



### 11 metres upwards

Why Wanzl, the corporate group and world market leader for shopping trolleys, is relying on BRECO® ATS15-polyurethane timing belts for a storage and retrieval system.

More on page 1 and 2



### High number of cycles

Knoll Feinmechanik GmbH manufactures dialysis sets around the clock. The connecting drive element: BRECO® AT20 polyurethane timing belts.

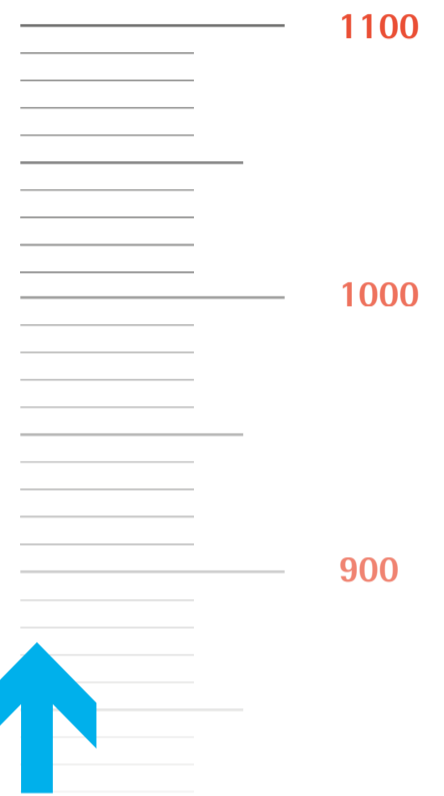
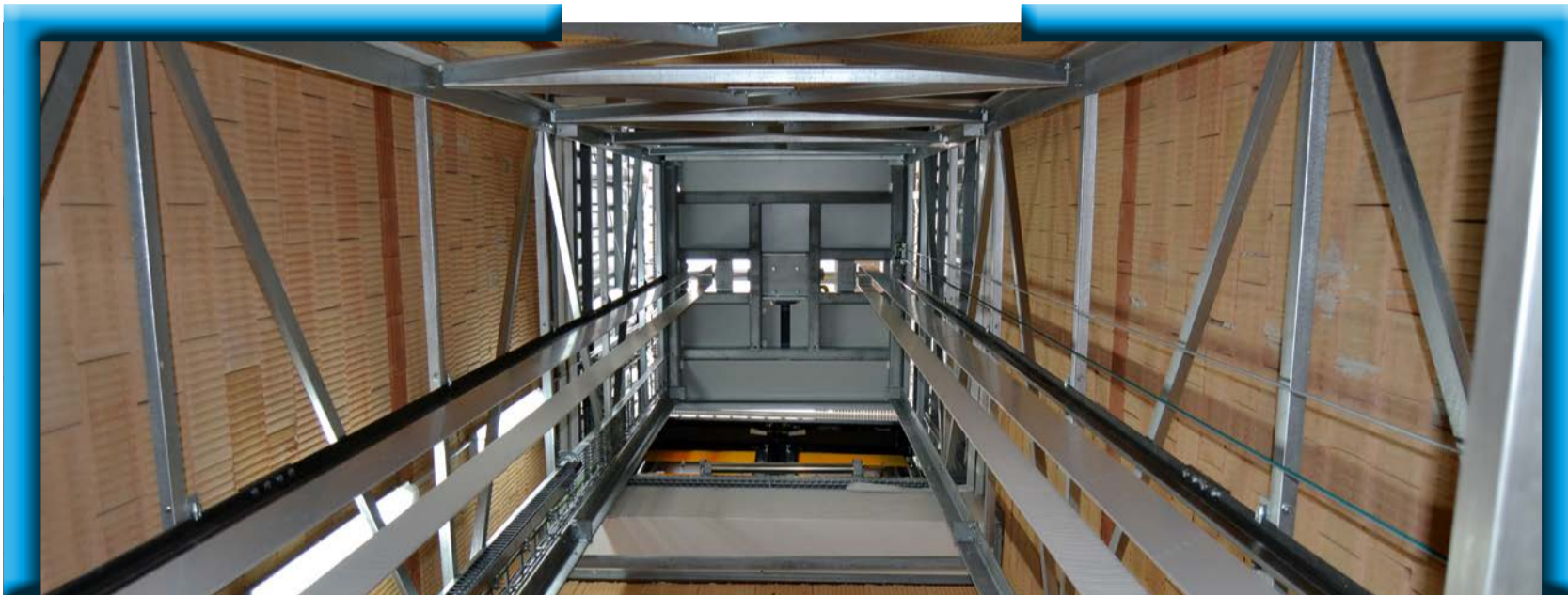
More on page 1 and 5



### Pole position

How CONTI® SYNCHROFLEX polyurethane high-performance timing belts ensure high speeds in model construction.

