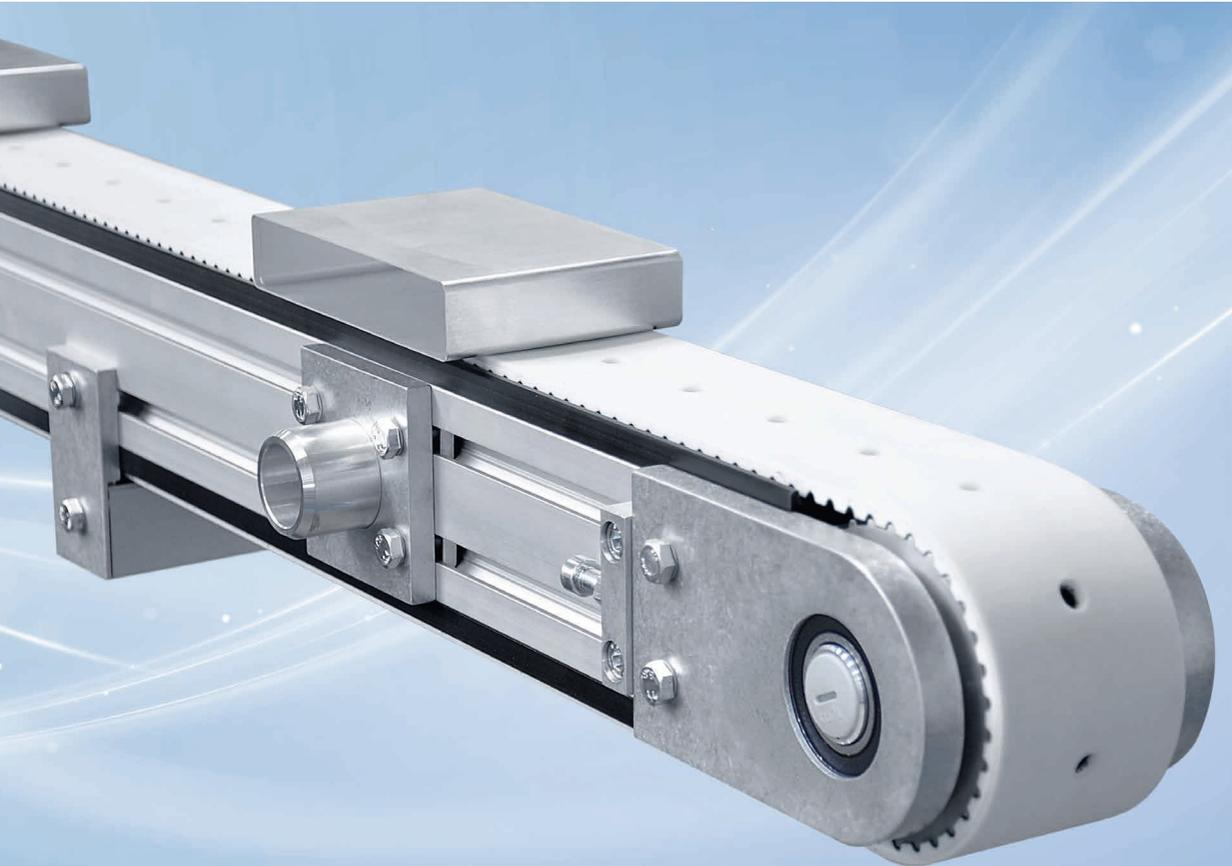




Vacuum Belt Conveyors



Easy product handling with vacuum



mk Vacuum Belt Conveyors



» Fixed-position transport without gripper or pallet. «

- **Do your products tip over or float on the conveyor at high accelerations?**
- **Do your short cycle times not allow you to stop and handle the products with a gripper?**
- **Do you want to coat, scan, label or laser the bottom of your products?**
- **Do your products have to be continuously elevated or bridge a gap?**

Vacuum belt conveyors from mk fix the products to the conveyor with a vacuum. This means that the products can, for example, be accelerated quickly or transported vertically, overhead or alongside the conveyor. Intermittent handling tasks can also run continuously with vacuum belt conveyors.

All our belt conveyors and timing belt conveyors are available with a vacuum. We simply modify the conveyor frame and belt for the vacuum function.

Accessories such as belt supports, side rails, etc. can still be selected from the standard construction kit. Our standard motors are also suitable for vacuum applications.

Our engineers will design all the necessary components, from the conveyor and suction line to the pump. Alternatively, you can request a complete solution that you can integrate into your production environment.

