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Business Energy Services

COMPRESSED AIR

Compressed air has long been a staple in many facilities and is broadly used in all types of industries, from mining to dentistry. Whether it's used to run a simple air tool or for more complicated tasks, such as operating pneumatic controls, compressed air accounts for approximately 10% of a typical facility's electrical use. The U.S. Department of Energy (DOE) also states that for some facilities, 30% or more of the electricity consumed can be attributed to compressed air generation.

Technology Terms

Analyzing Your System

Compressed air needs are defined by the individual air quality and quantity requirements:

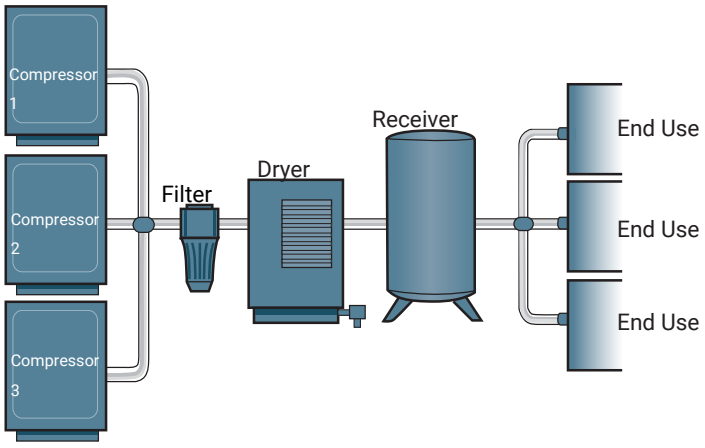
Quality: Typically determined by the air dryness and contaminant level set by end-use requirements. Money and energy often are wasted by over-treating air beyond the required dryness and contaminant level.

Quantity: Air volume is the sum of the average air consumption of each required application; add the requirements of your compressed air applications and process operations, and the duration of each.

Pressure: Understand the minimum pressure release level needed. As compressed air travels through the distribution system, the pressure drops. Excessive pressure drop results in higher energy consumption.

Demand: Understand the facility load or demand requirements. Operations with varied air demand need a system that operates efficiently under part-load or one that uses a sophisticated control strategy.

Simple Compressed Air System



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Calculate the Annual Cost of Compressed Air in Your Facility

$$\text{Cost \$} = \frac{\text{bhp} \times 0.746 \times \text{Annual compressor operating hours} \times \text{Compressor load factor (\%)} \times \text{Electricity cost (\$/kWh)}}{\text{Motor Efficiency (\%)}}$$

Compressor brakehorsepower

$$\text{\%} = \frac{\text{Compressor current load}}{\text{Compressor design load}}$$

0.7456=conversion factor hp to kW

Details

Cost of Compressed Air

The cost of compressed air generation is not exactly known. Some facilities estimate a cost of $0.15-$0.30 per 1,000 cubic feet of air. Thus, compressed air can be one of the most expensive forms of energy in an industrial plant. About eight horsepower of electricity is needed to generate just one horsepower of compressed air. For the total operating cost of compressed air, electricity usually exceeds 75% of expense, with the actual equipment and required maintenance making up the remaining 25% of the cost.

According to energystar.gov:

- Smaller, multiple-stage compressors operate more efficiently than one large single-stage compressor.
- Multi-stage compressors save energy by cooling the air between stages, reducing the demand required to compress the air.
- Replacing single-stage compressors with two-stage compressors typically provides a payback period of two years or less.

Minimizing Leaks for Improved Performance

Compressed air systems naturally are inefficient and frequently leak. Common problems with compressed air system operations include fluctuating pressure and excess capacity, leading to increased maintenance of equipment. These issues contribute to systems running less efficiently, slowing production times, increasing operational costs and decreasing overall service life.

According to the DOE, leaks waste as much as 20%-30% of the compressor's energy output. Detecting leaks can be done one of two ways: By using an ultrasonic acoustic detector, which recognizes high frequency hissing sounds associated with air leaks, or by applying soapy water with a paintbrush to suspect areas to see if bubbles appear. A leak prevention program should include periodically inspecting these common problem areas:

- Couplings, hoses, tubes and fittings
- Pipe joints, quick disconnects and thread sealants
- FRLs (filter, regulator and lubricator)
- Condensate traps, valves and flanges
- Point-of-use devices

Calculate the Cost Savings Realized After Eliminating Leaks

$$\text{Cost savings} = \text{Number of leaks} \times \text{Leakage rate (CFM)} \times \text{kW/CFM} \times \text{\# hours} \times \text{\$/kW}$$

REFERENCE: Minimize Compressed Air Leaks (August 2004), www.energystar.gov/ia/business/industry/compressed_air3.pdf

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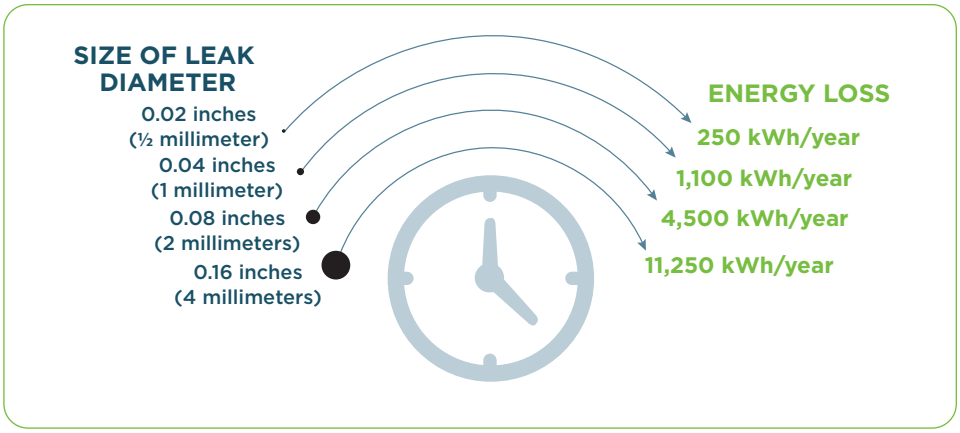
Based on a compressor operating 2,500 hours/year at 6 bar (87 psi), the following losses would be experienced:



REFERENCE: Managing Your Energy, www.energystar.gov/ia/business/industry/downloadsManaging_Your_Energy_Final_LBNL-3714E.pdf

Preventative Maintenance

Due to the high cost and energy use, compressed air should only be used at the minimum quantity for the shortest possible time. Proper system maintenance is needed to combat inefficiencies, air leakage and varying pressure. Poor or no maintenance will often lead to increased operating temperatures, poor moisture control and excessive contamination of compressed air system components. Compressed air system maintenance can be accomplished with these basic tasks: Replacing filters and fluids, inspecting cooling water, adjusting belts, and identifying and repairing leaks. Periodic, systematic maintenance will help bring an inherently inefficient system closer to operating standards.

To ensure that a compressed air system is well maintained and operating effectively, measure the baseline power consumption, pressure, airflow and temperature. Two free software tools that can be used to analyze energy use and energy system savings opportunities are AIRMaster+ LogTool and AIRMaster+. Use the LogTool first to gather critical data, then input that data into AIRMaster+ to model system upgrades. Both tools can be downloaded at http://energy.gov/eere/amo/articles/airmaster.

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