Monitoring pneumatics makes all the difference

Regardless of how state-of-the-art a pneumatic system may be, unwanted increases in air consumption can never be ruled out. Daily wear and tear, particularly on seals, eventually leads to leaks which waste energy and money, and hurt performance. When systems begin to leak, pneumatic components slow down. So users tend to increase system pressure to combat the problem. But adding compressor capacity means leaks draw even more air, leading to a downward spiral of inefficiency and energy losses.

Besides wasting energy, pressure drops due to leakage can cause pneumatic components to perform below par. The short-term fix of boosting pressure inevitably leads to more serious problems with components, eventually resulting in premature failure. Many users continue to run pneumatic systems until they fail, typically because it is difficult to isolate the process or component contributing to higher air consumption.

Monitoring pneumatics

To pinpoint leaks and losses, system air-consumption monitoring should be an ongoing effort. A leak-detection program is one option that usually involves complete, manual inspection of all air lines. Technicians typically diagnose leaks by listening for hissing air, inspecting tubes, and tightening fittings. But a disadvantage of leak-detection programs is that depending on inspection frequency, leaks can go undetected for a long time. Inspections are also time consuming and may be problematic in noisy industrial environments. In-
Festo’s GFDM energy-monitoring package consists of smart flow and pressure sensors, a diagnostic controller, specialized software, and a user-friendly graphical display. Monitoring compressed-air consumption on the plant floor can reduce operating costs, improve energy efficiency and reliability, and extend machine life. It also helps ensure cost-effective production and quality products.

Sensors often miss small leaks, which prevents repairs in the early stages before they become a major problem.

Continuous life-time monitoring of pneumatic systems is proving to be a better solution, resulting in cost-effective operation and longer equipment life. Limited monitoring and diagnostic audits for specific industry segments have been available but, until recently, there has been no generic tool that provides overall system monitoring, diagnostics, and comprehensive energy savings. Likewise, it has been possible to purchase an array of sensors, controller, display; write the appropriate software; and assemble, configure, and troubleshoot a custom monitoring system. But the time, trouble, and expense mean such systems are rarely installed.

**Energy efficiency**

As a better solution, Festo Corp. has developed a tool that monitors system flow, pressure, and air consumption using smart flow and pressure sensors, a diagnostic controller, and a graphical display. The latter, called a FED (Front End Display), can be combined with an external SCADA (supervisory control and data acquisition) system that permits remote data evaluation. Called GFDM, Festo’s energy-monitoring package comes as a complete system that provides real-time data and in-depth data analysis of machine performance.

Flow sensors, properly sized and installed at important locations within an air-distribution network, highlight deviations, send messages, and activate alarms when flow exceeds tolerance thresholds. Technicians can easily pinpoint leaks, failures, and other problems and take immediate actions to fix them. In addition, sensors in manufacturing facilities can track air consumption of pneumatic systems — even down to specific components — and help calculate true operating costs.

Sensors can be used throughout an entire air-distribution system, though the number and exact location depend on customer requirements. Typically some are integrated at important points and monitor flow to groups of machines. Any increase in air consumption would at least indicate a problem exists and note the general area of concern.

Other users are more interested in monitoring flow to a single machine or subsystem. In these cases, sensors quickly narrow the source of any increase in air consumption.

Finally, a single component is sometimes critical to a manufacturing process or operating an entire assembly line. In such cases, it is a good idea to mount a sensor to closely monitor just that component. A general rule of thumb is to install at least one flow sensor in the main supply line on every machine with an average-size pneumatic system. It tracks air consumption over the long term and easily identifies sudden increases in demand.

If air consumption varies when equipment changes from one process to another, the machine PLC updates the energy-monitoring controller with new operating guidelines. Otherwise, the GFDM package is totally self-sufficient and needs no external interface besides a power supply.

It comes preconfigured to streamline setup. For instance, software to initialize the sensors is embedded in the controller, which also includes analog input modules for flow sensors and digital input modules for communication with the machine.

Customizing the display for an application is straightforward: technicians just input the tolerance settings for flow and air consumption. Once configured, a simple teach-in process can be performed by averaging data over a number of cycles.

The GFDM also offers several possibilities for archiving or off-line number crunching. Recorded data can be exported into spreadsheets (.csv format) for use with post-processing software. It also archives data for later review. For instance, referencing can capture a “good” condition of the system. The data can then be used to monitor system conditions and can be invoked on-demand for troubleshooting in case of problems.

A graphical display provides real-time analysis of flow rates and air consumption — both through waveform analysis and bar charting. Alarms indicate when user-defined thresholds are violated for up to four concurrent failures.

Each package monitors up to 16 separate processes that can be totally independent from each other. And for recurring processes, new teach-ins are not necessary — previously generated data uploads automatically. This can permit 24/7 operations using a single monitoring package.

**Ensuring uptime**

Continuously monitoring for leaks helps manufacturers minimize energy losses and maintain high productivity. The resulting savings often pay for the cost of a GFDM...
system in a matter of months. In addition, manufacturers increasingly recognize the direct and indirect costs of unscheduled downtime that these systems help prevent.

For instance, unplanned machine stoppages upset the demands for fast cycle times and high productivity in the packaging industry. That's why Wolf Verpackungs-
maschinen GmbH, Lich-Birklar, Germany (wolf-pack.de), equipped its VPP 250 bag forming and packaging machine with a Festo diagnostic system. The machine processes 100 bags/min, and the diagnostics continuously monitor pneumatic and process-related parameters, including:

- Flow and pressure sensors monitor deviations in compressed air supply.
- Analog sensors measure position of the pneumatic feed cylinders, to monitor process parameters such as foil-dependent contact pressure and belt wear.
- Cooling airflow and pressure are monitored as process and foil-related variables to avoid unnecessary use of compressed air.
- Positioning time of cylinders is used to gauge wear and tear on the transverse sealing blade; premature wear on the longitudinal sealing system is also monitored via cylinder travel time.
- Stroke counters on cylinders and switching cycle counters on valves provide information for preventive maintenance and recommended replacement.
- The unit's CPX electric terminal monitors valve-control and proximity-switch signals, as well as faults such as short circuits, broken wires, overvoltage, and valve blockages.

By monitoring air consumption and positioning times, the diagnostic system detects and locates leaks and other malfunctions. Results displayed on the FED touch panel are also sent to the machine controller via a fieldbus. This makes all diagnostic data globally accessible, letting the machine builder's service staff help streamline maintenance procedures and maximize uptime.

The energy-monitoring package has no impact on automation processes, making it easy to integrate into an existing machine. It lends itself especially to evaluating air consumption for different operations, checking the health of pneumatics, finding the optimal operating point of a machine, preventive maintenance, and central or decentralized monitoring of air consumption.

The GFDM package is available as a kit or fully functional control cabinet, and also for periodic leasing for condition monitoring. It helps users improve compressed-air use at the point of consumption and develop efficient maintenance plans, which should ensure a considerable return on investment and longer machine life. Data from various projects show that cost recovery for the energy-monitoring package is well within one year. MD