EXAIR® WHITE PAPER

Compressed Air Open Blowing

Saving Compressed Air System Capacity through Implementation of Engineered Compressed Air Blowing Solutions

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Why is compressed air system capacity so important?

Compressed air is a limited resource that is generated in-house for the benefit of many operations within the manufacturing environment. This resource must be shared among various users who have different needs when it comes to cleanliness, pressure and volumetric flow. To meet the compressed air resource needs facility-wide, a set of guidelines or policy must be established to insure all point of use applications are evaluated to determine if a compressed air based solution is really the best one and if so, whether it is the most effective and efficient method of using compressed air to achieve the application objective. Without some guideline to follow, individual applications tend to be handled in rather haphazard ways with ineffective solutions that are not energy conscious.

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The following is an analogy to help develop a better understanding of the extent to which home-made solutions in a compressed air system can cause problems by creating more demand from the compressed air system than is necessary while producing poor or zero results.

Imagine that you want to water your lawn based on the understanding that if you water your lawn that will help it to become the lush green landscape that you want. Imagine also that your chosen method of watering the lawn included turning your hose bib on all the way and simply laying the end of the hose in the middle of your yard and never turning it off.

You're applying water to the yard, right? What do you expect to happen? That's right, not much. If anything, you will have a water bill that has gone through the roof and you will have a single stripe of green where the water has trickled down through the yard, surrounded by a desert of dry grass. Certainly, not the result that you had envisioned. What went wrong? You were applying water to the lawn and you were making sure there was plenty for the grass to grow.

The problem lies in the approach. A more well thought out approach, using the proper tools (a sprinkler and a timer valve) that are engineered for the task is what is needed to be successful in the above scenario.

While the above situation comes across as being extreme for reasonable consideration; apply this same thought process to a compressed air system. The scenario suddenly isn't all that far-fetched. Unregulated compressed air pouring out of a copper pipe or a hose onto a production line that is not currently producing any value happens more often than most maintenance personnel will admit. In the past, simply walking by and ignoring the tremendous waste taking place has been the norm. Since compressed air isn't a liquid that is pouring out all over the floor or machinery the usual reaction is no one pays much attention. This is the classic definition of Open Blowing – an unregulated hose or pipe used for cooling, drying, clean-up or any one of a variety of miscellaneous tasks performed in manufacturing and which has no mechanical or electrical means to be shut off when not in use.

Open Blowing is another area that can benefit immensely by applying a policy ... with an eye toward energy efficiency.

With the cost of energy going up steadily, much has been written about compressed air system leaks and leak audits as part of a comprehensive, organization-wide energy management program. Open blowing is another area that can benefit immensely by applying a policy of education of personnel as well as evaluation of applications with an eye toward energy efficiency. Utilization of engineered products and methods to apply a multi-layer level of control over compressed air flows to reign in energy use for open blowing applications is the root idea.

Energy Input Component of a Compressed Air System

When you look at the overall costs to purchase, maintain and operate an air compressor system over time, about 3/4 of the cost is attributed to energy use and only 1/4 is for purchase and maintenance. It takes 7 - 8 kW of power input to generate 1 kW of power output from a compressed air system. These figures should stand out to anyone concerned with their facility's overall energy use and compressed air system specifically as being significant and should drive decisions to look at all uses of compressed air within their compressed air system.

How Much Does Your Compressed Air Cost to Produce?

If you would like to make a detailed survey of your facility's compressed air cost, this formula used by the U.S. Department of Energy will help:

$$\text{Cost (\$)} = \frac{(\text{bhp}) * (0.746) * (\text{number of operating hours}) * (\$/\text{kWh}) * (\%\ \text{time}) * (\%\ \text{full-load bhp})}{\text{Motor Efficiency}}$$

bhp – Full load Horse Power rating of motor (this value is usually higher than the HP rating on the nameplate of the motor. Consult the equipment specifications for this value.)

0.746 - 1 HP = 0.746 kW

% time – this is the portion of overall time that the compressor operates at this load level.

% full-load bhp – bhp as a percentage of full-load bhp at this operating level.

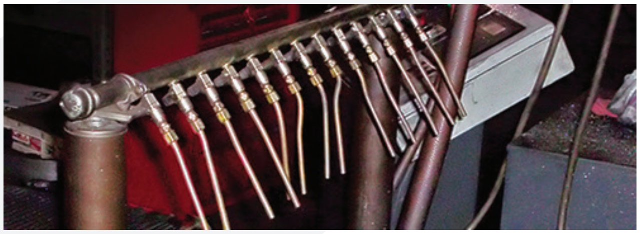
Motor efficiency – motor efficiency at the prescribed operating level.