More on page 3 and 4



## 11 metres up

BRECO® ATS 15 polyurethane timing belts move steel baskets on pallets in vertical conveyors 11 metres up. These high performance timing belts reliably move up to 2 tonnes to a precise position, up to 50 times an hour.

Shopping trolleys are pushed or pulled throughout the world. They are so useful for shopping that you can hardly do without them. They can carry up to 200 kg and withstand collisions. Most of the shopping trolleys made throughout the world are manufactured in Leipheim, a small town situated between Ulm and

Augsburg, near the Autobahn 8. Each year, more than 1 million shopping trolleys leave the production plant of the market leader Wanzl. With such a high throughput of steel rods and baskets, the transport of the baskets between the individual manufacturing steps presents a logistical challenge.

Production areas are expensive and development sites limited, therefore production lines often have to be arranged over several floors. This requires special transport solutions.

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As far as the eye can see: steel baskets waiting for final assembly in the huge production hall.

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## Timing belts in continuous operation 24/7

BRECO® timing belt drives, with a huge centre-to-centre distance of 27 m, are the connecting and central drive element in a modular assembly line for dialysis sets. Positioning accuracy, high loads and start-stop operation creates a challenging requirement.

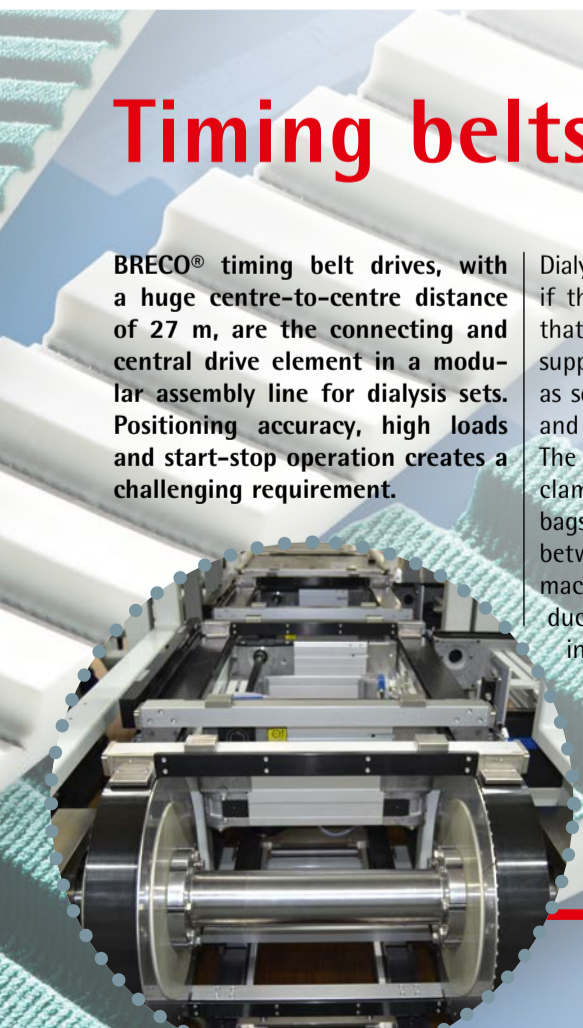
Dialysis is used as a life-saving measure if the kidneys fail. This is a process that removes toxins from the blood, supplies important substances such as sodium and calcium to the body, and balances the potassium levels. The dialysis set, including tubing, clamps, cannulas, connectors and bags, forms a life-saving connection between the patient and the dialysis machine. Only with automated production and very short cycle times in continuous operation 24/7 is it possible to produce a large quantity of these dialysis sets and meet the extremely stringent

requirements regarding cleanliness and leak-tightness.

