

PRODUCT NEWS 2020

LinMot®



LinMot Short Motors in Stainless Steel Design

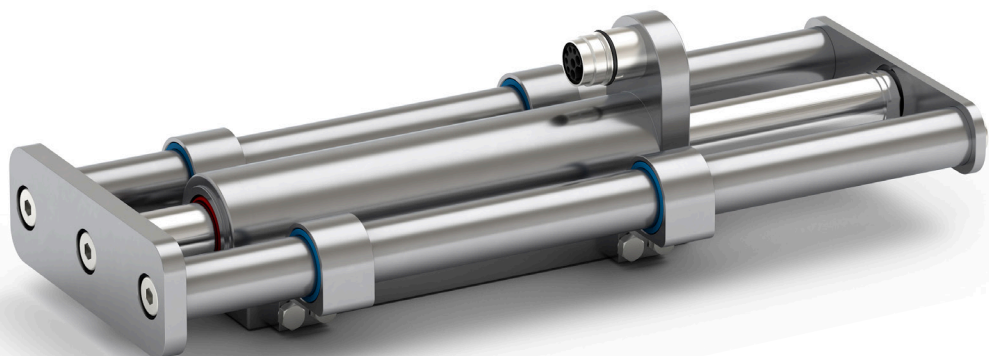
Engineers now have two additional options within the LinMot stainless steel product family. With the PS01-37Sx60F-HP-SSC and the PS01-37Sx120F-HP-SSC, LinMot expands its stainless-steel series with short linear motors. The addition of the stainless-steel option allows for use in food processing machines and plants and for operation in the pharmaceutical industry. These motors can easily cope with extremely rough or corrosion-prone environments and can be cleaned with all standard industry cleaning agents with confidence.

If the connection of a water-cooling system is not desired or necessary, these new stainless-steel short motors can be particularly impressive. The thermal dissipation of these motor has been significantly improved by calculated adaptations in the design. The integrated mounting flange allows flexible mounting in several positions and provides the necessary surface area for efficient heat dissipation. In addition, the increased diameter of the slider used with these motors results in an increase in the performance data in terms of peak and continuous force. At the same time, the stators with a total length of 120 mm or 180 mm are among the most compact representatives in the stainless-steel series.

In order to eliminate the formation of water condensation in the motor, the motor housing was poured out under vacuum. This keeps the stator free of any air pockets, in which condensation could form as a result of changing temperatures. When it comes to motor maintenance, the user benefits from the modular design of the motors, in which the bearing can be replaced very easily. The plain bearing material used is also specially designed for the food and pharmaceutical industries and is FDA-approved.

For the construction of a complete linear guide unit, LinMot simultaneously offers the appropriate stainless-steel guide. They offer high guiding accuracy and enable dynamic and precise positioning of the load.

Both stator types can be ordered beginning in 2020. Subsequently, two variants of the PS01-48 motor will also be launched on the market during the year.





		PS01-37Sx60F-HP-SSC	PS01-37Sx120F-HP-SSC
Stroke up to	mm	1455	1395
Peak Force	N	128	255
Nominal Force (*mounted)	N	24 / 32*	47 / 60*
Peak Velocity	m/s	4.9	3.8
Peak Acceleration	m/s ²	320	520
Repeatability	mm	±0.01	±0.01
Stator Length	mm	120	180
Slider Length	mm	1600	1600

Stainless-Steel MagSpring®



Stroke up to	mm	350
Constant Force	N	40 / 50 / 60
Stator Mass	g	440 - 2200
Slider Mass	g	75 - 420

Following the successful expansion of their stainless-steel linear motors and guides, LinMot has introduced the stainless-steel version of the MagSpring, which is now also available on the market. With this new version now available, customers can benefit from the advantages of magnetic springs even under difficult conditions. This MagSpring product variant is optimally designed for handling aggressive liquids and foam cleaners used by the pharmaceutical and food industries.

The MagSpring M01-40-SSC consists of a magnetic slider and a stator. The stator shell is made of stainless steel (WkNr. 1.4404, AISI 316 L). The moving slider is precisely guided by the plain bearing installed inside the stator. The bearing material used in these stators is specially designed for use in the food and medical industries and is FDA approved. For easy mounting and alignment of the MagSpring, the stator front is provided with M5 threaded holes and a centered fit.

As with the established standard MagSprings, the function is based on the attractive force of permanent magnets. A constant force is generated over almost the entire stroke range, so that the force due to gravity acting on the load can be passively compensated when paired with a linear motor in a vertical orientation. Additionally, other applications are possible, such as the position-independent generation of a constant contact force, the application of a constant holding force over a large stroke range, or one-sided force support in drive tasks.

“Close by” Drive D1150

The D1150 Drives are currently available upon request.