* Vacuum causes additional forces which have to be considered in the design

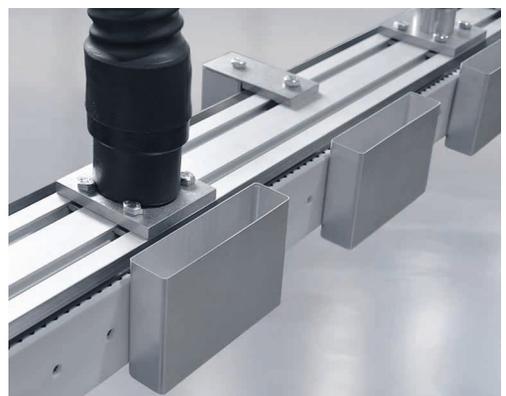
General requirements

To be gripped by the vacuum, the product surface has to be suitable. The design of the vacuum belt conveyor depends on the following **product characteristics**:

- Smooth or rough
- Even or uneven
- Dense or permeable to air
- Delicate or stable
- Clean or dirty

Since ambient air is drawn in, the **environmental conditions** also have an influence:

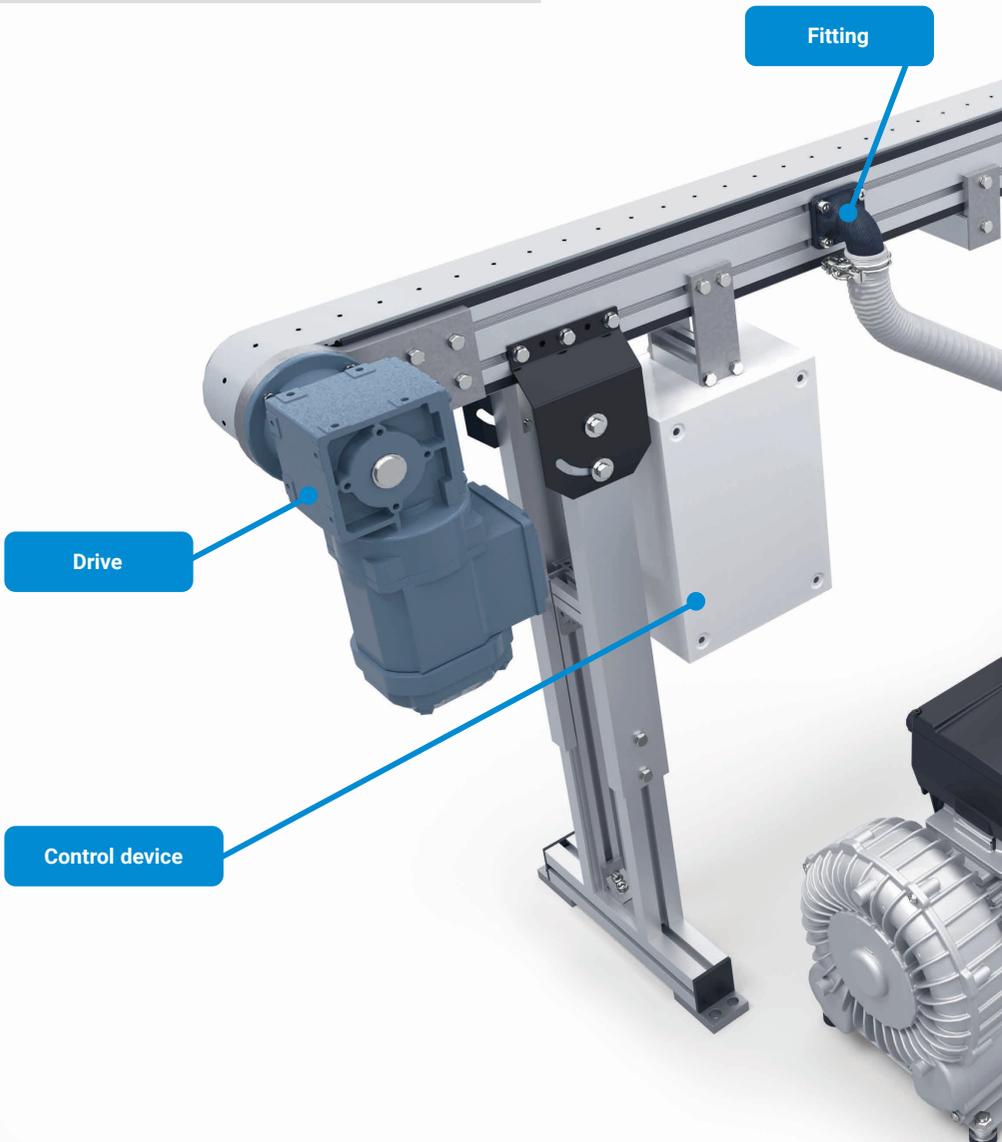
- Dust particles
- Pollution
- Cleanliness of the machinery
- Temperature
- Humidity
- ESD