In particular, the handling of the flexible tubing requires a lot of expertise. The special machine manufacturer Knoll Feinmechanik from Umkirch has been specialising in the automation of assembly lines for flexible parts since 1982. They have mastered all of the necessary handling steps such as winding, unwinding, cutting, application of packaging bands, positioning of components on tubing, leak-tight bonding using their own dosing system, ultrasonic

welding and printing. "Very few companies attempt this task, particularly not with the speed, precision and repeatability with which we can do it," says Thomas Karotsch, project manager at Knoll. The engineer explains why 100 % quality control is so important: "If a dialysis set develops a leak or contains foreign particles, this can cause serious damage to the health of the patient. We must ensure that the customer and the patient can have a very high degree of confidence in this product."

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## 11 metres up



There are proven solutions for Euro-pallets on the market. Due to the large range of products at Wanzl, diverse container dimensions and different pallet types, Wanzl was not able to use a standard solution. So a special solution had to be found.

### Technikmanufaktur Augenstein

Technikmanufaktur Augenstein, specialized in bespoke machines, is located less than 5 km from the Wanzl head office. Augenstein has been supplying the food, electrical, pharmaceutical and automotive industries with solutions for conveying, lifting, packing, filling, feeding and transporting for more than 30 years.

The list of products and custom-designed special machines is very long: Transport and distribution systems for cups, belt conveyors, box transport systems, gripper conveyors, pick-and-place machines, girth welders, infeed starwheels and infeed screws for the food industry, pallet control stations, pallet transport systems, chain conveyors, corner transfer units, palletizers, elevators, vertical conveyors etc.

Jörg Deiters, Managing Director at Augenstein, thinks back: "At the beginning of 2014 we received an enquiry for two vertical conveyors including the necessary roller conveyors for infeed, discharge and further transport, and for control and safety technology." The technical requirements are demanding: The load, weighing up to 2 tonnes, including the lift cage, has to be raised by more than 11 metres. In the case of the roller conveyor, an overall height of only 155 mm was required and the system had to be able to transport Euro-pallets, industrial pallets and wire mesh boxes. It was also necessary to take the overhangs of the outer contour of the pallets into consideration.

"We were eventually awarded the contract, and designed a pallet detection and contour detection system using light grids, an infeed and discharge station, the access control system, the entire transport technology for all pallet sizes and the vertical conveyors," project manager Norbert Zachmann adds. In addition, rapid action doors were installed in the individual storeys as anti-fall guards. They also suppress the draft in the walled-in vertical conveyor.

The employee drives with the pallet truck behind the access control system of the recently completed machine line up to the stop, deposits the pallet or wire mesh box onto the roller conveyor, drives out, operates the access control system and specifies which floor the item is to be taken to. As soon as the control system has given the traverse command, the item to be transported moves through the contour check



Reinhold Michl, field sales representative and applications engineer at Roth Ingenieurtechnik from Nuremberg (on the left), and Norbert Zachmann, project manager at Technikmanufaktur Augenstein, shortly before the vertical conveyor at Wanzl was put into operation.



View from the roller conveyor to the lift cage and the two lateral timing belt drives.



At the top: The geared servo motor distributes its torque via steel multiple-disc clutches to the pulleys.

and the rapid action doors into the lift cage of the vertical conveyor. This then transports the container to the preselected floor. A light grid in the vertical conveyor provides additional safety by signalling a malfunction if material falls from the container. The order of the traverse tasks entered into the terminal is decided by the control system. Up to 50 pallet movements per hour are possible.

During the design stage, Augenstein contacted its drive systems supplier Roth Ingenieurtechnik from Nuremberg to test the use of low-maintenance polyurethane timing belts. Reinhold Michl, the field sales engineer at Roth assigned with the task, designed the timing belt drives, to be arranged in parallel, for a load of 2.2 tonnes and a start-up acceleration of 0.25 m/s<sup>2</sup>. The selected polyurethane timing belts BRECO ATS 15 in a width of 150 mm carry the weight without any problem. The operating ratios for the tooth shear strength and tensile load are correctly dimensioned.

### Drive at the top or the bottom

Many suppliers position the motor of a lifting drive at the bottom because fastening and wiring is easier. However, if this requires a pit, it considerably increases construction

costs. Augenstein positioned the drive motors of its vertical conveyors at the top. The bottom pulleys are designed for diverting the belts and are non-toothed. "That is the optimum configuration for the timing belts in a lifting drive," Reinhold Michl explains, and adds: "This ensures that the length of the slack span side never goes below half the belt length. However if the drive were to be positioned at the bottom, the top pulley would serve as the deflection roller. The slack span side can be very short when the lift cage is moving up and has to take the entire elongation from the load span side."