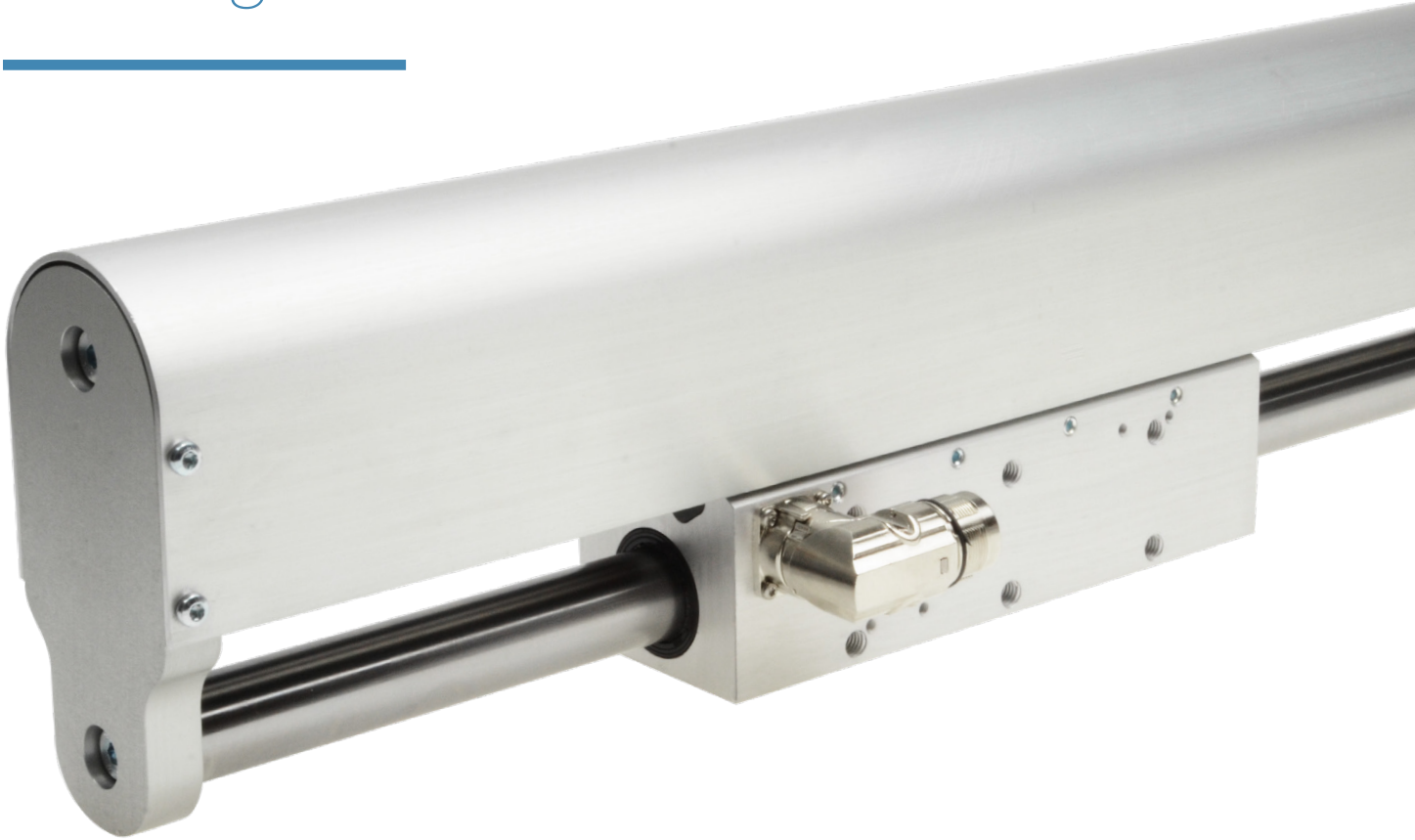
As part of the further development of the Servo Drives, LinMot presents a new Servo Drive in a compact IP65 housing. As a decentralized solution, this drive can be placed close to the drive component, which significantly reduces the space required in the control cabinet.

The D1150 series can be used for decentralized control of LinMot linear motors and rotary motors. The drive can be operated with 24-72 V DC and guarantees a phase current of up to 25 A for the motor. It has an Industrial Ethernet interface for PROFINET and EtherCAT. The device profiles CoE (CiA402) and SoE (SERCOS over EtherCAT) are also supported. Further field-bus systems are planned for future release.

The D1150 Drive is protected against dust and water in accordance with protection class IP65 and requires no additional cover. All operating elements, switches, and interfaces, as well as the status display, are mounted behind a protective cover, which guarantee the required protection for decentralized installation.



DM01 Linear Guides Featuring Higher Bending Stiffness



LinMot will complement the product group of linear guides with the newly designed DM01 series starting in 2020. This is a complete drive solution consisting of a linear guide and permanently integrated LinMot stators. Depending on the requirements in terms of stroke length and power requirement, LinMot offers more than 20 variants within the DM01 product family. This gives the user a wide range of options for solving the task at hand.

