How Green Are You?

Improve Operating Efficiency.

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Can operating a profitable company also be environmentally friendly? For most companies, the idea of protecting the environment and conserving natural resources brings to mind expensive renovations and higher operating cost. The information contained in this booklet should serve as a guide and offers a starting point for identifying ways to green up your plant. One smart way to help the environment and lower operating costs is to shine a spotlight on the air compressor system powering much of a plant's equipment.

Compressed air is used throughout many modern industrial facilities, and goes unnoticed until there is a problem. A closer look at the air compressors in most facilities reveals many simple opportunities to make quick, high-impact changes that will lower power costs and keep air-powered equipment operating reliably. A systematic approach helps uncover the best steps to take based on the current situation. Start by understanding the true cost of compressed air - it really is not free! Whether you are specifying a new system or evaluating a current one, the three target opportunities for positively impacting the environment come from making informed choices in regards to system energy efficiency, maintenance and air treatment accessories.

OPPORTUNITY NUMBER ONE: Determine Full Load kW

Why? Electrical equipment requires energy to operate, and energy costs money. How much energy is directly related to the work the equipment does, or in this case, the full load kW of the air compressors. A typical operation in a typical manufacturing facility requires a compressor between 5 and 15 horsepower (20 to 70 CFM). Air compressor manufacturers rate their equipment based on both the horsepower and air capacity (cfm or l/min).

To get an idea of the actual cost to operate an air compressor, users are left to interpret the horsepower rating of each compressor model. For instance, why does one five horsepower compressor cost about a third as much as another? A close examination of the motor nameplate and air capacity of each quickly reveals that the two compressors are not really alike.

To obtain the real cost of operation, examining the motor nameplate is the first place to start. The nameplate will reveal the voltage, operating amperes, nominal efficiency, power factor and the service factor of the motor. By comparing the efficiency, nominal amperes at the rated voltage, a determination of the full load kW can be made. Below is the typical nameplate data on a 5 HP motor:

Rated Horsepower - 5
Volts - 230 Amperes - 13.8
NEMA Efficiency - 87.5 Service Factor - 1.15

To calculate what the weekly, monthly, or yearly cost to operate the compressor the most common formula is:

Full Load kW
x Total loaded running time
x cost per kWh

To calculate full load kW, we need to know the

Full Load Calculation Shortcut

Look at the compressor motor nameplate and locate the following information:

- Nameplate HP
- Volts
- Amps
- Efficiency
- Service Factor

Use this equation to determine the approximate full load kW:

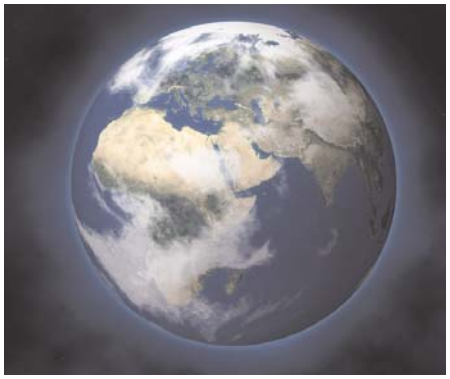
Full load kW) = (HP X 1.1 X .746) / motor efficiency

The result is in kw, and the $/kWh value of power is listed on a recent power bill. Complete the exercise by inserting the appropriate values:

$/hour of operation =
Full load kW X total running time X cost per kwh

full load brake horsepower of the motor. Full load brake horsepower is a term that measures the mechanical work that the motor is consuming. Most compressor manufacturers do not publish full load brake horsepower (bhp), so what do we do?

To get an estimate of operating cost, we can use the motor nameplate horsepower, as in our 5 HP example. Most air compressor manufacturers will use what is called the service factor of the electric motor to provide extra power to the air compressor and compensate for pressure drop, wear and high-temperature operation. The service factor is a designed-in overload factor that allows the motor to operate above the nominal nameplate rating.



Some motors are rated as continuous duty and can perform normally in the service factor. It is important to note this on the motor nameplate, as it explains how some air compressors are rated (intermittent versus continuous). The nameplate on the example motor shows a service factor of 1.15. Air compressor manufacturers will typically use 7-10% (1.07 - 1.10) of the overload capacity of the motor to generate extra power and keep the balance (5-8%) in reserve for high-temperature and low voltage operation.

