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Hey! This site is reader-supported and we earn commissions if you purchase products from retailers after clicking on a link from our site.If an air compressor generates 4 CFM of compressed air at 90 PSI, how much does it generate at 50 PSI, for example? That's what this page is all about. Calculating CFM output at various pressure levels for air compressors!Over the years, I have received many requests for information about calculating CFM at different pressures. Almost all compressor manuals that have compressed air output information provide it at 90 PSI and sometimes at 40 PSI. Knowing the air compressor output at 90 PSI output is good since many air tools are rated on their air consumption at that pressure.But, what if you want to know how much your compressor puts out at 55 PSI or 20 PSI? Turns out this isn't all that easy to figure out using the math, yet I've tried to help as much as possible below.Table of ContentsWhat engineers DO agree on about Air Volume vs Pressure:In a perfect world, if you half the volume, you double the pressureIn a perfect world, if you double the volume, you half the pressureWe don't live in a perfect world, and this simplistic view doesn't apply to flowing air.What engineers DO agree on about CFM to PSI relationship:The CFM at the air compressor outlet will increase if you reduce the outlet PSIThe CFM at the air compressor outlet will decrease if you increase the outlet PSIThe exact mathematical relationship between CFM versus PSI has lots of noise factorsIt would be nice if it was as simple as "if you half the PSI at the outlet, you double the CFM at the outlet" but it's not.The relationship between PSI to CFM isn't this simple because:Temperature also changes!The pressure inside the compressor air tank changes as air flows!PEOPLE GET CONFUSED ABOUT THE QUESTION!I wrote another article going into depth about what CFM actually means on an air compressor to help combat some of the confusion. So if this article feels like I'm jumping ahead, check out my explanation of CFM on Air Compressors.Lots of well-meaning engineers often chip in on this subject but often forget which part of the compressed air system the air compressor pump is designed to produce air at a certain flow rate and a certain pressure efficiently. If we change the pressure for CFM that the air compressor pump needs to operate at - we'll have lots of efficiency losses. Meaning the relationship between CFM and PSI gets very complex.However... let's ignore the air compressor pump for a moment and just concentrate on the compressed air tank.If a compressed air TANK has a regulator attached to it which is set to 90 PSI and the air in the tank is always kept between 90-130 PSI - let's say that the CONTINUOUS CFM out of the regulator is equal to "x". If you then adjust the air pressure regulator to 45 PSI and the air in the tank is once again always kept between 90-130 PSI..The CONTINUOUS CFM out of the regulator is now = 2\*x (approximately)\*This approximation is SOUND.REGARDLESS of what the CFM of the Air Compressor PUMP is.Note: This is still an approximation as temperature change IS a factor and the air also contains moisture molecules etc. It's not a "perfect gas". The above scenario does however rely on the fact that the air compressor pump has an average CFM of above x when replenishing air into the air tank at 90-130 PSI..So... to summarise the cubic feet per minute to psi question - it depends highly on where you're measuring.At the air tank outlet the relationship between CFM to PSI is inversely proportional... so to say:if CFM doubles, PSI halvesif PSI doubles, CFM doublesThis is a whole other equation which is far more to do with the mechanical configuration of the pump which will be designed to operate at a specific range of PSI and CFM and therefore the relationship of cubic feet per minute to PSI won't even approximately be linear!The actual relationship between PSI and CFM of the air compressor pump when it's refilling the tank from 90 PSI to 130 PSI isn't actually of much interest to a user - as it's the CFM at the outlet of the air pressure regulator that matters.The CFM and PSI at the outlet of the air pressure regulator have no relationship to the CFM and PSI capabilities of the air compressor PUMP in the event that:The CFM demand at 90 PSI in the above example is less than the stated CFM of the compressor at 90 PSI!This is because the air compressor tank decouples the CFM rating of the air compressor pump from the CFM flowing out of the air pressure regulator.Remember - when you read lots of "misinformation" out there about PSI vs CFM of an "air compressor" without the writer having specified where in the system the CFM and PSI are being measured, there's space for everyone to be right, and everyone to be wrong all at the same time.Ask yourself:Are they talking about the CFM versus PSI on the Air Compressor PUMP outlet?Are they talking about the CFM versus PSI on the Air TANK outlet/ Air Pressure Regulator Outlet?The relationship between CFM and PSI for those 2 different parts of the pneumatic system is COMPLETELY different.The rest of this article speaks to the levels of confusion that the subject of PSI versus CFM for air compressors can cause!Remember: The compressor pump CFM is what's specified in the user manual or the product specification. 