Age of air compressor equipment, efficiency of that equipment, the type of electrical customer your facility for the local electrical supplier and your regional location within the country all play a significant role in the outcome of your calculation.

For many folks, the above calculation can be distracting from the core understanding that puts the cost of compressed air into a relatable and quickly usable format. The cost of compressed air can be broken down into a cost per 1000 SCF (Standard Cubic Feet) generated. Accounting for the above variables, a reasonable range is anywhere from 15 to 30 cents / 1000 SCF. A reasonable value to use for purposes of making energy savings calculations is $ .25 per 1000 SCF.

How to Use This Information

In general, this information is normally used to make decisions about project payback for replacing home-made "open blowing" devices. These are typically cobbled together without a full understanding of the impact of such "solutions" on the energy consumption profile for a facility.



See Example on Next Page

Example: A 1/8", schedule 40 pipe nipple is used to blow continuously at a trimming die to eject aluminum waste material out of the area before the next part is inserted for the trimming application. The 1/8" pipe nipple operating at full line pressure of 80 PSIG will exhaust 70 SCFM of compressed air. If you multiply that per minute rate by 480 minutes (the number of minutes in an 8 hour shift) you get a total of 33,600 SCFM of compressed air used during that one shift. Multiply 33,600 SCFM x $ .25 / 1000 SCF = $8.40 to operate that pipe nipple for one shift. That in and of itself doesn't seem like a huge number, but when you multiply that by two shifts per day and 52 weeks per year that $8.40 turns into $4,368.00 per year to operate. And that is for only one pipe nipple. Most production facilities will usually have multiples of similar operations like this to effect production economies of scale.

••• an engineered nozzle has the capacity to reduce that 70 SCFM figure down to 10 SCFM.

In this example, the simplest of solutions, a "bolt on" product in the form of an engineered nozzle has the capacity to reduce that 70 SCFM figure down to 10 SCFM. That is 14.3% of the original energy cost or $626.62 per year. There was no difficult thought process to go through or special talent required to illustrate this example. It is a true definition of "low hanging fruit" when it comes to mitigating the high cost effect of open blowing.

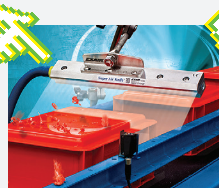
What is the definition of an engineered nozzle?

For the purpose of this article, we want to make a comparison to other forms of what I will term a commercially available "nozzle". A commercially available "nozzle" could refer to any metal fitting or somewhat modified pipe plug that may or may not have a cross-drilled hole for safety. Many times, the "nozzle" will not be designed for use with compressed air specifically. There are many times when a nozzle designed for liquid delivery is used for compressed air delivery. The companies that offer them, do not specialize in point of use applications for compressed air. Rather, the producer's focus is on liquid delivery, automation, hardware, or some other specialty that is completely unrelated to the pneumatics industry. Such providers simply seek to jump onto the bandwagon to provide a me-too solution.

Select from the products on the right to learn more

EXAIR.com®

Super Air Amplifiers

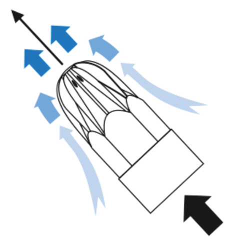


Super Air Knives

Super Air Wipes

Safety Air Guns

In all of the above cases, the item ended as a “nozzle” has not been given proper vetting regarding safety, air consumption, force generated on the target, sound level or effectiveness and overall efficiency within the production environment.



To contrast against the description above, an engineered compressed air nozzle solution is a nozzle design which has been carefully thought through to determine the most effective and efficient use of the compressed air needed to power it. First and foremost, the nozzle is designed to be used with compressed air as the utility. You might think that should go without saying, but it is possible that what is termed a “nozzle” is an adaptation of a liquid nozzle which have very different features and concerns. With this in mind, an engineered nozzle will generally start with the pipe size the air nozzle is intended to be installed onto. From that point, a force range, air consumption level and sound level that are considered appropriate for the nozzle connection size are selected. Once these factors are determined, an actual design that incorporates safety features into the body of the nozzle is conceived. These safety features are then included into nozzles made for larger and smaller pipe sizes to enable a complete “family” of products to deliver a wide variety of force, flow and noise levels on a consistent basis. It is important to explain this to drive home the point that not all “nozzles” are created with the same attention to these details.

There's More!

Remember, the “bolt on” solutions are the low hanging fruit in the quest to reduce the operational cost associated with open blow offs. With a little more thought applied to the problem solving process, further significant savings can be realized through the process of turning the air on and off at predetermined times relevant to the process needs. Remember, in the example above we are assuming constant operation at 80 PSIG for the full duration of an 8 hour shift.

