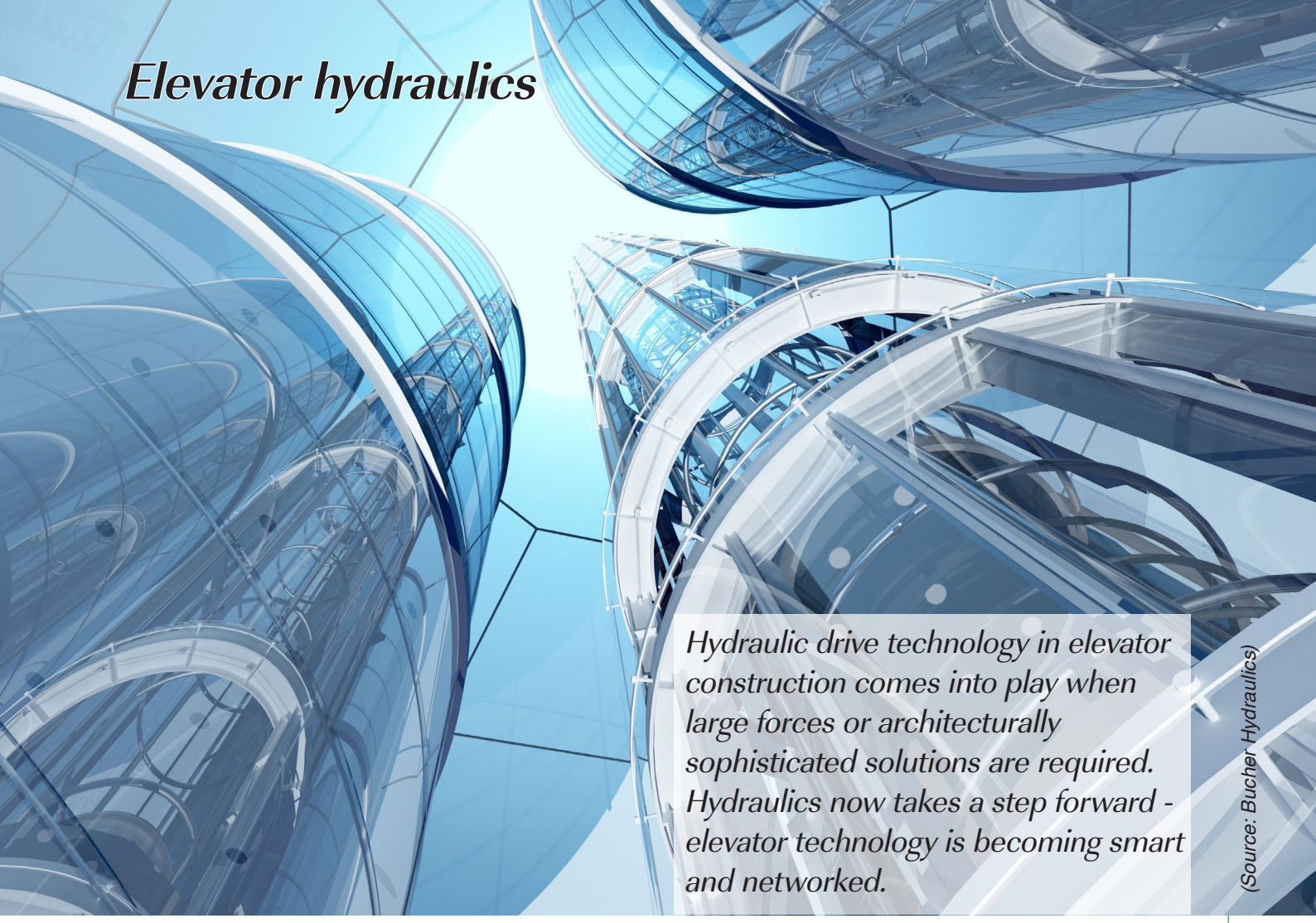
Elevator hydraulics



Hydraulic drive technology in elevator construction comes into play when large forces or architecturally sophisticated solutions are required. Hydraulics now takes a step forward - elevator technology is becoming smart and networked.

(Source: Bucher Hydraulics)

Tony Aschwanden, Head of Product and Application - Elevator at Bucher Hydraulics in Neuheim, Switzerland, explained: "Freight elevators with high loads are the domain of hydraulic elevators. Equipped with one or more cylinders, they can lift loads of more than 40 tons over 25 meters and higher". A clear benefit of hydraulics: the forces can be transferred directly via the building foundation, whereas in the case of traction elevators they usually make their way into the building structure via the shaft head.

But these powerhouses can also look elegant: another area of application is architectural elevators featuring large areas of glass, but with no sign of suspension ropes, which would have a negative visual impact and be distracting. A central cylinder, often a telescopic design below the car, slim and shining, appears delicate and aesthetic. Modern designs even work without any lateral car guidance at all, for example with round glass cars. This allows elevator doors to be installed in any direction. The hydraulics themselves also keep a low profile: the power unit and other equipment fit in a wall cabinet or in the shaft.