The advantages of the new linear guides prove to be useful with particularly precise and dynamic movements. LinMot has therefore developed a product concept in which the linear motor is permanently installed together with the guide. Precision shafts guided by linear ball bearings ensure precise linear motion. The rounded surfaces of the

housing also facilitate simple maintenance and cleaning of the new linear guides. Due to the selection of the material and the developed design principle, these linear guides achieve a higher bending stiffness than before when compared with a constant moving mass. The core technology of the guides consists of the already proven LinMot linear motors PS01-23, PS01-37 and PS01-48, depending on the choice. The user can thus realize a force range of up to 572 N and strokes of up to 575 mm. Accelerations of up to 390 m/s² and a maximum speed of over 2.9 m/s leave nothing to be desired in terms of dynamics.

Each DM01 linear guide is delivered pre-assembled to the customer and does not have to be assembled from individual parts. Therefore, only one

The DM01 guides in sizes 37 and 48 will be available beginning in January 2020. Later, in the first quarter of 2020, the DM01-23 linear guides will become available on the market.



article number is required for ordering. The commissioning of the drives is very simple as all DM01 linear guides are equipped with «Plug and Play»

technology. The required type parameters do not have to be selected manually; they are automatically read in by the servo drive.

		DM01-23	DM01-37	DM01-48x150	DM01-48x240
Stroke up to	mm	210	495	575	485
Peak Force	N	67	255	359	572
Moving Mass	g	452-766	1674-3604	4120-8570	4630-8570
Total Length	mm	200-350	322-722	368-818	428-818

Power with Precision Sensors

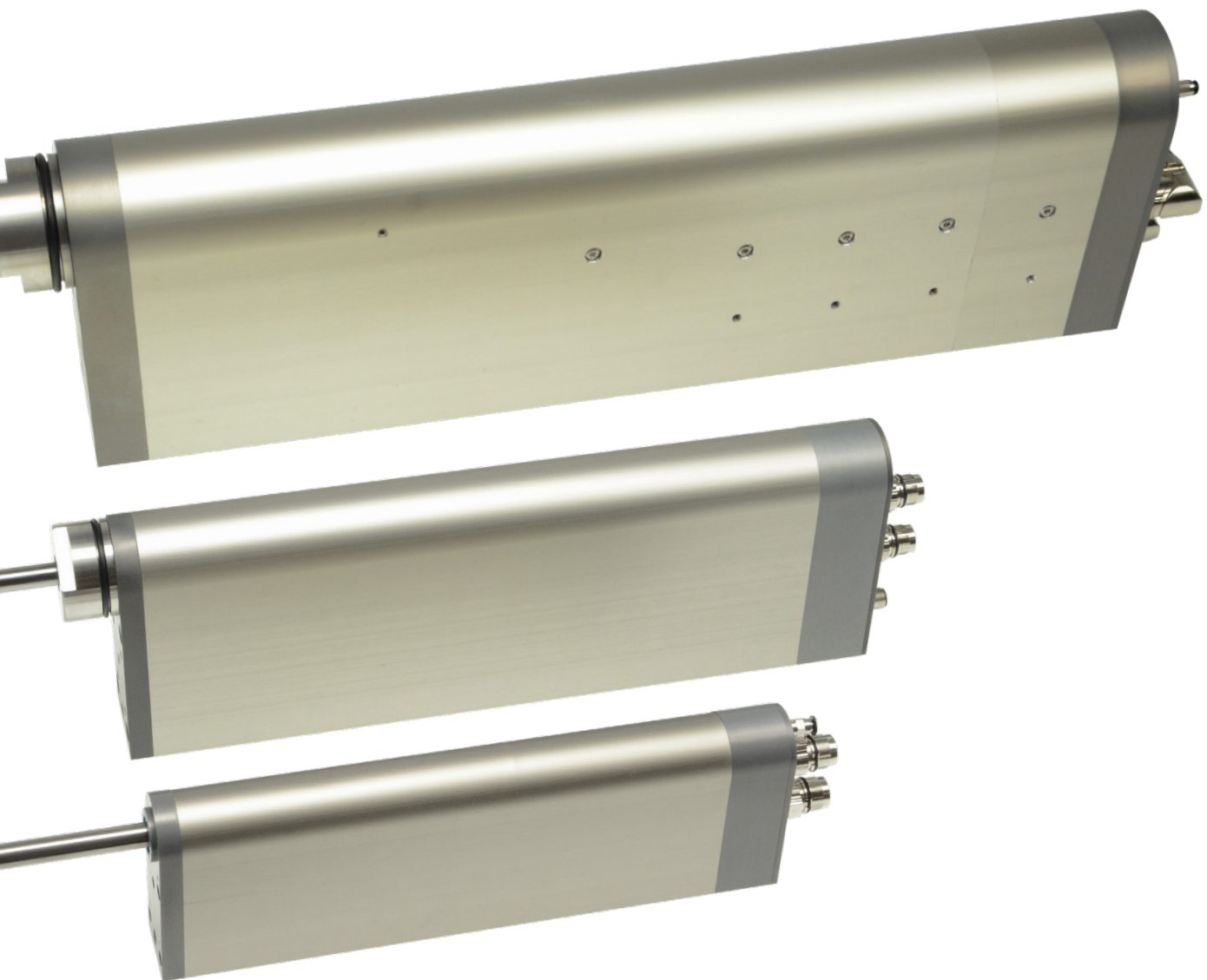
Following the successful market launch of the PR02-52 linear rotary motors, the larger representatives of this product family are now in the starting blocks. Like their smaller counterparts, the PR02-88 motors are optionally equipped with a fully integrated torque measuring shaft and an internal force sensor. These integrated features have proved to be successful since their initial release in the smaller PR02-52 models.