Basic Structure of the Vacuum Belt Conveyors

Benefits

- ✓ Fixed position transport without gripper or pallet
- ✓ Secure conveying of lightweight products at high accelerations – no tipping over or floating
- ✓ Products can be conveyed overhead or alongside the conveyor
- ✓ Products can be processed or checked while moving



Optional variant for longer
 or wider conveyors



Areas of application

To transport lightweight/large-area products at high accelerations or speeds, for example in the packaging, consumer goods or paper industry or in battery production.



Design of Vacuum Belt Conveyors

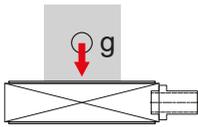
Transport position

Depending on the product weight, conveying task and transport position, different forces have to be considered. Therefore, the transport position has a significant influence on the design of the conveyor. Because the product is fixed to the conveyor by the vacuum, a variety of transport positions are possible.

Our engineers design the vacuum components according to the customer's required suction force. If the required suction force is not known, we can determine it using sample parts.

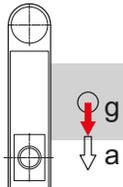
Examples of transport positions

$\alpha = 0^\circ$



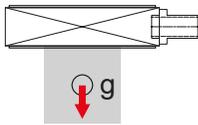
Horizontal conveying

$\alpha = 90^\circ$

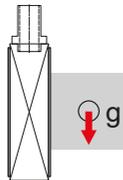


Vertical conveying

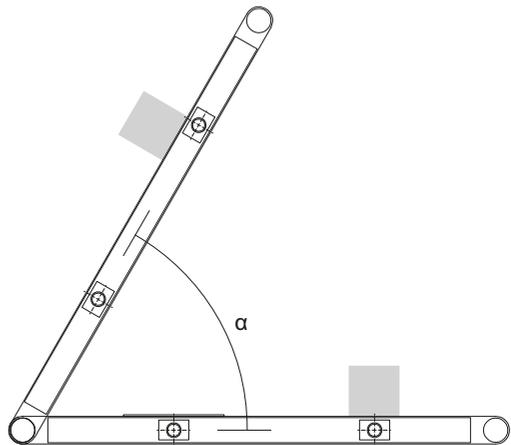
$\alpha = 180^\circ$



Product suspended beneath conveyor (overhead transport)



Product transported alongside the conveyor



The vacuum allows incline angles of $\alpha = 0$ to 360° without the product slipping, floating or falling.

Suction force

The suction force is calculated as follows:

$$F = p \cdot A \text{ [N]}$$

where:

A = suction area [m²]

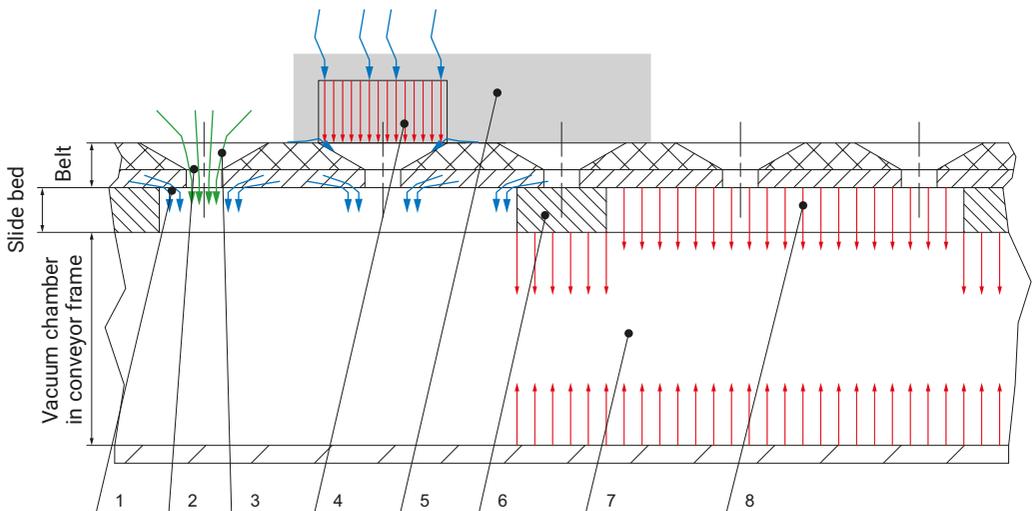
p = negative pressure [N/m²]

