

What to expect from an air audit

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Key Concepts

- Air audits offer an opportunity to improve productivity while reducing operating costs.
- Complete air audits must include the supply and demand sides of a system.
- Choose an auditing firm with experience in your industry.

To stay competitive, most plants are required to continuously increase production while reducing costs. This requires identifying productivity and quality improvements that result in lower operating costs.

Compressed air and vacuum system audits offer an excellent opportunity to achieve these goals with a viable return on investment. A complete audit or system analysis is the first step towards identifying and implementing these opportunities. Simple paybacks for these projects are commonly in the 6-24-month range.

Significant energy savings

In smaller systems with less than 300 hp online, there are opportunities to reduce operating costs by 35-50%. In larger systems with over 1000 hp online, 25-30% is typical. These rules of thumb hold true in virtually all industries.

Compressed air and vacuum systems are commonly the most inefficient utilities on site. To get one

horsepower of work from an air motor requires approximately 30 scfm of compressed air at 90 psig. It takes 6-7 hp at the compressor shaft to produce this compressed air. Assuming a 90%-efficient motor, this translates into 7-8 hp of electrical power to deliver 1 hp of compressed air. Only 12.5% of the input energy is available for useful

work energy on the plant floor.

This conversion efficiency assumes that all of the equipment is in perfect operating condition. Older equipment, dirty filters, rewound motors, etc., all work to further reduce system efficiency. The point is that compressed air and vacuum are not free and should be applied with an understanding of the costs involved.

The costs of compressed air and vacuum systems are usually not identified and are difficult to manage. Add up the total horsepower of all operating compressors and vacuum pumps in your plant. The list below estimates the annual operating costs of a system, including maintenance costs.

- 100 hp = \$50,000
- 200 hp = \$100,000
- 500 hp = \$250,000
- 1000 hp = \$500,000
- 3000 hp = \$1,500,000

These figures are based on 8760 hours of operation per year and \$0.05/kWh. At these rates, the decision to connect an air line to cool a production application can result in a \$13,000/yr operating cost, which would be completely unidentified. Over time, the costs of these kinds of decisions make an audit necessary to identify and quantify the total savings opportunity.

Half of compressed air is wasted (Fig. 1). Leaks are the easiest to understand and are on average 25-30% of the total system demand but can range as high as 50% in some systems. Inappropriate uses are applications where it would be more economical to use another method, rather than compressed air, to achieve the same result.

For example, applying an electric blower to clean or dry production parts, or an electric mixer or agitator for stirring liquids and slurries, instead of using compressed air, can reduce energy consumption by 90% for these applications.

Artificial demand represents the increased air demand that comes from running the system at a higher pressure than should be required; forcing unregulated applications and leaks to consume more air. Since only 50% of the air is consumed by legitimate production applications, the net system efficiency is only 6.5%. For this reason it is important to apply and use compressed air and vacuum wisely.

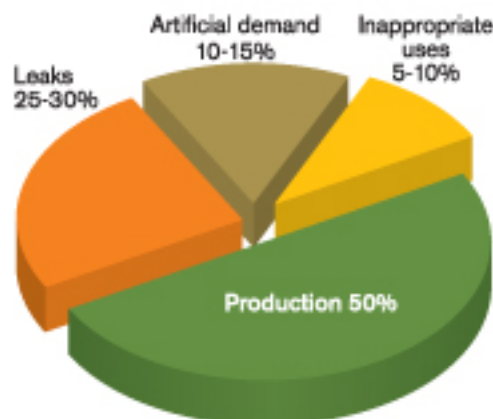


Fig. 1. Compressed air is wasted in many ways that a complete audit would uncover. (Courtesy US Dept. of Energy)

