

## GETTING THE MOST OUT OF YOUR COMPRESSED AIR SYSTEM

Air compressors can account for 10% of electricity use in the average industrial facility. Often, a significant amount of energy is wasted due to undetected air leaks, inappropriate uses, poor control, and inefficient equipment. This can add up to thousands of dollars in unnecessary energy costs per year.

Fortunately, opportunities for savings exist in almost every compressed air system. In addition to saving energy and reducing energy costs, a properly working, efficient compressed air system can:

- improve the quality of the manufacturing process, resulting in better quality control;
- reduce noise in the plant due to less leaking air in an open blow; and
- improve overall system reliability by reducing or eliminating the need for a secondary compressor through enhanced performance and improved air usage.

This fact sheet includes an overview of typical compressed air systems, and provides detailed information to help you and your compressed air vendor identify energy-saving actions you can take now, whether you're addressing individual problems or you're ready to invest in a full-system upgrade.

## TYPES OF COMPRESSOR SYSTEMS

**Variable Frequency Drive (VFD) Compressors** speed up and slow down in response to load. For a compressed air load that varies throughout the day, which describes most loads, a VFD compressor is typically the best choice for efficiency. However, a VFD compressor is not a good choice for a constant load that is over 90% of the capacity of the compressor, because the VFD never gets the opportunity to slow down the compressor, making the VFD—and the additional energy it uses—unnecessary.

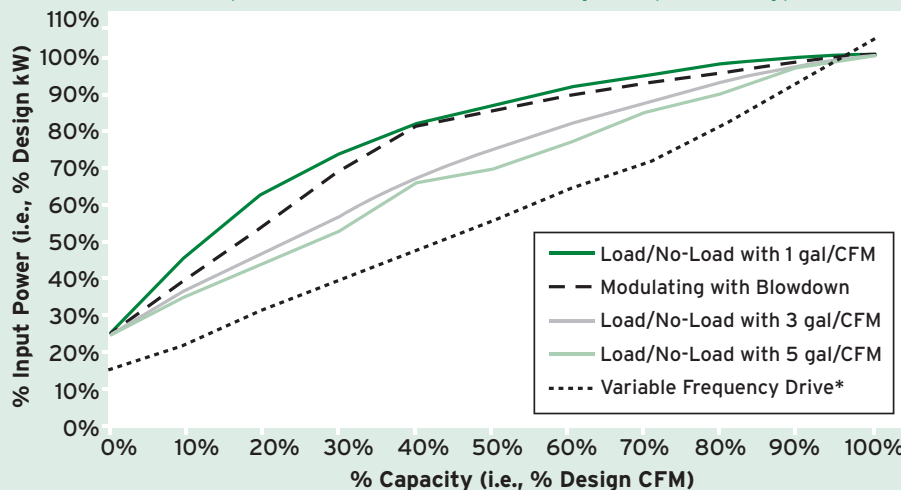
**Load/No-Load Compressors** are usually screw type, but can also use rotary vanes. They run continuously, loading and unloading the aircend to produce compressed air, or not, in response to changes in plant pressure. Unloading the compressor saves energy when no air is needed, but the unloading process results in compressed air loss. To minimize short cycling, couple the compressor with a large tank. Load/no-load compressors are only efficient if combined with a large enough tank.

**Multi-Compressor Systems.** Load/no-load compressors can be coupled with VFD compressors. While the load/no-load compressor runs continuously as the base load compressor, the VFD unit acts as the trim compressor by speeding up and slowing down. Care must be taken in setting up the controls so that the compressors do not work against each other.

**On/Off Reciprocating Compressors**, most common in smaller sizes up to 10 or 20 HP, turn on and off in response to pressure in the storage tank. This type of compressor is very efficient.

**Modulating Compressors** run continuously and modulate air output in response to load, controlling the incoming air to the compressor by opening or closing a valve. This type of compressor is often the least expensive to buy, but is also the least efficient.

Input Power at Partial Loads by Compressor Type



If an ideal compressor existed, load capacity and input power would match (e.g., 50% capacity at 50% input power.)