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If however, in our example, we made a quick and easy time study to determine the true need for the air blowing, we could determine that out of each minute of operation we only need the air to be on for a total of 4 seconds out of every 10 seconds. In other words, the cycle time for the trimming die to operate is 10 seconds. The die is open for 4 out of those 10 seconds.

The other six seconds that the die is closed, the air is not doing any work. This means that the air nozzle only needs to be on for 24 seconds out of every minute, a 40% duty cycle for the application. With this in mind, we can apply that duty cycle to the air consumption of the engineered nozzle solution. That figure was 10 SCFM @ 80 PSIG. So, multiply 10 x 40% and you get 4 SCFM of actual need. If the energy cost with the engineered nozzle operating full time is $626.62 per year, then $626.62 x 40% = $250.65 per year to operate intermittently using a few, inexpensive controls. This value is only 5.7% of the original cost to run the 1/8 pipe nipple. Conversely, this is a 94.3% energy savings compared to a non-engineered method.

Compounding Interest

You have probably heard of this term from a financial perspective that the dividends earned through an initial investment are added back into the total and reinvested for further or compounded benefit of the account holder.

Simple improvements made at the point of compressed air use within a facility as outlined in the example have a similar compounding effect on the rest of the compressed air system too. How? A prudent air compressor maintenance schedule is run off an internal clock that keeps track of the number of hours of operation. If an air compressor does not have to run longer and harder to keep up with compressed air demand that isn't really necessary, you have less frequent maintenance intervals for the compressor, aftercooler, air dryer and filters. Less downtime for maintenance on all of these items is also a time and money savings. If an air compressor is not trying to keep up with an artificially high air demand, the pressure in the whole system stays more consistent. Providing consistent pressure allows all the processes that depend on the compressed air system to operate in a more consistent manner which is good for the overall health of the production process to be stable. In many cases, the system-wide pressure can also be reduced which further reduces the necessary energy input. For every 2 PSIG reduction in pressure that can be achieved, the energy input requirement drops by 1%. That can lead to significant savings for many facilities that operate more than 5 – 10 PSIG over their actual needs.

Everyone Has Skin in the Game

With such possible achievements as lower overall operational cost and more stable processes at stake, every department within a given facility stands to benefit from improvements to compressed air systems from reduced scrap material or non-conforming parts to enhanced reputation for quality due to more stable processes as a result. For this reason it is desirable to get buy-in from all departments to commit to a central policy on compressed air use. Everyone within a production site can contribute to safe, efficient and effective compressed air use, not just maintenance personnel.

Conclusion

Compressed air is one of the most useful utilities available in the production environment. It allows users to pack a lot of energy into a small space which makes many job functions much easier to perform. It is also one of the most expensive to produce. The methods for controlling its use in open Blowoff applications can range from the simplest of "bolt on" products to PLC and sensor based controls. Simple planning using facility-wide policy and a true desire to be energy efficient along with some good resources to find the right engineered solutions is all it takes to be successful for your organization in this way.

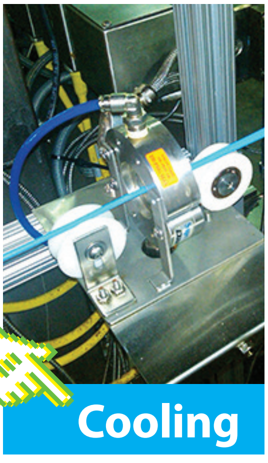
INTELLIGENT COMPRESSED AIR® Products

SUPER AIR NOZZLES

Select from the products below to learn more

What are some typical applications that use these types of products?

As previously mentioned these products excel at using compressed air safely and efficiently for applications such as blowoff, cleaning, drying, cooling, ventilating, circulating, part ejection, part manipulation and environmental separation.


Cooling


Drying


Environmental Separation

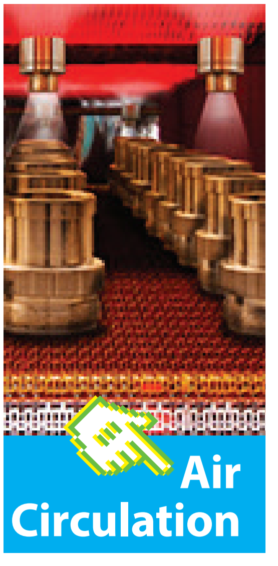

Blowoff


Cleaning


Ventilating


Part Ejection


Part Manipulation


Air Circulation

Technical Support

EXAIR has a staff of application engineers ready to assist you in selecting the appropriate model for your application.

They can be contacted at **1-800-903-9247**.
Or you can email them at **techelp@exair.com**