### High modulus polyurethane timing belt

A high modulus timing belt, specified as elasticity, is particularly important in this context. In catalogues it is normally specified in N. The correct unit is [N/m] (m belt length). The specific elasticity specifies the force required to stretch a 1 m belt by 1 m. The BRECO ATS 15 polyurethane belt with a width of 150 mm, used in the vertical conveyor, has a specific elasticity of 1.03 x 10<sup>7</sup> N. This means that a load of 10150 N (approx. load of 1015 kg) is required to stretch the belt by 1 mm. This peak value is

achieved by the high-strength tension members that have a diameter of 1.6 mm. A high pitch accuracy and equal belt length guarantee precise transport to precise positions.

The vertical conveyor designed by Augenstein allows companies to speed up the flow of materials and make better use of the space in their factories on all floors. The automated detection of pallet type, overhangs and dimensions leads to considerably higher flexibility of production. The capacity limits of the timing belts have not yet been reached with a weight of 2 tonnes and accelerations of 0.25 m/s<sup>2</sup>. "We have higher performance solutions in our range if required," Reinhold Michl adds.



BRECO@-fix: The polyurethane timing belt is connected to the lift cage with these clamping elements from the BRECO range.

## What makes desert buggies indestructible

CONTI® SYNCHROFLEX polyurethane high-performance timing belts in model construction

A toy for grown-ups: Desert buggy Baja with a 3 hp petrol engine, converted from a gear transmission to a maintenance-free timing belt transmission.

Photo: STERN

The main business of STERN Automation & Maschinenbau in Berge (Nauen) in Brandenburg is the development, production and sale of CNC cutting machines. The standard range encompasses three machine sizes for small, medium and large format panels. Company owner and passionate model maker Thorsten Stern also uses his machines for his own model construction. Carbon fibre reinforced plastic parts and aluminium parts for boats and buggies are produced on the in-house designed machines. "It started as a hobby but thanks to my sons it has developed into an interesting business model," Thorsten Stern explains, not without pride.

Today the family business supplies model construction components to countries as far away as the USA and New Zealand under the label "Stern-CNC Modelbaukomponenten". The remote controlled buggies weighing just under 10 kg are about 800 mm long, and are driven by a 23 cc two-stroke cycle engine with about 3 horsepower. That is easily enough for them to reach a speed of 60 km/h. Specialists use special fuel and tuned ignition timing to achieve double the speed. Thorsten Stern reminisces: "About six years ago we started replacing the wear-prone, open and unlubricated spur wheel gears with timing belts. In those days that was completely new territory. The toothed gearing of the buggies often lasted only one

season; the version made of plastic sometimes only a few races. We wanted to improve this. Low weight and a small mass moment of inertia are particularly important because fast acceleration is what the buggies are all about."

### Reversal of the rotational direction with timing belts

To test the market for complete conversion kits from toothed gearing to timing belt gearing, Thorsten Stern offered a first kit on an auction site as a "buy it now" product. "The kit was sold in six minutes," he says. Most buggies have gears with three gearwheels so that the drive and output rotational direction are identical. They can be replaced with a simple timing belt drive.

The company has been using these drives successfully for many years. However, at first he thought it would be difficult to convert the desert buggy Baja.

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Wear-prone and unpleasant noise development: The set of spur gears installed as standard.

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## What makes desert buggies indestructible

This is equipped with a simple set of spur gears with two gears for changing the rotational direction of the drive. "My son had the great idea of using a double-sided timing belt to allow the rotational direction to be changed when using a belt drive," Thorsten Stern explains. By using a double-sided timing belt, the belt can be guided between the two shafts along the inside of the small pulley, changing the rotational direction.

This drive required much more development work, which was why the three model makers sought professional assistance from the Mulco member and specialist for timing belt technology, Wilhelm Herm. Müller GmbH & Co. KG, Garbsen. André Schmidt, engineer and customer consultant, has been advising industry customers from the Müller branch in Leipzig for more than 20 years on the subject of polyurethane timing belts. He explains: "Stern had already manufactured prototypes, so our job was to produce drawings for the pulleys and give advice on the permissible manufacturing tolerances, to ensure the correct belt tension. A fixed centre-to-centre distance was chosen for this drive to exclude possible installation mistakes by the customer and damage to the bearings and belts."