With the introduction of the PR02-88 family of linear motors, the PR02 family increases its maximum stroke length up to 300mm. This allows applications such as closing trigger and pump spray bottles to be optimally covered. Since both the maximum linear force and rotative torque have been increased with the introduction of this series, this motor family is the right choice in the field of assembling parts and closures with higher torque and force requirements.

Like the rest of the PR02 product family, the motors responsible for the linear stroke and rotary motion for the PR02-88 motors, as well as other additional components, are all integrated within a slim housing. With additional integrated options selected, the customer receives not only the drive motors, but also the internally installed torque measuring shaft and force sensor, as well as a magnetic spring. In vertical applications, the accordingly named MagSpring® ensures that the downward force of the moving load caused by gravity is passively compensated and prevents the axle from lowering in the current-less state. The torque and force sensors enable precise, reproducible and recordable capping and assembly processes such as those required in the pharmaceutical industry.

For demanding applications and to increase flexibility, LinMot offers the option of a hollow shaft for all PR02 motors. This makes it easy to integrate non-rotating tappets, compressed air or vacuum feedthroughs, for example. Compared to LinMot's PR01 linear rotary motor family, the user also benefits from the shorter installation length of the entire unit and from the hygienic design with easy-to-clean surfaces.

The PR02-88 family has endured extensive field testing and is now available. The PR02-38 will go into series production in 2020. This motor type has the smallest dimensions of the complete PR02 product family and is perfectly suited for lighter pick and place, capping, bending, or press-on operations.



		PR02-38	PR02-52	PR02-88
Stroke up to	mm	70	100	150 / 300
Peak Force	N	67.1	255	572
Nominal Force	N	14	51	140
Peak Velocity	m/s	7.3	3.9	2.9
Peak Torque	Nm	1.2	2.2	10
Constant Torque (Halt)	Nm	0.3	0.47	3
Max. Number of Revolutions	rpm	1500	1500	1000
Repeatability	mm	±0.1	±0.1	±0.1
Length	mm	333	453	705 / 1105

New D24 Interface for **P10-54** Linear Motors



LinMot now offers a new interface for the linear motors type P10-54. In addition to the PTC sensors, the product family is now also equipped with temperature sensors with PT1000 characteristics, thus enabling a further group of users to use their own drives.

On the outside, the motors remain the same as their predecessors, but are identified by the LinMot type code with the suffix «D24». As with the D25 interface, temperature feedback is available both on the signal and on the power connector. The new PT1000 sensor technology ensures even more precise temperature control, with which the outgoing signals are easily interpreted by external drives. In terms of position control, there is also maximum compatibility with drives from other manufacturers, as standard encoders are deliberately used here. The position signals are output by a digital A/B incremental encoder. LinMot offers a position resolution of the encoder signal with 1 μm (D24 interface) or 5 μm (D24S interface). Optimum integration into existing control concepts is thus always guaranteed.

In terms of performance, the P10-54 linear motors typically operate using 3 x 400VAC technology, although they can also be easily operated on inverters with 1 x 230 VAC mains supply. Available in 4 sizes, they

Stroke up to

Peak Force

Nominal Force

Peak Velocity

Peak Acceleration

Repeatability

Stator Length

Slider Length



cover a force range of 335 to 870 N. The comprehensive slider range results in a stroke spectrum with a maximum stroke of up to 1720 mm. With accelerations of up to 400 m/s² and a maximum speed of over 7 m/s, the motor specs leave nothing to be desired in terms of dynamics.

The rotatable TWIN connector with push-pull connections for power and encoder cables provides the greatest possible flexibility in cable outlet and guarantees reliable, time-saving cabling in the system.

		PS10-54
mm	1720	
N	871	
N	270	
m/s	7.3	
m/s ²	413	
mm	±0.01	
mm	222-402	
mm	350-2000	



Stainless steel linear motors help keep farmed fish healthy

Linear motors reduce the use of antibiotics in fish farms

Skala Maskon has developed the VX-8 machine, which can automatically vaccinate up to 20,000 fish per hour. It thus has the potential to significantly reduce the use of medications in aquaculture and to secure a supply of healthy fish for the world's population. This revolution in fish farming is made possible by the use of a high-performance image processing system in conjunction with dynamic, compact stainless steel linear motors rated at IP69K from LinMot.



