

Intelligent On-Off Valves

Jonas Berge writes how intelligent on-off valves, in conjunction with asset management software, can help reduce unnecessary valve inspection, speed up valve overhaul, and enable shorter turnarounds to be planned in plants.

To increase productivity and reliability, new plants are now being built with intelligent on-off valves featuring microprocessors and digital communication, while existing plants are being modernized with wireless technology and automation for manual valves.

Plants are gaining immediate benefits from added intelligence in sensors and on actuators. In the future, the value of this technology will increase further as Machine-to-Machine (M2M) and Internet of Things (IoT) capabilities are used for remote valve monitoring.

On-off valves are often used in general purpose service operations, such as emptying and filling tanks, backwash and blow-back of filters, loading and unloading, and sequencing of equipment and products in batch applications.

On-off valve controller

Traditionally, a pneumatic on-off valve is automated with a separate solenoid valve and two feedback limit switches for open and closed positions. However, the feedback limit switches can be challenging to align for correct position indication.

A better solution is an integrated on-off valve controller mounted on the on-off valve. A low-power piezo pilot valve with spool valve and limit switches are built into the self-contained on-off valve controller protective housing. The single integrated unit simplifies engineering, procurement, and construction which makes it easy to mount on the valve actuator and connect the wiring. An on-off valve controller can be used on rotary or linear motion valves, most commonly with rack and pinion, scotch-yoke, or vane actuators, but also linear type of actuators with direct or reverse action.

A wired on-off valve controller uses only a single pair of wires from the on-off valve to the junction box and is two-wire loop powered. Thus, no separate electrical power is required. An on-off valve controller can be intrinsically safe, non-incendive, and flame/explosion-proof, making it suitable for all hazardous areas. The

command and valve position feedback signals, which indicate if the valve is open, closed, opening, closing, or stopped, are carried on the same two wires, making wiring easy. Plus, the feedback signals from the on-off valve can be utilized immediately or incorporated into the control strategy later in the project.

Wireless actuation

Many of the on-off valves around existing plants are manually operated. These on-off valves may not have been automated due to the high cost of hardwiring an on-off valve the traditional way, since this required three pairs of signal wires and three I/O channels on the control system for each on-off valve; one command signal for the solenoid, and two feedback signals from the limit switches. It is important to note that adding automation on manual valves in an existing plant can damage the existing wiring when working in junction boxes and laying more cables in trays.

Manual valves require operators to go to the field to manually open and close the valve, or simply check if it is open or closed. Such tasks are time-consuming and inefficient, particularly considering how huge and expansive plant complexes can be.

Existing plants are now modernizing their manual on-off valves with wireless on-off valve controllers. The WirelessHART digital communication technology enables on-off valves to be automated without running any wires or using up I/O card channels on the control system. Only compressed air has to be provided. The installation is low risk since cable trays and junction boxes need not be opened. A WirelessHART gateway is installed at the edge of the plant unit and integrates with the existing control system. Control system uses Modbus/RTU, Modbus/TCP, or OPC communication to send “open” and “close” commands to the valve via the wireless gateway and to read the feedback, while other software uses HART-IP communication to write configuration settings and read the diagnostics. The same wireless gateway is also the access point for various wireless transmitters around the plant used for asset monitoring to improve reliability and maintenance, sub-metering for energy efficiency, and monitoring various other points for reduced HS&E risk.

Start modernizing aging plants by installing wireless on-off valve controllers on the most frequently used manual on-off valves. Reducing the need for operators to go to the field to open and close valves improves plant



Figure 1: WirelessHART on-off valve controller.

productivity, freeing up the operators to perform more value-added tasks. There is also an element of improved safety since operators spend less time in the field, and situational awareness is improved as the valves get actual position feedback.

There is intelligence out there

On-off valves are in direct contact with the process and have to withstand demanding applications, sometimes in challenging ambient conditions, or with harsh process fluids. On-off valves in certain applications, such as Pressure Swing Adsorption (PSA) or filter backwash/blowback, work very hard and are cycled on-off frequently, causing more wear-and-tear on both valve and actuator parts.

