



Full electric transition

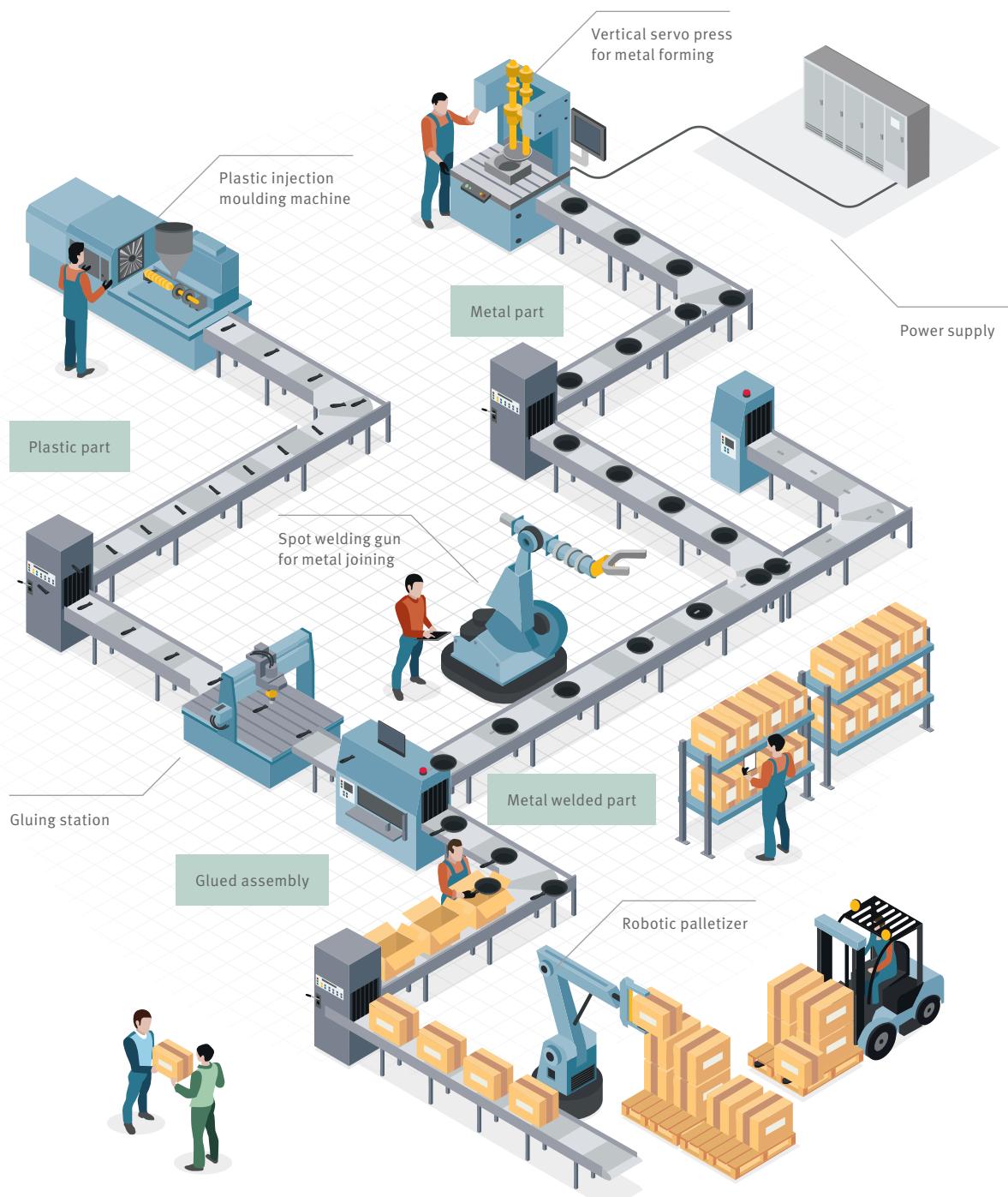
Solutions for your electrification journey

We pioneer motion

SCHAEFFLER

The electrification opportunities in manufacturing

This illustration represents a generic production line for cooking pans with different processing stations. The electromechanical solutions advantages are detailed in the following pages.



Full electric transition

Energy-saving and sustainable solutions are the topic of the day

The efficiency of electric technologies is usually much higher than that of alternatives based on fluid power. Therefore, electrification offers an excellent potential to reduce final energy consumption and is rapidly changing the mechanical design landscape in all sectors.

Depending on the industry, this trend may be in its early stages or already be more mature. While fluid power technology will continue to be used, the transition to electrified solutions will become more important in the future.

Advantages of electromechanical solutions over established technologies such as pneumatics and hydraulics



Increase productivity

Complete controllability and positioning precision with high speed



Lower Total Cost of Ownership

Maximise uptime, increase quality and reduce maintenance cost



Reduce carbon footprint

Higher efficiency with power consumption close to zero while not in use



Improve safety

No fluid under pressure during operation, safer during inspection and service

Pneumatic and Hydraulic



Electromechanical



Performance

Discover the future of industrial automation. We help customers transition from established manufacturing process technologies to innovative approaches with easy, safe and environmentally friendly linear motion solutions.



Benefits

- Complete controllability
- Higher positioning repeatability
- Precise speed control
- No warm up time
- Easier predictive maintenance operation
- Less sensitive to contaminants, ensuring longer lifetime
- Lower power consumption, optimised for the application
- Smaller installation space required in the machine
- Overall system is significantly lighter

Controllability and positioning precision

The compressibility of air provides limitations on the level of control that can be achieved with pneumatic actuators. It's also difficult to provide the slow, controlled speeds that are needed in certain applications. With hydraulics, the situation improves but, to control in multiple positions, still requires a complex servo-hydraulic configuration that increases the cost and setup time of the overall system.

Electromechanical actuators have a direct mechanical link between the motor and the screw that provides complete controllability of the system, with high levels of repeatability, down to the micron level as well as higher stiffness. Moreover, it's very easy to precisely change the speed along the motion cycle. Finally, for electromechanical systems, there is no warm up time, increasing the productivity of the machine.

	Pneumatic	Hydraulic	Electromechanical
Positioning precision	Low	Medium	High
Controlled speed	Difficult	Possible, but complex	Easy
Warm uptime	Needed	Needed	Not needed

Reliability and lifetime

While electromechanical actuators have more components than a generic pneumatic or hydraulic cylinder, the entire fluid power system has many more critical parts (compressor, filter/regulator, valves, seals, hoses... etc.). If these components have issues, it will affect the entire system, leading to machine downtime. The fluid power system is also very contamination sensitive and requires efficient filters that need to be serviced over time.

With electromechanical systems, the most common points of failure are the screw or the bearings. These components have L10 life ratings, which can be calculated based on the life equations typically found in our catalogs. This greatly helps in selecting the correct product sizing, and facilitating predictive maintenance operations. Moreover, electromechanical actuators are less sensitive to contaminants as they do not have a complete circuit constantly under pressure (with several parts subject to wear).

	Pneumatic	Hydraulic	Electromechanical
System complexity	High	High	Low
Predictive maintenance	Possible	Possible	Easy
Contamination sensitivity	High	High	Low

High speed performance

With pneumatic cylinders, it is easy to reach very high speeds in operation. With hydraulics, a large flow is needed to meet the same goal, but there must be enough pressurized oil in the system to reach the required flow level.

An accumulator can do the job by holding the pressurized volume, deploying additional capacity when needed.

In any event, this means a more complex and costly system setup that can lead to very high power consumption.

With electromechanical cylinders, it is easy to match the application needs by selecting the best combination of screw lead and gearbox ratio, which optimises the power consumption without any added system complexity.

	Pneumatic	Hydraulic	Electromechanical
High speed	Very Easy	Difficult	Easy
Power consumption	High	High	Low

Power density

Pneumatic cylinder force capacity is heavily limited by the maximum pressure (typically up to 6 bars) that can be achieved and by the related energy losses due to the air compression. This means that to generate high forces, very big cylinder diameters and pressure levels are needed. And forces are usually limited to 48 kN for a size 320 cylinder.

Electromechanical cylinders can always provide much higher forces compared to a pneumatic cylinder with the same section size, with a power density up to 8 times higher. Hydraulic cylinders can have an even higher power density but they need more installation space in the machine due to tubes and hoses. Electromechanical cylinders just use power cables for operation, requiring a smaller space.