So for full load brake horsepower, we will simply take 5 HP X 1.1 which equals 5.5 full load bhp. Now we need to convert this value to full load kW and we do this by multiplying the full load bhp by .746 (kW conversion factor) and divide by motor efficiency (remember this from the nameplate information). So for our example, we plug in the numbers as follows:

(5.5 (full load bhp) X .746 (kW conversion factor)) / .875 (motor efficiency) = 4.68 (full load kW)

Let's figure that the compressor will run a total of 26 loaded running hours each week and our last electric bill had a $0.11 per kWh charge. If the power bill doesn't list a cost per kW figure, simply divide the total power bill in dollars by the total number of hours. This is commonly known as "blended power" in the industry. Now we are ready to figure the estimated cost to run our compressor by the following:

4.68 (full load kW) X 26 (loaded running hours) X $0.11 per kWh = $13.38 cost /week

The reason you want to know or estimate the loaded running hours is simple; when the compressor is off and not compressing air, you don't have any electricity being used by the compressor, so you are not paying anything. This is why the compressor output is important to you. You may not know how many hours your compressor is running loaded (compressing air). A good rule of thumb is 75% running loaded and 25% off (this is a 75% duty cycle). This means if you have one 8-hour shift operation the compressor is running loaded a total of 6 hours a day or 30 hours for a 5 day work week.

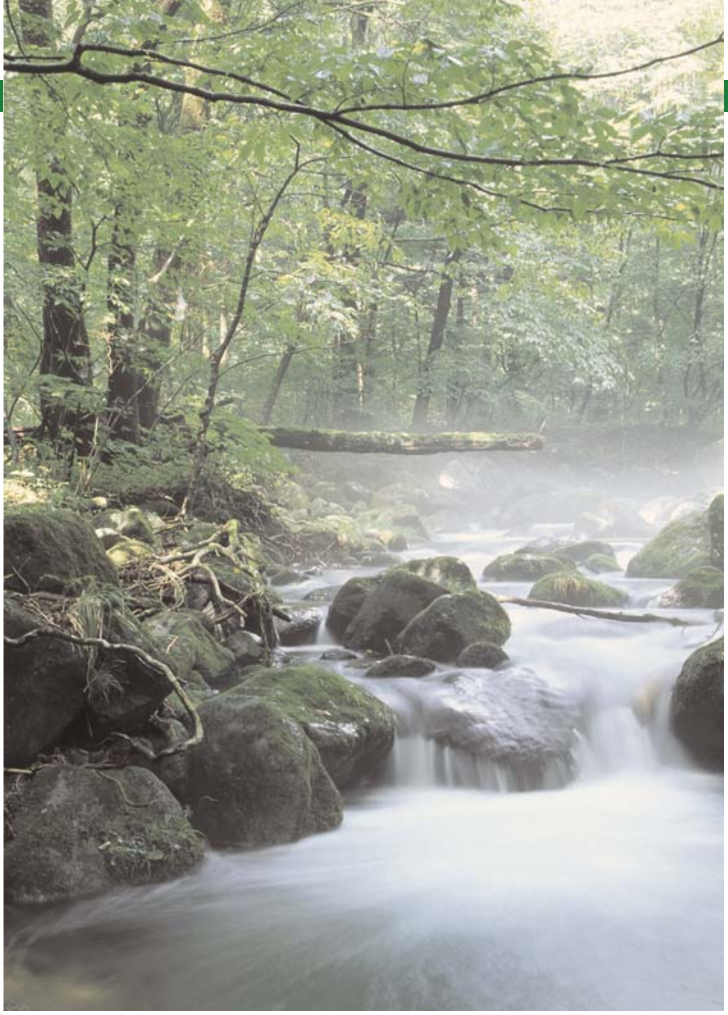
So what determines how long the compressor runs loaded, simply, how much air the compressor delivers versus your air consumption or your demand? You can use the above operating costs formula to evaluate estimated operational expense, and the key is to keep your duty cycle as low as possible without going below 60%. The compressor is designed to run and come up to operating temperature which helps eliminate problems with moisture.

