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In addition to safety, key aspects for guards are efficiency, economy and digitalisation

Safety gate management 4.0

Ostfildern, September 2021 – **Few barriers between human and machine would be the desired position. But in many applications, the required safety must be guaranteed using movable guards – while always keeping an eye on production efficiency. Safety gates as an automation solution, including management of access permissions (via a "digital keyring"), represent safety concepts that offer both: protection and efficiency.**

But what does "required safety" mean? As a first step, users should weigh up the protection or safety gate monitoring they actually need: that's because there are a variety of solution approaches available, both for safeguarding an accessible safety gate and for monitoring maintenance flaps – i.e. non-accessible gates – for example.

For users, against tampering

Whichever safety solution you use, however, it must be accepted by users, otherwise tampering is inevitable. User friendliness is limited unnecessarily if safety is oversized. It's exactly this issue of "Defeating safeguards" that's a key aspect of EN ISO 14119. The standard defines guiding principles for the design and selection of safety gate systems and so offers practical guidance on how to prevent tampering. It divides interlocking devices into categories, distinguishing between four types. There are types 1 and 3,

"Interlocking devices with uncoded actuator", for which additional protective measures against tampering are required, and there are also types 2 and 4, "Interlocking devices with coded actuator", which are used most frequently. Mechanically operated position switches belong to type 2. A coded actuator is a specially designed actuating element that belongs to an assigned switch. Type 4 devices include coded magnetic sensors or sensors with RFID technology.

Coordinating safety components and solution

The excerpt from the standard already makes it clear: the issue of “preventing tampering” is closely connected to the respective application situation. And these are manifold. Much thought must therefore be given to the type of monitoring and switch type that's appropriate for the specific situation or safety gate type – swing and sliding doors, covers, flaps or rolling doors. Additional criteria concerning the actual installation situation must also be taken into account; whether space is critical, for example, or whether installation must be concealed or out of reach. Or whether environmental conditions are particularly rugged. Economic efficiency must also be considered, of course.

Dimension of protection: the basis

When the keyword is “economic efficiency”, “simple” safety switches are what come to mind. Generally speaking, these are always an adequate solution when guard locking isn't necessary to achieve the required safety for human and machine. In other words, when machines don't have a dangerous overrun and where basic protection is enough to guarantee sufficient safety.

These “simple” devices can already master many of the application requirements “without guard locking” and can be used to monitor

the most diverse types of safety gates, without incurring unnecessarily high costs. Various operating principles are available for selection, such as mechanical, non-contact magnetic or non-contact (fully) coded safety switches.
Users can also select “their” dimension of protection in the Pilz PSEN sensor technology portfolio: if both human and process are to be protected, then mechanical safety switches PSENmech are suitable. However, additional measures must be considered during installation (positioning out of reach, concealed or screened). If maximum safety is to be combined with absolute economy, however, then non-contact magnetic safety switches PSENmag or PSENcode come into the frame, as they can also be concealed – and can monitor the position of the guard as well as covering general position monitoring.

Hazardous overrun requires greater protective measures
ISO 14119 also specifies: an interlocking device must stop the hazardous machine movement immediately when the safeguard is opened and also prevent a restart as long as the safeguard is open. The question then is: when does an interlocking device with guard locking need to be considered? Whenever there is still danger from the machine after the stop command, i.e. when there is an overrun, when machines have rotating knives or flywheels, for example, and on robots. The safeguard is not unlocked until the machine is in a safe state or has completely stopped – the safety gate cannot be opened until the machine no longer presents a danger.

So whenever the machine still presents a danger after the stop command, i.e. the machine still overruns, interlocking devices with guard locking come into consideration and safety guard locking devices or even modular safety gate systems come into the frame. The latter enable a tailor-made solution. What's more, with the

appropriate expansions they combine the requirements of safety and industrial security in equal measure, offering an adequate solution, particularly when the issue of access permission is to be considered – keyword: digital key or even keyring.

When process protection, when personnel protection?

Depending on the application, there are different operating principles that can be used with respect to safe guard locking. The fundamental question here is: Are operating personnel to be protected in addition to the process? The distinction is made between conditional unlocking (personnel protection) and unconditional unlocking (process protection). For pure process protection (i.e. preventing unintended interruption of the production sequence), guard locking in accordance with the open-circuit current principle is sufficient, for example. Guard locking is held in place by a magnet – the magnet is deactivated again for unlocking. This is an operating principle offered by the non-contact safety gate system PSENslock from Pilz, for example. It combines safety gate monitoring with an integrated electromagnet and thus offers safe position monitoring with process guard locking in a single system.