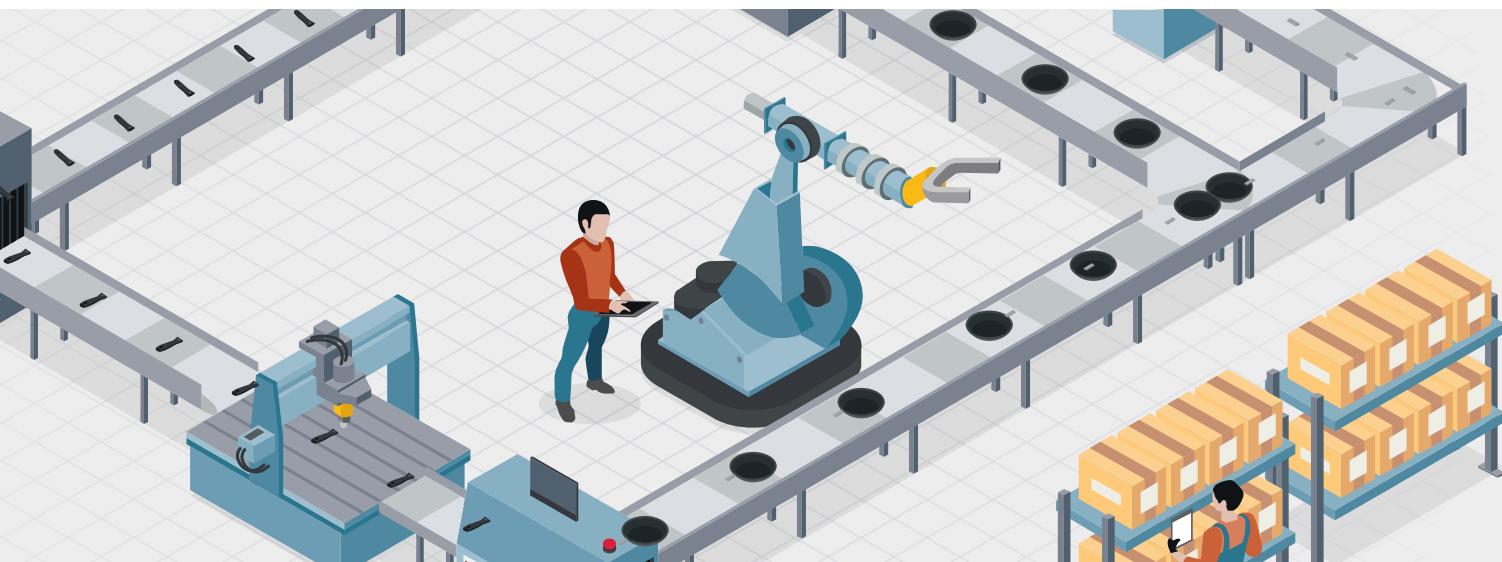
	Pneumatic	Hydraulic	Electromechanical
Force	Up to 48 kN	> 500 kNz	Up to 500 kN
Cylinder dimension vs force	1	More than 8 times smaller	Up to 8 times smaller
Installation space	Big	Big	Small

Weight

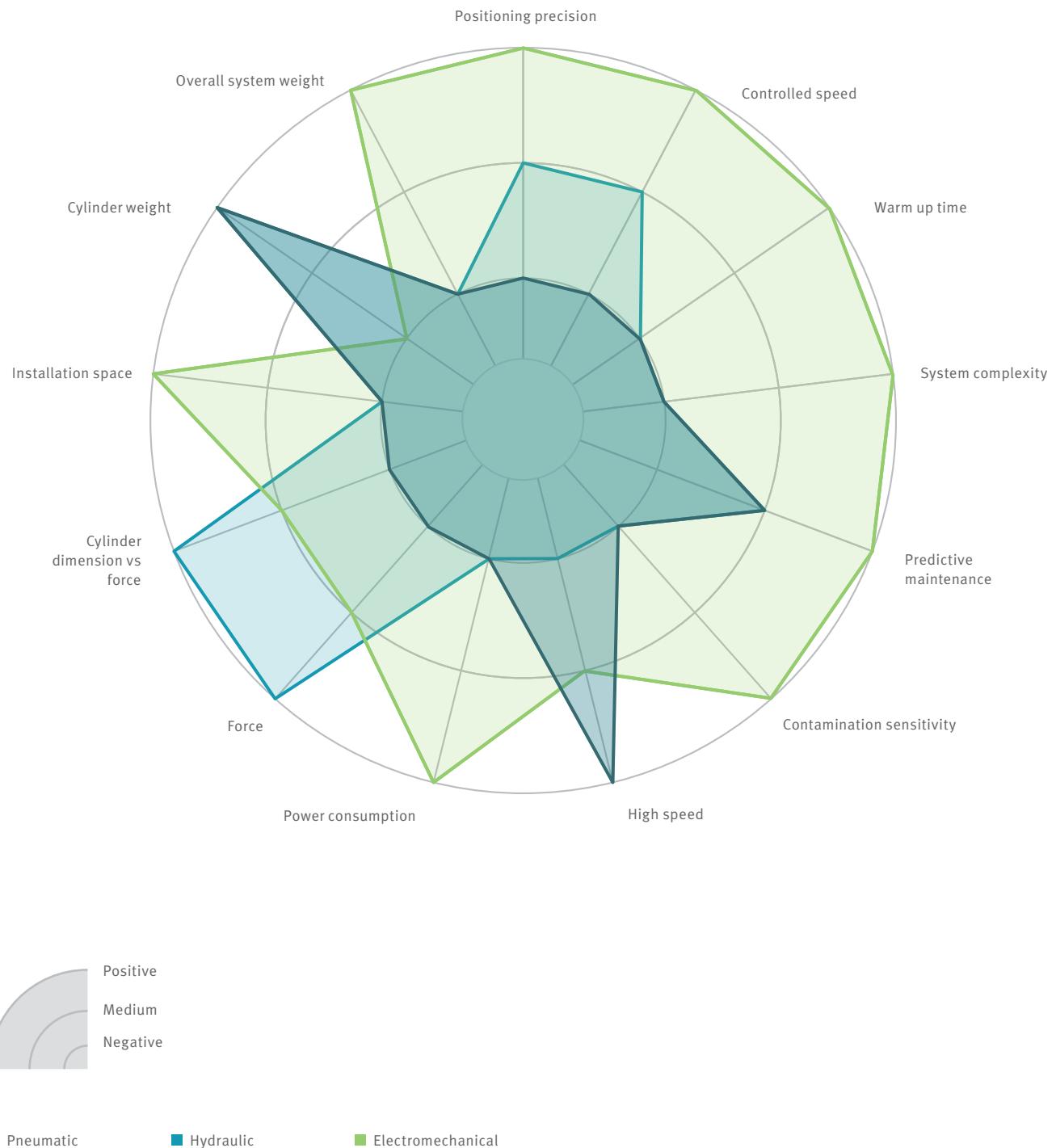
Pneumatic cylinders by themselves are lightweight devices, but if we consider other components like hoses, valves, air filter and so on, the overall system weight increases. The same concept applies to hydraulics.

Electromechanical actuators have a higher weight if compared just to an equivalent fluid power cylinder, but are significantly lighter once we consider the overall system.

	Pneumatic	Hydraulic	Electromechanical
Cylinder weight	Low	Low	High
Overall system weight	High	High	Low



Performance overview



Environment

Performance optimisation, easy integration and environmental friendliness are 3 key factors that lead to savings in total cost of ownership.



Benefits

- Safer during inspection and service
- Safer during machine operation
- Power consumption close to zero while not in use
- Higher efficiency in converting electric into mechanical power
- Noise is generated only when operated
- Noise level is usually negligible
- Grease lubricant entirely contained inside the actuator body
- Very low heat generation

Safety

Hydraulic cylinders usually work with very high pressures (up to 350 bars) and represent a potential hazard for personnel working around the system, due to pinhole leaks and improper couplings. Moreover, if mineral oil is used, they can create a potential fire hazard. For pneumatics, the situation improves but the stored energy can still be a danger during maintenance checks or unexpected system shutdowns.

It is possible to minimize such risks by using relief and bleed valves, non-combustible fluid, automatic fire alarm systems and dedicated safety procedures for inspection and

maintenance. However, doing so dramatically raises the overall cost and complexity of the system.

Electromechanical actuators do not have fluid under pressure and therefore are safer during operation, inspection, and service. In addition, by cutting off the motor power, the entire system is de-energised and can therefore be handled safely. Finally, by using selflocking actuators or an external fail safe brake, it's also possible to significantly minimise safety risks and the hazard of accidents and personal injury.