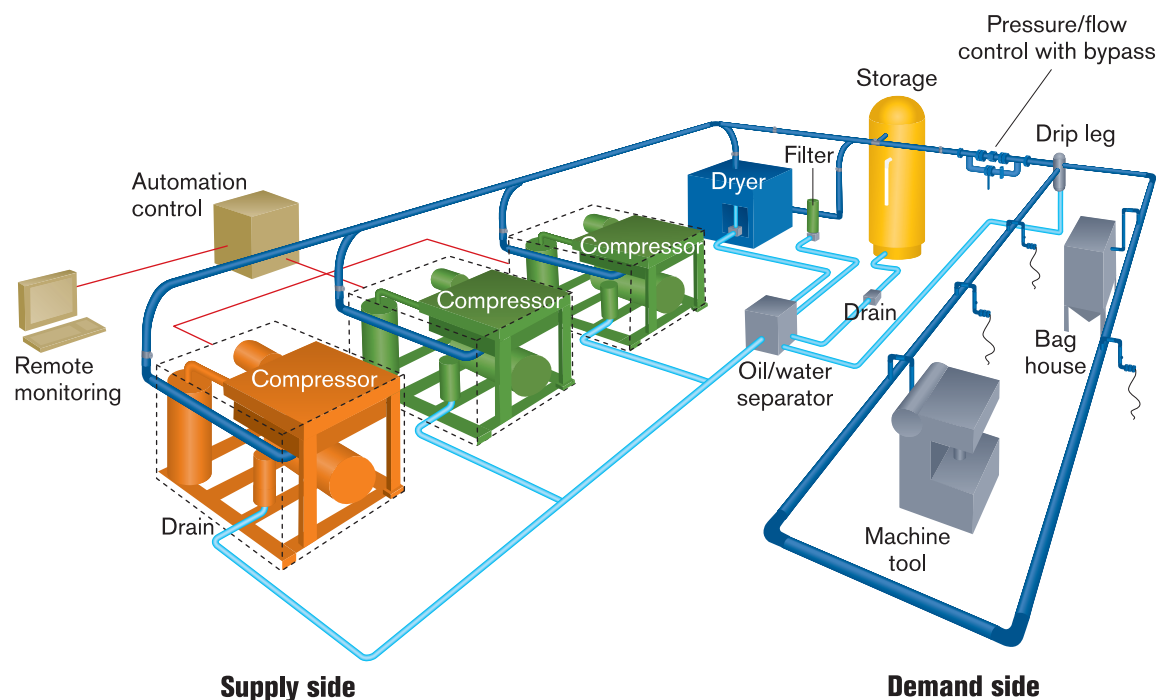


Fig. 2. A complete audit must include examining the supply and demand sides of a compressed air system.

Audit benefits

Energy cost reduction is usually the driving force behind most audits; however, energy costs are just the tip of the iceberg. In addition to lower energy costs, the most common benefits of having a compressed air or vacuum system audit performed are:

- Improved plant or process productivity
- Higher product quality
- Reduced scrap rates
- Increased system and equipment reliability
- Reduced maintenance costs.

The first three items are concerned with production and not with compressed air or vacuum directly. These improvements are far more valuable than the energy cost reductions. Capturing them requires an audit of the production floor, not just the compressor room.

Fluctuating pressure and vacuum levels inside production equipment is a leading cause of limited production rates and scrap expense that goes unidentified in most plants. The normal reaction to any suspected problems with these systems is to elevate the air pressure or vacuum level by turning on more compressors and pumps. This approach increases costs exponentially and actually leads to greater variations inside the production processes.

It appears, from observing whatever gauge is available, that the problem is solved in terms of air and vacuum, but nothing could be further from the truth. For example, packaging equipment is limited by the abil-

ity to time coordinated processes. The increased variations in pressure limit the speed of these coordinated processes to that of the least stable application.

It is also common for contamination in air systems, in the form of water, lubricant, and rust, to impact quality and productivity. If the air comes in direct contact with the product being produced, contamination often results in elevated scrap rates. This contamination creates downtime and high maintenance costs on production equipment that in reality should be applied to the cost of compressed air.

All of these problems can be corrected, often at surprisingly low amounts of expense or capital, if properly understood in relation to the functioning of the complete system.

The last two items are directly related to each other. In both air and vacuum systems, unacceptable performance in the supply equipment is the result of a system design or operating issue in more than half of the cases. For example, high differential pressures and/or a lack of storage can cause rapid cycling, premature equipment failures, and system contamination.