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"Having not been able to find a conversion table, I had to rely on the Ideal Gas Law:PV = nRTWhere:P = pressureV = VolumeT = Temperature = amount of gas presentn = a constant depending on the units used for the other variablesAir is a mixture of gases and water vapor so would deviate from this law based on humidity and the molecular properties of the gases present. This law is also not generally applied to a flowing gas.Assuming constant temperature, a simple interpretation of this law is that pressure is inversely proportional to volume.So, for example, with a compressor rated to output 24 CFM at 175 PSI, I got a result of 52.5 CFM at 80 PSI. I consider this a very rough approximation."I was finding this puzzling for my limited math skills so I asked the contributor:"Thank you! Would you mind explaining the steps? 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And thank you again to the anonymous contributor.With my decided lack of math skills, it's my opinion that knowing how much CFM an air compressor is generating at any pressure, and if knowing this is critical to your use of the compressed air, then the first choice is acquiring an airflow meter. For compressed air, use knowing the amount of flow out of the fitting and the pressure of the air in that flow is what we want.The pressure of the air in the flow to be tested is controlled by the regulator at the compressor discharge. If there were a long airline between the on-compressor regulator and the point of air use, I would be inclined to install the regulator at the air tool end, ensuring the pressure of the flow at that point.Between that regulator and the point of use, install an in-line flow meter. There are many makes and manufacturers out there, so Google compressor airflow meter and find one that suits your needs.Here are a few inputs from visitors to the website:"Hi Bill, Just found randomly your page about Calculating CFM and I think you should correct it because the entire idea exposed is wrong.The key factor here is that the capacity of a compressor is always expressed at atmospheric pressure, not discharge pressure. A capacity of 20 CFM means that the compressor can suck up 20 cubic feet of air at atmospheric pressure every minute. Then it will compress this volume to the final operating pressure. So if the manufacturer indicates a capacity of 18 CFM, it will always be that, no matter the operating pressure.But actually, this is not completely true because there will be a slight variation due to volumetric efficiency loss. As you increase operating pressure, the temperature rises in the pump, and volumetric efficiency decreases, leading to a little decrease in capacity. This is why some manufacturers will post for example a capacity of 20 CFM at 90 psi and 18 CFM at 125 PSI for the same compressor.You cannot calculate it, you must measure it. So if you ask yourself "How much CFM my compressor will deliver if I use it at 50 psi and the manufacturer posted a capacity of 20 CFM at 90 psi?" Then... it will be quite the same capacity, maybe a few CFM more. Hope this info is useful."Source: Alexandre Pare, ing., Conseiller technique, www.airindustriel.com"Hi:Ok, I have it. Here are the basics - the airflow and CFM are based upon three things:1. The larger the tank, the greater the supply of air (longer supply of CFM for a more gradual drop in pressure). This is the "capacitor" or "flywheel" in the system. However, this is only the "time" relationship. If you know your pressure and just want CFM, you don't care about the tank size.2. Separate the Tank from the compressor (ie, the compressor is off). The relationship between CFM and PSI is just linear. 