Torsten Stern designed an additional outer support plate for the two pulleys to reduce the load on the bearings and to avoid skewing of the pulleys. The support plate is made of carbon fibre for reasons of weight. "Due to the small pulley diameter and the large wrap-around, we chose a flexible CONTI SYNCHROFLEX polyurethane timing belt with a 5 mm pitch. The 15 mm wide belt T5-DL (DL double lip) transmits the 3 horsepower rated load of the petrol engine without any problems and there has not been a single failed drive to date," says André Schmidt.

### Customized timing belt solutions in small quantities

The timing belt drive is protected from sand and stones by a specially designed cover. "Some customers like the appearance of the drive so much that they leave off the important cover," Torsten Stern says with a grin. Without the cover, stones can get into the drive and tear the timing belt. "We simulated this on our test stand and discovered that in the worst case scenario the steel cord of the torn belt can wrap around the rotating shaft," the resourceful inventor explains. André Schmidt from Wilhelm Herm. Müller suggested using tension members made of aramid as a customised solution:

"Aramid doesn't develop such high tensile forces and tears when overloaded. This avoids additional damage due to the tension member wrapping around the shaft."

Revealed: The drive pulley and the two guide pulleys can be interchanged. This allows three different transmissions.

### Three transmissions with one belt drive

The inventors from Nauen have achieved an ingenious design with the two guide pulleys: the driven pulley and the two guide pulleys with different numbers of teeth can

be interchanged. By interchanging the pulleys it is possible to operate the buggies with three different transmissions depending on the race course and selected tyre size. The original has only one set of gears with a fixed transmission. That is real added value.

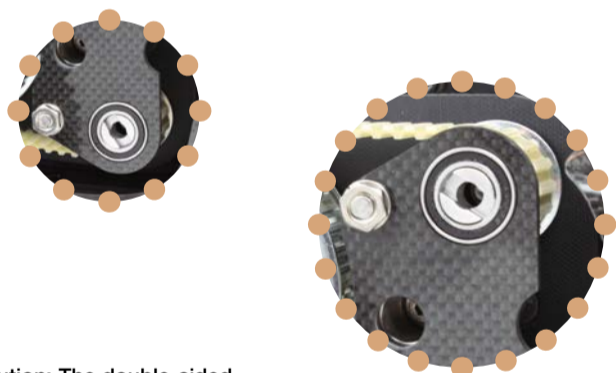


## Three different tension members available on request

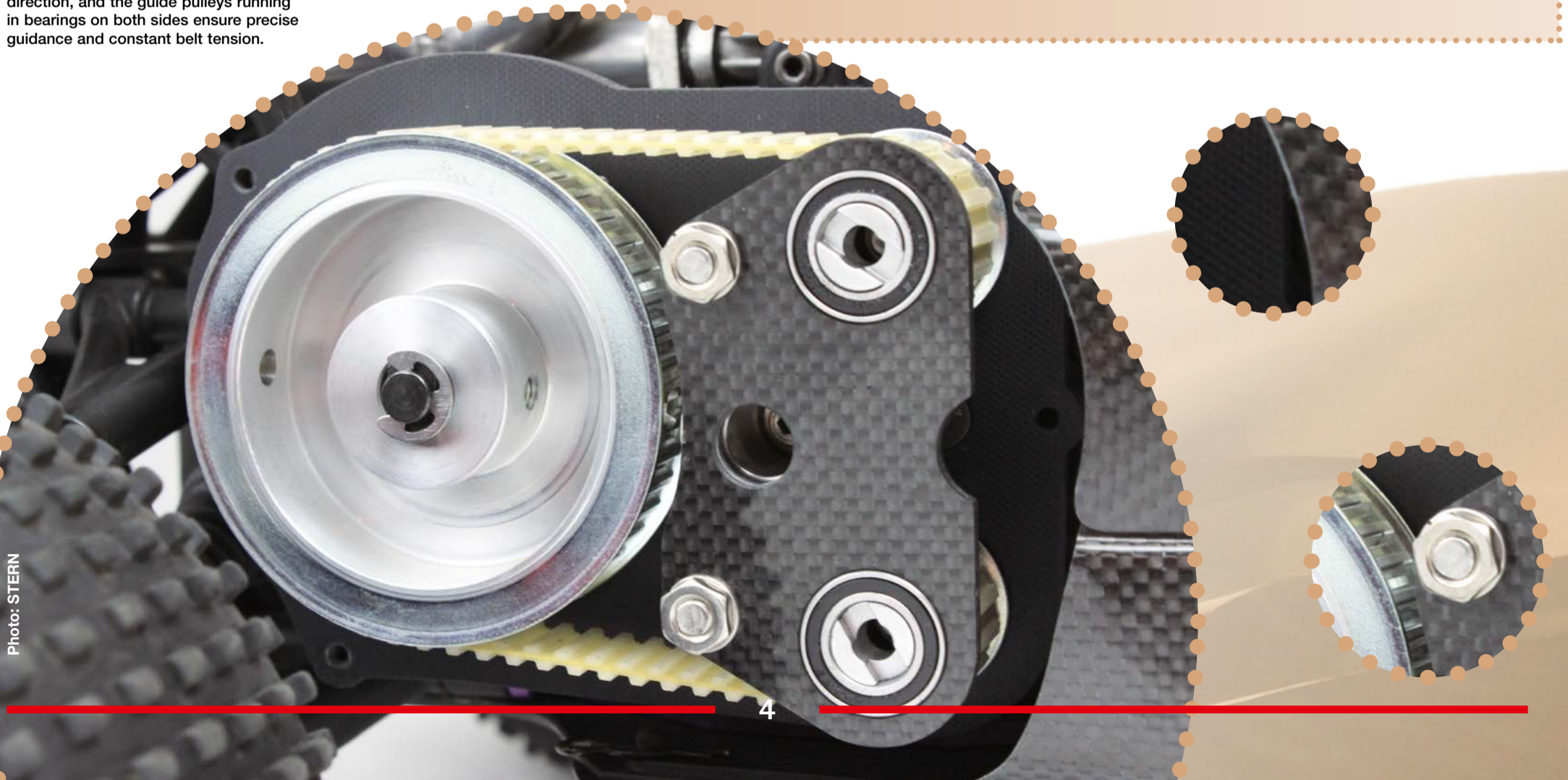
Three further variants as an alternative to the standard tension members made of steel are available for the CONTI SYNCHROFLEX polyurethane timing belts:

