

Digital oxygen valve paving the way for the future



Oxygen is the most abundant element in the Earth's crust and the second most common of the Earth's elements as a whole. Without oxygen, humans cannot survive and health professionals cannot save lives. Supplying medical oxygen requires extensive logistics and many human resources. Linde Healthcare is one of the leading medical gas suppliers and has raised the management of oxygen cylinders to a new level, in partnership with KELLER AG für Druckmesstechnik.

Comprehensive gas supply across the globe

Linde Healthcare supplies medical gas to clinics and hospitals in more than 50 countries around the world. When it comes to medical care, it is vital that diagnostic and therapeutic applications function reliably, complying with the highest possible safety, quality and efficiency standards worldwide. Gaseous oxygen is stored under extreme pressure in cylinders. Medical oxygen for mobile use is generally available in cylinder sizes of between two and five litres. At a pressure of 200 bars, one litre of medical oxygen is equivalent to 200 litres of oxygen at normal air pressure.

Oxygen cylinders with an analogue pressure gauge have been used to supply medical gas for more than 20 years. The user takes a reading of the remaining oxygen on a physical table and calculates it based on the residual pressure, the size of the cylinder and the set oxygen flow. This requires an enormous amount of human resources, as hospitals use up to 1,000 gas cylinders every day, with each cylinder lasting for around three hours when used at the maximum flow rate. These huge logistics are handled by the nursing staff themselves.

Linde Healthcare came up with the idea of a digital display on oxygen cylinders with the aim of simplifying hospital logistics. The project definition was to develop a digital valve which is compatible with the existing, durable oxygen cylinders. Linde found its way to KELLER AG für Druckmesstechnik via an official call for projects.

New level of competence thanks to complex starting point

KELLER AG für Druckmesstechnik is Europe's leading manufacturer of isolated pressure transducers and transmitters. Its many years of experience in providing customised solutions and its relish for new challenges made the company an ideal partner for Linde. KELLER has been developing fill level measurements with specifically designed sensors for all manner of difficult environments for many years now. With the project for Linde Healthcare, however, KELLER took the deliberate decision to take on this new challenge in order to further develop its internal infrastructure and process operations for products in the medical industry.

Aside from making it compatible with the existing cylinder, no modifications to the structure of the new digital valve were permitted. In addition, the sensors must also meet the high purity standards required for medical oxygen applications. In order to meet these standards, KELLER had to develop a completely new sensor which was fully tailored to the specified environment. The sensor needs to be able to measure pressure ranges of up to 300 bars and must be manufactured in a sterile room.

From analogue to digital

In order to meet these strictly defined specifications, the project team tested out a variety of designs and prototypes until they found the perfect combination. The recently developed pressure transmitter is extremely robust, reduced to the bare essentials and is made with materials that tolerate oxygen particularly well. With these qualities, the PA-5 sensor by KELLER excels with its very compact structure and is now becoming the centrepiece of Linde's digital oxygen cylinders.



Oxygen cylinder with
analogue pressure gauge



Innovative gas cylinder system
with digital display and acoustic signal

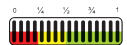


The analogue sensor built into the valve measures the pressure of the gaseous oxygen in the cylinder and sends this information to the electronics behind the display via a plug connection. The patient can access the following prepared data at any time using clear icons.

Remaining oxygen and flow



Display of the time remaining with the chosen flow setting



Fill level



Current flow rate

Safety alert symbols



Critical situation



Gas flow is lower than set flow



Temperature too high or too low



Low battery level



No acoustic signal



Magnetic field detected

Status



New, unused cylinder

In addition to the digital display, the valve also has an acoustic and visual alert signal. The alarm indicates critical situations such as a low fill level or a limited gas flow caused by a bend in the hose. This gives patients greater safety when monitoring the cylinder themselves.

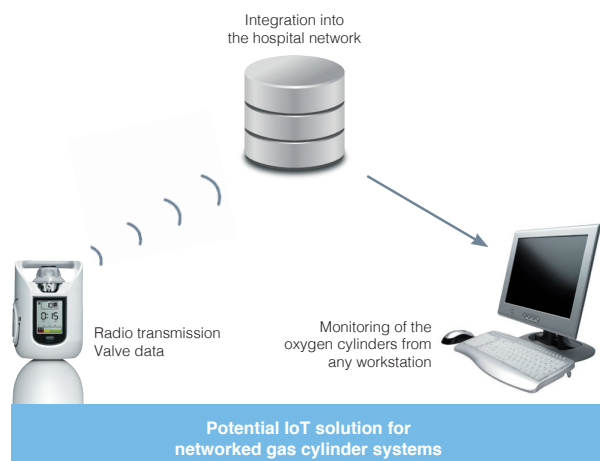
This new and innovative gas cylinder system is called **LIV® IQ (Linde Integrated Valve)** and has become very well established on the market. The major advantage of this system lies in the self-monitoring aspect and the better mobile oxygen supply, for example when transporting a patient. Furthermore, it helps nursing staff tremendously as they spend less time taking readings as they know down to the exact minute how much longer the oxygen will last with the current settings.

Networking of digital oxygen cylinders

The optimisation of medical gas supplies will go a step further in the future. There are plans for an IoT (Internet of Things) process for the LIV® IQ. The valve's digital data will then be integrated into an internal hospital network via radio and prepared in a customer-friendly way.

Nursing staff can access all digital, acoustic and visual display information from any workstation within the hospital across a network. Once again, this vastly reduces the additional effort of checking each oxygen cylinder in situ.

This step towards the Internet of Things is currently being developed by Linde Healthcare. With this planned solution, the next generation of the LIV® IQ will revolutionise how oxygen cylinders are managed in hospitals.





Linde Healthcare is a global business unit of the Linde Group and specialises worldwide in the field of integrated respiratory care, covering everything from the pharmaceutical supply of gases and the medical products that go with them to supplying patients at home and in specialised ventilation care centres. Safety, quality and innovation of treatments and services are the main areas of focus at all times. Linde Healthcare also operates in more than 60 countries.

You can find more information at
www.linde-healthcare.com



Bernd Rieker
 Global Expert, Medical Devices
 Linde Healthcare

« When you break new technological ground as Linde has done with the LIV® IQ, it is very reassuring to have the best experts on your team. When it comes to pressure measurement technology, there was no doubt that KELLER met these requirements admirably. What is important in our case is not only that our suppliers have the necessary technical expertise, but also that they are prepared to offer individual solutions. Last but not least, only top production quality is good enough when it comes to medical applications. In KELLER we have found a partner who emphatically supports us in this endeavour. »



Michael Mack
 Product Manager
 KELLER AG für Druckmesstechnik

« Thanks to the close cooperation with Linde, KELLER was able to gain valuable knowledge about the market requirements for medical oxygen in the product development and launch phases. This is how, for instance, the quality of the working environment in specific production departments at KELLER was boosted to a new level. In return, Linde was able to benefit from KELLER's extensive experience in the fields of pressure sensor measuring and sensor data analysis and compensation. With the pressure sensors that are currently being developed, the joint path into the future of intelligent oxygen cylinders is being paved. »