mk specification: p = -100 mbar \triangleq 0,01 N/mm²

We dimension the pump for a negative pressure of -100 mbar in the vacuum chamber. This relative vacuum has proven effective for most applications. The vacuum must be guaranteed at all times, regardless of how many holes are covered by products. Therefore, we dimension the pump such that the necessary vacuum is provided even when all the holes are open. A certain degree of leakage is expected in every system, which we take into account when dimensioning the pump.

The area relevant to the suction force is the total area of the openings in contact with the product (4). The area relevant for calculating the flow rate is the narrowest cross section in the belt (2). These openings can be thought of as an orifice in a pipe system. The total area of these orifices is called the equivalent orifice.

Belt with coated surface*



- | | |
|---|--|
| 1) Leakage between belt and slide bed | 5) Product |
| 2) Orifice | 6) Area where the product is not fixed |
| 3) Relevant flow rate | 7) Negative pressure in the vacuum chamber |
| 4) Suction force between belt and product | 8) Suction force on belt |

* Cylindrical clearance holes are used for belts without a surface coating.

In this case the area in contact with the product (4) is the same size as the orifice (2).

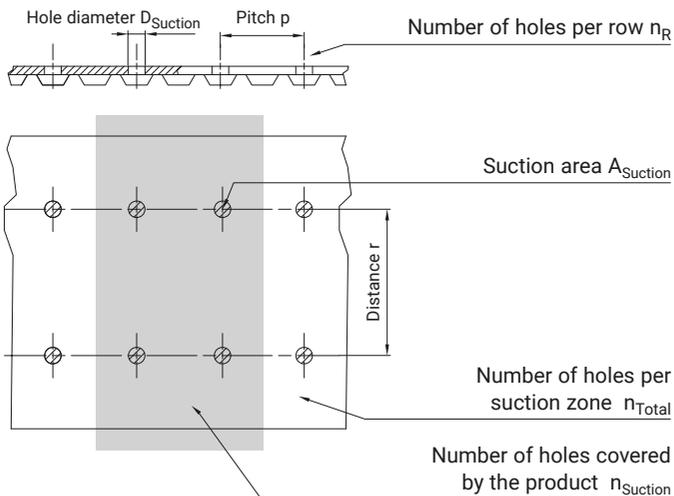
Design of Vacuum Belt Conveyors

Belts

mk uses high-grip belts or timing belts for its vacuum belt conveyors. Accumulating belts or timing belts can also be used, for example if products need to be ejected sideways.

The hole pattern in the belt is of crucial importance when selecting the right pump. The number, size and location of the holes under the product will affect the suction force and therefore the appropriate pump needed to transport the product securely.

The arrangement and size of the individual holes will depend on the product shape and the suction area required to generate the necessary suction force. This hole pattern is then distributed over the entire circumference of the belt. The smallest possible holes with a diameter of 3 to 6 mm are recommended.

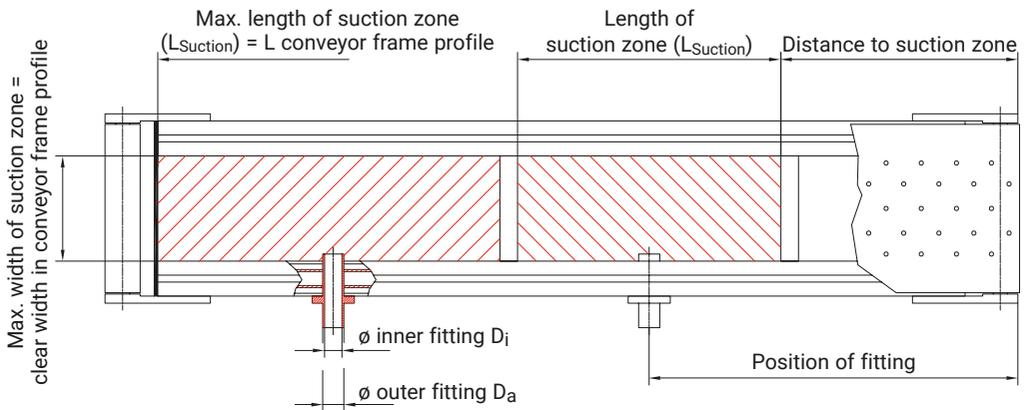




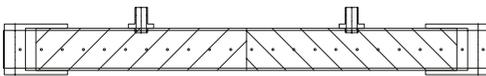
Conveyor frame

The geometry of the conveyor frame defines the suction zone. Depending on the application and to reduce leakage, it may make sense to divide the conveyor frame into different suction zones.

