

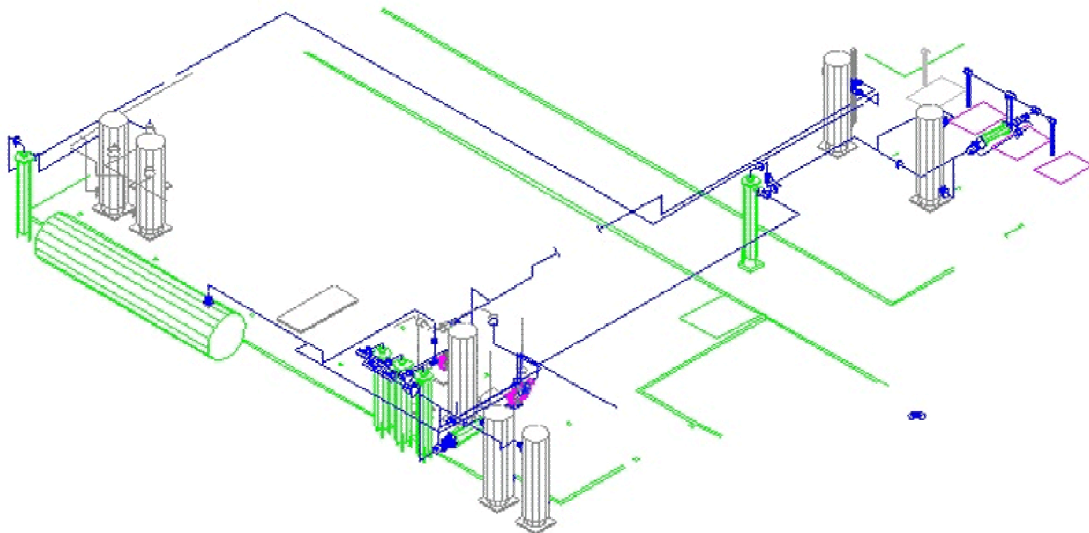
Why audit the compressed air system?

By Robert B. Laine II

Compressed air systems will almost always have more power on-line than necessary. How do we know this? For example, if the average demand (volume) is 1,000-scfm, the demand may vary ± 350 -scfm, which requires 1,350-scfm of supply for peaks. Because events that create the peak are almost instantaneous, supply may have to be 1,500-scfm to maintain a minimum pressure during the event, especially if there is little storage, and most systems have very little storage.

Some compressor manufacturers recommend no storage for some compressor designs. Therefore, the norm is to install one 1,500-scfm compressor for a 1,000-scfm system, that frequently only requires 650-scfm. The 1,500-scfm compressor will be twice as large as necessary part of the time and 11 % larger than the peak demand. Most compressors do not trim efficiently, that is the reduction of power and volume is not linear. Most compressors will trim volume to match demand, but the power remains at or near peak as the volume varies. Some designs of compressors do trim power more efficiently than others.

CAS design has been mostly influenced by compressor suppliers, whose goal has been to provide a solution with little or no knowledge of the system outside of the compressor room. The only reliable solution under these conditions is to make sure that there is always enough. And with system efficiency not an issue, the compressor and in most cases multiple compressors will always be significantly larger than the average demand.



The poorest performing system with enough on-line power will be fairly reliable, but at a significant penalty in operating cost. It will not be an efficient system, but efficiency in compressed air is something that only recently has become an issue. There is a general trend in the industry to recommend one large compressor versus several smaller ones, which means that the back up compressor must be another large unit.

As plant demand grows, the back up is turned on. An occasional peak slightly greater than 1,500-scfm will turn on the 1,500-scfm back up, which frequently remains on from that point in time. Now, two 1,500-scfm compressors are required to support a demand of less than 2,000-scfm. A new compressor is purchased as back up, and to maintain consistency of equipment and spare parts, a new 1,500-scfm compressor is installed. Capital cost is based on 4,500-scfm of compressors and operating cost on 3,000-scfm of compressors. If the initial design had been three 500-scfm compressors, the capital cost would be 2,500-scfm (5 x 500-scfm) and the operating cost would be based on 2,000-scfm. Even with this multiple compressor arrangement, if there is no knowledge of the system events and the fifth compressor may be required from time to time.

Installing compressors to solve a problem inefficiently does not make the compressor manufacturer's method or approach bankrupt, since efficiency in the compressed air system is not part of the agenda of the owner or equipment supplier.

A second issue that makes for an inefficient system is compressor controls. Remember that the manufacturer has no knowledge of the system that this compressor will support as no one from the manufacturer, salesman, or factory representative, has set foot outside the compressor room. The compressor is not custom designed for the individual plant and must work in any system. Therefore, the compressor controls are designed to protect the compressor, not system efficiency or operating cost. The more compressors that make up a system, the results are in producing a greater inefficiency, especially if the compressors are multiple designs (rotary screws, reciprocating, and centrifugals).