OPPORTUNITY NUMBER TWO: Determine Maintenance Investment

Why? All mechanical equipment requires maintenance, and air compressors are no exception. Saving a few dollars on the initial investment can sometimes haunt a company when the bargain equipment is constantly being worked and repaired. Like the investment in a high efficiency piece of equipment, selecting a reliable air compressor will be a decision that could save money for decades. Plus, consider the types of parts replaced during routine maintenance for environmental impact and ease of disposal.

When selecting an air compressor it is important to know your dependency on the compressor and to ask the distributor or dealer for an estimated cost of maintenance and spares for a year. Simply put, if you have to send workers home because the air compressor failed, it doesn't make a lot of sense to purchase a cheaper "consumer rated" compressor when an "industrial rated" compressor might be more dependable. By asking the supplier to provide the list of spares and their estimated costs, there is no doubt about the requirements for complying with manufacturer's warranty and a fair comparison can be made among different brands. Some important information to gather includes:

- Standard warranty period
- Extended warranty availability (and cost)
- Requirements to keep the warranty valid
- Authorized service center locations
- Special or unique parts requirements (like filters or synthetic oil)
- Maintenance intervals (in operating hours)
- Recommended rebuild/overhaul interval
- Special handling or disposal requirements for waste filters and oil

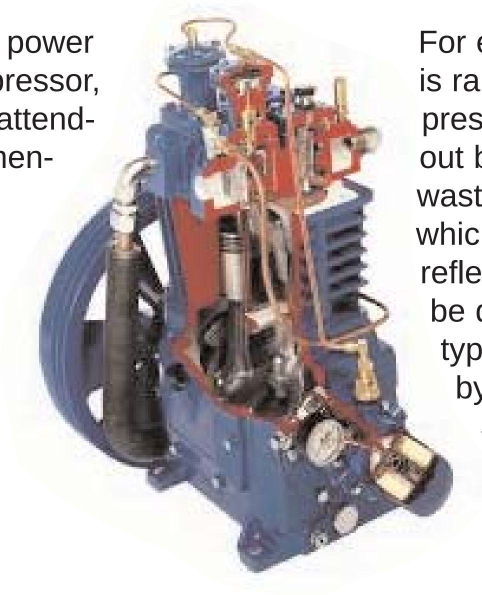


Depending on the type of air compressor that is appropriate to meet capacity requirements, either a reciprocating (piston) or rotary screw type compressor might be selected. Additionally, lubricated or oil-free (oil-less) compressors, which often have lower life cycles, might be required. Each compressor type will require maintenance, and the oil-free (oil-less) compressors are a bit more complex than their lubricated counterparts. (For more information on selecting the right compressor for your application, download the booklet "*Selecting an Air Compressor*" from the resource section at www.quincycompressor.com).

While maintenance will not have the kind of impact on cost of ownership that power does over the life of the air compressor, it can become quite costly if not attended to per manufacturers' recommendations.

Typically, manufacturers will offer different levels of equipment based on value and design. A less expensive air compressor will have the same basic technology as its more expensive cousin, but will not have the same quality valves, motor, oil, or other basic components. This helps keep the first cost low. The trade-off is often lower efficiency and shorter life. It is not uncommon for five horsepower air compressor pricing to range from less than $750 to near $2000. The difference can be measured in compressor life, sometimes as short as 2000 hours versus 40 years for a heavy duty pressure lubricated compressor. While the upfront cost is attractive, it would seem the maintenance would involve throwing away the lesser air compressor every year or so and replacing it with a new machine. Even if it were planned to keep the air compressor and perform a rebuild, it may not be possible with less costly air compressors.

The consumption of special parts and oil also must be considered in the cost of ownership. It is typical for manufacturers of rotary screw air compressors to provide a long-life synthetic fluid to enhance the performance of the air compressor. Synthetic oils will last from 4000 hours to an indefinite period before requiring a change-out. Depending on the type of fluid, special handling and disposal might be required.

