SAFETY – THE RISK WITH VERTICAL AXES

Efficient and effective risk management for vertical axes:

Monitoring and controlling brakes through on-drive functional safety technology

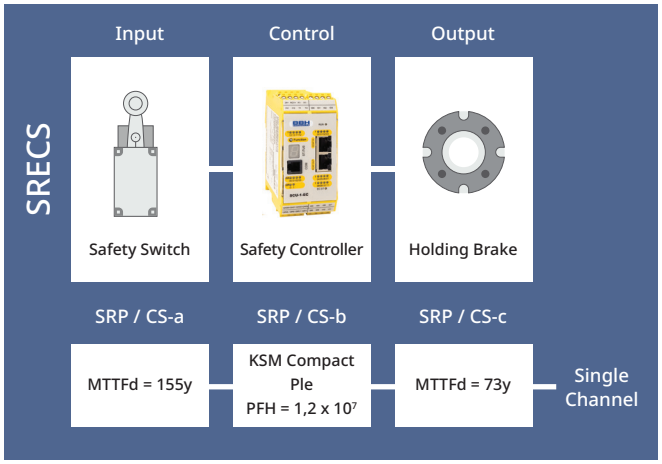
KOLLMORGEN

When machine motion has to work against the force of gravity, you need to address multiple operational challenges to ensure the safety of products, processes and people.

Traditional solutions for safe brake control can become problematic when implementing the newest safety standards. For example, motor brakes must be tested periodically to ensure proper functionality. Under the requirements of safety standard ISO 13849-1, however, the test function cannot be embedded into standard machine controls. Given this restriction, what options are available? AKD2G servo drives from Kollmorgen offer integrated SafeMotion™ safety functions, including Safe Brake Control (SBC) and Safe Brake Test (SBT). These safety functions, implemented independently of the machine controller, can help you remain compliant with regulations while maintaining the efficiency of your production line.

Built-in SBC and SBT make AKD2G drives particularly useful for improving the operational design of machines that incorporate vertical axes while ensuring compliance with safety standards.

To drive efficiency in production environments and meet market demands, there is an increasing need for plant automation—whether for setup operations, assembly or maintenance—while maintaining the safety of employees who work in close proximity to machines. With collaborative production becoming more prevalent, applications incorporating on-drive SBC and SBT will prove to be increasingly useful—particularly when the use of redundant dual-channel safety brakes is deemed too complicated or too expensive.



The challenge with single-channel brake is no redundancy and complex calculation of the safety level in accordance with ISO13849. AKD2G with SBC and SBT allows for increased safety without the need to employ a dual-channel brake.

SAFE BRAKE MONITORING

For vertical loads, the general principle is that the holding brake must be designed to safely hold the maximum anticipated load. Two implementation requirements follow from this principle: (1) adequate sizing for the holding brake with a torque surplus of 30% in relation the maximum load, and (2) secure identification of faults or errors that result if the specified braking torque is not achieved. In the second case, operators can no longer be guaranteed protection, as the risk increases that loads may fall.

Kollmorgen enables users to test their brakes and safely identify any braking errors or faults using integrated SBT, an effective safety function for servo drives in the S700 series and the AKD2G series.

AKD2G servo drive with Safe Brake Control (SBC) and integrated Safe Brake Test (SBT) function.

The SBT safety function is responsible for carrying out regular tests on the spring-applied brakes installed in the servo motors of Kollmorgen's AKM and AKM2G series. The required braking torque derived from the application is reviewed automatically by the safety technology in the drive controller at regular intervals, thereby ensuring safe functionality.