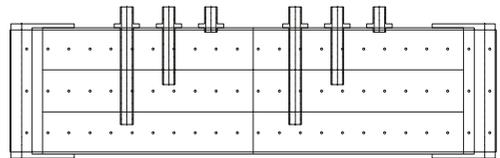
It is advisable to design these individual suction zones so that they can be switched on and off individually. Longitudinal divisions can be used to account for various functions such as loading, accelerating or separating. Transverse divisions are commonly used with products of different widths. This minimises the number of open holes in order to reduce the flow rate and obtain a reliable suction force for each suction area.



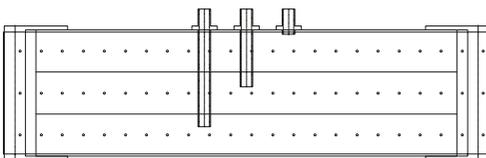
Longitudinal division



Longitudinal and transverse division



Transverse division



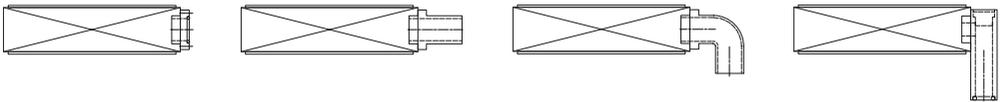
Design of Vacuum Belt Conveyors

Connection point and suction line

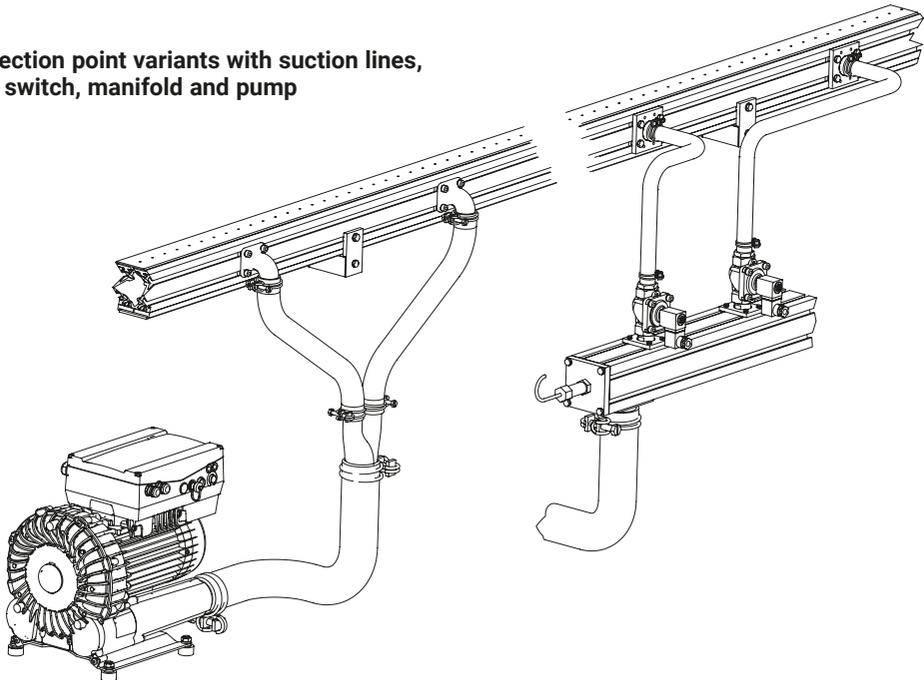
The connection fitting can be designed in different ways. The size and number of the fittings are determined individually with the customer according to the flow rate, the suction zones and accessibility constraints. We can design complete systems with short suction lines (consisting of hoses) and a pump in the immediate vicinity of the conveyor.

Other options such as manifolds, valves, pressure measurement systems, specific integrations or longer suction lines can be added on site as needed. Or, in many cases, the customer can implement these themselves. There is also the option of a vacuum pump and/or exhaust air line.