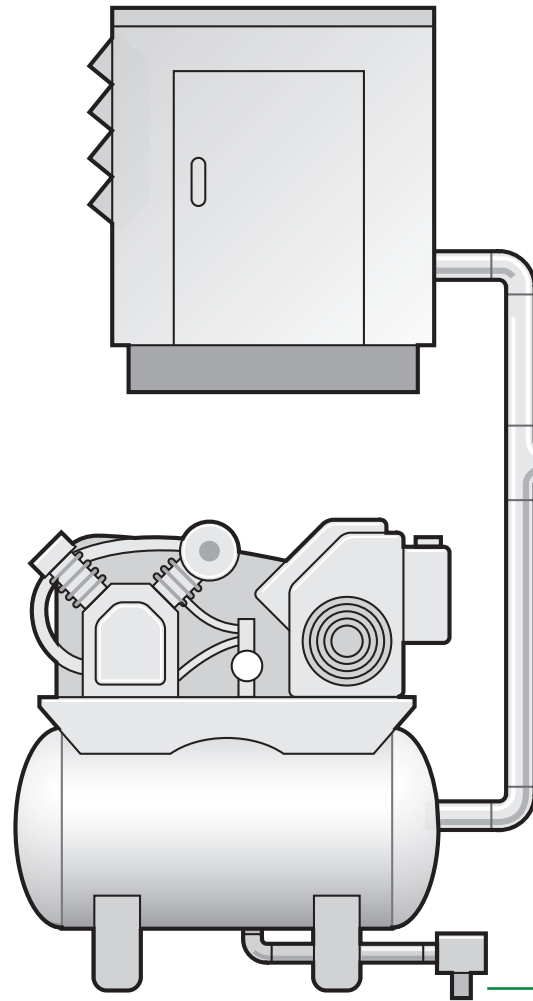
\* Most efficient compressor type for variable loads below 90% capacity.

Source: The U.S. Department of Energy (DOE)

A TYPICAL COMPRESSED AIR SYSTEM

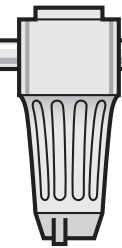
**1 COMPRESSOR**

Variable frequency drive (VFD) compressors are the most efficient option for variable loads below 90% capacity, using less energy than modulating compressors. Reciprocating compressors often come mounted on a tank (as shown on bottom).



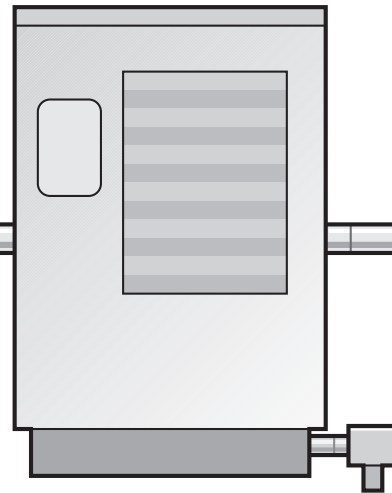
**2 FILTER**

Low-pressure-drop filters save energy by allowing a lower pressure set point at the compressors.



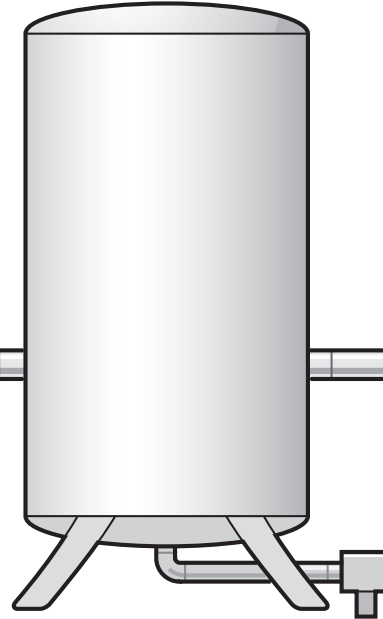
**3 DRYER**

Cycling refrigerated dryers run as determined by the airflow instead of operating continuously.