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I appreciate the contribution to this seemingly increasingly complex issue which is important to all air compressor users.Are they right... can you or can you not use math to calculate the CFM of different air compressors at different output pressures, or is a flow meter your only option?The Proper EquationThe proper equation would be the Bernoulli equation:P + 1/2\rho v\_1^2 + pgh = P\_2 + 1/2\rho v\_2^2 + pghWhere P is pressure for instances 1 and 2, v is their respective velocities, rho (rho) is a constant that you must find, and for the purposes of air compressors, g and h are not needed as we are assuming that gravity (g) is a constant and the heights (h) at which all the measurements are taken do not change. So, the last term is not needed and the new equation is:P + 1/2\rho v^2 = P\_2 + 1/2\rho v\_2^2 A small caveat of this method, you absolutely must have two provided values from the manufacturer.As an example, the Husky 30 gal. electric air compressor (model: C303H) has 6.8 CFM at 40 PSI, and 5.1 CFM at 90 PSI, but I'd like to know what CFM it has at 23 PSI to utilize a DeVilbiss Finishline 4 HVLVP paint gun (model: FLG-670), which requires a minimum of 13 CFM at that PSI to run properly (per manufacturer specifications).First, I must find out what p is for this specific air compressor, so I fill my equation for all known values:40 + 1/2\rho(6.8)^2 = 90 + 1/2\rho(5.1)^240 + 1/2(46.24p) = 90 + 1/2(26.01p)46.24p = 100 + 26.01p20.23p = 100p = 4.943\*\*no need to worry about units, so long as you stick with PSI and CFM, everything cancels out with the use of rho.Next, use one of the known values, our newly found rho, and the desired PSI to find our resultant CFM:40 + 1/2(4.943)(\rho)^2 = 23 + 1/2(4.943)(\rho)^2\rho^2 = 53.118\rho = 7.28 CFMAs we can see, this air compressor will not work for my application and I will need to find a more powerful compressor.Each time new values are provided for the initial PSI and CFMs, you have to solve for rho to be able to find the accurate CFM of the desired PSI.You can always double-check your work as well. 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Using this formula, you can get an idea of how much compressed air your air compressor will provide at a variety of pressures.How many CFM do I need a compressor?The majority of air tools made for general use with portable air compressors will generally require 0 to 5 cubic feet per minute (CFM) at 70 to 90 pounds per square inch (PSI), while larger tools connected to stationary systems, the requirements usually exceed 10 CFM at 100 to 120 psi.How do you calculate CFM from PSI?To calculate CFM from PSI on your air compressor, measure the time taken in minutes for your air compressor to "fill", let's call this figure T. Once you have the time taken between your air compressor starting (cut-in pressure) and stopping (cut-out pressure) you can begin the next phase of calculation. Minus the cut-in pressure, in PSI from the cut-out pressure, also in PSI, this gives you a single PSI figure. Multiply this PSI figure by 14.7 (1 atmosphere in PSI), let's call this number Vx. Now you need to calculate the volume of your compressor tank in Cubic Feet - this calculation will be unique to your tank's size and shape. You then need to multiply the tank volume by the figure Vx you calculated previously. This gives you the volume of the air at atmospheric pressure. Let's call this figure Va. Now you can divide this figure by the time you measured earlier (T) giving you Va/T = Cubic Feet Per Minute.Additional CFM reading:What size air compressor:I need to know how to calculate the CFM of my air compressor and the ratio at which it needs to work in correspondence with the psi.Michael, the rule of thumb is you get about 4 CFM of compressed air at 90 PSI for each HP of electric motor size.Since I have no idea of the make or model of your air compressor, I can offer no more than that.Please see the sitemap page for links to pages that provide much more info.Why/how does the CFM increase as PSI decreases and vice versa?Mickey, very good question, and one that has been responded to many times on this site.There are a number of pages on this site that address this issue - I hope the above information on this page will serve to answer your question in detail!!I can tell you that there are a number of methods to calculate this, some suspect (the one I suggested?) and some quite complex.Please have a look and then come back with your comment.And last, but certainly not least... here's a link to a blog post from Exair that offers a formula to calculate CFM at any pressure!!If you have any questions regarding how to calculate CFM of compressor, please leave a comment below, with a photo if applicable, so that someone can help you! Hey! This site is reader-supported and we earn commissions if you purchase products from retailers after clicking on a link from our site.If an air compressor generates 4 CFM of compressed air at 90 PSI, how much does it generate at 50 PSI, for example? That's what this page is all about. Calculating CFM output at various pressure levels for air compressors!Over the years, I have received many requests for information about calculating CFM at different pressures. Almost all compressor manuals that have compressed air output information provide it at 90 PSI and sometimes at 40 PSI. Knowing the air compressor output at 90 PSI output is good since many air tools are rated on their air consumption at that pressure.But, what if you want to know how much your compressor puts out at 55 PSI or 20 PSI? 