	Pneumatic	Hydraulic	Electromechanical
Potential hazard	Medium	High	Low
Safety in operation	Complex	Complex	Very easy

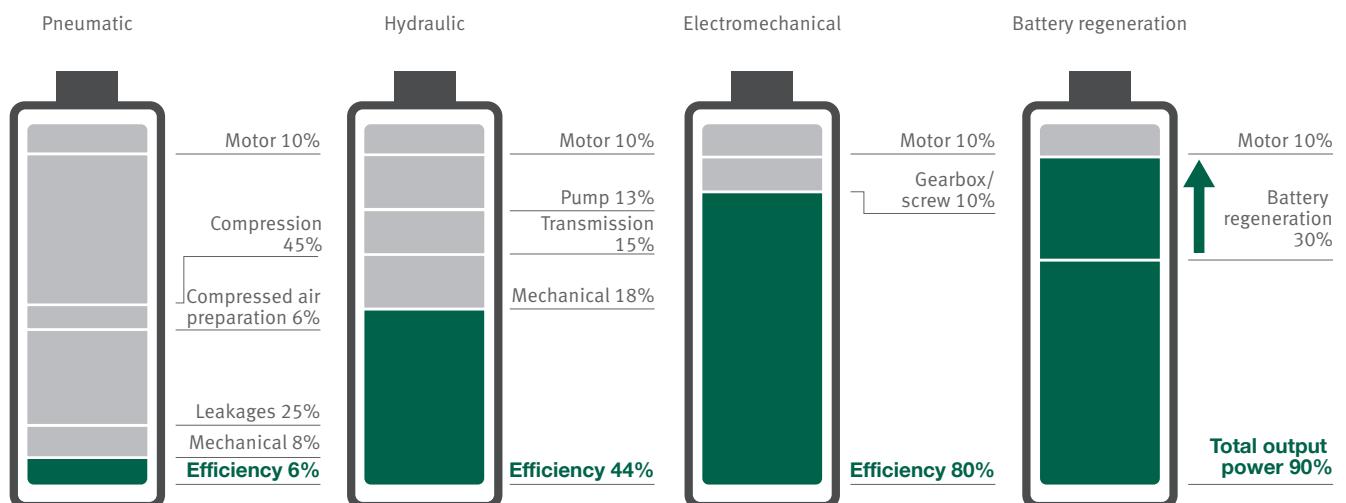
Energy saving

Pressure losses and air compressibility make pneumatics less efficient than other linear motion methods. Hydraulics have better efficiency but still experience several losses in the conversion between pressure generation and linear movement. In both cases, a compressor must run continuously, creating pressure even if there is no movement.

Electromechanical systems use energy on demand, so they have consumption close to zero while not in use. Their higher efficiency in converting electric into mechanical power allows them to achieve tangible energy savings in operation. Moreover, in battery-operated devices such as mobile machinery, it is possible to recuperate energy, e.g. in lifting applications, while moving downwards, which dramatically increases the uptime allowing to downsize the battery pack.

	Pneumatic	Hydraulic	Electromechanical
Consumption while not in use	Medium	High	Close to zero

Efficiency: Energy losses comparison



Environmental

Even though air is free, it can be contaminated by oil or other impurities and needs to be filtered to avoid environmental pollution. Also, the leakages and disposal of hydraulic oil represent a significant environmental issue and a potential source of pollution.

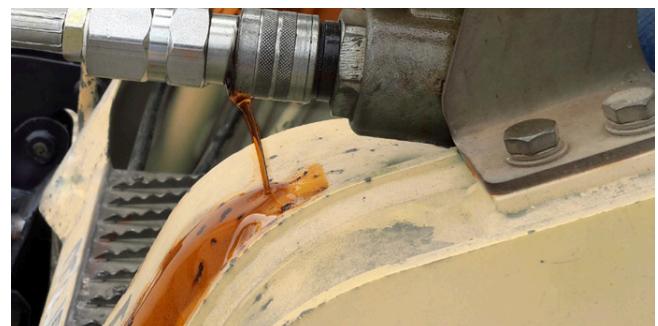
A single hydraulic leak of one drop per second is equal to approximately 1 500 l/year, at a cost of about € 5 000/year. However, the costs associated with hydraulic leaks are much higher than the cost of the hydraulic oil. What starts as a “small” leak can eventually lead to a system failure that causes higher costs.

Furthermore, there are costs for energy losses, safety, environmental concerns, hazardous waste disposal, clean-up and downtime for repairs.

The energy losses on the whole system, especially on hydraulic, can cause ambient overheating that must to be evacuated, causing extra energy waste for the cooling system.

Electromechanical systems use grease as lubricant that is entirely contained inside the actuator body. As a result, the quantity used is small and doesn't represent a significant source of pollution.

Electromechanical actuators also generate heat but at a negligible level compared to hydraulic, and are much more efficient.



	Pneumatic	Hydraulic	Electromechanical
Environmental pollution risk	Medium	High	None
Heat generation	Medium	High	Low

Noise

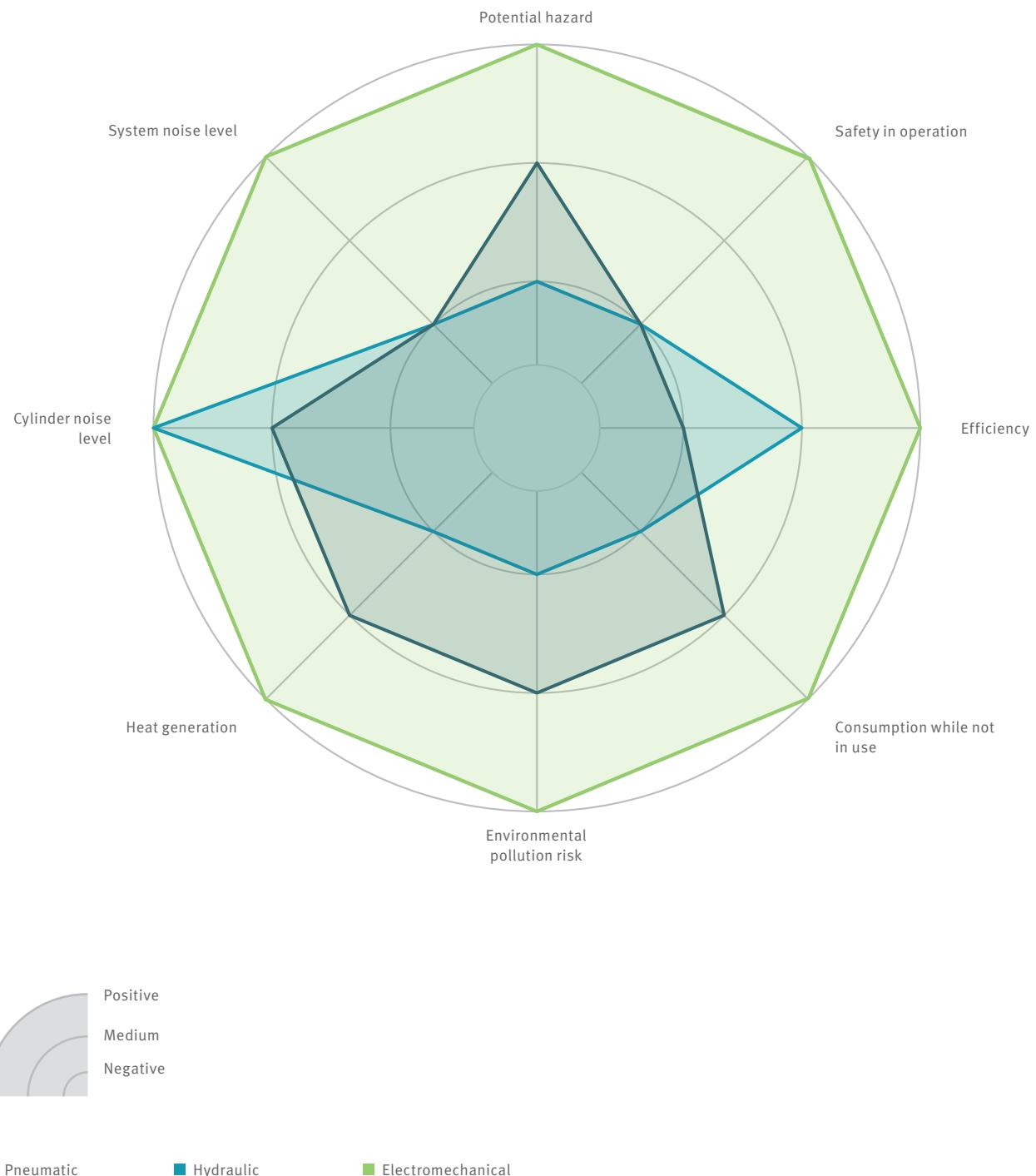
Pressure pulsation, created by the operation of pumps in a fluid power system, is one of the primary causes of noise issues for this technology. But also other components like valves and compressors are contributing to noise generation.

The average noise level of hydraulic systems is 80-90 dB.

Electromechanical systems are generating noise primarily from the screw movement. Therefore, noise is generated only when the actuator is in use. Moreover, the overall noise level of <45 dB is usually negligible compared to a fluid powered system.

	Pneumatic	Hydraulic	Electromechanical
Cylinder noise level	Medium	Low	Low
System noise level	Very high	Very high	Null

Environment overview



Simplicity

We are in a fourth era in the history of manufacturing, Industry 4.0, where technologies and processes are connected in a collaborative network.

Benefits

- Significant reduction of the occupied production floor footprint
- Reduced installation and commissioning time
- Shorter machine design time
- Easier routing with wiring harness compared to tubes and hoses
- Virtually maintenance free
- Easier implementation of predictive maintenance strategies
- Easier and quicker cylinder replacement
- No recalibration required after cylinder replacement

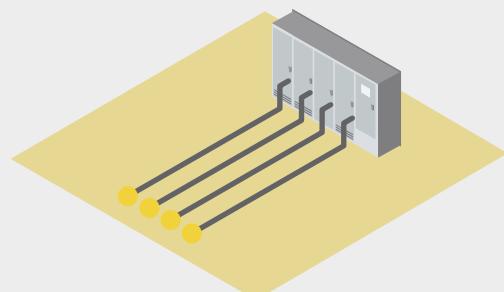
Installation

Pneumatic systems require many components, including hoses, pumps, valves, regulators, lubricators, and air filters. Hydraulic systems, as well, require a complex setup including a fluid reservoir, pumps, motors, release valves, heat exchangers, along with noise-reduction equipment. This means the commissioning time is also long since several parts of the system must be fine-tuned.