From a global perspective, fish is already the most important source of protein for human consumption. According to expert opinions, demand could be as much as double within one or two decades. Without aquaculture, this hunger for fish cannot be sated. The negative side effects of industrial aquaculture, such as high levels of pollution from medications, however, have scared off consumers in Europe in parti-

cular, causing sales to collapse a few years ago. Aquaculture fish are bred for maximum production and for economic reasons they have significantly less living space than their cousins in the wild. This makes them especially susceptible to illness and parasites. The damage caused by an infestation can quickly threaten the livelihood of the farmer. The epidemic of infectious salmon anemia (ISA) that broke out

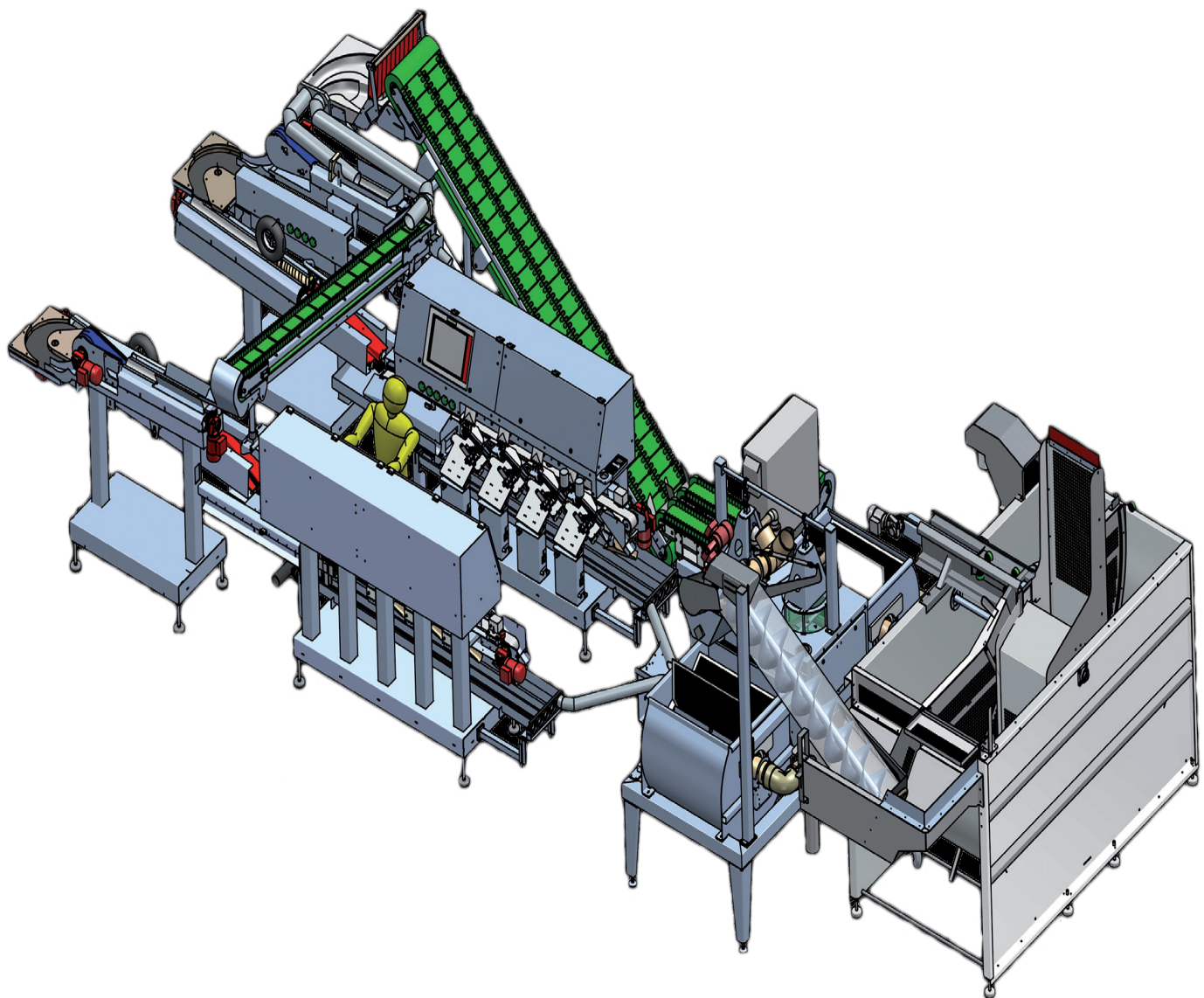
in 2007, for example, caused salmon production in Chile to plummet from 400,000 t to just 250,000 t within two years. There are many other diseases besides ISA, such as furunculosis, that threaten fish stocks. Many breeders therefore use large amounts of prophylactic medications, especially antibiotics. Growing criticism of these side effects has led to the use of medications being restricted in Europe.

