

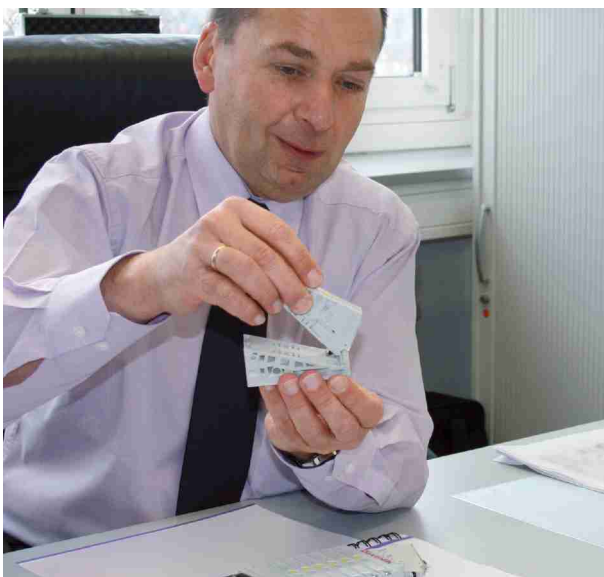


Original interview in German language, taken from the o+p journal (issue 6/12)

„Half the Installation Space and Weight, Increased Performance“

Innovation in pneumatics: the newly developed valve series Advanced Valve AV03 from Rexroth radically improves energy efficiency.

With ever shorter product life-cycles and the depletion of “new” physical possibilities, true innovations are becoming more and more of a rarity, also in the field of pneumatics. The Advanced Valve system presented by Bosch Rexroth at the HANNOVER MESSE trade fair truly merits the distinction “innovative”: it reduces compressed air consumption by up to 65% while increasing flow rates by roughly 40% – all with half the weight. The design of the new valve system makes it more energy efficient. We spoke with Theo Paulus, Head of Development and Product Management Pneumatics at Bosch Rexroth in Laatzen, Germany. He explained the considerations behind these impressive figures, as well as how the Pythagorean theorem helped in this endeavor.



Theo Paulus, Head of Development and Product Management Pneumatics at Bosch Rexroth in Laatzen, Germany, shows the valve design during the interview.

Mr. Paulus, what challenges is the field of pneumatics currently facing?

Pneumatics have clear advantages in terms of economy. They are also very simple to use. The integration of fieldbus controls, and especially the use of the new Ethernet-based data transmission protocols in recent years, enable pneumatics to be successfully integrated in a wide variety of equipment automation structures. Improvement potentials primarily exist with regard to energy efficiency – a topic which has recently become extremely important for equipment manufacturers and users.

How does the new valve generation from Rexroth contribute to increased energy efficiency?

We use the universal Rexroth 4EE approach (Rexroth for Energy Efficiency) for all of our developments. It begins by increasing component efficiency and also considers subsequent component use in the system. The new Advanced Valve series takes a dual approach: First, we have made significant reductions to internal throttling losses. Second, we were able to minimize installation space and weight by at least 50% compared to conventional valve systems. This opens up new possibilities for design engineers to mount AV valve systems directly onto moving equipment parts near the actuator or compressed air consumers. This reduces tubing lengths and minimizes dead volumes, and thus compressed air consumption.



How were you able to achieve these significant advantages? What is innovative about the new design?

During the early development phase, we questioned all of our familiar design principles. We also consulted professionals from completely different technological fields within the Bosch Group, as well as external experts. We had a set valve design and asked ourselves how we could make its housing as compact as possible. In retrospect, it makes perfect sense that we looked to Pythagoras for inspiration. The result of this highly systematic development approach was the diagonal arrangement of the valve functions.

What is the effect on internal energy efficiency?

With the Advanced Valve series, we have improved the flow rate by about 40% over previous designs – while simultaneously reducing the frame size. For practical purposes, this means that the user can reduce the supply pressure by up to 15% without a loss in performance at the actuators.

How did you achieve this improvement?

Our developers conducted extensive simulations to analyze internal valve flows. The simulations enabled us to improve the geometries inside the AV valve and, for example, to create a smaller deflection angle for the supply and exhaust channels. Additional detailed improvements targeted the inlet and outlet channels on the base plate. We utilized every angle in the valve system and the results are astonishing. All in all, the AV valve system is protected by more than ten patents and proprietary rights applications.

What specific advancements have you made in terms of installation space and weight?

