HOW DO PNEUMATIC MOTORS WORK?

Pneumatic motors come in various configurations for different applications. The motor provides the power that drives the tools. It receives compressed air and transforms it into rotating energy for one group of tools (e.g., grinders, drills, impact wrenches); or reciprocal energy for an array of other tools (e.g., rivet hammers, chippers, scalers).

Looking at it more closely, the motor receives a jet of compressed air when the operator squeezes the trigger that flows against a vane, which causes the rotor to turn. As more vanes pass through the jet of air, the wheel accelerates.

The air speed generated can be improved by using a **motor cylinder** that concentrates the flow of air against the vanes.

A few factors determine the speed of the rotor:

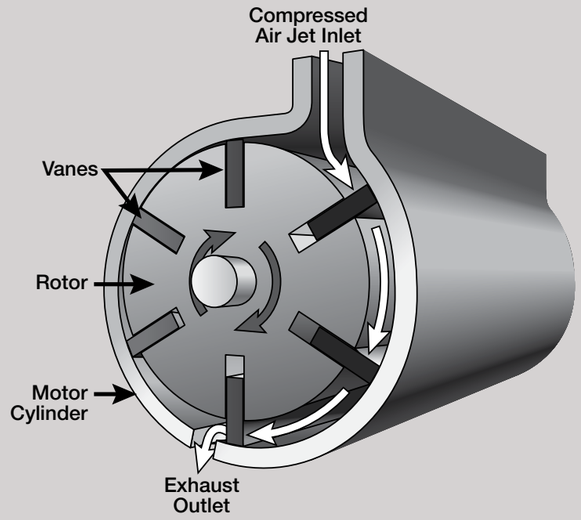
- Drag on the vanes
- Trigger pressure
- Amount of air hitting the vanes

REVERSIBLE AND NON-REVERSIBLE PNEUMATIC MOTORS

Reversible motors can turn clockwise or counterclockwise, depending on the application.

For example, a power wrench might be used in a clockwise direction to tighten a nut or bolt, but in a counterclockwise direction for removal of the nut or bolt.

Unlike the reversible motor, non-reversible motors run in only one direction. Tools having non-reversible motors include grinders, sanders and routers, among others.



TERMS RELATED TO MOTOR OPERATION

CFM – Cubic Feet per Minute (metric equivalent: liters per minute) – Measurement of air consumption.

Free Speed – The speed of a tool when active but not under load.

Governed Tool – A tool whose power is controlled in order to achieve optimal speed for the application. The governor works much like cruise control on a car) – governing the airflow to ramp up and maintain a particular speed.

HP – Horsepower (metric equivalent: watts or kilowatts) – measurement of the power generated by a tool.

RPM – Revolutions per Minute – Measurement of motor speed

Stall Torque – The amount of torque required to stall the motor. Useful in choosing an assembly tool for fastening a bolt, nut or screw.

Torque – Twisting force that creates stretch (or clamp) load. Measured in foot- or inch-pounds (ft.-lbs. or in.-lbs.) Metric equivalent: Newton-meters (N-m.)

SIOUX offers innovative, high quality pneumatic tools for a wide array of industrial manufacturing, assembly and finishing applications.

For an in-depth look at other applications, ask your SIOUX salesperson or distributor for our companion brochures.

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See the full line of SIOUX products:
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The information contained herein is for informational purposes only and is not intended to provide instruction or to serve as a training manual. Applications for the tools described herein may vary. Additional and different steps or procedures may be required to properly complete a given task. Always wear safety glasses when operating power tools.

#1 in an Education Series

KNOWLEDGE IS POWER

A quick course on pneumatic systems

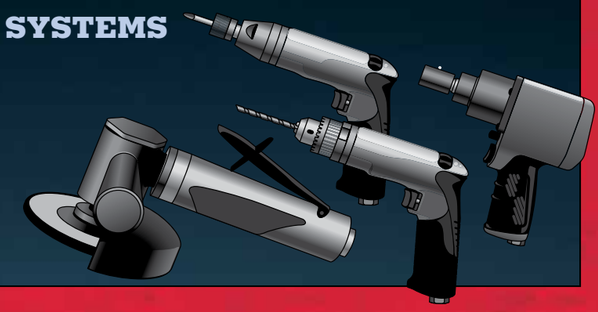
PRECISION TOOLS FOR PRECISE PERFORMANCE

Sioux Tools are known around the world for quality, durability and performance. Our extensive array of industrial power tools are engineered and built to make jobs easier, safer and more efficient. Sioux tools are designed to stand up to the demanding specifications required by today's industrial manufacturing, assembly and finishing needs. Many Sioux tools rely on pneumatic systems for power.

Let's take a look.

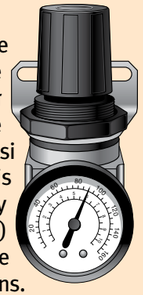
PNEUMATIC SYSTEMS

Pneumatic (compressed air) systems serve a variety of industrial applications. Our focus here is to explain how a pneumatic system powers air tools and equipment. The more you know about how a pneumatic system functions, the better. There are many important factors at play, and many excellent products to keep these systems performing optimally



WHAT MAKES A GOOD PNEUMATIC SYSTEM?