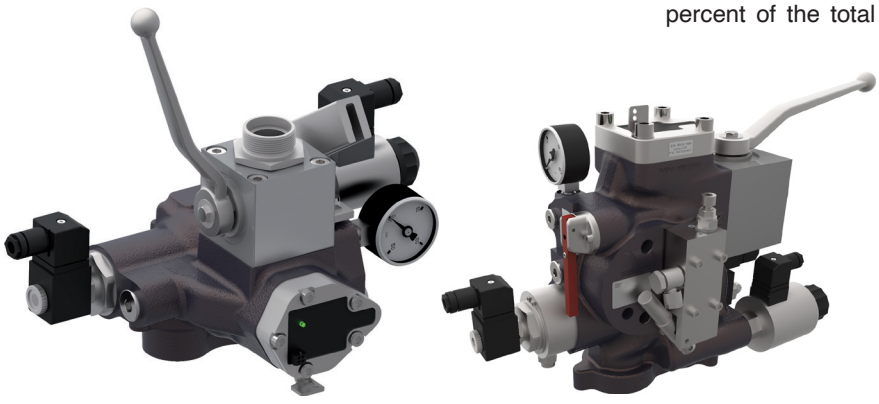


Figure 1: The iValve is an electronically controlled lift-control valve for controlling hydraulic elevators (Source: Bucher Hydraulics)

Frequency inverter - No more oil than necessary

There are about five million elevators in the EU. They use about 18 terawatt hours of electricity per year, about 0,7 percent of the total electricity demand. That's why within the foreseeable future, elevators are to become subject to the EU Ecodesign Directive. A pilot study has already been completed under the leadership of the Fraunhofer Institute for Systems and Innovation Research (ISI). In terms of energy efficiency, however, hydraulic elevators have already been heading in the right direction for quite a long time. In fact, looking at their whole service life, they are usually superior to traction elevators, according to a study by the Spanish technology ▷

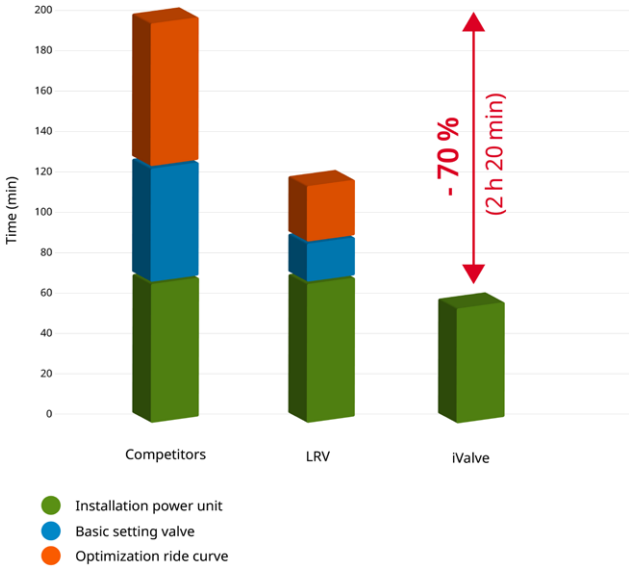


Figure 2: The iValve eliminates the basic valve settings and optimizes the travel curve (Source: Bucher Hydraulics)

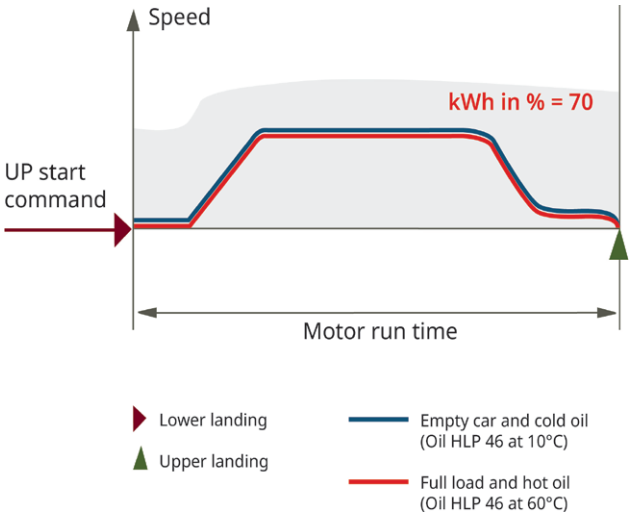


Figure 3: The lift-control valve automatically compensates for varying loads and oil temperatures (Source: Bucher Hydraulics)

center Instituto Tecnológico de Aragón (Itainnova). The Swiss Federal Office of Energy, in its study "Electricity Consumption and Savings Potentials in Elevators," also attests that typical hydraulic elevators in apartment buildings have lower maintenance costs than traction elevators.