AV valve technology demonstrates the full flexibility of a base plate system with the key difference of needing about 45% less space than normal valves. The valve system is

therefore even more compact than the widely used cassette valve systems, which have the additional drawback of limited flexibility. One more plus: the AV valve system weighs around 55% less than conventional valves as we consistently use highly filled engineering polymers. These high-performance plastics have proven themselves in the automotive industry for years. They are resistant against oils, greases, and solvents, as well as refrigerants and lubricants. The combination of a compact design and low weight taps into a significant energy-savings potential: the valve systems are installed decentrally, directly on the machine, even in confined installation spaces or near moving machine functions.

Where can you pinpoint the savings effect?

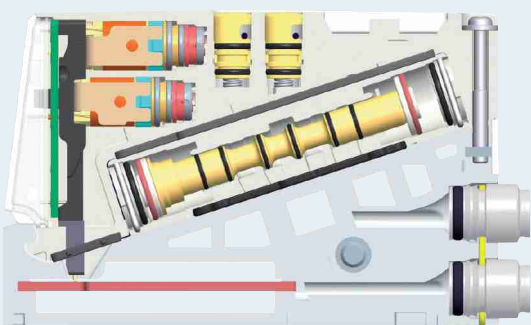
The air column in the tubing between the valve and actuator is what we refer to as “dead volume.” When the valve opens, the dead volume needs to be compressed before the actuator can move. The longer the tubing, the more air and energy are required. AV valves are situated close to the actuator and reduce the dead volume both in the compressed air supply to the actuator and in the exhaust via the valve system. This equates with compressed air savings of up to 65%. An additional important effect of shorter tubing: it increases the dynamics of pneumatic movements and creates the necessary preconditions for shorter machine cycle times with the same level of air pressure.

Which applications is AV valve technology geared towards?

The AV03 valves are designed to achieve a flow rate of 300 l/min and the protection class IP65. This performance class is often used for handling tasks in general automation settings, but also in the food and packaging industry, as well as in printing presses.

Have you already received feedback from customers?

We worked closely with key customers during development and cooperated in testing prototypes and preproduction samples in the field. Customer feedback was integrated in the end product. We responded to a suggestion from a user to reduce the height in the final AV valve system series by an additional 4 mm compared to the prototypes, for example. This solution allows the customer to create even more compact systems.



The diagonal interior reduces installation space.

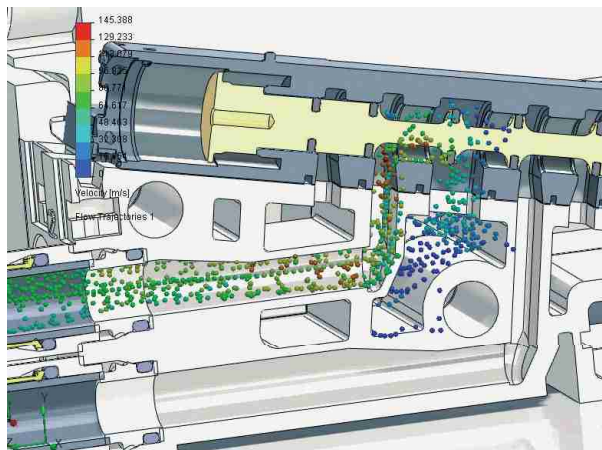


▲ **Extremely small and lightweight:** The valve system can be efficiently integrated into the system, even directly on the actuator.

► **Rexroth engineers calculated optimum air flows** based on extensive simulations.

To what extent can AV technology be adapted to individual user requirements?

The AV valve series covers all conventional single and double solenoid valve variants. In the bus control version, every base plate can be equipped with up to 64 valves and up to 128 electrically actuated pilot systems. From the second AV valve, the system can be expanded in single increments. Users can implement different pressure zones with supply and partition plates. Valve system versions with fieldbus or Ethernet communication modules enable the direct connection of up to ten digital I/O modules. This is also one of our experiences from the field: when valves are located near



the actuator it makes sense to reduce cabling and connect the associated sensors directly to the bus module, which also cuts the potential for error significantly.

Could you give us a brief conclusion: why are you convinced of the success of the new AV valve technology?

It is the first pneumatic valve system that was developed in line with 21st century technology using comprehensive flow analyses and modern high-tech materials. The upshot for the customer is excellent technology paired with increased performance. A 50% reduction in installation space and weight is especially advantageous in compact systems. The energy-related benefits, such as 20% less compressed air thanks to a close proximity to the actuator, provide a convincing argument for all other applications. The integration of electronics in the AV valve system is completely adapted to the design of the mechanical components, meaning that the mechanics and electronics are intertwined in a perfect symbiosis. The AV valve technology thus combines all previous advantages of the pneumatic and electronic components with a considerable increase in energy efficiency. These features will prevail on the market.

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