MAINTAINING GOOD QUALITY AIR



The air delivered to the tool needs to be clean, dry, lubricated and must provide the proper pressure. **Air regulators** maintain air pressure at a fixed level at key points in the system. An operating pressure of 90 psi (pounds per square inch), or 6.2 bars, metric, is a standard pressure established by Compressed Air and the Gas Institute (CAGI) and the American National Standards Institute (ANSI), for industrial pneumatic tool applications.

THE PROBLEM WITH MOISTURE AND PARTICLES

Water, water vapor and debris must be minimized in pneumatic systems to keep things working properly. Excessive moisture will negatively effect the performance of the system and may cause deterioration of the pipes over time if not properly managed. Moisture and debris must also be blocked from reaching tools and equipment to maintain system performance.

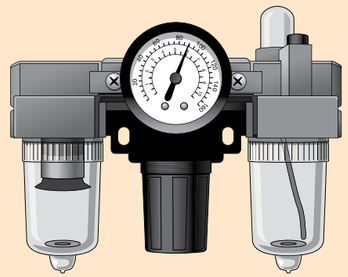
KEEPING MOISTURE AND PARTICLES TO A MINIMUM

Top performing pneumatic systems incorporate **filters** at all key points, such as workstations and air intakes.

Some filters are designed to capture debris. Others, called moisture separators, remove excess moisture. If **moisture separators** are properly maintained, they do a great job of removing trapped moisture. On the other hand, a poorly maintained moisture separator will do almost nothing. So it's good to use quality filters and conduct regular pneumatic system inspections. Even the best filters may need **auxiliary storage receivers** or **automated traps** in order to perform properly and to avoid early failure.

CATCHING WATER AT THE OUTLETS

Many air tools come with **strainers** to keep moisture and other contaminants out of the tool itself. These strainers are especially useful in older pneumatic systems and in those that remain idle for long periods of time. Water and other contaminants tend to build up inside these systems and may not be filtered out upstream.



EXPLAINING THE PNEUMATIC SYSTEM

Pneumatic tools use compressed air for operation. The pneumatic system delivers that air in the ideal condition for optimal tool performance. The system generates and distributes compressed air through a network of pressure regulators, pipes, connectors, valves and outlets. Many factors contribute to a successfully operating pneumatic system. Let's consider a few of the most important ones.

PROPER LOCATION OF THE COMPRESSOR

The positioning of the compressor can promote successful operation of the entire pneumatic system and minimize potential problems. The compressor should be placed where the incoming air is the coolest, driest and cleanest. The angle of the intake leading into the compressor should be as direct as possible, without bends that can accumulate moisture and particles. The intake should also be large enough to minimize moisture build-up.

When possible, the compressor should be located outside of the building and should be protected with screening. The compressor should not be placed near steam pipes or in dusty or wet locations where moisture and other contaminants can easily enter the system. In addition, the compressor should have sufficiently large **intake filters**.

MINIMIZING MOISTURE IN THE SYSTEM

Water is a fact of life with compressors. But moisture can be a problem when it passes into the piping and eventually reaches the tools and machinery. Moisture can be minimized by using a variety of tools including **intercoolers**, **after coolers** and **full-size receivers**. As compressed air passes through the piping, **traps**, **drains**, **strainers**, **moisture separators** and **filters** also play a role in capturing and minimizing moisture and particulate matter. These tools are discussed in more detail in this brochure.