Access calls for additional protection

If operators are required to access a machine or are able to access it, and at the same time hazardous overrun movements are still an issue, then personnel protection must be considered in addition to process protection. This is where safe guard locking in accordance with EN ISO 13849-1 is required. Selection of the appropriate interlocking device is then based on the performance level (PL) determined by the risk analysis. In this case, safe guard locking can be achieved by means of the closed-circuit current principle. In contrast to the open-circuit current principle, a spring is used to

activate guard locking, while a solenoid coil is used to open the guard locking. The mechanical safety gate system PSENmech from Pilz enables this type of safe guard locking up to PL c; up to PL d with fault exclusion. These new electromechanical safety gate switches provide guard locking on the safety gate until the hazardous production process has ended and the plant or machine is stopped safely.

Alongside the closed-circuit current principle, it is the bistable principle that equally ensures safe guard locking. This dual-channel operation of the guard locking only locks or unlocks when both channels have switched safely. It also detects faults such as short circuit, which cause the OSSD outputs (output signal switching device) to shut down, but prevents the gate being opened unintentionally, even in the event of a fault. At Pilz, this principle is implemented with the safety gate system PSENmlock, which can provide safe interlocking and safe guard locking up to PL e on the basis of this technology.
In conjunction with a controller such as the configurable small controller PNOZmulti 2 from Pilz, the result is a complete safety gate solution, including comprehensive evaluation options.

Industrial security holds the key for safety
In contrast to safety switches, modular safety gate systems not only allow tailor-made solutions but, with the appropriate expansions, also combine safety and industrial security. Such a "building block for safety gate guarding" offers flexibility and decentralised intelligence for safeguarding a wide range of applications. These systems combine sensors, escape release and handles, as well as control and pushbutton units. The necessary components can be

assembled to form an individual solution to suit the relevant application.
Such systems also offer added safety when they integrate access permission. They prevent safety measures from being defeated to (supposedly) make the work easier. Essentially these are intuitive operator systems that come into play here. Modules for access permission are integrated into modern safety gate systems to ensure that only authorised persons gain access to the application, i.e. safety gate monitoring and access control are combined, with industrial security included. As an example, the modular safety gate system from Pilz is operated via a pushbutton unit: the pushbutton unit PITgatebox is available in various pre-configured versions with combinations of pushbuttons, key switches and E-STOP pushbuttons. Also, there is an option for the reader unit for permission management to be already integrated into the control unit. Users receive their individual permission on a coded RFID key and use this to authenticate themselves on the safety gate: in the Pilz system, the key is read in the reader unit PITreader; access is enabled if the appropriate permission is present. It’s possible to ensure that only authorised persons have access to the plant, based on the qualifications and functions of the relevant personnel. Commands such as machine stop, unlock, lock or reset the machine can be controlled following successful authentication. That protects the machine from misuse or tampering and prevents unwanted downtimes.

Managing permissions centrally and efficiently

Together with the configurable safe small controller PNOZmulti 2, also from Pilz, the result is a complete solution that extends beyond safety gate monitoring. In combination with PITreader it implements efficient permission management: users can configure access

permissions for plant and machinery simply via “drag and drop”, using the corresponding software PNOZmulti Configurator. Complex, hierarchical permission matrices can also be configured in the free user area. Staff members who are permitted access to the plant or machine because of their job or qualifications are identified. Depending on the size of the company it may also be sensible to implement group-based permission management. In this case, the various enables are assigned not to individuals but to whole groups with the same access rights. At the same time, access rights for a machine type used company-wide, for example, can be recorded and assigned centrally. All permission matrices are transferred to the RFID keys using the reader unit PITreader.
This simplifies the assignment and administration of access permissions and therefore safety gate management, particularly for companies with multiple sites.

Conclusion: modular safety gate systems lend themselves to complete gate applications. With comprehensive systems such as these, applications can be implemented flexibly and individually by combining individual components. If these modular systems also combine safety gate monitoring with access control, the result will be individual safety gate solutions, which efficiently manage access to the machine.

