

Technical Paper

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Intelligent monitoring of brakes for vertical axes

Scheduled and cost-effective maintenance through efficient Industry 4.0 safety brakes

In many safety-critical applications, safety brakes are often the only protection against crashes or unintentional descent of suspended loads. mayr® power transmission not only offers a wide range of reliable safety brakes for vertical axes, but also solution concepts for their predictive maintenance. Here, the focus is placed on the ROBA®-brake-checker module, which is not only able to monitor and supply brakes without the use of sensors. In an advanced version, it also provides data, thus enabling scheduled and cost-effective maintenance.

Suspended loads in machines and systems, in particular in machine tools, handling systems, assembly facilities, hoisting devices, cranes and stage winches, represent a substantial risk potential – especially when people have to stand underneath them. Therefore, it is important to permanently exclude the risk of an inadvertent descent of loads as well as unpermittedly long stopping distances already in the design phase. Decisive for this purpose are the correct selection of the safety brakes as well as their proper integration into the overall system. Safety brakes according to the fail-safe principle are the first choice for applications with vertical axes, as these brakes generate the braking force through thrust springs and are closed in de-energised condition. Reliable motor drives, whilst also being able to decelerate vertically-moved loads to a standstill even in case of power supply failure (SS1 operation), cannot subsequently hold loads suspended without a supply of power.

Safety through reliable linear brakes

Two proven safety braking systems that are frequently used to safeguard linear movements are brakes that act either on separate round rods or on guide rails. These include, for example, the ROBA®-linearstop brakes (round rod) and the ROBA®-guidestop brakes (guide rail) by mayr® power transmission. These linear brakes are particularly suitable for use in gravity loaded axes, as they are mounted directly on the masses which are to be braked or held. Drive

elements such as toothed belts, couplings or spindle nuts, which in other braking systems also transmit the braking torque and could have an influence on safety, do not exist here. If linear brakes are also used as a second brake unit, for example in addition to a motor brake, their operating principle - on a rod or rail - also ensures high-quality redundancy with exclusion of the same errors.

Linear brakes can be used in many different application fields. That is the reason why mayr® power transmission offers a wide range of linear brakes in pneumatic, hydraulic and electromagnetic designs. "We are the only manufacturer to offer electrically opening linear brakes which are also safety brakes", explains Bernd Kees, Product Manager at mayr® power transmission in Mauerstetten. "Users looking for solutions can turn to us for systems with both round rods and guide rails."

More than just clamping units

Most linear brakes available on the market today function as static clamping units, and have been designed to hold the axes safely at a standstill. However, there might be people under suspended loads during initial operation, maintenance or even during the production process without the load transfer to the mechanical linear brake having taken place first. If the drive fails completely during these operating conditions, the linear brake alone is responsible for the reliable deceleration of the load. Such dynamic braking actions repeatedly occur in practice. Therefore, when making their selection, users should make sure that the clamping units are designed in such a manner that they are also suitable for emergency braking actions. mayr® power transmission subjects the units to dynamic tests on a drop test stand specially designed for linear brakes. This drop test stand makes it possible to accelerate different weights, the so-called load masses, to different drop speeds and then decelerate the load masses. This way, the influencing factors can be determined in a realistic setting, because only products that have been tested under realistic conditions can subsequently meet all requirements without any problems.

Never compromise on safety

Depending on the design, there are further possibilities for integrating or retrofitting safety brakes. One possible position is directly between the servomotor and the spindle. With the ROBA®-topstop® brake system, mayr® power transmission has an independent module in its product range which holds the vertical axis safely in any position, even if the motor is disassembled for maintenance or

transport. The axis does not have to be additionally supported, which considerably accelerates the replacement of the drive motor, for example. This reduces costs, and also downtimes for repairs are considerably shorter. Thanks to its adapted flange dimensions, the brake can also be easily integrated into existing constructions. The safety brake meets high IP standards and is currently available up to Protection IP65, which means it is already well protected against the penetration of grease or oil mist. A voluntary type examination by the German Social Accident Insurance (DGUV) confirms the braking device as a "tried and tested component" in terms of Category 1 acc. DIN EN ISO 13849-1.