Vaccinating 20,000 fish per hour automatically

Norway in particular has long endeavored to solve the problems of aquaculture. The country, where fish is the third most important export, has recently succeeded in nearly completely eliminating antibiotics. At their peak in 1987, Norwegian

fisheries alone used about 50 tonnes of antibiotics per year—more than were prescribed for the entire population of Norway in the same time period. Usage in fish farms is now less than 100 kilograms per year. Ninety-eight percent of all salmon

farmed in the Scandinavian country have absolutely no exposure to antibiotics. This was made possible by vaccinating the fish. Typically several vaccines are injected at once. Fish are classified as cold-blooded animals, which means



The VX-8 from Maskon, with eight vaccination stations, vaccinates up to 20,000 young fish per hour.

that their metabolic rate depends on the temperature, so the injection also contains an agent that heats up the immune system. This procedure is difficult, however, because up to now each fish has had to be manually injected with the vaccine using a syringe. Considering the number of fish raised annually—1.4 million tons of salmon in aquaculture worldwide in 2010—this procedure has reached its limits. The machine builder Maskon has therefore turned to automation of the vaccination process. A system developed by the company, which requires just a single opera-

tor, can automatically anesthetize, sort, singulate, and vaccinate up to 20,000 fish per hour, depending on the model. This would previously have required four to six experienced «fish injectors». The machine can not only vaccinate substantially more fish, but also ensures a significantly higher level of quality of vaccination than humans can provide. The core of the system consists of one (VX-4) or two (VX-8) vaccination modules each equipped with four vaccination stations. An image processing system by the Oslo company Tordivel first measures each fish and

provides information used to calculate the individual point of injection. The entire vaccination station is then positioned accordingly by a linear motor from LinMot. This makes it possible to hit the optimal injection site for each fish with a precision of over 98%. The length of the fish, as determined by the image processing system, is also used to calculate the depth of the injection for each individual fish. A sensor on the needle then monitors the injection process and the vaccine dosage for each fish. As a result, the mortality rate is less than 0.02 percent.

Compact stainless steel linear motors with class IP69K protection

The requirements for the injection station drives are accordingly high for this application. In particular, they need to comply with the hygiene requirements of the food products industry. The stainless steel motors in the P01-37x120F-HP-SSC series from LinMot optimally meet this requirement. They are made entirely of stainless steel (1.4404/316) and are characterized by their high protection class of IP69K. Gaskets were deliberately eliminated from the motor design. All connections are welded. The motors are also fully potted in order to prevent condensation from forming. Thanks to these features and the closed, easy-to-clean stainless steel surface, the INOX motors are an excellent match for use in machinery and equipment that processes food products or pharmaceutical goods. This was not the only reason, however, that the customer decided to use these stainless steel motors



LinMot INOX Motoren P01-37x120F-HP-SSC

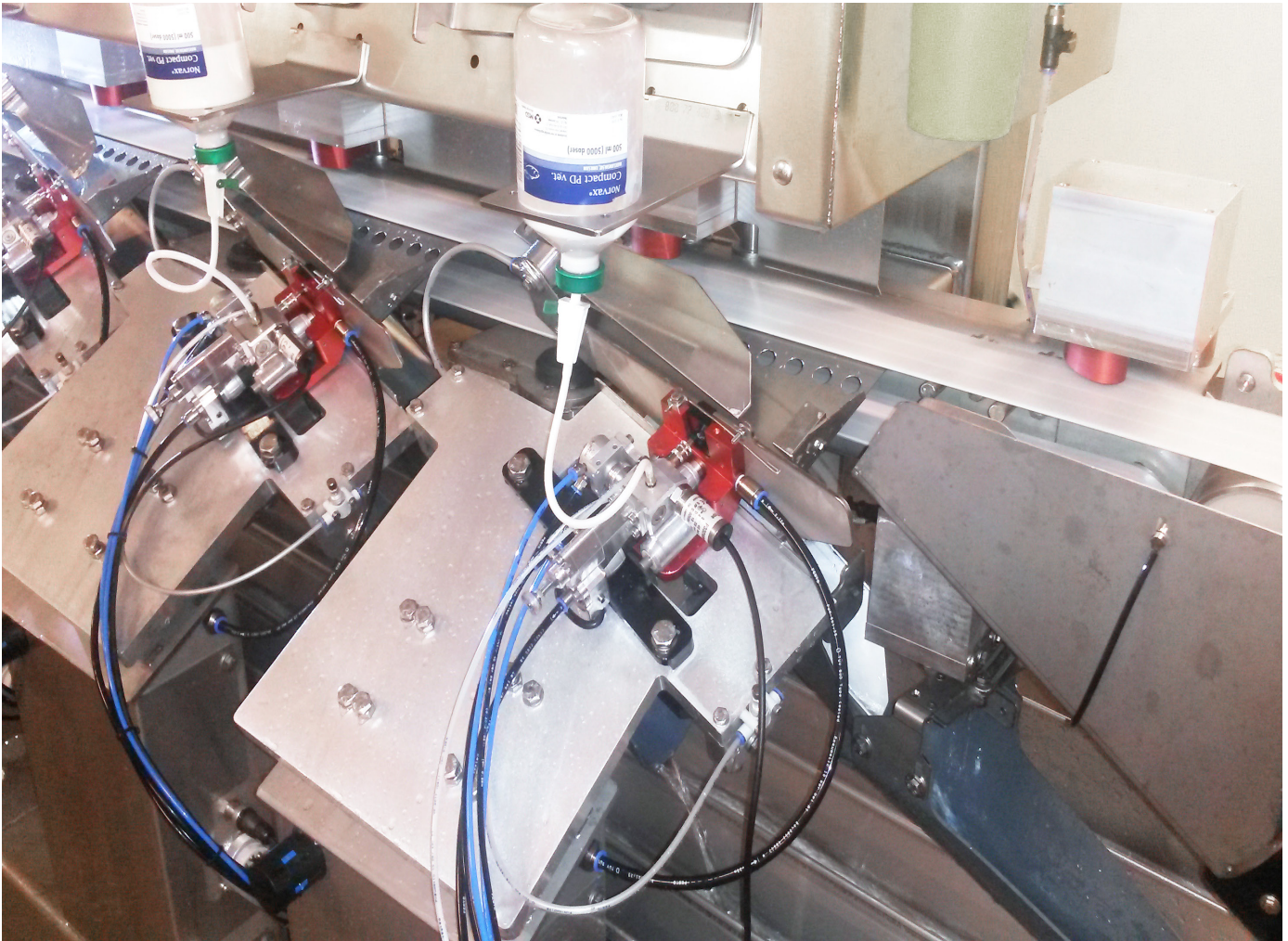
from the Swiss company. Space requirements were also a deciding factor, because the space available in the vaccine modules is tight. The compact form factor of the linear motors, which have no protruding parts or gearboxes (unlike conventional servomotors), was very appealing to the designers at Maskon. The use of pneumatic cylinder was eliminated as an alternative right from the