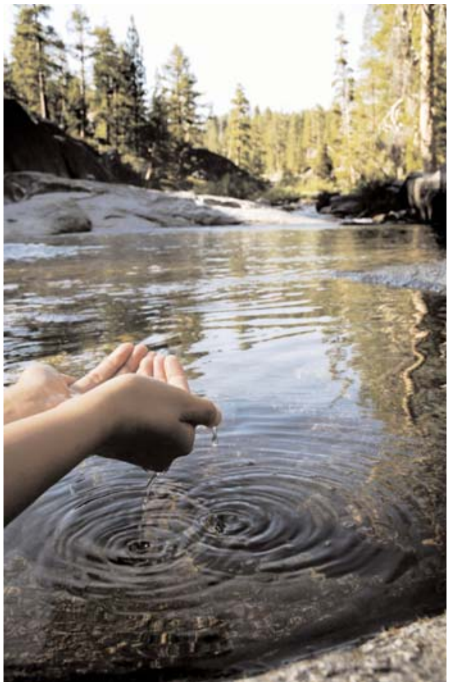


While a low-cost compressor might seem like a bargain, heavy-duty designs will last longer and have features like pressure lubrication and high efficiency valves that improve efficiency and capacity.

For example, normal motor oil, which is rarely used in any type of air compressor, can be easily discarded without being considered a hazardous waste. Automatic transmission fluid, which will last about twice as long and reflects that in its price, can similarly be disposed of fairly simply. Both types of fluid are collected routinely by oil recyclers to be re-blended. Synthetic fluids and blends, however, sometimes require special handling for proper disposal.

Ester and olefin type fluids must be identified and require special disposal in some municipalities. It is best to check before buying to ensure all costs are factored. Other types of fluid are considered to be biodegradable, and thus suitable for disposal in a sewer system. Such fluids, polyalkeneglycol or polyglycol, should have a certificate from the manufacturer that states the fluid's biodegradability.

Other specialty chemicals like silicon blends or pure silicon represent another disposal issue and should be disclosed prior to purchase. Note that the more features a fluid has, like long life and high temperature stability, the more expensive it will be to buy and discard.



By carefully selecting an air compressor that has a balance between long service life and parts cost, it is possible to save even more money over the life of the equipment. Also, by weighing the maintenance requirements, the impact of waste filters and fluid can be managed as well. Less cost and less waste is better for the economy and ultimately is better for the environment.

OPPORTUNITY NUBMER THREE:
Uncover Hidden Costs

Why? Every mechanical system changes with age. Corrosion, changes in demand and tired equipment can cause a system that was once state of the art to be a secret energy vampire. New pieces of equipment are added that require more air, more piping is added, scale forms inside pipes and joints, drains stop working…the list can be overwhelming. A fresh look at any air system can usually identify actions that will save energy and improve air quality. For a cursory overview or an in-depth system audit, many companies can assist. Websites like the one for Quincy Compressor offer best practice solutions, as well as self-audit tools and resources for obtaining full engineering audits. Fully trained compressed air systems experts can easily help optimize nearly any system, no matter how large or small. They can also recommend environmentally friendly accessories for air treatment requirements such as removing contaminants, drying point-of-use air and delivering proper pressure.

Some areas to consider when deciding if a system audit would help include: the air compressor itself and its duty cycle, controls, the compressed air treatment devices like filters and air dryer, proper compressed air storage, piping and condensate removal equipment. This list represents pretty much the entire air system, and each section has potential to either rob energy or provide savings, depending on how it is treated.

Whether you enlist the help of a professional or use a simple self-auditing tool like the Quincy Compressor EQ™ worksheet, the benefits will be felt immediately and for as long as the best practice advice is followed. Simple advice and guidance in the operation and maintenance of your compressed air system will make your operation more efficient, profitable and friendly to the environment.

Being efficient helps keep your profits, as well as the planet, in the green. Make sure you know how the business partners you select will impact your efforts. Seemingly simple choices can have the greatest and long-lasting impact on the future.

Seven Steps to Getting Started

To get started, consider the seven-step action plan provided by the Department of Energy citing the Compressed Air Challenge's *Fundamentals of Compressed Air Systems:*

1) Develop a basic block diagram of your compressed air system.

2) Measure your baseline (kW, pressure profile, demand profile and lead load) and calculate energy use and costs.

3) Work with your compressed air system specialist to implement an appropriate compressor control strategy.

4) Once controls are adjusted, re-measure to get more accurate readings of kW and pressures and to determine lead load. Recalculate energy use and costs.

5) Walk thorough and check for obvious preventive maintenance items and other opportunities to reduce costs and improve performance (air treatment accessories, storage considerations and improper usage considerations).

6) Identify and fix leads, and correct inappropriate uses - know costs, re-measure and adjust controls as mentioned above.

7) Begin implementation of continuous improvement programs.