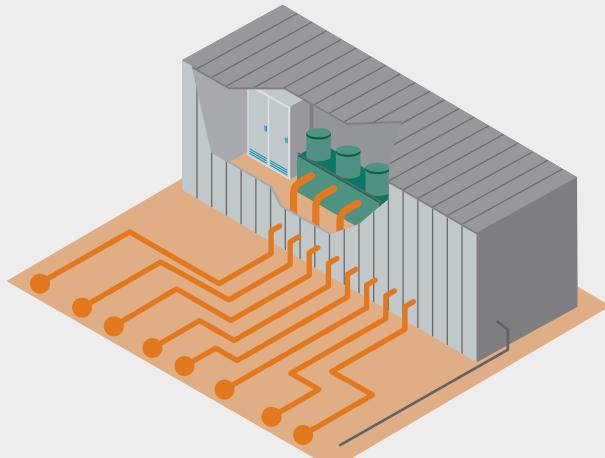
Electromechanical systems only require a motor, electric cables and, depending on the motor type, a driver. This allows a much smaller system footprint and a simple mechanical layout, reducing significantly the installation and commissioning time of the equipment.

	Pneumatic	Hydraulic	Electromechanical
Footprint	Large	Large	Very small
System commissioning time	Very long	Very long	Short

Electric power supply



Fluid power supply



Design

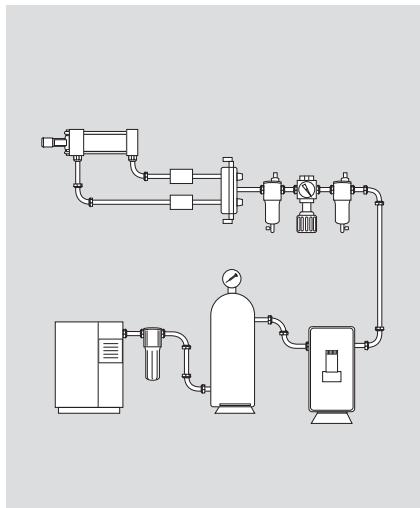
When designing a fluid powered system, it's important to correctly place the numerous components and to accurately define the right route for the pipes and hoses, creating constraints in the machine layout. Depending on the number of cylinders, the distance between them and the overall machine layout, the design phase can take some time as the

designer also has to consider a simple installation and maintenance process.

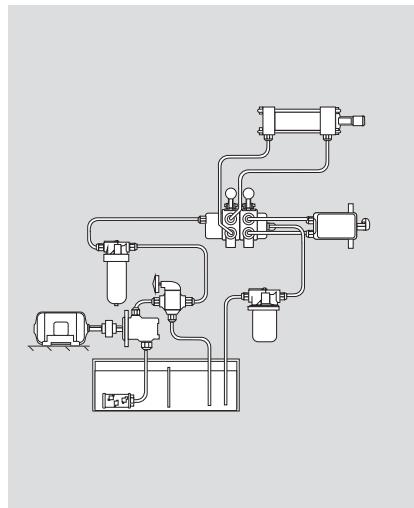
With electromechanical systems, the design process is lean thanks to fewer components and to the usage of electric cables only, that allow a more flexible routing and installation.

	Pneumatic	Hydraulic	Electromechanical
Design time	Long	Long	Short
Project constraints	Significant	Significant	Less

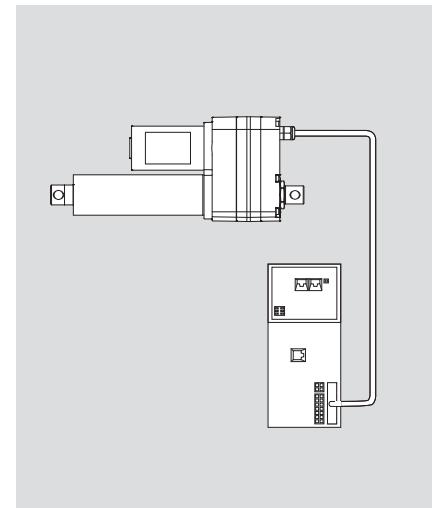
Pneumatic



Hydraulic



Electromechanical



Maintenance

Fluid powered systems require constant maintenance to achieve overall system efficiency, avoiding leaks and failures. Filtering system, valves, pipes and fittings should be monitored and serviced to improve cylinder performance over time. Moreover, manual inspection operations are required to check the system status and spot possible issues.

Electromechanical actuators can be operated virtually without maintenance for their whole lifetime or, depending

on the working cycle and application, they may just require a relubrication operation at defined intervals. It's also possible to perform predictive maintenance strategies thanks to the integrated sensors (like current, displacement, force, acceleration) that allow real-time remote monitoring and that can be used to forecast product lifetime in operation.

	Pneumatic	Hydraulic	Electromechanical
Maintenance	Constant	Constant	Not required / seldom
Cost of maintenance	High	High	Very low
Remote monitoring	Possible	Possible	Easy

Quicker replacement

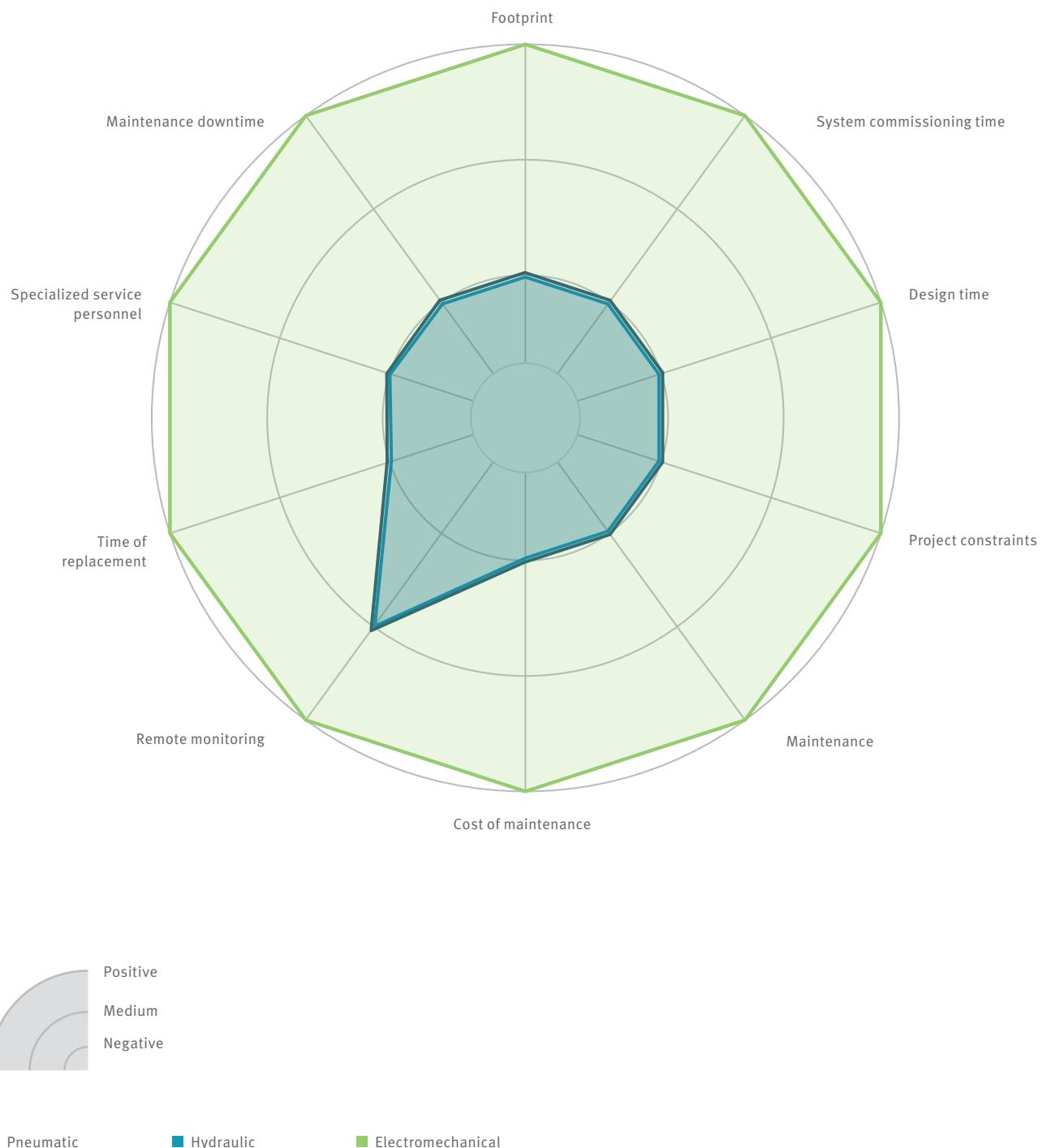
Replacing components in a fluid power system requires de-pressurization, oil disposal (in the case of hydraulics), part substitution and re-calibration to get back into operation. This requires a defined amount of time with specialized service personnel.