- E tension members made of steel with specially thin individual wires,
- tension members made of VA stainless steel, and
- aramid tension members.

In the E tension member, the cross-section of the tension member is distributed to a larger number of thinner individual wires, therefore the bending fatigues are markedly lower in the individual wires. The advantage of the E tension members is a higher flexibility. This is especially important when smaller mounting dimensions for pulleys and tension rollers are required. It is possible to reduce the minimum number of teeth and/or minimum diameter of the pulleys by up to 30 % compared with standard tension members. Timing belts with E tension members are recommended for multi-shaft drives with frequent bends.



A clever solution: The double-sided CONTI® SYNCHROFLEX polyurethane timing belts allow reversal of the rotational direction, and the guide pulleys running in bearings on both sides ensure precise guidance and constant belt tension.



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## Timing belts in continuous operation 24/7

### Automation with modular linear indexing systems

The engineers in Umkirch developed linear indexing systems with very short cycle times for this complex automation task. The system shown is nearly 30 m long, about 15 m wide and divided into individually functioning modules. This makes commissioning considerably faster and facilitates de-installation, transport and re-installation of the system in the customer's factory. It is also possible for the customer to completely exchange individual modules, for example, for a change of product.

More than 60 product carriers are used in one cycle in the linear indexing system. The product carriers – large anodised aluminium plates with a weight of nearly 30 kg – are cycled from one station to the next with a cycle length of 1 m. The timing belt drives on the longitudinal sides with a huge centre-to-centre distance of 27 m from the connecting and central drive element of the modular system. They transport the product carriers from station to station for assembly, welding, gluing, filling and inspection.

### Quality feature: welded-on timing belt cams

The torque of the large geared motor is transmitted by two parallel timing belts from pulleys measuring almost 500 mm to two welded-on belt cams. These are bolted to a stainless steel bracket and an aluminium cross support and are not visible when fitted. The manufacturer of the heavy duty timing belts is BRECO Antriebstechnik from Porta Westfalica. The customer-specific cams are equipped in the factory with precisely drilled holes for the screw connection between the stainless steel brackets and cross supports. Each product carrier is supported "floating" between two cross supports. At the assembly stations, two bottom vertically moveable centring pins align the product carriers to a tenth of a millimetre. The precise and repeatable precision of the position is necessary to allow the robot assembly of the flexible hoses onto the ports.