start, because they could not have reached the speed and precision required by the application. An evaluation by Maskon of the linear motors available on the market ultimately determined that only the stainless steel solutions from LinMot could provide the dynamics, precision, and especially the protection class and compact form factor required by the vaccination machine.



The especially compact stainless steel linear motors from LinMot used for positioning have a protection rating of IP69K, are absolutely watertight, and meet the most stringent hygiene regulations.

Extensive product portfolio, including EX variants



Based on the individually calculated injection depth and site, the LinMot linear motor precisely positions each vaccination station.

This applies as well to the LinMot stator model PS01-37x120F-HP-SSC-R used in the vaccination unit, with an outer diameter of 48 mm and length of 296 mm. When used together with the appropriate slider, it is able to apply a constant force of up to 210 N over the entire range of its stroke. In the standard product line, LinMot sliders are available for strokes from 75 to 680 mm. A high-clearance variant,

PL01-19x350/260, with a stroke of 120 mm was selected for the vaccination unit. The motor is controlled by a model B1100-VF-HC servo inverter, also from LinMot, which supports both force control and speed control and is designed for integrating the linear motors into systems with a master axis controller. The force or speed of the motors is thereby set by the master position controller via an analog differential

signal of $\pm 10V$. Either the internal LinMot measurement system or a high-precision external measurement system can be used for feedback. Simple positioning controls can actuate the E1100-VF controller with stepper motor or directional pulse signals. For testing and commissioning, the VF controller can also be operated in point-to-point mode, with four freely programmable end positions.

In line with Industry 4.0

Linear rotary direct motors in filling and closure applications

Filling and closure processes can be implemented dynamically and flexibly with linear rotary direct motors. That's why noted packaging machine manufacturer OPTIMA uses them in the closure units for its monoblock and free-standing machines. Another important reason is that the motors directly provide data on the actual stroke and torque values generated for ongoing quality assurance or subsequent process analysis. This type of drive supports modern Industry 4.0 concepts right down the line.



«Our customers in the food products, cosmetics, and chemical industries have to deal with smaller lot sizes and therefore more frequent product changeovers. We are currently working on a project, for example, where a filling and packaging line needs to be changed over to a new product

every 30 minutes,» says Andreas Seitz, Project Engineering Director for Food and Chemical Solutions at OPTIMA consumer GmbH.

«It wasn't that long ago that one lot would run for one or two weeks. Now a half an hour is not uncommon.» Medium-sized companies in particu-

lar are driving this trend in the industries mentioned above. They include a German manufacturer that produces an extensive portfolio for discounters and drugstores, ranging from spot removers to wood and leather polishes to car care products for automotive interiors.

Frequent product changeovers—short setup times

«These are not batches of a million units, like we typically see for laundry detergents,» explains Andreas Seitz. «On the contrary. Lots consist of a few thousand units, and the product range is enormous, with a nearly incomprehensible variety of package styles, shapes, and sizes. Order-based production is actually indispensable here for logistical reasons.»

The affected companies have correspondingly high demands for flexibi-



OPTIMA relies on direct linear rotary drives in the closure units of its modern, rotary indexing closure machines, achieving output of up to 600 containers per minute.

lity, setup times, and process reliability of the filling and packaging lines. OPTIMA started addressing this trend

early and has adapted its packaging systems to the changing market conditions. Comprehensive modularization and the intensive use of servo technology form the foundation.

In 2016, the company converted the closure units in its packaging systems to direct-drive technology for medium and high-performance applications. Up to 16 closure spindles mounted vertically on a rotating table are driven by a linear rotary motor from LinMot's PR01 product family.

Linear rotary motors provide flexibility in the manufacturing process



LinMot's PR01 linear rotary motors are deliberately compact and combine a rotary and a linear direct motor in one housing, which can be controlled independently of each other.