Electromechanical actuators can be quickly replaced by disconnecting the cables and substituting the current actuator with a new one. No further action is required to restart operation.

	Pneumatic	Hydraulic	Electromechanical
Time of replacement	Long	Long	Very short
Maintenance downtime	Longer	Longer	Very short



Simplicity overview



Total cost of ownership

The continuous industrial processes evolution is becoming more demanding in terms of motion control performance

The current pneumatics and hydraulics solutions are not competitive in terms of TCO (Total Cost of Ownership) that considers all direct and indirect costs associated with an asset over its entire life cycle.

Beside the more obvious performance advantages, there are several others hidden behind the technology or the usual production and factory processes.

For example, a higher system efficiency - both in operation or standby situation - lead to direct savings proportional to the number of cylinders, in the monthly and yearly energy expenses.

Concerning costs related to machine downtime and maintenance operation, a system with less components, less sensitivity to re-lubrication needs, easier to be serviced and with a quicker replacement time can provide tangible savings in different accounting areas of the factory.

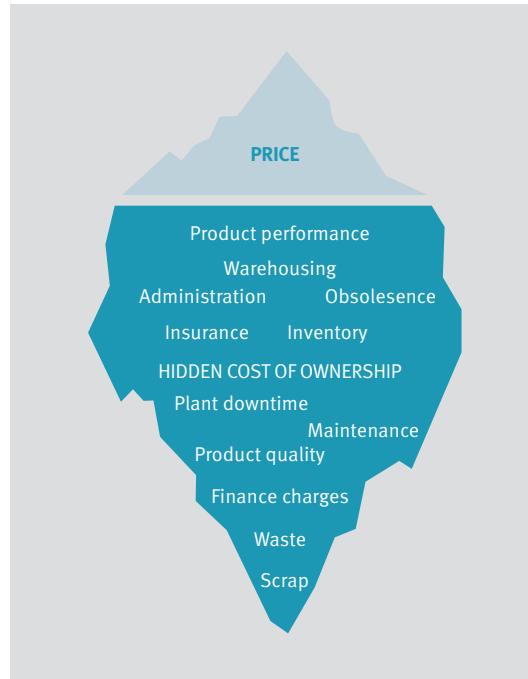
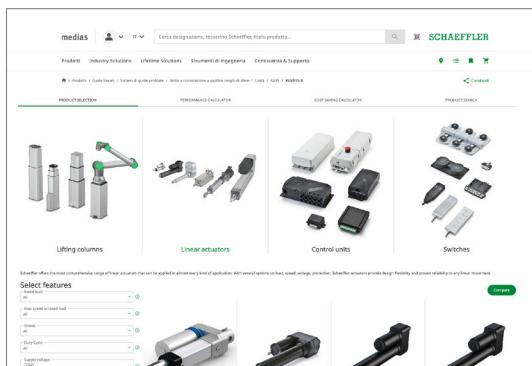
Moreover, less components mean less spare parts need and so a lower capital investment on stock.

Another hidden cost concerns safety and hazard prevention devices and procedures. A system with an embedded higher safety level can dramatically reduce the cost to run a safe manufacturing operation. Moreover, removing the oil from some areas of the plant helps to reduce costs related to oil cleaning and disposal.

Cost saving calculator

We have developed a tool to support customers in evaluating the cost of running their machinery comparing, hydraulic or electromechanical technologies. By inserting some basic information into the tool, the user can get an estimation of the cost saving achievable by switching to mechatronic solutions.

Visit Actuator select in the Cost saving calculator section to get started.



Replacement advice

The right design approach to realize electromechanical potential

To realise all the advantages of electromechanical actuators, the approach to system redesign must be different from the commonly adopted one. As pneumatic, hydraulic and electromechanical cylinders have unique features, there needs to be a change in thinking when it's time to replace one with the other.

In fact, it's important to understand the different mechanical and electrical specifications along with the required budget, as there are always multiple ways to replace one application. This requires more time to analyze and study but it's the only way to make an effective product selection that can save a lot of money at the end.

There are some common mistakes that designers can make when replacing a fluid powered cylinder with a electromechanical one that may lead to oversized systems. To avoid them, it's important to consider the following:

Define the real force requirement

In many applications, the real work load and related required push and pull forces are not known, as it's quite easy with fluid power to oversize the system by using higher pressures or bigger cylinder diameters. This can lead to an oversize of the actuator screw and motor that significantly increases the cost. Instead, by measuring the real force in the application, it's possible to select an optimised solution that delivers the required performance at the right price.

Evaluate the duty cycle in operation

While duty cycle can have a minor impact on fluid powered systems, in actuators it can determine the type of motor technology required and therefore the related system complexity and cost. If the application is done from time to time (e.g. 1 minute operating – 4 minutes standing still), it's possible to use brushed motors that can deliver the required power much cheaper than equivalent brushless motors with drivers.

Analyze the mechanical layout

Hydraulics can deliver more power in a smaller package than electromechanical actuators. In case of leveraged connections (e.g. scissor mechanism), it's quite common to have an unfavorable situation where the high forces are exerted over a very short stroke. By slightly revising the mechanical layout, it may be possible to have more favorable leverages that spread the load over a longer stroke, requiring less peak output power and then a smaller actuator.

Define the required motion accuracy

Depending on the application, it may be needed to perform a simple motion from one position to another and back or to have fine control of the speed and acceleration in multiple positions. With electromechanical actuators, the simple DC and asynchronous AC motors can perform basic movements in an ON/OFF control mode while with a servo motor, it's possible to achieve complete control in operation with the use of a motion controller. Moreover, depending on the positioning accuracy required, it's possible to select a simple trapezoidal screw with axial play or a recirculating pre-loaded roller screw for the ultimate positioning precision and repeatability, down to microns. The cost and control complexity rises linearly allowing a direct selection tailored to real application needs.

With over 40 years of experience in developing electromechanical actuators, we have extensive expertise in sizing EWELLIX electromechanical solutions for different types of industries and applications. A dedicated team of Application Engineers are available to support customers in defining the right solution, and advising on the best choice based on theoretical calculation and field expertise.

We offer the widest range of actuators on the market that can also be customized to fit any application requirements.

Visit [Actuator select](#) in the Performance calculator section to easily select and size your actuator and to get in contact with our experts.