Due to the high and very frequent acceleration and braking, in conjunction with the high weight of the product carriers, the welded joints of the cams are subject to high loads. Engineer René Preßler from Mulco's sales partner, Hilger u. Kern in Mannheim, who is overseeing this project for the automation specialist from Knoll, adds: "The cam is welded over only one tooth so as not to change the flexibility of the timing belt. This means that there is a limited area for welding. However the load on this cam is still within the permissible range of 190 N/cm line load. We could have chosen a screw connection as an alternative. However, we had to take into

consideration that a screw connection could come loose during continuous operation 24/7. As long as the permissible load is not exceeded, the welded variant is a very durable and reliable solution."

### Maximum pitch accuracy from one batch

When two timing belt drives are connected in parallel, their pitch tolerance must be as close as possible. Otherwise the system could become jammed or deformed. Therefore, BRECO supplies both polyurethane timing belts of the type BRECO AT20 for this application from one manufacturing batch. René Preßler continues: "The entire drive and, in particular, the timing belt has to keep the position precisely at all stations along the 27 m so that all product carriers stop at the same time. Therefore the timing belt has to have low elasticity. After all, nearly 1.5 tonnes have to be accelerated and braked in less than one second."

### Ingenious load bearing solution

For transport systems that carry light loads the timing belt normally runs on a sliding rail that deflects the weight forces of the goods to be transported via the belt to the frame. This is a tried and tested solution.

Due to the high loads in this application, Knoll chose an elegant alternative: The cross supports are bolted onto stainless steel plates so that they run on sliding rails. In this way, Knoll was able to achieve a better tribological pairing, reducing friction and wear, which is particularly important in the clean room.

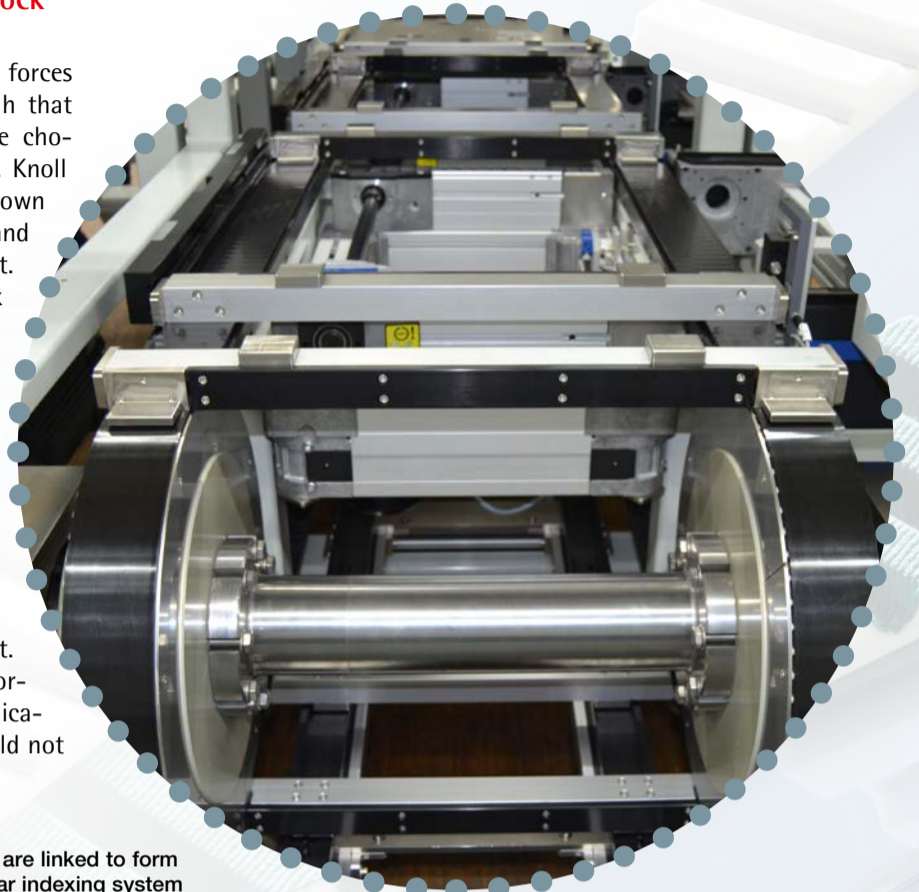
If the permissible number of particles in the air is exceeded, the entire production batch has to be disposed of for safety reasons due to the risk of contamination.