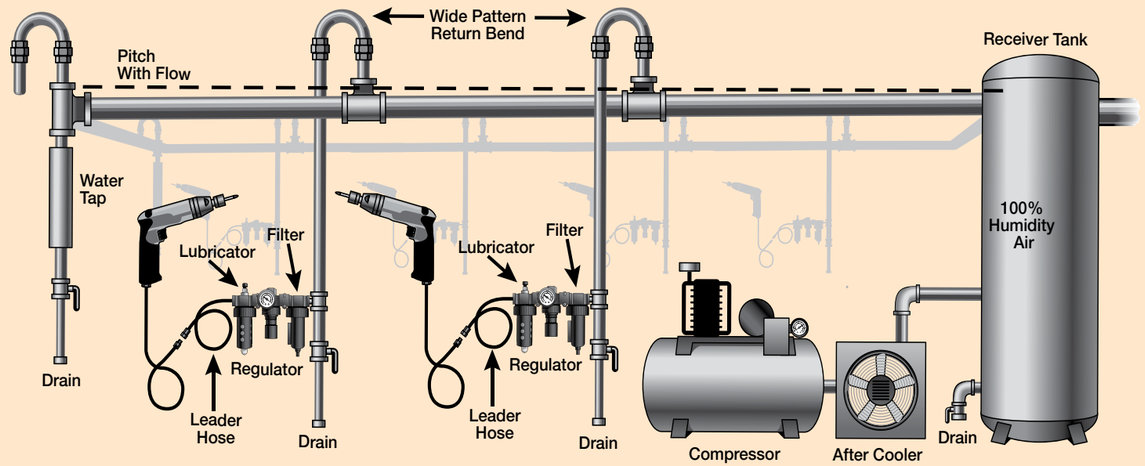
THE IMPORTANCE OF LUBRICATION

Pneumatic tools need lubrication to work properly. You might think that lubrication would only be applied directly to the tools and equipment. However, the most efficient and best way to lubricate is both at the tool and also within the compressed air. Lubricants can be introduced in the compressed air directly into the air stream. The lubrication becomes atomized—broken into tiny particles that form a fog. This fog travels through the air and coats and protects the operating parts of tools and equipment.

It is important to keep equipment continuously lubricated while in use. **Airborne lubrication products** take care of that, feeding the system automatically and continuously with measured lubrication whenever the equipment is operating.

Using high quality airborne lubrication products saves time, trouble and money. Some lubrication products are especially good. **Air motor oils** have a sticky quality and keep parts lubricated for long periods of time. These products can mix with water, which is important to the delivery system. They also resist rust, which increases tool and equipment life.

Filter-regulator-lubricators (FRLs) should be used near the hose outlets where the tool connects to the system. FRLs make it easy to manage distribution of lubrication.



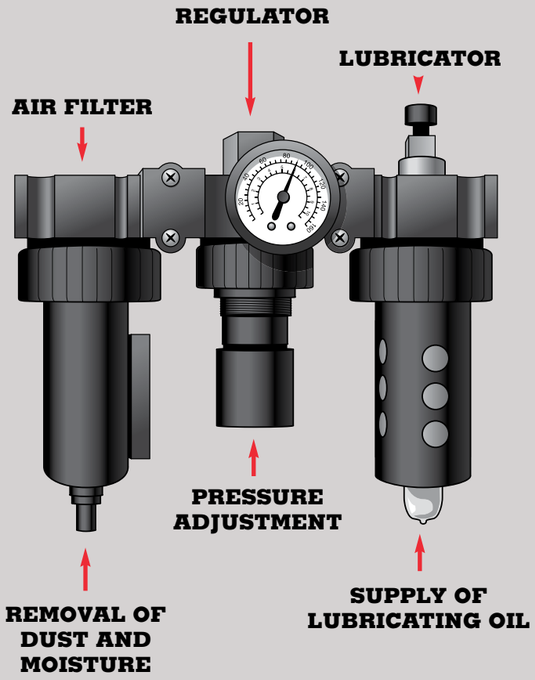
ENHANCING PERFORMANCE OF THE PIPING SYSTEM

Excessive pressure loss is a common problem affecting pneumatic systems. This problem can be minimized by using air mains and lines that continue to operate effectively when pressure levels drop.

As mentioned earlier, water poses a problem for tools and equipment. The air cools after compression and precipitates moisture, so it is important to provide a means for draining or trapping this water before it reaches the hose outlets where tools and equipment are connected.

One thing you can do is to angle the air line mains downward in the direction of airflow. Gravity and airflow will hold the water back and direct it into **traps** or **water legs** positioned at frequent intervals. Please note that these devices for trapping water need to be drained regularly and never allowed to fill completely. **Automatic traps** empty water before the trap becomes full, and eliminate the need for manual draining.

A word of caution about traps that drain to sewers: They can waste a lot of air. This situation can be avoided by having traps inspected for leakage during the installation process. **Shut-off values** (also known as **petcocks**) positioned in the drain allow for control of the airflow to minimize waste.



TROUBLESHOOTING COMMON ISSUES

A pneumatic system has many components and is quite complex. Fortunately, experts have been working with systems for years and have identified common problems and solutions.

PRESSURE IS TOO HIGH OR TOO LOW.

Check your air regulator. It should read 90 psi while the tool is running.

TOOLS AND EQUIPMENT NOT WORKING WELL

Make sure the system is adequately lubricated. Without lubrication, tools and equipment will not function properly and could even become damaged and require replacement.

WATER IN THE SYSTEM

- Check the compressor location.
- Make sure your system has properly sized intercoolers, after coolers and receivers.
- Make sure to inspect all strainers, moisture separators and other filters.
- Lower the humidity of the compressed air. Products are available for this purpose.
- If practical, angle your main supply line downward, and your feeder lines from the top of the compressor. Extend your feeder line past their connection points with tools and equipment.

That way, excess water can drop to the bottom of the feeder line and drain off.

WHERE DOES MOISTURE COME FROM?

The compressor is the foundation of a pneumatic system. Ambient air enters the compressor containing some level of moisture. Once the air is compressed and enters the receiving tank, it cools down and the moisture falls out of the air, a process called precipitation.

The important thing to know is that moisture is bad for pneumatic systems and for the tools and equipment that rely on compressed air. That's why we have **filters, strainers and moisture separators**. They keep moisture and contaminants out, and keep the system functioning well.