A major factor in saving energy: the use of frequency inverters. Without a frequency inverter the pump's drive motor runs at full speed right from the start. The travel curve - i.e. acceleration, full speed, and deceleration - is controlled by a valve. The surplus oil is fed back to the tank in an energy wasteful manner, causing it to heat up unnecessarily. As a result, an oil cooler may even become necessary.

Frequency inverters, on the other hand, control the motor from as low as zero speed. As a result, only as much oil is pumped as is needed for the ideal travel curves. "With 30 to 40 percent energy savings, the extra cost of the frequency inverter pays for itself, especially in frequently used elevators," reasoned Aschwanden.

But there's more. One example: the use of supercapacitors, or supercaps for short. They can be charged and discharged much faster than rechargeable batteries. In addition, they withstand far more charging cycles. Among other applications, they became known for storing electrical energy in Kers, - the Kinetic Energy Recovery System - used in Formula 1 racing cars, and for regenerative braking in buses and trains.

About Bucher Hydraulics

Bucher Hydraulics is an international provider of drive and control technologies, from the initial project phase to the finished product, for mobile and industrial hydraulic applications. Production facilities and sales centers are located in Europe, India, China, Brazil, and the United States. Target industries are construction machines, materials handling and lifting technology, municipal equipment, renewable energy, agricultural technology, mechanical engineering, and elevator technology.

Elevator builders worldwide, including not only global market leaders but also many medium-sized companies, use hydraulic elevator components from Bucher Hydraulics. The valves, power units, and cylinders can be found in passenger and freight elevators in airports, train stations, shopping centers, and commercial buildings. The elevators reach travel heights of 25 meters and more. The payload ranges from 320 kilograms to over 40 tonnes. The components can also be used to modernize existing installations and offer architects a wide creative scope. Machine room-less (MRL) hydraulic systems, for example, solve the problem of space and also meet design requirements. The systems are characterized by low maintenance requirements and high energy efficiency. They are long lasting, offer a very good cost-benefit ratio and can be modernized to make a decisive contribution to the deduction of the environmental footprint. Last but not least, passengers appreciate the ride comfort.

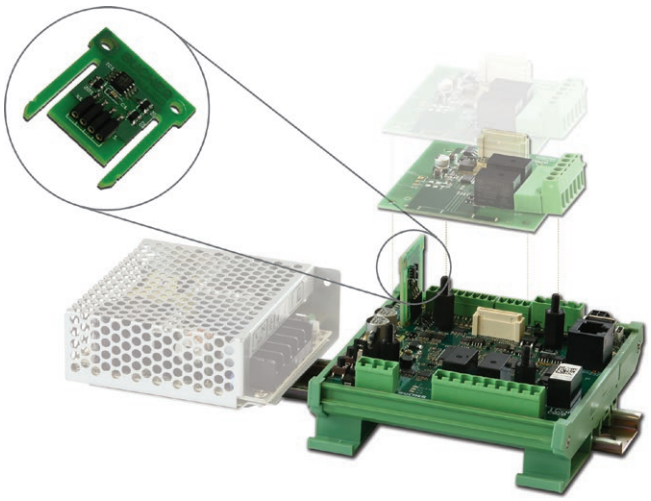


Figure 4: The iCon-2 electronic card checks the electronic control actions, the valve conditions, and the ride comfort. Travel curves are recorded in the electronic system. During operation, the travel curves for that particular elevator are optimized by the learning algorithm iTeach (Source: Bucher Hydraulics)

Figure 5: Is everything ok with the elevator? The iCon-2 controller delivers information directly to the lift controller via CANopen Lift (Source: Bucher Hydraulics)

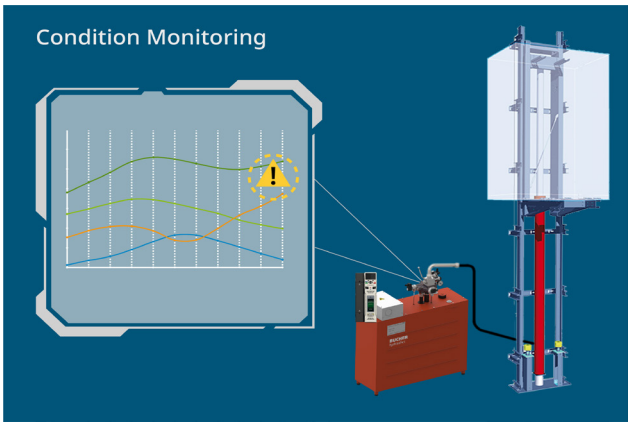


Figure 6: The iValve, in conjunction with the iCon-2 controller, provides data for predictive maintenance that helps prevent breakdowns (Source: Bucher Hydraulics)

