

# Are you taking full advantage of pneumatic valve technology?

BY CHRIS LANDIS

## Put advancements in pneumatic valves to work for your organization

Pneumatic valves have come a long way since the development of the compressor over a century ago. Starting with large manual and mechanical valves, they migrated to individually wired electric solenoids and ultimately ended up with plug-into-the-base electronics allowing for a single multi-pin connector or fieldbus installation. Today's valves are smaller, faster and more advanced than their predecessors and offer many advantages that can be easily overlooked. With advancements in ISO valve standardization, collective wiring solutions and diagnostic capabilities, both end users and original equipment manufacturers (OEMs) are seeing significant cost reductions resulting from multi-vendor support, wiring simplification and decreased machine downtime.

The International Organization for Standardization (ISO) specifications 15407 and 5599 offer valve users protection against ever changing business conditions and product obsolescence, which are often the cause of vendor issues. These industry standards dictate the size and location of the valve porting, base porting and mounting screws, as well as the electrical connector location, size and wiring, if utilized. By migrating away from proprietary valve mounting patterns to a completely standard and interchangeable pneumatic and electrical ISO pattern, companies are able to ensure multi-vendor support on a global scale. Gone are the days of regionally based vendors undercutting prices at OEMs with hopes of high MRO prices at the end user facility. ISO interchangeability and consistent cost structure ensure consistent pricing levels.

Collective wiring solutions, especially when integrated with a fieldbus solution, provide an elegant mechanism to consolidate solenoid wiring into a single "collective" connection on the valve manifold. This methodology offers significantly reduced cost and complexity of the machine. Industrially rugged electrical connections, combined with advanced sealing technology,

allow the valve manifold to be moved out of the control cabinet to point-of-use application located near the pneumatic process. This eliminates long tubing runs and corresponding delayed responses in pneumatic operations. When integrating a fieldbus solution, there is a sharp reduction in the number of components on the bill of material as terminal strip laden junction boxes and control cabinets are reduced to simple connections. Now, two cables — one communication and one power — can handle the work-load of hundreds while eliminating home-run wiring and long conduit runs. Large machines can be broken down for shipment and reassembled with an absolute minimum of labor since the wiring is bus connected with only two cables.

Finally, diagnostic tools like short circuit detection, confirmation of signal and status LED lights offer advancements in troubleshooting and maintenance. When combined with an integrated fieldbus solution, status bits from advanced valve driver modules are able to quickly alert an industrial PLC when a short circuit is detected on any valve solenoid, which is the most common failure mode of an electric solenoid. With user programming, the status bit change can be turned into a detailed error message stating, "Valve Number four Must Be Replaced with a Two-Position Double Solenoid ISO 15407-2 Valve." Also available from advanced valve driver cards is a status bit indicating that the current has been sent to the solenoid. This functionality acts as a double check to confirm the PLC program issued by the command, that the fieldbus network communicated the request and that the valve driver module had the correct working voltage and applied it to the solenoid. This is a way to confirm the command was executed by all components in the system, as expected. Status LED lights offer a fast, visual indication of the component status. Malfunctions in the power source, fieldbus status and modules can be detected without queries to the PLC. With some upfront programming, these types of feedback will alert the user to a potential issue and offer a way to stop production before bad parts are made, improving both scrap rate and machine downtime costs.

## Benefits to OEMs

The benefits offered to OEMs regarding advancements in ISO standardization, collective wiring solutions and diagnostic capabilities are tremendous. ISO standardizations with multi-vendor support ensure lead-time is no longer an issue. Regional business issues sustained by one vendor will very rarely affect the performance or output of another. With many manufacturers offering complete ISO valve product lines, including discretely wired valves, collectively wired valves, sandwich regulators, flow controls, transition plates, English threads, metric threads and a variety of voltage and fieldbus options, designers can work with confidence knowing all their needs can be met. And with the ISO specification governing valve sizes ranging from 18mm up to 64mm wide, a complete range of flow rates are available.

When utilizing collective wiring solutions with fieldbus, the time required to measure, cut, strip, terminate and label a solenoid is eliminated, equating to a savings of three minutes per connection. When analyzing a standard hard-wired system where each solenoid is wired individually, the time-savings become more apparent. A standard solenoid will have three leads going from the valve to a junction box, one for positive voltage, one for common and one for ground. Once back at the junction box, most machine builders group all the common voltage lines together as well as all the ground lines together for the run from the junction box to the control panel to reduce wiring. Thus, there can be four connection points for each solenoid on the valve in the system: one at the solenoid, one at the valve side of the terminal strip in a junction box, one at the control panel side of the junction box and one at the PLC output card inside the control panel. Considering many fieldbus equipped valve manifolds offer a 32 solenoid capacity, this could have an assembly time reduction of over 13 hours!

CONNECTION LOCATION	TYPE OF CONNECTION	CONNECTIONS	TIME
Valve Connection	(3 valve leads) x (32 valves)	96	288 min
Junction Box – Valve Side	(3 valve leads) x (32 valves)	96	288 min
Junction Box – Control Panel Side	32 outputs + common ground	34	102 min
Control Panel	32 outputs + common ground	34	102 min
<b>Total</b>		<b>260</b>	<b>780 minutes (13 hours)</b>

Wiring savings of a 32-station valve manifold, at three minutes per connection.