Audit types

To achieve the kind of results discussed above, an audit must include all aspects of system operation including the compressor and pump room, distribution piping and storage, as well as the demand or production users of the system (Fig. 2). The quality and value of an audit is directly related to the effort

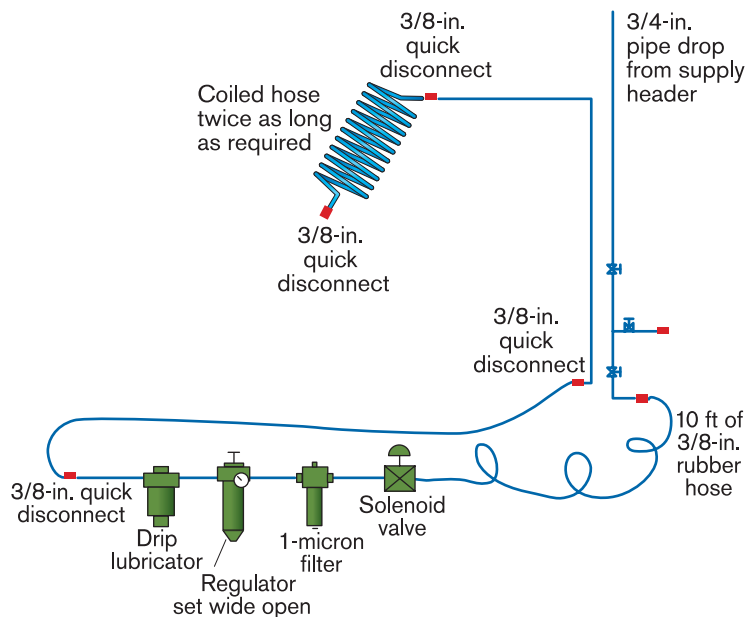


Fig. 3. This air tool application has excessive pressure drop and is driving system operation.

expended and the subsequent costs. A variety of services are available which are called audits.

Leak audits are performed on both air and vacuum systems with ultrasonic detectors. While it is a rather simple task to locate and tag a leak, it is quite another task to quantify the rate of flow and cost associated with it.

Leak audits are offered on a day rate basis at \$500-\$1000 per day by steam trap service organizations or compressed air distributors. Repairs are the responsibility of plant personnel, which is the more costly effort.

Supply surveys normally include logging of pressures in the system and power at the compressors and pumps, which are summarized in a brief report, but no real time is spent on production equipment issues and opportunities. This type of audit is often offered free or is refunded, based on equipment purchases from the distributor or manufacturer providing the service.

Normally, the solution will involve a significant amount of supply side equipment. While this survey may identify energy savings, the same savings can often be achieved at lower capital costs and improved productivity and quality if a complete audit is performed.

A complete compressed air or vacuum system audit must include a majority of time spent on the demand or production uses of the system, if it is going to provide any of the additional benefits discussed above. These uses need to be identified and analyzed and engineered solutions provided as part of a complete audit.

Production uses set the pressure requirements for systems, and no significant changes can be made without a thorough understanding of the impact any change will have.

Low-cost solutions to production problems can enhance the value of a system upgrade dramatically (Fig. 3). Alternative solutions to wasteful applications can reduce total demand and eliminate the need for additional compressors, pumps, and ancillary equipment. The use of storage to support some users can reduce the total peak demand for air and vacuum and make backup supply equipment available again.

Choosing audit firms

To maximize the return on investment it is critical to choose the right audit firm. An experienced firm should have no problem providing all of the following information upon request:

- References of the individuals performing the work at your plant
- Confirmation of the ability of the auditor to get projects implemented — engineering studies without results are commonplace
- Actual audit reports from your industry to ensure the information is relevant and appears technically grounded.

Look for a technically complete audit that includes the following components of a complete system analysis:

- A simple process flow diagram of the existing system and any proposed modifications to it
- An analysis of production applications focused on improving performance and quality
- Recorded pressures throughout the system with a thorough analysis of pressure loss, variation, and corrective measures, especially in the production equipment
- Recorded, verifiable power costs with an analysis of compressor and pump performance relative to design
- A detailed action plan with costs for both short-term and long-term solutions for the system, including any anticipated growth
- A return on investment calculation that meets corporate guidelines.

Be aware that some local equipment distributors and auditors are only interested in proving there is a need to purchase a newer or more efficient air compressor or vacuum pump. These simplified approaches are limited and focus on only a small piece of the puzzle. They commonly overlook the most important part of the air system: the distribution and end users. Remember that 65-75% of the savings potential in most systems is typically located in the production or demand side and at a better ROI. **PE**

More Info:

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