Bucher Hydraulics has adapted this technology for elevators. It can even be retrofitted to existing units - with the appropriate software modifications. The oil displaced from the cylinder by the car drives the pump. The pump turns backwards and the motor generates electrical energy, which is temporarily stored in the supercaps via the frequency inverter. During the next UP travel, this energy is available and reduces the power consumption from the grid. Depending on the application, energy savings of 20 to 30 percent can be achieved this way. The system is particularly worthwhile in highly utilized industrial installations.

iValve in elevator hydraulics

Bucher Hydraulics is a member of the VDMA Bluecompetence initiative and has committed itself under the motto Ecodraulics. Based on this, they develop and manufacture products with a particular focus on energy-savings, low-emissions, long life, lightweight, and space-savings. A prime example: the intelligent hydraulic valve iValve for the elevator industry, with flow rates of 250 and 500 liters per minute (66 and 132 US gpm).

The iValve is a strategic optimization of the LRV (lift control valve) towards industry 4.0. It can be installed and put into operation significantly faster. Thanks to sensors and corresponding software the valve is self-learning and self-optimizing. In addition, it has extensive networking capabilities. This makes the iValve a future-proof choice, as it can be substantially retrofitted thanks to its modular design. Installation time is reduced by up to 70 percent compared with a mechanical hydraulic valve. Besides, it saves up to 30 percent energy. A very precise closed-loop control circuit ensures first-class ride quality and excellent leveling accuracy (± 3 millimeter) in both directions, regardless of the temperature and viscosity of the oil. "Smart" is the upcoming predictive maintenance, which makes it possible to respond before any damage occurs.

iTeach ensures commissioning

The installation and commissioning time for an iValve is only 60 minutes as opposed to 120 minutes for an LRV series valve or 200 minutes for a conventional valve. The installation time is shortened because only two connecting lines between the electronics and the valve are used instead of several cables to the pressure sensors. The major part of the time saving, however, is due to the complete elimination of the basic valve settings and the optimization of the travel curve. This is done by the iValve itself using iTeach based on the shaft information supplied by the lift control system. An initial travel curve after installation looks like this: start with long start-up phase and slow speed, full speed, deceleration, and again a long travel distance at slow speed until the valve stops. For a typical travel distance, this takes about 14,5 seconds between starting and stopping the car. The iValve optimizes itself during the first five travels via iTeach and reduces the total travel time to 8,5 seconds, which saves a lot of energy.

Networking made easy with CANopen Lift

In combination with the iCon electronics, the iValve offers every option for modern networking. The bus system used is CANopen Lift (read more on page 6), an open source quasi-standard in elevator engineering. This simplifies the wiring effort for the overall system and communication with the drive. Initial systems with this CANopen connection are in operation in Germany, the Netherlands, and Switzerland.

Thanks to the optional CANopen connection via plug-in card on the iCon controller, no additional terminals are necessary. The parameters can be changed centrally via the lift control system. The iCon board is equipped with a fault memory, which can be read out for analysis on site, or remotely using smart devices. For the elevator manufacturer, this is the direct path to predictive maintenance: the iValve can pass on status information, data log files, and warnings, which are sent to the lift control system, and from there they can be shared globally. And this does not just apply to new systems: it can also be retrofitted to approx. 50 000 systems worldwide. ◀

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1992 - 2022

On June 1 and June 2, CiA celebrates its 30th anniversary with an in-person event in Nuremberg (Germany).

30th CiA anniversary days

Day 1	
10:00 to 11:00	Registration and welcome coffee
11:00 to 12:30	**Session I (three 30-min presentations)** - Dr. Arthur Mutter (CAN XL) - Magnus Hell (CAN physical layer options) - Fred Rennig (CAN FD Light)
12:30 to 14:00	*Lunch break*
14:00 to 15:30	**Session II (three 30-min presentations)** - Christian Schlegel (Classic CANopen - The universal and flexible communication standard) - Uwe Koppe (The CANopen FD Story – Fast & Furious) - Holger Zeltwanger (J1939-based networks)
15:30 to 16:00	*Coffee break*
16:00 to 18:00	CiA general assembly
18:00 to 22:00	Get-together

Day 2	
09:00 to 10:30	**Session III (three 30-min presentations)** - CAN applications and implementations
10:30 to 11:00	*Coffee break*
11:00 to 12:30	**Session IV (three 30-min presentations)** - Thilo Schumann (UML usage in CiA documents) - Yao Yao (Overview on CiA technical groups) - Reiner Zitzmann (Generic CANopen bootloader)
12:30 to 14:00	*Lunch break*
14:00 to 16:30	BC and CiA group meetings

Subject to change without notice.

Reserve not just the date, but also a seat. The number of participants is limited due to the event location.

For registration please contact CiA office at events@can-cia.org

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