

Top Ten Air System Mistakes

Article courtesy of Freelin-Wade

CompressorWise.com interviewed hundreds of individuals who are involved with compressed air systems. The interviews led to insight into the problem areas that are common to most air systems. Hopefully, this report will give you some ideas for making improvements in your plant.

1. Believing compressed air is cheap
2. Air leaks
3. Compressor controls
4. Pressure loss in piping system
5. Contamination from piping system
6. Poor condensation management
7. Supplying higher pressure air than is needed
8. A lack of air system training
9. lack of trouble shooting information
10. Cookie cutter approach to oil and filter changes

1. Believing compressed air is cheap

Air compressors powered by electrical motors will use a surprisingly large amount of energy each and every year of operation. The annual power cost to operate a compressor can equal the initial cost of the unit. The initial purchase price of a 100 horsepower air compressor will range between \$30,000 and \$50,000 depending on the type and options. The same 100 horsepower compressor operating 6,000 hours a year (a power rate of \$0.07 per kW and a motor efficiency of .90) will have an annual power cost of \$34,800. You can determine the annual electric power cost of your compressors with this formula. The first step is to multiply the horsepower of the compressor times .746 times the hours of operation times your power rate ($HP \times .746 \times \text{hours} \times \text{power rate}$). Then, divide that number by the motor efficiency. Everyone in the plant should be made aware of the total power cost for operating the compressors. This is especially important for anyone that works with air-operated equipment.

2. Air leaks

The most common opportunity to recover energy cost is to control the compressed air leaks. Effective leak control in an air system can pay huge dividends. A quarter inch leak in a 100-psi system will pass about 100 CFM of compressed air. This is approximately \$12,000 in annual wasted power cost based on 24 hours a day compressor operation with a power rate of \$0.07 per kW. The process of detecting and monitoring leaks should focus on more than the basic header and piping system. The fact is that you will find a majority of your leaks at valves, fittings, connections, tools and at the point of use. It is important to remember the interdependent relationship between air system components. Controlling air leaks will not translate into reduced energy cost unless the compressor controls and air delivery system are in proper working condition.

3. Compressor controls

There are several types of control systems in operation for reciprocating, rotary screw, and centrifugal compressors. It is common to find a variety of these in use in the same plant. Compressor controls make it possible for you to translate lower air usage into lower energy cost. However, the typical plant is operating multiple compressors at part load that is inefficient and expensive.

4. Pressure loss in piping system

It is important to minimize pressure drop throughout the compressed air system. This prevents you from producing pressure that never reaches the demand point which is a direct waste of energy. Every pound of increase or decrease in pressure requires a one half of one percent increase or decrease in power. Therefore, a 10-psig decrease can save you 5% in power costs.

This amounts to \$1,740 in annual savings for the 100 horsepower compressor in the earlier example. This adds up because most Industrial plants have more than one 100 horsepower compressor. The pressure of an air system is often raised to overcome pressure drop. The cause is usually found to be shortcomings in the piping system and pressure loss at the filters and dryers. Each of these problem areas will cost you money on an annual basis.

The following are some common problem areas:

- a. Delivering air to the point of use in pipe that is too small. An example: using 30' or more of 3/8" rubber hose rather than 1" pipe with a short hose at the tool.
- b. Using "tee" pipe connections rather than 30 or 45-degree angle entry connections when introducing air into a flowing stream of air.
- c. Saving money by using undersized filters and dryers that have a higher pressure drop.

5. Contamination from piping system

The following are two common mistakes made during the installation of the piping system:

- a. Dirt, rust, and liquids are commonly found in the piping of a compressed air system. These cause maintenance and interrupt the supply of air. The amount of these contaminants that are carried along with the air stream will increase when the air velocity increases. Air velocity increases as the pipe size goes down. It's acceptable for the interconnecting pipe (from compressors, dryers and inline filters to main header) and main air header pipe to have a different air velocity specification than the piping from the main header to the points of air usage. The interconnecting pipe and main header should have an air velocity between 20 and 30 feet per second (not to exceed 30 feet per second). The air lines running to the points of air usage should not exceed 50 feet per second. You can calculate the air velocity of your system. The formula is Flow in CFM divided by compression ratio in the pipe divided by the area of pipe divided by 60. This will give you the velocity in feet per second.
- b. The piping system should always take the air off the top of an air line when running a line from a header to the point of air usage. This will prevent condensation and trash from migrating to the air usage equipment.

6. Poor condensation management

Condensation is the moisture that drops out of airflow as it cools. The condensation in a compressed air system is a constant threat to cause expensive problems. The following are a few examples:

- a. Moisture washes lubrication from air tools and production equipment causing downtime and maintenance.
- b. An inconsistent supply of dry air causes production quality problems.
- c. Excessive rust and scale often forms in the air distribution system.
- d. Water can back up into the compressor and wreck the machinery.
- e. Air dryers can become overloaded.
- f. In-line filters can be destroyed.