Traditionally on-off valves do not have intelligence technology and therefore lack diagnostics data that informs maintenance personnel which on-off valves are in good condition and which need servicing, before running to failure.

An on-off valve controller is intelligent, having digital communication and a microprocessor capable of on-board diagnostics. Depending on the on-off valve controller, the diagnostics may include open and close travel time, which can be trended to detect deteriorating valve performance, as well as reversal counters used to estimate wear and tear. Diagnostics also include high and low temperature monitoring to detect exceeded operating conditions. It is possible to distinguish between an internal on-off valve controller problem and a valve problem in where the valve is not moving. The on-off valve diagnostics makes it possible to more accurately predict need for maintenance and schedule maintenance and turnaround activities based on how hard the valve is actually working and how it performs. An on-off valve controller can also be configured similar to a control valve positioner. Some on-off valve controllers include an auto-setup button for function testing of the valve actuator package and to automatically calibrate the open and closed positions. In the future on-off valve controllers will feature even more diagnostic capabilities.

Since on-off valve controllers make on-off valves intelligent, these intelligent on-off valves can now be integrated with the control system, as well as with asset management software working with control valves, electric actuators / motor operated valves, analyzers, and transmitters. Therefore, on-off valve controllers can be managed centrally from a computer in an office accessing configuration and



Figure 2: On-off valve controller on valve and actuator.

diagnostics without going to the field. The software also provides around-the-clock automatic device diagnostics monitoring, alerting personnel to any problems. Advanced on-off valve controllers support NAMUR NE107 status signals for reporting of instrument diagnostic alarms. On-off valves share the same common audit trail for changes and event log for failures as all transmitters and control valves in the plant, thus all of them can be seen in one place. The principles from the upcoming ISA108 standard for intelligent device management can be applied to make sure instrument diagnostic alarms are routed to the right person based on the criticality. In the field it is possible to work on an on-off valve controller using the same familiar handheld field communicator used for other field instruments such as transmitters and control valves.

In asset management software, an intelligent on-off valve is displayed as a ‘dashboard’ designed by the on-off valve controller manufacturer using the Electronic Device Description Language (EDDL) with easy-to-read dial gauges and indicators to display overall status and operational information such as actual position.

Plant technicians can tap into the know-how of the on-off valve controller manufacturer’s specialists in the form of help text and illustrations.

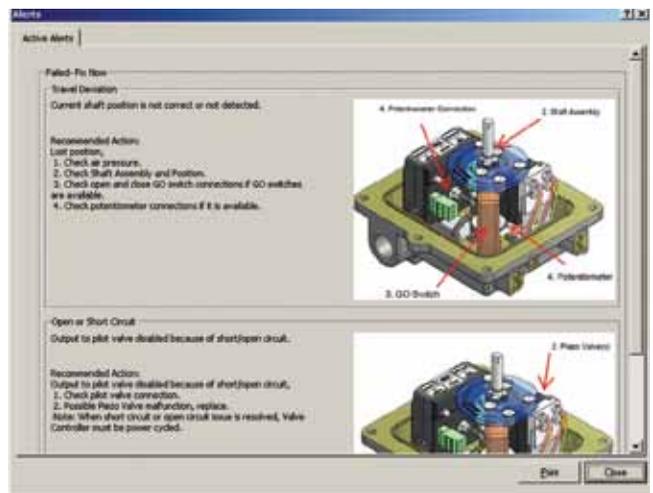


Figure 4: Diagnostics detect problems which are displayed with description, illustration, and recommended action.

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Valve automation

An on-off valve controller is an integral unit that includes position feedback. A built-in microprocessor and digital communication capabilities enable valve diagnostics from a central location to allow for greater maintenance efficiency. Wired on-off valve controllers can be designed into new plants and wireless on-off valve controller can easily be deployed into existing plants to automate manual valves.

CEA

Jonas Berge is Director of Applied Technology at Emerson Process Management.



Figure 3: “Dashboard” provides an at-a-glance overview of on-off valve status.