Applications using high performance actuators and ball and roller screws



Spot welding



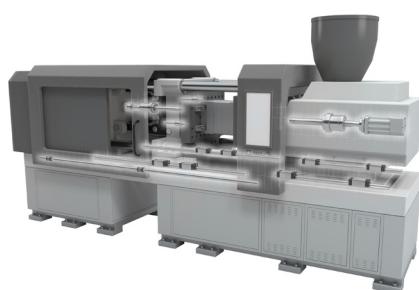
Dispensing



Press forming

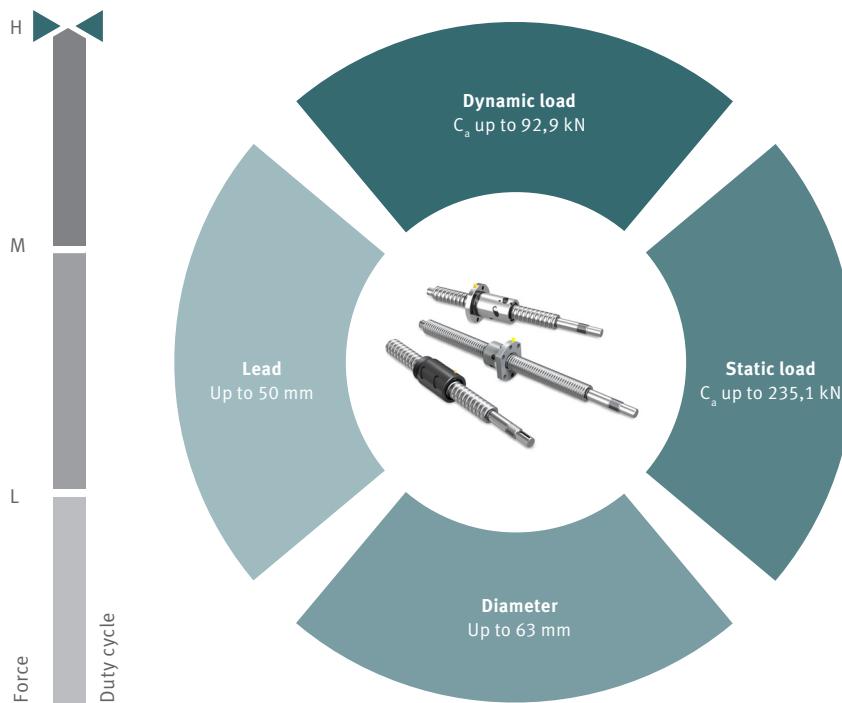


Servo press



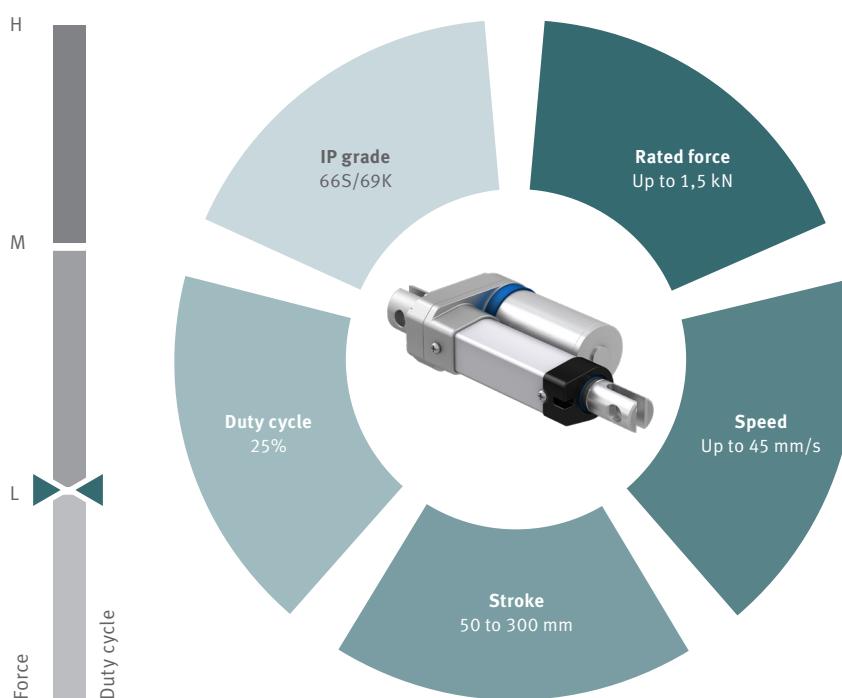
Plastic injecting moulding

Our solutions for pneumatic replacement



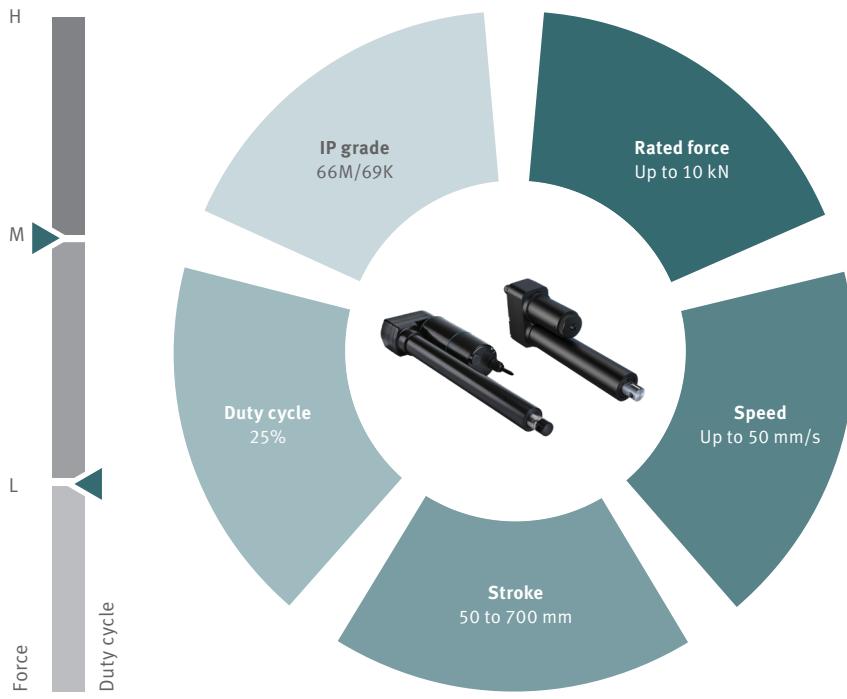
Ball screws

Schaffler offers a wide range of rolled and ground ball screw variants for applications that require high precision and high stiffness. Our ball screw assemblies provide high performance solutions suitable for a wide range of applications where precision driving and durability are prerequisites. High technology machinery associated with precise control of the cold forming and metallurgical processes enable the production of screws that offer virtually the same accuracy and performance of ground ball screws, but at a lower cost.



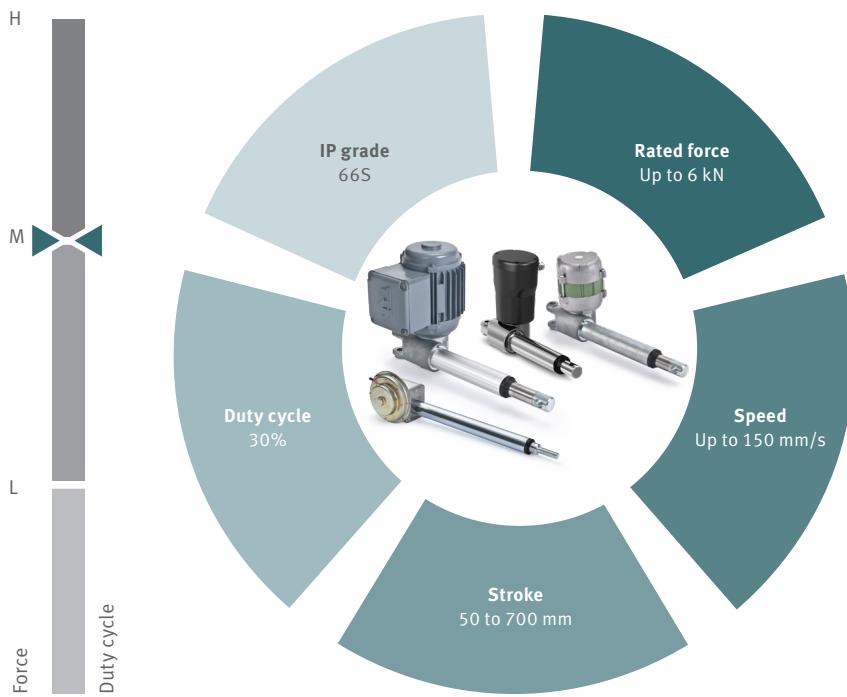
EWELLIX CAHB-10*

This compact solution for low-load applications is virtually maintenance-free and self-locking. Designed to operate in temperatures from -40 to 85 °C. The EWELLIX CAHB-10 actuator features robust metal gears and corrosion-resistant housings. Additional design options are available. They represent the ideal solution for replacing pneumatics in low load, low duty cycle applications.



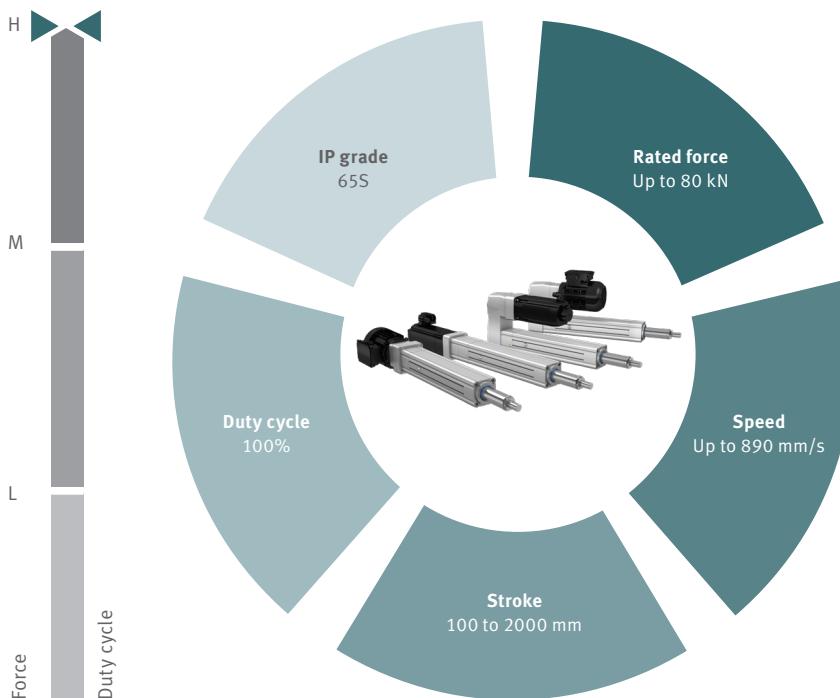
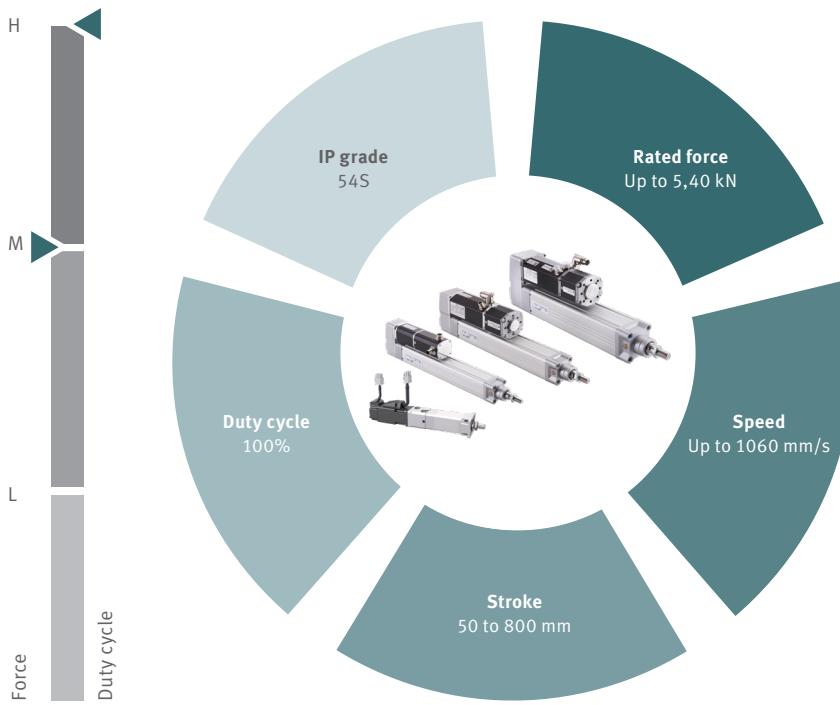
EWELLIX CAHB-2xE/S – 31N*