Regarding the reliability of the timing belts, design engineer, Thomas Reiser, adds: "One of our customers has been operating a machine line 24/7 since 1998 and not a single timing belt has yet had to be replaced." This proves that the belt is correctly designed and the quality is how it should be.

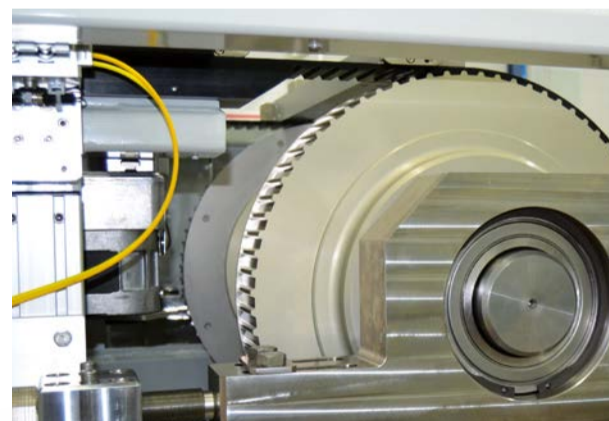
### Welding or timing belt lock

For this application the tensile forces in the timing belt are so high that a timing belt lock had to be chosen in preference to welding. Knoll Feinmechanik developed their own timing belt lock years ago and have constantly optimised it. This very sturdy and stiff lock is specific to this application. During fitting it is important that the first and last tooth are precisely within the pitch tolerance of the tensioned timing belt. René Preßler explains: "The tensile forces in this machine line are so high that they can only be transmitted by an endless manufactured timing belt. Therefore the lock is an important component in this application; without it the drive would not function properly."

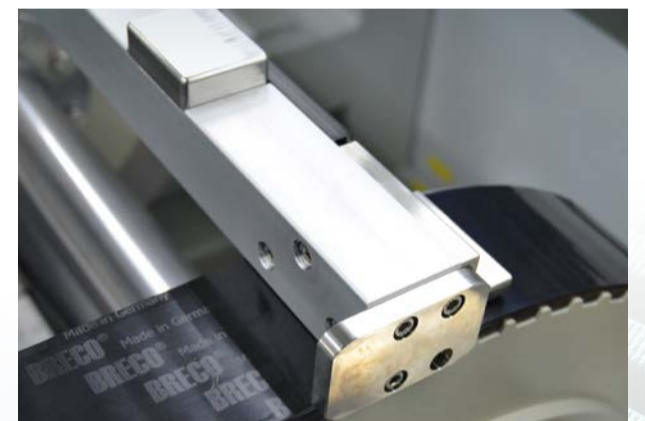
Individually functioning modules are linked to form a 30 m long, highly dynamic linear indexing system for the cleanroom production of dialysis sets.



Engineer Thomas Karotsch (on the right) talking to engineer René Preßler: "Our machines are sometimes transported overseas by air so that they can be put into operation sooner. That says something about the extremely high productivity of our machines."



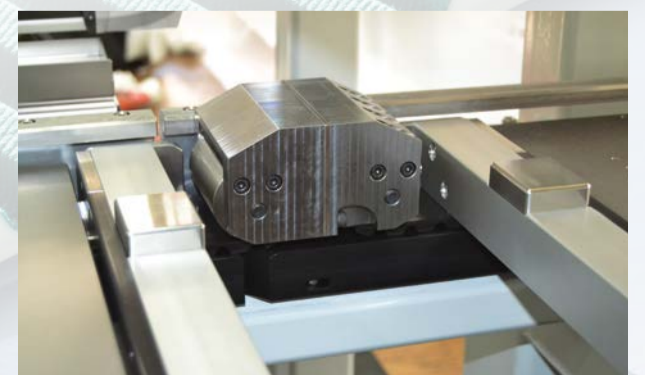
The diameter of the pulleys measures nearly half a metre. Flanges are fitted on only one side, as the belts are axially connected together by cross supports.



Separate functions: The 75 mm wide Breco® timing belts perform the drive function, whereas the lateral stainless steel plates transmit the weight forces of the product carriers to the laterally arranged black sliding guides.



Robot station: The product carriers do not lie on the timing belt but on L-shaped stainless steel brackets that are fastened to belt cams and aluminium cross supports.

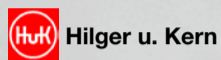


In-house designed timing belt lock for maximum tensile forces.

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