The problems get worse if you operate lubed reciprocating or oil flooded rotary screw compressors, which is just about everyone. Compressor oil makes its way into the distribution system with the compressed air. The mixture of oil, water, dirt and heat tends to build up a sludge that will ultimately jam or clog production equipment, air tools and drains. The situation is further complicated by climate and seasonal weather changes. This is because the amount of condensation generated will change according to changes in the temperature and the relative humidity of the inlet air. Consider that a 200 horse power compressor operating in a climate of 60 degrees F with 40% relative humidity will generate approximately 50 gallons of condensate a day. However, that same compressor operating in a climate of 90 degrees F with 70% relative humidity will generate approximately 260 gallons of condensate a day. The typical compressed air system is designed to remove condensation at strategic locations. This means there are drains at the after cooler separator, receiver tank, air dryer, in-line filters and at drain points in the piping. The problem is that there are shortcomings with the products being used to drain the condensation. A condensation drain should automatically remove condensate when it appears at the drain without wasting air or clogging. We have found only one drain that meets these criteria. Visit <http://www.CompressorWise.com/jorc> for more information. Send an email to drain-compressorwise.com with your mailing address and we will make sure you get the complete product specifications, pictures and installation instructions.

7. Supplying higher pressure air than is needed

The first consideration is to determine the specific pressure required for all the air requirements in your plant. Plants that have studied this issue often found that they were producing high-pressure air for the entire plant just to satisfy all isolated high-pressure requirement. They solved this problem by installing a small departmental compressor designed to handle the higher pressure. This allowed them to lower the pressure requirement of the main compressors and immediately save energy cost.

8. A lack of air system training

The operation and management of a compressed air system takes the efforts and talents of many people. A decision to work towards energy savings will require all of these individuals to be part of the process. However, they cannot be effective if they don't understand the cost of compressed air and the interdependency of the components of an air system. The companies that have trained their people on the importance of saving energy have reaped the biggest savings. This type of training has a very fast payback. The energy savings will go directly to the bottom line and can make a difference in the profitability of any company.

9. Lack of trouble shooting information

Temperature and pressure readings can organize your trouble shooting efforts when dealing with a problem in the compressed air system. Specifically, you can use normal condition readings as a reference point in order to isolate the cause of the problem. The normal condition readings are taken on a regular basis for historical reference and to observe any trends that indicate the beginning of a problem. The readings are usually taken at locations before and after air equipment including, among others, the compressors, after coolers, dryers, receivers, air tools and filters.

- a. Increasing temperature in a compressed air system is one of the best indicators of a problem. If you monitor temperatures over time, you can build a base line for normal conditions and create a model for predicting when you will have trouble with your compressed air equipment. The most useful tool for this application is an infrared thermometer. This is a hand held device that gathers temperature readings by aiming at an object. There are a couple of points to keep in mind on this issue. The first is to be aware that you are measuring the surface temperature, not the temperature of the oil, air, or water inside the object. This method is not as accurate as putting a probe in the oil, air, or water. However, it is a practical way to get information that can be used in troubleshooting. The second point is to always take temperature readings when the compressor is at full load. This gives you meaningful information that can be compared to the design standards for the equipment.
- b. Monitoring pressure is another useful trouble shooting tool. The best idea we observed was the use of a single gauge that was adapted to fit in an air line quick connection. The operator simply inserted the gauge into quick connections that were mounted in key locations on the air system piping. Accuracy is critical when comparing readings and trying to isolate a problem. It is important that you use a high quality gauge.

10. Cookie cutter approach to oil and filter changes

A preventive maintenance program is essential for maximizing the service life of a compressor. The key is to make sure your program matches your application. This means monitoring filter and lubricant condition by measuring pressure drop and by using a regular oil analysis. This will help you create a schedule for change intervals that will provide the best protection for your compressor.

- a. The best way to determine when to change your inlet air filters is to measure the restriction in the piping between the filter and the intake of the compressor. This restriction can be monitored by a water manometer, an intake filter indicator, or a dial gauge that is calibrated in inches of water. The idea is to service the filter when the monitor reaches a certain level of restriction. This specification can vary between 10 and 20 inches of water because of the different designs of filters. We recommend that you get a guideline from a filter vendor that is knowledgeable about compressors.
- b. Oil analysis can be a helpful tool for compressor diagnostics. Quarterly samples of the oil appear to be more than adequate to keep an eye on normal wear. There are many good labs available for oil analysis.