This range is for medium and heavy load applications and is virtually maintenance-free, self-locking and has an IP grade up to 69K. Designed to operate in temperatures from -40 to 85 °C up to 25 % duty cycle, EWELLIX CAHB 20E-22E and 30A-31N actuators features robust metal gears, high force, high holding force, medium speed, mechanical overload protection, and a manual override option. The smart EWELLIX CAHB-2xS, offers unique features at a competitive cost with integrated controller with BUS communication. The EWELLIX CAHB series can provide high stability compared to the rated load, up to 20 kN. Equipped with DC and AC motor variants with different voltages, they represent the ideal solution for replacing pneumatics and light hydraulics in medium load, low duty cycle applications.

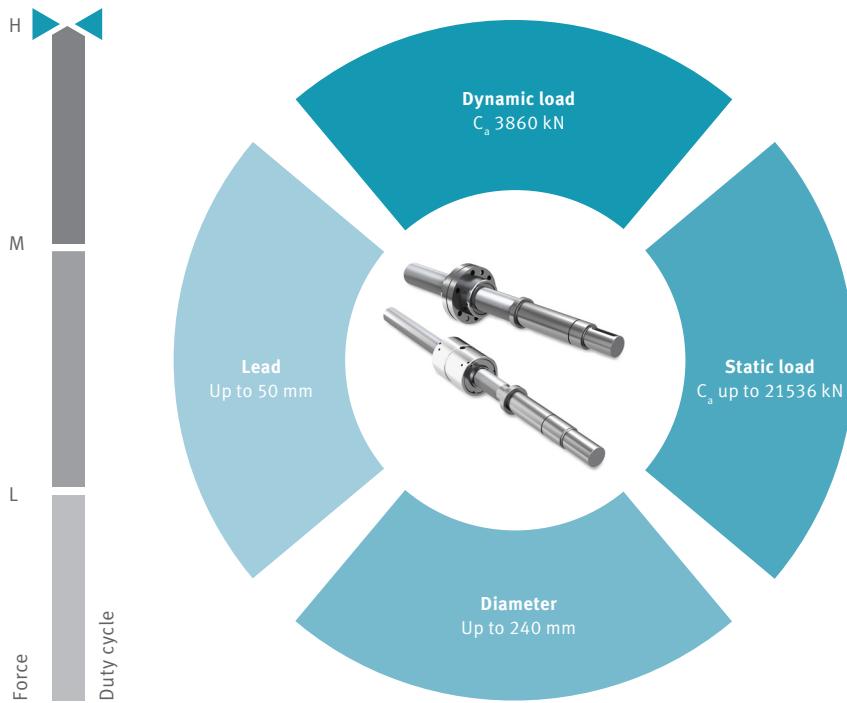


EWELLIX CAT – CAR Series*

The EWELLIX CAT-CAR modular design concept makes it easy to interchange critical components such as motors, gears, screws, attachments, etc. Custom-built actuators are easily and cost efficiently configured from standard parts. This range flexibility makes it suitable for an infinite number of applications of application with duty cycles up to 30 %. They represent the ideal solution for replacing pneumatics in medium load, medium duty cycle applications.

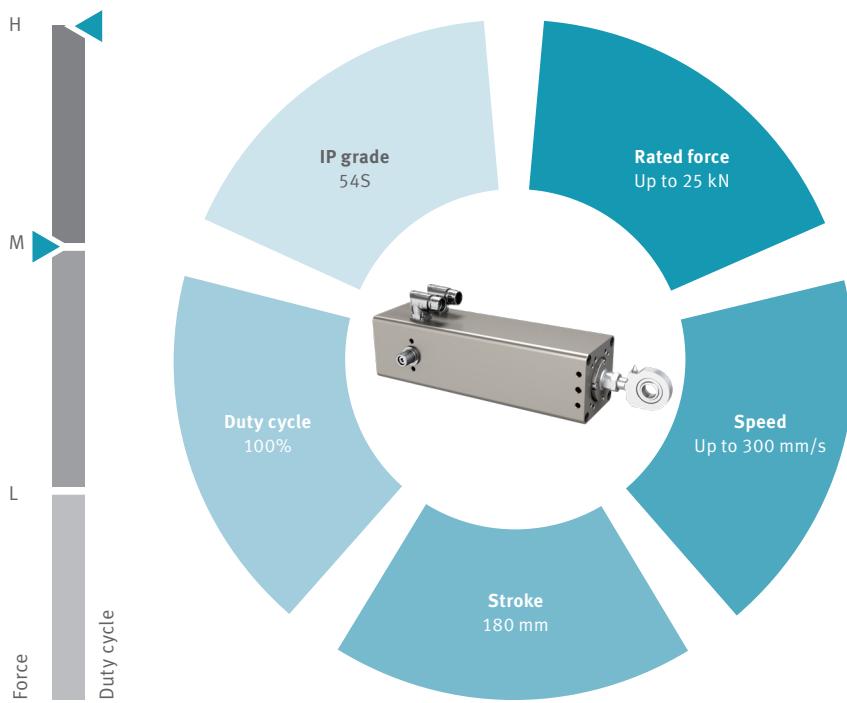


Our solutions for hydraulics replacement



Roller screws

Schaeffler roller screws offer a performance level far beyond the capabilities of ball screws. They are well suited for heavy loads, and high duty applications even in harsh environments. Planetary roller screws feature high rotational speed, high linear speed, high accelerations coupled with extremely high load carrying capacities. Recirculating roller screws provide ultimate positioning precision and rigidity, thanks to their very short leads.

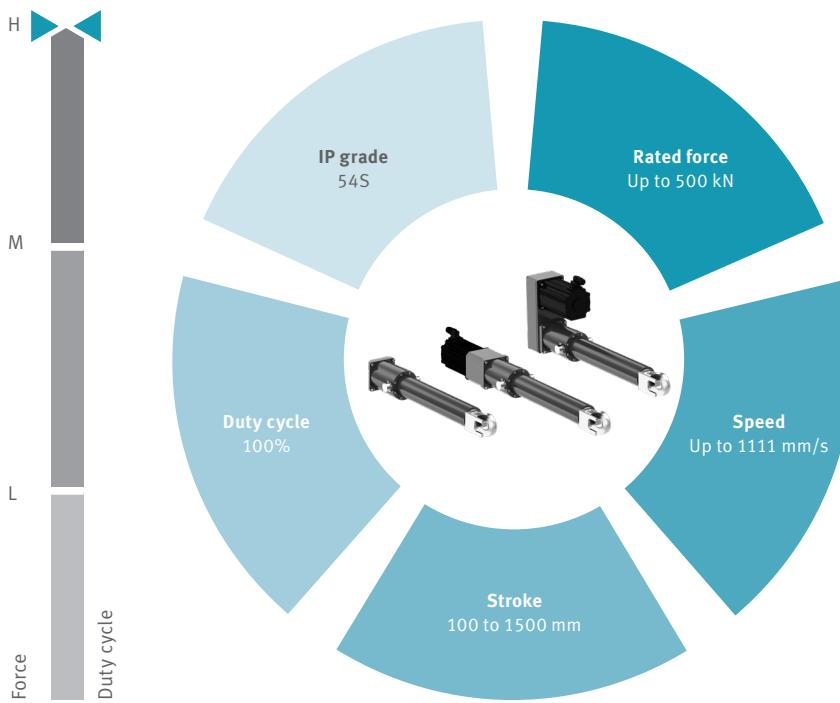
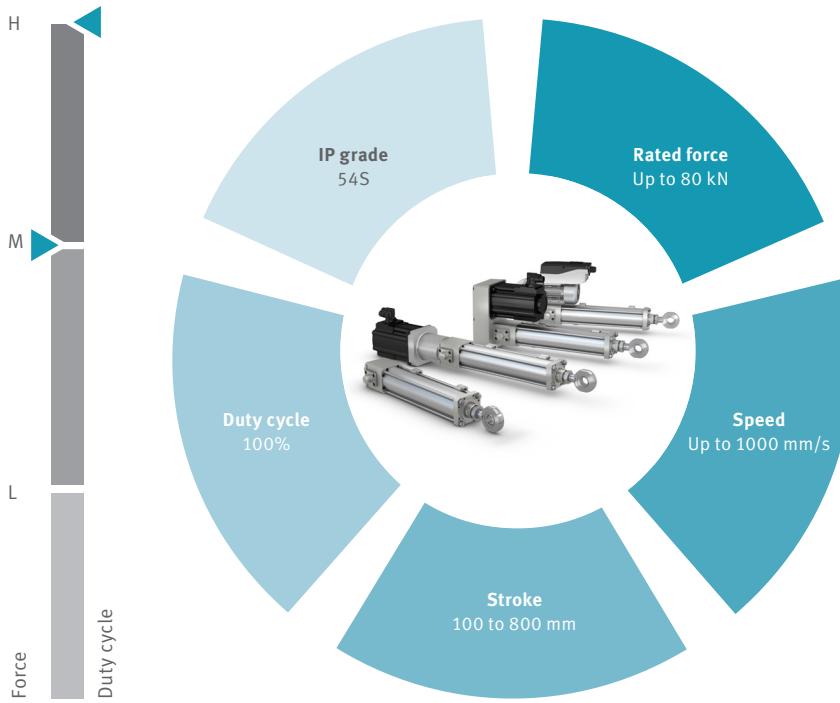