**4 RECEIVER/STORAGE TANK**

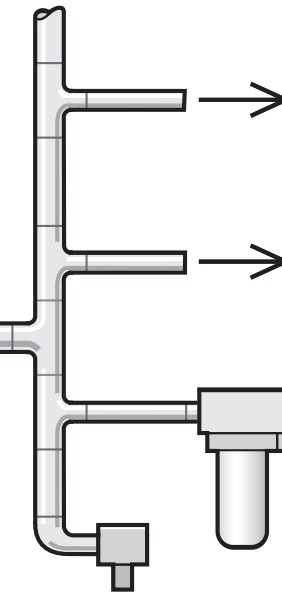
A properly-sized receiver/storage tank saves energy when coupled with a load/no-load compressor. It also enables a VFD compressor to provide more stable system pressure.



**DEMAND-SIDE (End Use)**

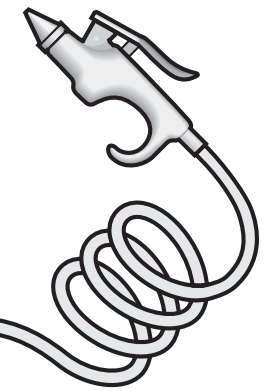
**5 MAIN PLANT MANIFOLD**

The plant manifold and piping should be properly designed and sized so as not to restrict air flow or cause an excessive drop in pressure.



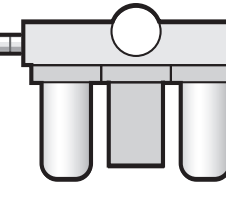
**8 AIRHOSE & NOZZLE**

Air-entraining air nozzles use less air to do the same amount of work as standard nozzles.



**7 QUICK DISCONNECT**

High-quality disconnects reduce air leaks.



**6 NO-LOSS DRAINS**

No-loss drains throughout the system only allow condensate to escape—not valuable compressed air.

**Managing System Pressure**

Pressure and CFM flow can have an inverse relationship: Turning up the pressure results in less air flow. **If you are short on air, turning up the pressure could be the wrong thing to do. Take action to determine if you are having a pressure or flow problem by talking to an expert.**

In general, you want to reduce your system pressure as low as possible to maximize air flow and save energy. Be sure to turn down the pressure slowly over time—one psi per day—to make sure that a pressure-reduction does not cause problems in the plant. By reducing pressure, you reduce the amount of loss from leaks, therefore reducing artificial demand.

**Eliminating System Leaks**

**Leaks in your compressed air system can add up to thousands of dollars a year in wasted energy, so it's important to check your system regularly to identify and fix leaks as quickly as possible.** Leaks can be estimated by measuring compressed air flow or compressor power during times when no compressed air is being used in the plant, such as on nights or weekends. Alternatively, a professional auditor can conduct a leak audit, typically by using an ultrasonic listening device, to identify and tag leaks, and provide an estimate of the volume—and value—of the escaping air. A *leak audit* can usually be completed in a day or two.

**Conducting System Audits**

A *system audit* takes a comprehensive look at the compressed air system—both the supply side and the demand side—to identify if inefficiencies exist. This approach requires an experienced auditor to meter the compressors for a week or more, and to conduct extensive analyses and calculations to determine the magnitude of the costs and savings of proposed improvement projects. **The result? A written report that will help you prioritize opportunities based on savings, simple payback, investment rate-of-return, and any other business goals or metrics you request.**

Identifying and fixing leaks saves valuable compressed air, and saves you energy and money.

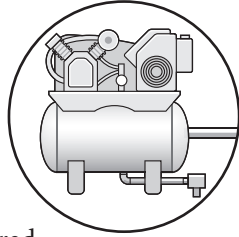
Your compressed air system might also have other, larger savings opportunities beyond leaks. To find a compressed air contractor, consultant, or vendor near you, visit the online Business Marketplace at [www.encyvermont.com](http://www.encyvermont.com).

**For additional information, call Efficiency Vermont toll-free at 888-921-5990.**

## SAVINGS OPPORTUNITIES

The most cost-effective approach to reducing compressed air energy use is to optimize your entire system; both the supply side (compressor system) and the demand side (end use). Below, you'll see typical ways that energy savings can be achieved.