The highly dynamic electric motors, specially designed for closure and screwdriving processes, combine a linear and a rotary direct drive in a compact housing with IP 64 protection, each of which is actuated separately. «This solution guarantees not only

highly dynamic screwdriving processes and currently up to 600 closure operations a minute for our users, but also allows them to adjust critical parameters, such as stroke length, impact force, angle of rotation, and torque from the user interface on the packa-

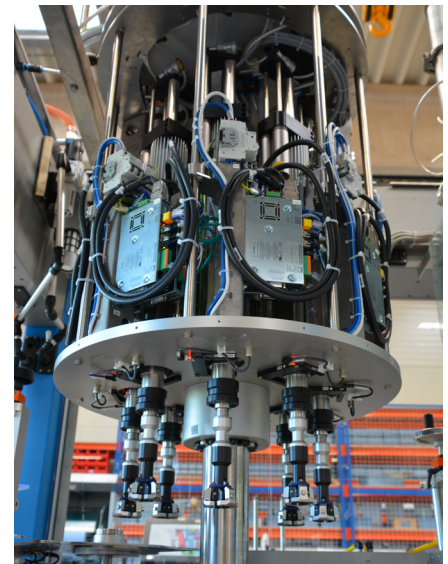
ging machine,» says Andreas Seitz of the significant advantages of this new closure technology. Time-consuming changeover of cam discs or manual setup of slip clutches are eliminated, so setup times are much shorter than for conventional systems.»

Efficient and sustainable direct drives

Maintenance is also easier, as the linear rotary motion is implemented with direct linear and rotary drives, which do not produce dirt or dust and are not sensitive to them. If a defect occurs, the affected spindle can also be shut down until the repair can be made, so production can continue at a reduced pace. For a planned machine stop, it is also possible to finish production of the containers located in the closure system. These features, along with the fact that the selected parameters can be achieved from a

standing start when production resumes, even after a long period of downtime, contribute to the high efficiency of this solution.

Quite efficient: With linear rotary direct motors from LinMot, the closure process for each spindle on the rotary dial can be designed individually and adapted to the product at the push of a button. This means that different types of closures, including screw-on and press-on caps, can be processed on the same machine.



Compact form factor and extensive connectivity

«The use of linear rotary motors for closures is a logical step as lot sizes drop,» says engineer Markus Die-rolf, a designer at OPTIMA who contributed significantly to the design of the new closure stack. «We decided to go with the LinMot solution because we have used them since 2011 for handling applications, for example, and have always had a good experience with them. For the closure system, it was particularly important that the motors be very compact and that the servo drives have numerous integral interfaces for various control systems.»

Even if it becomes necessary to change the format, however, the servo technology used, the lack of cam discs, and the resulting mechanical decoupling has a positive benefit. All spindles can be run up to the top position at the same time for better access when changing over the transport nests and closure heads to adapt to different geometry. They are safely held in this position by a «magnetic spring,» even when the machine is deenergized. This technology, developed by LinMot and sold under the name MagSpring, provides a constant force over the entire working range, unlike a mechanical spring, so it is optimal for balancing the force of gravity. Because the working principle is based on the attraction of permanent magnets, it also does not require an energy source, so the MagSpring can be used for safety functions without a problem.



Magnetic springs (in the picture left of the cooling fins) compensate for the weight of the closure spindle and maintain a safe position even when power has been disconnected.

Linear rotary motors as a data source

Another point in favor of direct linear rotary motors, which optimally supports digital transformation and traceability along with quality assurance measures, is that the motors «automatically» supply the parameters and the torque applied and distance traveled for every threading operation. «Our machines have been

capturing and utilizing this data for a while, but now we can entirely eliminate the external sensors such as torque transducers and camera systems for height control,» explains Markus Dierolf. This reduces cabling and material costs and simplifies the transfer of data to upper-level systems. The new OPTIMA closure units are

very well received by their customers. «The customer who received the first packaging line equipped with LinMot technology has already ordered a second one to replace existing systems. I think that speaks for itself.»

In the pipeline: linear rotary motors in filling stations

But OPTIMA is not yet satisfied. For the next step, the company plans to equip filling stations with linear rotary motors as well, as Andreas Seitz reports: «These concepts already exist. The arguments are the same as for the closure units—but here we are dealing with individual, parameter-based control of the filling needle motion at each filling point. This means optimal filling, even for extremely sensitive products that can easily decompo-

se or that tend to foam easily.»The company has already demonstrated this with extensive filling tests using the new technology. Over the longer term, the packaging machine specialist wants to expand the new filling and closure technology to other industries and applications. LinMot still has some homework to do for this, which Seitz has sent back with the responsible parties: «Along with the existing ATEX linear motors from LinMot,

we want solutions that allow linear rotary motors and servo drives to be used in an ATEX environment as well. It would also be very helpful if the motors and control electronics were located in a single housing.»LinMot has followed this wish and already presented the first solutions at the SPS/IPC/DRIVES 2017 show.



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