EWELLIX CEMC*

This product range provides high power density in a small package. Whatever the requirements, EWELLIX CEMC cylinders provide a compact and dynamic solution, maximum performance and value through high reliability, productivity and result in low costs through the life of the product. By using inverted roller screws, these actuators can reach the shortest possible retracted length while providing a very high output power.

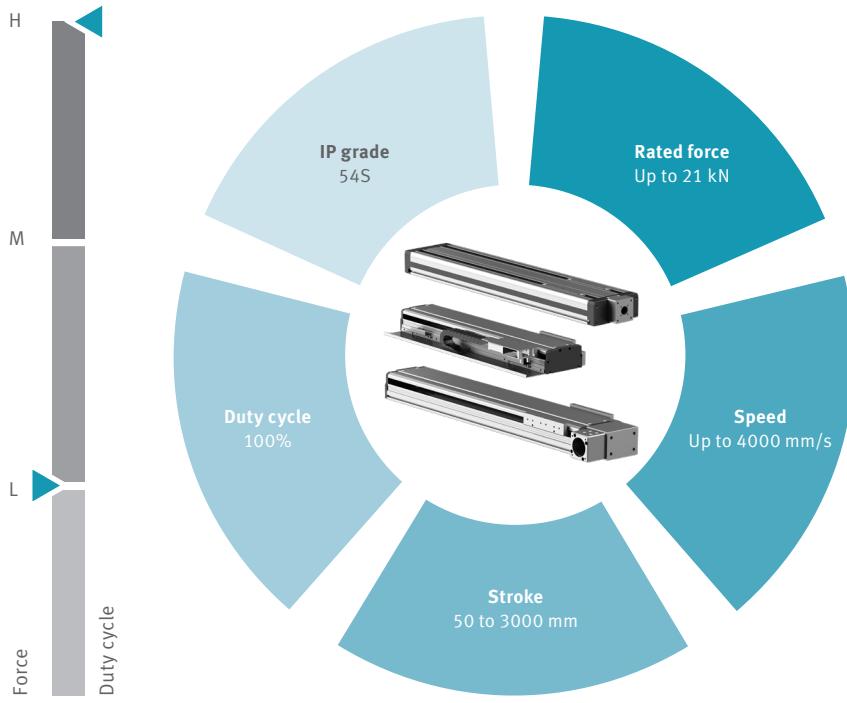
They represent the ideal solution for replacing hydraulics in medium load, high duty cycle applications.

* EWELLIX actuators offered by Schaeffler



EWELLIX EMA-100*

See page 21.

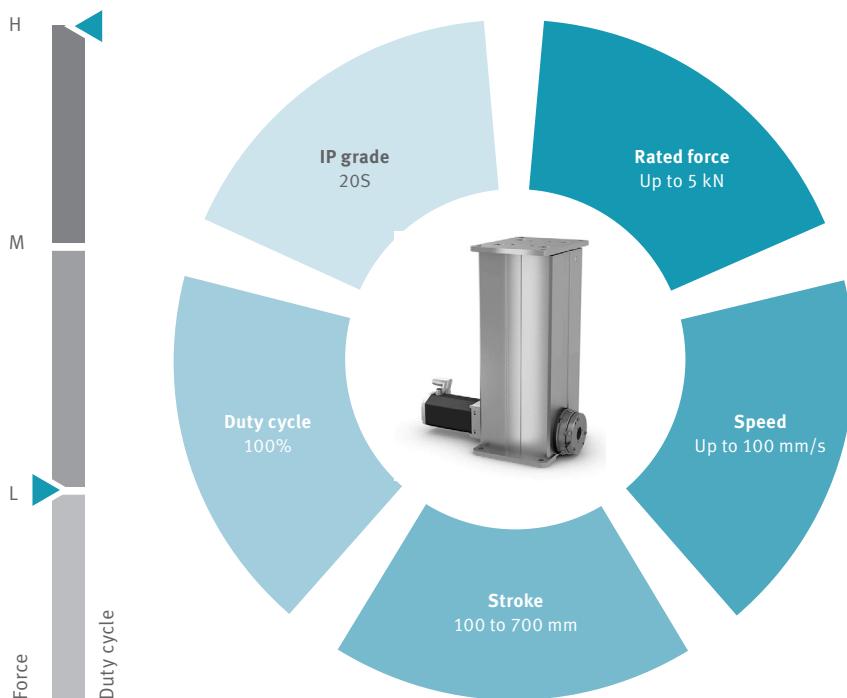


EWELLIX CLSM*

The linear module range provides precise motion with different drive units (ball screw, belt and linear motor) and motor types (servo AC, brushless DC and linear motors).

With their high load and life time capacity and their flexible design for customization, these products represent a good solution to couple the driving and guiding function in one compact solution.

They represent the ideal solution for replacing hydraulics in low to medium load, high duty cycle applications.



EWELLIX CPSM**

Lifting columns EWELLIX CPSM are the ideal solution to combine strong guiding functions with linear movements. The robust, manually adjusted and virtually backlash-free aluminium extrusions are able to carry high eccentric loads in push and pull directions. To provide enough power to lift and lower heavy weights with high speed, the columns are equipped with brushless DC or servo motors. Of course, we also support the usage of preferred motors with a customizable motor interface. Optional brakes and damping elements are key features that allow effective usage in heavy duty industrial applications.

They represent the ideal solution for replacing hydraulics in low load, high duty cycle applications.

* EWELLIX linear modules offered by Schaeffler

** EWELLIX actuators offered by Schaeffler

Your engineering partner

Customisation

With more than 50 years of experience, we provide customers with tailor-made solutions that fit any application needs. Our extensive product knowledge, combined with engineering expertise, transforms customer needs into tailored solutions. Focusing on client-specific requests, our engineers help customers develop and implement cost-effective solutions to optimise the performance of the application.



EWELLIX EMA made of stainless steel



EWELLIX CASM with spring around the push tube



Cylinder with very long stroke length

Testing capacities

All our products are extensively tested for their key parameters according to a comprehensive test plan that covers all regulatory and environmental requirements and meets the most stringent industry standards. We are able to test all components down to the ball or roller screw. In addition, we can simulate mechanical, electrical and environmental application conditions.



Vibrator test



EWELLIX EMA testing



Roller screws testing

Supporting tool

Digital

Schaeffler has developed a portfolio of tool to support customers in easy selection and calculation the right Schaeffler product for their application.

EWELLIX Actuator select

- Product selection
- Performance calculator
- Cost saving calculator

Ball and Roller Screw select

- Product selection
- Product calculator
- Product verification



EWELLIX Actuator select

- Scan QR code
- Click on [link](#)

Ball and Roller Screw select

- Scan QR code
- Click on [link](#)

Publications

Supporting documents are available for download on Schaeffler.com on each product page under the technical data section:

- Operating manual
- Mounting instruction



Ball screw
› Scan QR code
› Click on [link](#)



Roller screw
› Scan QR code
› Click on [link](#)



EWELLIX CAHB-10
› Scan QR code
› Click on [link](#)



EWELLIX High performance actuator CEMC
› Scan QR code
› Click on [link](#)



**EWELLIX
CAHB-2xE/S - 31N**
› Scan QR code
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**EWELLIX High performance
actuator LEMC**
› Scan QR code
› Click on [link](#)



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Issued: 2025, December

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