For axes with a rack and pinion drive, the ROBA®-pinionstop could be used as an additional braking system. This electromagnetically opening safety brake with integrated, bearing-supported pinion directly locks into the toothed rack at any required position and therefore operates independently of the drive motor. It can also be retrofitted in existing systems.

Short switching times over the entire service lifetime and reliable switching condition monitoring

In particular on vertical axes, short stopping distances are important for the safety of people and machines. Here the brake switching times are decisive for the braking distance, because during the free-fall time until the brake closes and the retardation takes effect, the mass additionally accelerates – possibly to such extremes that the permitted brake values are exceeded. Users should therefore pay attention to verified switching times which are as short as possible when selecting safety brakes – and also assure themselves that these switching times can be maintained throughout the entire lifetime of the brake. In order to achieve the highest possible level of safety in each application and to guarantee the planned switching times throughout the entire brake lifetime, it is also important that the brakes are equipped with a reliable switching condition monitoring system.

Intelligent brake monitoring

mayr® power transmission offers solution concepts for the predictive maintenance of electromagnetic safety brakes based on the principle of permanent inspection. The monitoring of the safety brakes takes place without the use of sensors with the retrofittable ROBA®-brake-checker module. "Users benefit from the permanent inspection of the safety brakes by the ROBA®-brake-checker module", explains Kees. "If, for example, the limit temperature is

reached, this is an indication of damage to the brake, of brake failure or even incorrect dimensioning. The ROBA[®]-brake-checker also shows when critical wear values have been reached. This permits predictive maintenance, which in turn ensures higher system availability." Temperature progressions and changes in parameter across a product's lifetime are also made visible. In the case of previous solutions, such as contactless release monitoring, users are only able to see the failure or destruction pattern, but do not know how the error occurred. Using the ROBA[®]-brake-checker, on the other hand, progressions are made visible and error analyses can be used and even transferred onto other user systems. All this data from malfunctions and normal operation thus supply valuable input for future improvements and optimizations, for example for more system safety or an extended performance limit.

Checklist: Safety brakes for vertical axes

- Please ensure that the safety brakes are also suitable for dynamic braking actions and have been tested under realistic conditions. Please also enquire here about the testing possibilities of the manufacturer.
- Make sure that the supplier implements a 100% final inspection, including the automated storage of all test data. For gapless traceability, the brakes must also be labelled with a unique serial number.
- Check the response times of the brake (attraction/drop-out). You can only achieve short, reliable stopping distances using a quick brake and constant switching times throughout the service lifetime.
- Rely on a supplier with a wide standard product range. A large selection of rotatory and linear brakes based on different functional principles (electromagnetic, pneumatic or hydraulically released) provides flexibility for many different applications. Furthermore, you will be able to obtain complete solutions from a single source here.
- Rely on manufacturers with development, production and application experience, a rapid global on-site service (especially if you market your machines globally) and competent consultancy. Ask for a consultation to see the differences.
- Take the time to view the production facilities of the supplier, especially in case of important purchases.

You can convince yourself what is really going on behind the scenes during a visit to the plant.

Company portrait

The family-run company Mayr power transmission, which was founded in 1897, is a leading manufacturer of safety brakes, torque limiters and shaft couplings. These products are primarily designed for application in electrically driven machines and systems. They can be found, amongst other things, in filling plants, machine tools, packaging and printing machines as well as in elevators, wind power plants and in the stage technology. The company is active in over 60 branches worldwide. Currently, approximately 700 employees work at the headquarters in Mauerstetten, in the Allgäu region. Worldwide, Mayr power transmission has more than 1200 employees. With production plants in Poland and China, sales subsidiaries in the USA, in France, Great Britain, Italy, Singapore and in Switzerland as well as 40 additional foreign representatives, the company is active around the globe.