sub>) each gas molecule acts independently. If you have enough CO<sub>2</sub> molecules in a keg to generate 15 psi of pressure, and you add N<sub>2</sub> to bring the total pressure to 30 psi for example, you still have 15 psi of CO<sub>2</sub> molecules hitting the surface of the beer and entering solution. If the CO<sub>2</sub> molecules are in equilibrium before adding the N<sub>2</sub> pressure, it will still stay in equilibrium after the N<sub>2</sub> is added. Adding N<sub>2</sub> pressure will not change the number of CO<sub>2</sub> molecules, nor will it change the force with which they hit the surface of the beer, so it will not change the amount of CO<sub>2</sub> dissolved in the beer.

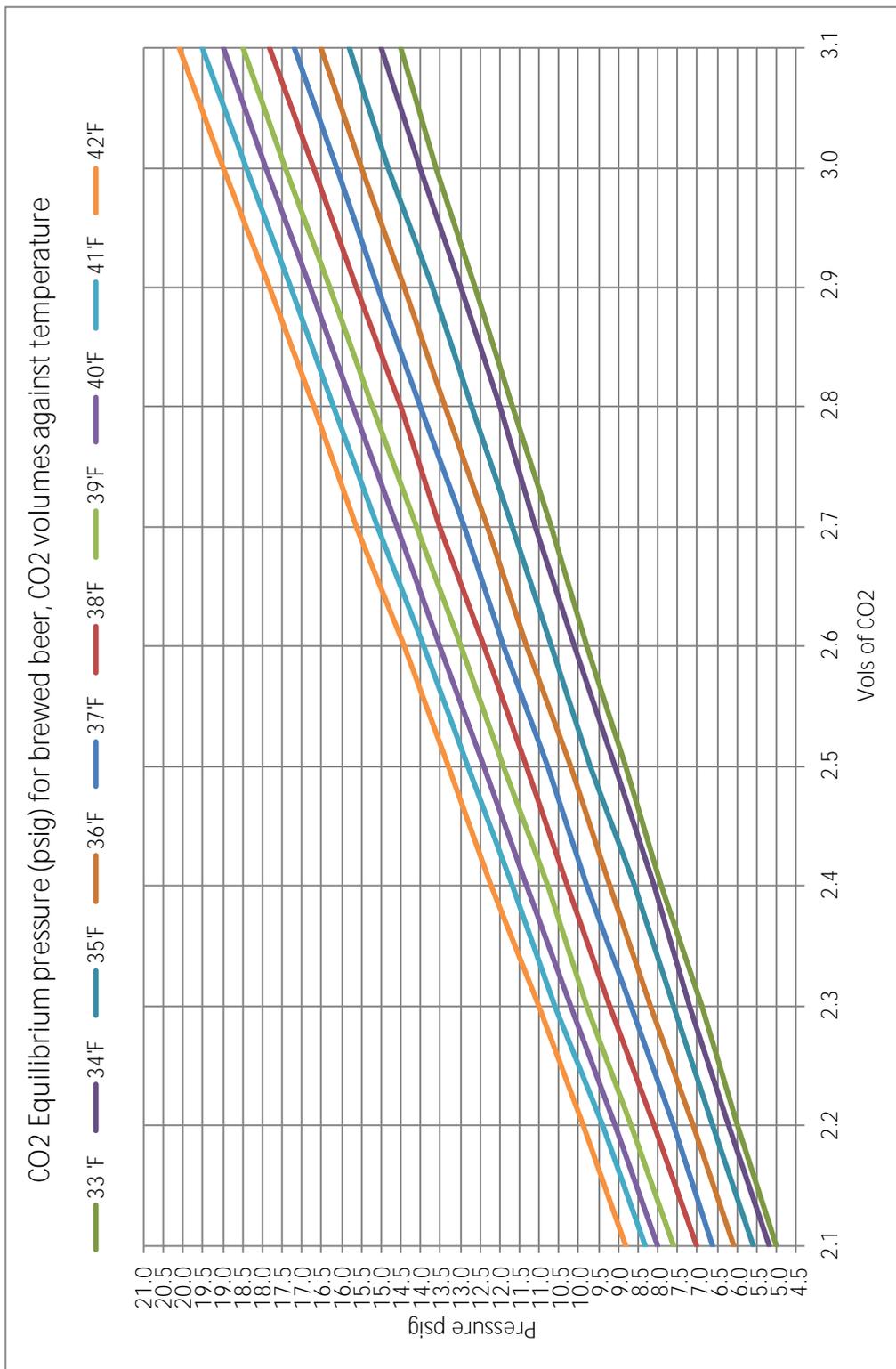
**Correct Partial Pressure of CO<sub>2</sub> gas**—A critical point to understand is that the correct partial pressure of CO<sub>2</sub> is what is required to maintain the beer quality. When CO<sub>2</sub> content in beer is changed, the beer changes, the taste changes and beer will be wasted. When the Beer is delivered from the Brewery it should be perfect, if subsequently the dissolved CO<sub>2</sub> content in the beer changes, the quality and consistency reduce and the costs associated with dispensing it increase.

**Nitrogen gas**—Nitrogen is much less soluble than CO<sub>2</sub> in Beer. So it is naturally a good choice to use for dispensing normally carbonated beers. It does not react chemically, where air does and it is readily available. It is critical for beers brewed with nitrogen in them, to stop N<sub>2</sub> coming out of solution and it can be used to provide the additional pressure to make a total effective pressure to move beer from a keg to the point of dispense without upsetting the natural CO<sub>2</sub> content of the beer.

**Nitrogen molecules are around 100 times less soluble in beer than CO<sub>2</sub> at the same temperatures. This means that you can use the N<sub>2</sub> molecule partial pressure to move the beer to the point of dispense whilst maintaining the CO<sub>2</sub> partial pressure perfectly in the keg.**



# CO<sub>2</sub> Equilibrium pressures in Beer?



The attached table indicates the approximate equilibrium pressure of beer with different CO<sub>2</sub> volumes and at temperatures between 33 and 42°F.

These are the effective partial CO<sub>2</sub> pressures you would have to start with when considering the calculation of the overall effective keg pressure you need to dispense your beers.

The numbers are approximate and make some assumptions about altitude and the beer.

Sea level altitude is assumed. A specific gravity of beer of 1.015 and a typical alcohol content of 4.8% abv.

Carbonation is proportional to absolute pressure not gauge pressure. Atmospheric pressure decreases with elevation so to achieve proper carbonation above sea level, we need to compensate by adding 1 psi for every 2000 feet additional elevation.

**For example...**

- With a 2.5 volume beer and 38°C
- \* at sea level...11.3 psi g
- \* at 4000ft...13.3 psig

# Mixing Gases for Beer Dispense

**Sales / General Enquiries -**  
David Blanchard  
(Managing Director)

**Technical / Engineering -**  
Keith Kerwin  
(Engineering & Quality  
Director)

**Manufacture / Sales -**  
Chris Tring  
(Production & Safety  
Director)

**We would like to thank you  
for  
reading through this  
information pack.**

**We hope it has been helpful  
but please don't hesitate to  
contact us if you have any  
questions.**

**Beverage  
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