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So, the last term is not needed and the new equation is:P + 1/2\rho v^2 = P\_2 + 1/2\rho v\_2^2 A small caveat of this method, you absolutely must have two provided values from the manufacturer.As an example, the Husky 30 gal. electric air compressor (model: C303H) has 6.8 CFM at 40 PSI, and 5.1 CFM at 90 PSI, but I'd like to know what CFM it has at 23 PSI to utilize a DeVilbiss Finishline 4 HVLVP paint gun (model: FLG-670), which requires a minimum of 13 CFM at that PSI to run properly (per manufacturer specifications).First, I must find out what p is for this specific air compressor, so I fill my equation for all known values:40 + 1/2\rho(6.8)^2 = 90 + 1/2\rho(5.1)^240 + 1/2(46.24p) = 90 + 1/2(26.01p)46.24p = 100 + 26.01p20.23p = 100p = 4.943\*\*no need to worry about units, so long as you stick with PSI and CFM, everything cancels out with the use of rho.Next, use one of the known values, our newly found rho, and the desired PSI to find our resultant CFM:40 + 1/2(4.943)(\rho)^2 = 23 + 1/2(4.943)(\rho)^2\rho^2 = 53.118\rho = 7.28 CFMAs we can see, this air compressor will not work for my application and I will need to find a more powerful compressor.Each time new values are provided for the initial PSI and CFMs, you have to solve for rho to be able to find the accurate CFM of the desired PSI.You can always double-check your work as well. If you place the rho and 5.1 in instead of the 40 and 6.8 when solving for v\_2, you should come up with the exact same value for v\_2.This is actually how I found that the original equation: P = K - 1/2\rho did not work. I ran the P and V for a different air compressor through to solve for K and then used the second set of P and V, but I did not come up with the same value for K.40 = K - 1/52.90\rho = K - 1/4K = 208 K = 3601 thought that maybe it was a proportionally equivalent value to the difference in CFMs, however, the proportions come out to 1.731:1 for 360:208, as compared to 1.3:1 for 5.2:4, which performs as a proof, thus invalidating this equation.I hope this clears things up. Please don't hesitate to ask if I didn't make something clear. Happy to help.LukasHow do you calculate CFM?Calculating air compressor CFM is complex. It's possible to estimate the CFM coarsely by using the ideal gas law PV = nRT. Using this formula, you can get an idea of how much compressed air your air compressor will provide at a variety of pressures.How many CFM do I need a compressor?The majority of air tools made for general use with portable air compressors will generally require 0 to 5 cubic feet per minute (CFM) at 70 to 90 pounds per square inch (PSI), while larger tools connected to stationary systems, the requirements usually exceed 10 CFM at 100 to 120 psi.How do you calculate CFM from PSI?To calculate CFM from PSI on your air compressor, measure the time taken in minutes for your air compressor to "fill", let's call this figure T. Once you have the time taken between your air compressor starting (cut-in pressure) and stopping (cut-out pressure) you can begin the next phase of calculation. Minus the cut-in pressure, in PSI from the cut-out pressure, also in PSI, this gives you a single PSI figure. Multiply this PSI figure by 14.7 (1 atmosphere in PSI), let's call this number Vx. Now you need to calculate the volume of your compressor tank in Cubic Feet - this calculation will be unique to your tank's size and shape. You then need to multiply the tank volume by the figure Vx you calculated previously. This gives you the volume of the air at atmospheric pressure. Let's call this figure Va. Now you can divide this figure by the time you measured earlier (T) giving you Va/T = Cubic Feet Per Minute.Additional CFM reading:What size air compressor:I need to know how to calculate the CFM of my air compressor and the ratio at which it needs to work in correspondence with the psi.Michael, the rule of thumb is you get about 4 CFM of compressed air at 90 PSI for each HP of electric motor size.Since I have no idea of the make or model of your air compressor, I can offer no more than that.Please see the sitemap page for links to pages that provide much more info.Why/how does the CFM increase as PSI decreases and vice versa?Mickey, very good question, and one that has been responded to many times on this site.There are a number of methods to calculate this, some suspect (the one I suggested?) and some quite complex.Please have a look and then come back with your comment.And last, but certainly not least... here's a link to a blog post from Exair that offers a formula to calculate CFM at any pressure!!If you have any questions regarding how to calculate CFM of compressor, please leave a comment below, with a photo if applicable, so that someone can help you!