### SUPPLY-SIDE SAVINGS



**Heat Recovery:** Approximately 80% of the energy used by a compressor turns into heat, which can be recovered and used to warm a building. This can save heating fuel.

**Pressure Drops:** It's a common misconception that turning up the pressure at the compressor will mean more airflow and fewer problems in distribution piping. In fact, the higher the pressure the fewer cubic-feet-per-minute (CFM) the compressor can produce. If pressure drops and flow chokepoints occur, identify and fix their causes rather than increasing pressure or using a bigger compressor. Minimize sharp bends and elbows in distribution piping, use a closed-loop header layout, install distribution piping of a sufficient diameter, and maintain filters regularly. A low-pressure-drop filter saves energy by allowing a lower pressure set point at the compressor.

**Compressor Control:** Proper control of multiple compressors on the same system is critical for efficient operation. This can be achieved with a single set of controls for all compressors or with individual compressor controls that are carefully set to maintain system-wide pressure without excess compressor cycling.

**Compressor Operation:** For a load that varies throughout the day, VFD compressors use less energy than modulating compressors.

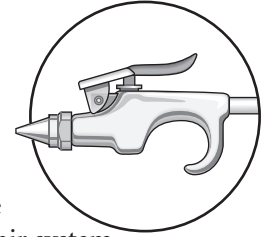
**Cycling Refrigerated Dryers:** Cycling refrigerated dryers turn on and off in response to demand rather than operating continuously, making them more efficient than standard refrigerated dryers.

**Desiccant Dryers:** If extremely dry air is required for end use, a desiccant dryer may be needed. However, a desiccant dryer uses more energy than a refrigerated dryer and often consumes so much air that it becomes a significant air load on the system. Be sure to choose the most efficient dryer that fits your needs.

**Storage:** Reduce demand spikes by installing additional receivers/storage tanks close to high-volume/short-duration points of use. A properly sized receiver/storage tank of four or five gallons per CFM of air flow saves energy when coupled with a load/no-load compressor. It also enables a VFD compressor to provide more stable pressure.

**No-Loss Drains:** No-loss drains allow only condensate to escape—not valuable compressed air—by only opening a valve when signaled by the condensate level control. Timed drains waste air by operating for a fixed time, even when there is no condensate to drain.

### DEMAND-SIDE SAVINGS



**Leak Detection/Correction:** Air leaks can significantly increase the energy demands of a compressed air system and can be extremely costly. Put a regular leak-detection and fixing program into place. Listen for leaks when the facility is quiet, such as during off hours, or consider purchasing and using an ultrasonic leak detector.

**Regulated Use:** When compressed air runs continuously—even when it is not required—energy and money are wasted. Turn compressed air on and off as needed to complete a task or use a solenoid valve to shut air down automatically when not needed.

**Appropriate Use:** Using compressed air when a task can be accomplished by other means—such as a broom, a vacuum pump, an electric motor, or a blower—adds up to higher electricity costs. Using compressed air to cool a bearing or an electric panel, for instance, is not cost-effective; identify and fix the underlying problem instead.

**Quality Disconnects:** Reduce pressure drops and air leaks by using long-lasting, high-quality disconnects made of hardened steel or plated brass with six or more ball bearings.

**Air Nozzles:** Standard handheld and fixed air nozzles use compressed air to clean or dry things. In comparison, air-entraining air nozzles use less compressed air by grabbing or entraining atmospheric air to do the same amount of work.

### WHEN IT'S TIME TO REPLACE OR UPGRADE YOUR EQUIPMENT

Rebates are available through Efficiency Vermont for purchasing select energy-efficient compressed air system equipment that is installed in your facility.

Visit the Business Rebate Center to download a rebate form or the Business Marketplace to find a compressed air contractor, consultant, or vendor near you; both online at [www.encyvermont.com](http://www.encyvermont.com).

To obtain information on additional custom incentives, low-cost financing, or other approaches that may be available to you, contact Efficiency Vermont toll-free at 888-921-5990.

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