TEST ROUTINES FROM THE DRIVE

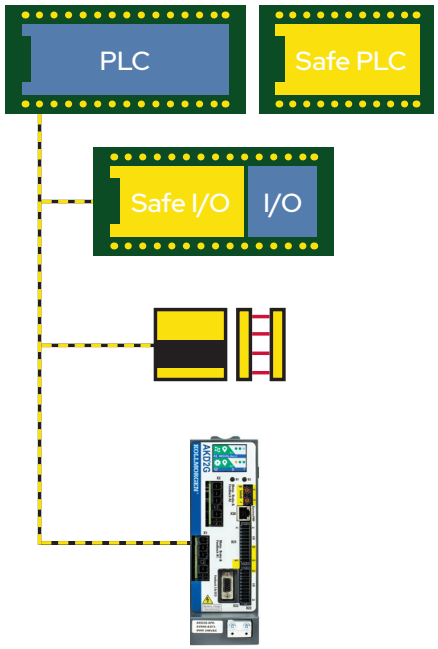
There can be multiple root causes for the loss of nominal braking torque in a spring-applied brake, such as glazed or worn friction pads, oil residues or broken springs. The spring-applied brake can no longer achieve its full braking torque if springs crack or fracture as a result of material fatigue. As it can be assumed that not all springs will fail at the same time, the decrease in the braking torque will occur gradually—a process that can be monitored using SBT. These tests should be carried out at least once per shift depending on the risk assessment for an application.

Since torque needs to be applied for SBT, integrating this safety test function into the drive controller is the only option, as the controllers have to produce this torque. Similar test functions carried out previously by system PLCs are problematic under current standards. ISO 13849 is particularly relevant here. This standard stipulates that the parameters for the brake test must be configured safely. However, because an external Safety PLC is unable to apply torque, integrating SBT into Kollmorgen servo drives is an elegant solution for reaching the required performance levels in conjunction with SBC.

Kollmorgen is bringing additional safety functionality to the drive level during ongoing operation with SBC. This can be conveniently configured via the WorkBench graphic user interface without requiring any additional application software for the safety technology.

SIMPLIFIED DESIGN FOR SAFETY TECHNOLOGY

Since safe motion guidance also logically requires secure communication, AKD2G servo drives use the safety protocol FSoE (FailSafe over EtherCAT®). This allows safety technology communications to be incorporated into the machine's existing real-time communication. No additional wiring or I/O modules are required for SafeMotion™ functions. Advantages include space savings of almost 15% in the control cabinet and up to 20% cost savings in the reduction of safety components and wiring. Machine uptime also increases since the reduction of components and cables are known to improve system reliability and Overall Equipment Effectiveness (OEE).



AKD2G servo drive SafeMotion™ functions provide secure real-time communication via safety protocol FSoE. No additional wiring or I/O modules required resulting in control cabinet space savings and improved Overall Equipment Effectiveness (OEE).

Kollmorgen supplements this simplified approach to implementing drive-based safety solutions for vertical loads with safe power reduction for the motor brake. This is made possible by a magnetic coil used to raise a spring-applied brake. It is worth reducing the power accordingly since a higher level of power is required to raise the brake than is required for maintaining a raised state. Two benefits of this approach are that energy consumption is reduced during machine operation and the amount of heat dispersed inside the motor is reduced while motor output increases.

THE BOTTOM LINE

The original task for spring-applied brakes in servo motors involves holding loads or taking hold directly during an emergency stop. These components are not safety components by design and do not therefore have their own PL or PFH values. Ensuring that the drive controllers are able to control the spring-applied brakes safely and monitor these means that safety level SIL2/PLd can be achieved simply and cost-effectively. With a second redundant brake, it is possible to achieve a safety level up to SIL3/ PLe.

$$MTTF_d = \frac{B_{10d\ Relay}}{0{,}1 \bullet n_{op}}$$

Rating of $MTTF_d$	Range of $MTTF_d$
Low	3 Years < $MTTF_d$ < 10 Years
Medium	10 Years < $MTTF_d$ < 30 Years
High	30 Years < $MTTF_d$ < 100 Years

These spring-applied brakes are not safety components by design and do not therefore have their own PL or PFH values: instead these have to be calculated via the reliability parameter B10d.

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