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Figures

Fig. 1:
F_Press_Group_4_safety_gate_systems_B8_2_cold_2020_04 (© Pilz GmbH & Co. KG)

CAPTION: Pilz offers safety gate systems for guard protection, which stop the hazardous movement in accordance with EN ISO 14119 and prevent a restart, safe from tampering and defeat.

Fig. 2:
F_Press_Group_PSEN_ml_DHM_6O000006_PSEN_ml_570401_P1_B8_2_cold_2020_04 (© Pilz GmbH & Co. KG)

CAPTION: Safe, complete solutions for gates: with PSENmlock and the PSENmlock handle module with integrated escape release, the latest addition to the modular safety gate system from Pilz, both people and plants are safely protected.

Fig. 3:
F_Press_Group_7_Modular_safety_gate_system_with_diagnostic_and_evaluation_P1_B8_2_cold_v0 (© Pilz GmbH & Co. KG)

CAPTION: The flexible combination of the safety gate system PSENmlock, appropriate handle module, pushbutton unit PITgatebox, configurable safe small controller PNOZmulti 2 and diagnostic solution Safety Device Diagnostics offers a complete safety gate solution with access permission:

Fig. 4: F_Press_group_PITgb_G1000020_G1000021_B8_2_cold_2020_05_v0 (© Pilz GmbH & Co. KG)

CAPTION: the pushbutton unit PITgatebox is available in various pre-configured versions with combinations of pushbuttons, key switches and E-STOP pushbuttons. Also, there is an option for the reader unit for permission management to be already integrated into the control unit.

Fig. 5:
F_Press_Group_6PSENmag_with_steel_version_B8_2_cold_2018_01_v1(© Pilz GmbH & Co. KG)

CAPTION: If maximum safety is to be combined with unconditional economy, then non-contact magnetic safety switches PSENmag come into the frame as they can also be concealed and can monitor the position of the guard as well as covering general position monitoring.

Fig. 6: F_Group_3_PSENcode_B8_2_cold_2013_02_v0 (© Pilz GmbH & Co. KG)

CAPTION: Coded, non-contact safety switches PSENcode from Pilz can be used to monitor the position of guards as well as for general position monitoring, offering maximum protection against tampering in the smallest space.

Fig. 7:
F_Press_Group_PSEN_me5_mechanical_safety_switch_6L000018_PSEN_me5_actuator_6L000001_B8_2_cold_2_v0 (© Pilz GmbH & Co. KG)

CAPTION: Whether safety gate monitoring with or without guard locking, with PSENmech from Pilz, both are feasible: as a mechanical safety switch, it enables pure interlocking of the safety gate; as a mechanical safety gate system it has added guard locking.

Box

A modular safety gate system: smart diagnostics included

As a modular safety gate solution with access control, the safety gate system provides sensors, escape release, handles, a diagnostic system and a pushbutton unit with optional integrated access permission system as well as an appropriate evaluation device. Users benefit from rapid assembly and installation. All modules in the safety gate system can be assembled individually, providing flexible safeguarding for accessible gates. Together with the configurable safe small controller PNOZmulti 2 from Pilz, the result is a safe complete solution for safety gate monitoring. Combined with the diagnostic solution Safety Device Diagnostics (SDD), comprehensive diagnostics and status information are available to enable rapid troubleshooting, thereby reducing

downtimes. SDD also enables safe series connection and, at the same time, targeted control of individual sensors.

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Figures for box:

Fig. : F_Group_5_PSEN_SDD_ETH_PSEN_cs6_cs5_PMI_B8_2_cold_2016_05 **(**© Pilz GmbH & Co. KG)

CAPTION: With the diagnostic solution Safety Device Diagnostics, it is possible to call up advanced diagnostic data from Pilz safety devices. That increases the availability of plant and machinery and reduces downtimes – including with remote maintenance via web server.

Pilz Group

The Pilz Group is a global supplier of products, systems and services for automation technology. The family business is based in Ostfildern and employs around 2,500 staff. With 42 subsidiaries and branches, Pilz creates worldwide safety for human, machine and the environment. The technology leader provides complete automation solutions comprising sensor, control and drive technology – including systems for industrial communication, diagnostics and visualisation. An international range of services with consultancy, engineering and training completes the portfolio. Pilz solutions are used in many industries beyond mechanical engineering, such as logistics, railway technology or the robotics sector.

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