A compressor is an air pump. When purchasing a liquid pump, a pump curve is provided to the purchaser by the manufacturer to permit the owner to design around a given performance standard. Alternatively, the performance requirement is provided to the manufacturer and the pump is then designed to meet the performance requirement. This never happens with compressors, and compressor performance curves are almost never asked for and seldom provided. Compressor controls limit performance, which is never the intent with a liquid pump design. For example standard compressors are equipped with Turnvalves[®], Spiral Valves[®], blow off valves, and throttling inlet valves. All of these devices throttle the volume to the system, but the power remains relatively constant. The power of most compressors fully loaded will not be much greater than a partially loaded compressor. Frequently, multiple compressor systems will have

several, if not all, of the “on” compressors in some state of part load, but the power will be 75% to 95% of the motor nameplate. This configuration will become fairly reliable in the sense that there is always plenty of air supply. As the system pressure decays, the partially loaded compressors will all load to some degree maintaining supply with a fluctuation pressure. This is called minimum acceptable results at the highest operating cost. System pressure can fluctuate an average of 10 to 15-psi with extremes of 20 to 30-psi.

What is a compressed air audit?

An audit is a complete analysis of the compressed air system with the “system” as the focal point. The supply side of the system is where the audit starts. How do all of the different pieces of equipment made by different manufacturers with different standards function in a system? Most compressor manufacturers make only compressors, but sell dryers filters, drains, and aftercoolers, all made by some other manufacturer to fill out their product line. Different manufacturers will have different standards for differential pressure drop, cooling performance, drainage standards, etc. The owner is not aware of the different standards and will frequently purchase from the low bidder, which means several different brand names will find their way into the compressor room.

Frequently the system will have perfectly functional equipment that does not provide the intended result. For example, all standard dryers (refrigerant and desiccant) are designed for 100 degrees F @ 100-psig. However, the compressor aftercooler is not functioning appropriately and the dryer inlet temperature is 115 degrees F, which overloads the dryer by 75 %.

There are many performance issues that are frequently ignored and/or not considered in the design, and for the most part go unobserved by the owner. The audit will identify all of these issues and make specific recommendations that will resolve all of these issues. Very specific recommendations will be made that address all the different designs and how they can function in a common system. Drawings, written discussions, and specific performance non-proprietary equipment specifications will be provided as part of the audit process. The intent is to make recommendations for retrofit of the system, but at the same time teach a different philosophy of compressed air that will permit personnel to manage this utility efficiently. Other utilities have significantly more stringent standards. For example, would your utilities and production departments allow a 10 to 20 % fluctuation of electrical system voltage? Not if they want to keep their jobs, but the plant puts up with this type of variation with compressed air.

Supply is only half the system. On the demand side of the system, compressed air is often wasted and poorly applied. Frequently

compressed air is left on when production stops for breaks, meals, off shifts, or even weekends. Production equipment frequently consumes air whether production is active or not and the leaks are supported even if no air is consumed for idle production. All sources of waste will be identified with specific solutions provided. Poor application of compressed air frequently can be moved to another energy source that is less expensive than compressed air. Specific design recommendations will be provided for these alternatives.

Many times alternatives are presented that are inappropriate for specific plants. The design will be flexible as the audit intent is not to advise the client what to do, but to present all the alternatives and assist the client in making the most appropriate decision, which may very well be unique for that facility. Purchasing the best equipment money can buy in a poorly defined system will result in a poorly performing system.

Summary:

There are no un-audited systems that cannot be improved for air quality and performance. Typical savings in the form of reduced operating cost is 25% to 40%. The extremes in savings are 10% to 90%. Return on investment averages less than two years, including the cost of the audit. The extreme range of return is less than one to three and one-half years. A clean dry compressed air utility with constant pressure will support every piece of air consuming equipment more consistently, reliably, and repeatably. Plant performance and efficiency will improve, which will directly affect production cost.

Compressed air operating cost is usually constant regardless of sales and the economy. During a slow economy, retrofit of the compressed air system can be more attractive than during the best of conditions. The savings in operating cost from a retrofitted efficient system goes straight to the pre-tax bottom line with little or no risk. Frequently, a system retrofit is easier to implement during a slow economy, but the value to the bottom line will be the same as during a strong economy. Plant expansion to increase sales is still dependent on the economy, which has risk. The savings in operating cost of the compressed air system has no risk.

The greatest savings opportunity of reduced operating cost in a compressed air system is one that the owner feels that there are no problems. This system will be significantly overpowered.

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