**ISO Specifications 15407 and 5599 offer pneumatic valve users protection against ever changing business conditions and product obsolescence.**

Point-to-point testing time is also reduced proportionally to the reduction in solenoid leads. With many valve manufacturers integrating both digital and analog input and output capabilities into their fieldbus equipped valve manifolds, many additional terminal strips and wiring runs can be reduced, in the same three minutes per connection. Many manufacturers and distributors offer completely assembled, pneumatically and electrically tested manifolds, reducing the potential for errors.

Now consider the cost of the conduit runs, which need to be cut, threaded, bent, supported and installed at an estimated six minutes for each operation. With one bend, and two threaded ends, a standard 10 foot long piece could add up to 36 minutes. When you consider the time to layout, cut, drill and assemble the junction box or main panel, estimated at 45 minutes each, along with two 32 solenoid valve manifolds and 20 feet of conduit, you have just reduced your machine assembly time by 28 hours. Using an estimated fully burdened labor rate of \$65 per hour, the labor savings approach \$2,000. Remember, this does not include the cost of the components no longer needed.

COMPONENT	QUANTITY	TIME SAVINGS	TOTAL SAVINGS
32 Solenoid Valve Manifold	2	780	1,560 min
Junction Box		45	45 min
Control Panel	1	45	45 min
10' Conduit Run	1	36	72 min
	<b>2</b>	<b>260</b>	<b>1,722 minutes (28.7 hours)</b>

Total sample machine time savings.

Additional cost savings can be realized by OEMs as a result of valve enhancements. Point-of-use valve installations offer easy tear down and rebuild of machines when moving from the OEM floor to the end user facility, potentially reducing reinstallation time at the end user site by 50%. As mentioned before, simple twist-to-connect cordsets replace extensive junction boxes or bulky multi-pin connectors. The total wiring reduction of collective wiring solutions offer a lower probability of wiring errors. This wiring reduction, along with the

elimination of junction boxes and conduit runs, will translate into simplified engineering drawings, saving additional time. And with point-of-use application, the ability to use predesigned layouts or reuse layouts from other projects becomes much easier, as the input and output modules are not located inside the panel.

PLC manufacturers are beginning to incorporate vendor specific profiles into their software resulting in easy controls startup of valve fieldbus solutions by selecting module profiles from a pull-down list. These profiles can significantly reduce configuration time by eliminating the need to search through maintenance manuals and instruction sheets for fieldbus variables necessary to add collective wiring manifolds to the network. This eliminates the potential to enter an incorrect variable and corresponding time required to troubleshoot the mistake.

## Benefits to End Users

Benefits aren't just limited to OEMs, as end users are able to capitalize on advancements of ISO standardization, collective wiring solutions and diagnostic capabilities. OEE (Overall Equipment Effectiveness) is improved with ISO valve standardization by minimizing machine downtime. By using the diagnostic capabilities of an integrated fieldbus solution, a faulty valve can be identified and an appropriate ISO style replacement given. MTTR (Mean Time to Repair) is reduced with a simplified ISO 15407-2 or 5599-2 design requiring the removal of only two to four fasteners and no cables or wiring. Many advanced valve driver modules offer auto device replacement, clearing the error status bit automatically, once the worn valve has been replaced. No programming or controls engineering assistance is needed. This is also true of many integrated input and output modules often attached to the same valve manifold (check with your supplier for guidelines). Additionally, users will have reduced potential for down time in their facility due to the reduction of components, such as junction boxes, terminal strips and conduit runs resulting in a reduced bill of material and hence a reduced opportunity for failure. Crib inventory is reduced as proprietary valves, and consequently specific vendor nuances as well, are eliminated.

Furthermore, end users are likely to see a cost savings benefit passed on by their OEMs in the form of more competitive bids resulting from the labor and material reductions of collective wiring pneumatic valves. You can expect manufacturing

time to be reduced by the time savings associated with collective wiring, as end users may see a reduced lead time from their vendors, with a potential further reduction of expedited costs and concerns over system installation deadlines.

Point-of-use valve installations integrated with fieldbus make it significantly easier to expand collective wiring valve manifolds for last second machine enhancements as well as machine upgrades performed after initial installation. There is no need to have individual leads running back to the junction box terminal strips or control panel, resulting in significant time-savings for engineering and assembly. For valve manufacturers incorporating fieldbus with input and output capability on their point-of-use valve manifolds, it is easy to add I/O to the machine. There is no need to worry about control panel spacing and whether or not there will be room to expand because the system is located outside of the panel.

With many end users adopting Lean principles of manufacturing and continually striving to eliminate waste and improve material flow, collective wiring offers the additional benefit of easy relocation of manufacturing centers. With the elimination of junction boxes, disassembling a station can be as easy as disconnecting a few cordsets and reconnecting after the move. The control panel and overall machine size will be reduced because valve manifolds can be located conveniently around the machine, rather than in one large, central location.

Whether your organization is an OEM or an end user, there are a myriad of ways to capitalize on pneumatic valve advancements like ISO standardization, collective wiring solutions and diagnostic capabilities. The next time an opportunity to specify a pneumatic valve solution arises, think about specifying an ISO standard with integrated fieldbus. Standardizing on a standard will allow you to take advantage of global multi-vendor support and fair MRO pricing structures. If rising labor costs and wiring complexity are causing increases in machine cost and maintenance complications, look into the ever-advancing capabilities of collective wiring solutions and diagnostic capabilities. Improved profitability, decreased machine build times and enhanced diagnostics are all possible with today's pneumatic valve solutions.

*For more information please contact Chris Landis, Product Sales Manager — Valve/Vacuum, Parker Hannifin Corporation, Pneumatic Division, tel: (269) 629-5000, Email: CLandis@Parker.com, <http://www.parker.com/pneu/simplify>*