Connection points for the suction line on the conveyor frame



Connection point variants with suction lines, valve switch, manifold and pump





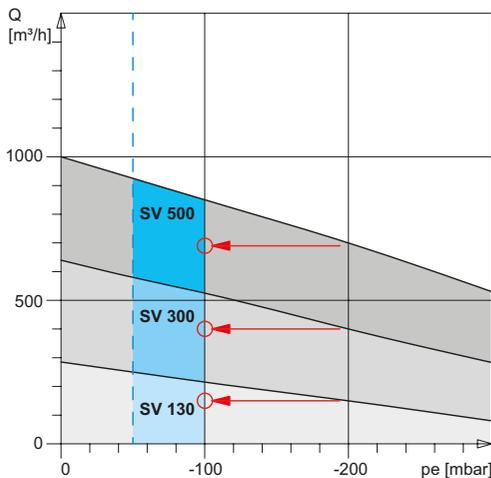
Vacuum pump

mk prefers to use single-stage side channel blowers. These generate a high flow rate and a moderate vacuum. The flow rate Q [m³/h] indicates how many m³ of air per hour the pump can draw in at its connection point.

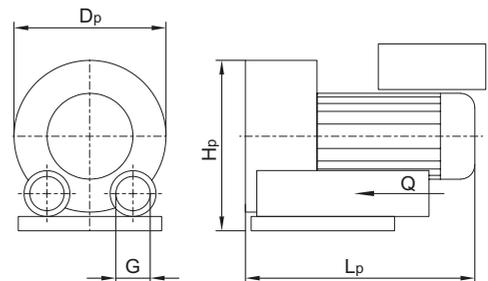
The diagram shows a sample selection of 3 controlled pumps in different sizes*. We use a negative pressure of -100 mbar as a reference. For preliminary design considerations, we recommend dimensioning the pump to run at only 80% capacity (see red dot), which would also allow a vacuum of -200 mbar.

Our engineers calculate the required flow rate, taking into account the equivalent orifice and leakage air.

Flow rate



Vacuum pump



*other pumps are available as an option

Pump FU 10-100Hz	Flow rate Q at -100 mbar from [m ³ /h] to [m ³ /h]		Connection G [inch]	$\varnothing D_p$ [mm]	Height H_p [mm]	Length L_p [mm]
SV 130	35	200	1 1/2"	265	310	410
SV 300	200	500	2 1/2"	370	430	470
SV 500	500	850	3"	475	525	600

Customer-Specific Applications



Vacuum belt conveyor GUF-P 2000 AC in the packaging industry, cycles at high accelerations without containers slipping or tipping over



Vacuum belt conveyor GUF-P 2041 AC including frame and control unit



Vacuum belt conveyor GUF-P MINI



Vacuum belt conveyor GUF-P 2000, products are packaged at very high speeds



Vacuum belt conveyor GUF-P 2041 BC with 3 chambers in transverse direction for batches of paper envelopes of different widths



Vacuum belt conveyor GUF-P 2000 AC with narrow suction zone

Customer-Specific Applications



Multiple-line vacuum belt conveyor GUF- P2041 BC with electronically coupled drives



Vacuum belt conveyor made of stainless steel with knife edge for fast transport of fleece strips



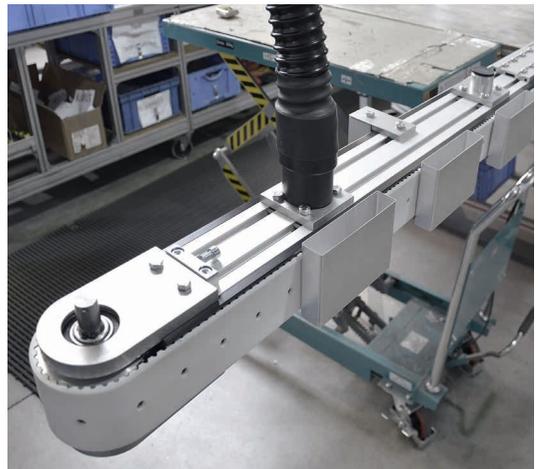
Vacuum belt conveyor made of stainless steel for FDA-regulated industries



Vacuum belt conveyor in stainless steel with conveyor frame made of square tubes



Vacuum timing belt conveyor ZRF-P 2040 with ESD anti-slip surface coating



Vacuum timing belt conveyor ZRF-P 1010 for transport alongside the conveyor



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