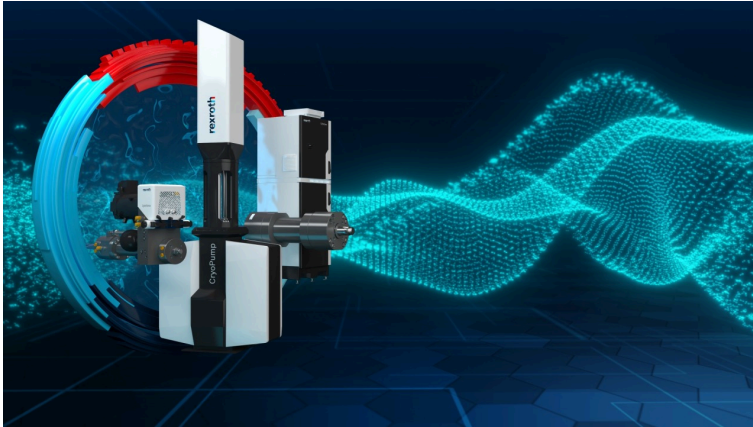


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# Drive systems for compressors for hydrogen filling stations: Scalable, robust and compact

Manuela Kessler | 22.04.2024 | Lohr am Main /Germany | PI 015/24

Servo-hydraulic drives for hydrogen compressors and cryopumps increase efficiency and shorten refueling cycles



Together with partners from the hydrogen industry, Bosch Rexroth has developed a scalable portfolio of servohydraulic drives for compressors in the power range between 10 and 280 kW. (Image source: Bosch Rexroth AG)

**Within the next six years, several thousand hydrogen filling stations will go into operation worldwide, making an important contribution to the decarbonization of the mobility sector. Together with partners from the hydrogen industry, Bosch Rexroth has developed a scalable portfolio of servohydraulic drives for compressors in the power range between 10 and 280 kW. A new cryopump for example directly compresses liquid hydrogen to 875 bar and thus allows heavy commercial vehicles to be directly refueled within a few minutes.**

Long service life and start-stop operation, high efficiency with low hydrogen losses and low operating costs: OEMs and operators are looking for solutions that can be implemented quickly in technological terms to ensure the economical operation of hydrogen filling stations. Based on its decades of experience in electrohydraulics, Bosch Rexroth has developed customized solutions for an economical hydrogen infrastructure, working together with partners.

The company relies on servohydraulic drive technology with an infinitely variable hydrostatic transmission. The robust hydraulics has a long service life. Long-stroke, ATEX-certified drive cylinders for compressors increase delivery rates thanks to end position-optimized control. The portfolio covers the power range between 10 and 280 kW as well as various applications.

### **New cryopump: 100 kg of hydrogen in 10 minutes**

Bosch Rexroth developed the new electrohydraulically driven cryopump in collaboration with FirstElement Fuel, the market leader for the commercial operation of hydrogen filling stations in the USA. With a connection rating of 280 kW, it compresses liquid hydrogen to 875 bar for the direct refueling of heavy trucks. The aim is to refuel vehicles with 100 kg of hydrogen within 10

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minutes. With direct refueling, there is no need for temporary storage tanks at filling stations. The first filling stations will be equipped with the new system from 2025.

Bosch Rexroth also offers variants developed together with partners for medium and smaller outputs. The 75 kW CytroCore compressor drive can be used to compress both liquid and gaseous hydrogen. In the lower output range of 10 kW, a ready-to-connect self-contained actuator CytroForce drives the compressor cylinders. No specific hydraulics know-how is required for either of the solutions.

### Standard modules finely scalable in hardware and software

For optimum energy efficiency, Bosch Rexroth relies on so-called displacement control. In contrast to throttle control which is used in most industrial hydraulic systems, position and force control is achieved by means of servohydraulic pump control. This control concept reduces energy consumption by approx. 75 %. In addition, the drive system for compressors require less than one square meter of installation space and are much quieter than conventional drive systems. After a one-off parameterization, they are ready for immediate use. They communicate with the control system for the hydrogen filling station via open interfaces. All modules continuously record operating data, thus putting in place the conditions for systematic condition monitoring and predictive maintenance for maximum availability with the digital service CytroConnect Solutions.

Bosch Rexroth can configure the standard drives in its portfolio in hardware and software to suit specific applications and thus precisely meet the requirements of users. The drive systems for compressors simplify the system architecture and operability of hydrogen filling stations and are suitable for both established companies in the hydrogen industry and newcomers.

### Basic Information Bosch Rexroth

As one of the world's leading suppliers of drive and control technologies, Bosch Rexroth ensures efficient, powerful and safe movement in machines and systems of any size. The company bundles global application experience in the market segments of Mobile and Industrial Applications as well as Factory Automation. With its intelligent components, customized system solutions, engineering and services, Bosch Rexroth is creating the necessary environment for fully connected applications. Bosch Rexroth offers its customers hydraulics, electric drive and control technology, gear technology and linear motion and assembly technology, including software and interfaces to the Internet of Things. With locations in over 80 countries, around 33,800 associates generated sales revenue of 7.6 billion euros in 2023.

### Basic Information Bosch

The Bosch Group is a leading global supplier of technology and services. It employs roughly 429,000 associates worldwide (as of December 31, 2023). The company generated sales of 91.6 billion euros in 2023. Its operations are divided into four business sectors: Mobility, Industrial Technology, Consumer Goods, and Energy and Building Technology. With its business activities, the company aims to use technology to help shape universal trends such as automation, electrification, digitalization, connectivity, and an orientation to sustainability. In this context, Bosch's broad diversification across regions and industries strengthens its innovativeness and robustness. Bosch uses its proven expertise in sensor technology, software, and services

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to offer customers cross-domain solutions from a single source. It also applies its expertise in connectivity and artificial intelligence in order to develop and manufacture user-friendly, sustainable products. With technology that is “Invented for life,” Bosch wants to help improve quality of life and conserve natural resources. The Bosch Group comprises Robert Bosch GmbH and its roughly 470 subsidiary and regional companies in over 60 countries. Including sales and service partners, Bosch’s global manufacturing, engineering, and sales network covers nearly every country in the world. Bosch’s innovative strength is key to the company’s further development. At 136 locations across the globe, Bosch employs some 90,000 associates in research and development, of which nearly 48,000 are software engineers.

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