

Which safety locking device for which application?

Safe gate management

Ostfildern, November 2024 – **Plant and machinery must always be safe for people. Regardless of whether you are an operator, maintenance personnel or bystander. People are often protected by fences, i.e. a guard. However, such protective measures only make sense during the machine's operating phase. During material feed, setup or even maintenance, people come into direct contact with danger zones. This is why, in many industrial applications or production halls, it is necessary to guarantee the required level of safety by using "movable" guards – i.e. different types of safety gates. However, the safety gate must do more than guarantee the necessary safety. It must also excel in terms of production efficiency.**

For those responsible for production safety, this poses the question as to what type of guard, and which safety locking device, is really needed. In actual fact, it is the application that determines which is the right type of safety gate. The standard EN ISO 14119 "Safety of machinery – Interlocking devices associated with guards – Principles for design and selection" shows the way: it closely links the issue of safety with the very diverse range of applications. The issue of "Defeating safeguards" is also a key aspect of the standard. Not only does it define guiding principles for the design and selection of safety gate systems, but it also offers practical guidance on how to prevent manipulation.

Putting a stop to manipulation

When implementing protective measures, it is important to ensure ease of handling and usability for users at the company to prevent manipulation. For machine builders, this applies already in the development process. Intuitive operating systems that are easy for

users to handle prevent workers from bypassing safety precautions or operating machinery incorrectly. A well-considered safety system also contributes to efficient procedures without unnecessary downtimes.

That is why it is important to think carefully about the type of safety gate that is suitable – swing and sliding doors, covers, flaps or rolling doors. The type of monitoring, the switch type and the appropriate safety locking device for the safety gate must also be considered, depending on the application. After all: there is no such thing as a standard solution for safety.

Diverse criteria for safe guard locking

An essential criterion for an appropriate safety gate solution is the installation situation itself: e.g. concealed installation or the situation regarding space. Safety locking devices like the Pilz PSENmlock mini safety switch with guard locking are suitable for space-critical situations. It has a compact design, for example. With its compact design of just 30x30x159 mm, you'll always find space for this safety locking device. It can be installed inside or outside the safeguard, while the flexible actuator can be attached from the right, left and front – to suit the application. A space-saving version like this makes sense particularly on smaller swing gates and sliding gates, as well as covers and flaps.

Considering environmental conditions too

It's also important to consider whether particularly harsh environmental conditions prevail, such as dust in the form of wood chips, or even water. In this case, a guard locking device such as the safety locking device PSENslock 2 from Pilz is required, which has a more hygienic design and is available with stainless steel elements. It can be used to implement secure safety gate

monitoring with process guarding even in robust environmental conditions, as it meets protection type IP 67 / IP 6K9K. With this guard locking device, the latching force, i.e. the force that connects a safety switch to the actuator, can be set individually using an RFID tag. In this way, safety can be implemented precisely to suit the respective machine. Like the safety locking device PSENSlock 2, the compact RFID safety switch PSENmlock mini with protection type IP67 also offers a high level of manipulation protection in accordance with EN ISO 14119: the coding is freely selectable – coded, fully coded or uniquely coded. An auxiliary release is integrated on two sides.

When is “just” interlocking enough, when do you add guard locking?

If safety is implemented via an interlocking device, for example, then it must prevent a machine’s hazardous movement for as long as the movable guard – such as a safety gate – is open. In practical terms: the hazardous machine movement must stop immediately when the safeguard is opened, and a restart must also be prevented for as long as the safety gate is open.

It is a different situation if the machine can still pose a danger after the stop command. In this case, interlocking devices with guard locking monitoring protect the user. This relates to machines that still overrun, such as robot applications. Here, the guard may not be unlocked until the machine is in a safe state and has completely stopped.

The question regarding the type of guard locking also depends on the stopping time. If the time to reach the danger zone is longer than the stopping time, process guarding is sufficient. If the intervention time is shorter than the stopping time, however, safe guard locking –

also called personnel protection – is required. For 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 via a magnet – the magnet is deactivated again for unlocking. This is an operating principle offered by the electromagnetic safety locking device PSENslock 2 from Pilz, for example. It combines safety gate monitoring with an integrated electromagnet and therefore offers safe position monitoring with process guarding in a single system.

The appropriate safeguard for each safety level

A different situation arises when there are dangerous overrun movements, which could injure operating personnel. Personnel protection must be taken into account in addition to process protection: selection of the right safeguard for both process protection and personnel protection is made on the basis of the performance level (PL) in accordance EN ISO 13849-1, as 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 locking device PSENmech from Pilz, for example, enables this type of safe guard locking up to PL c, and with fault exclusion also up to PL d. These electromechanical safety switches provide guard locking on the safety gate until the hazardous production process has ended and the plant or machine is stopped safely.

Principles that ensure safety

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 or shorts across contacts, 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. Dual-channel operation of the solenoid and the bistable guard locking principle guarantee a high level of safety in the event of a power failure: because the last state is retained and the gate remains closed. At Pilz, this principle is implemented using the safety locking devices PSENmlock and PSENmlock mini, which can implement safe interlocking and safe guard locking up to PL e or PL d on the basis of this technology. The safety switch PSENmlock mini manages safeguards such as flaps and covers with a holding force FZH of 1950 N (F1max: 3900 N). So this “small” safety locking device reliably safeguards even higher forces.

Productivity benefits thanks to smart diagnostics

If a diagnostic solution such as Safety Device Diagnostics (SDD) from Pilz is also used, then extensive diagnostic information (e.g. device properties such as the article number, product version and serial number) and status information (e.g. the status of the safety sensors and the state of their inputs and outputs) can be implemented. SDD can also be beneficial for a safe series connection: it enables targeted control of individual sensors. In other words, you can define exactly which gates are allowed to be unlocked and opened after switching off, if a plant is to undergo maintenance work, for example. Otherwise, all safety gates connected in series would open at once if the unlock function were requested! This could become a safety issue because a person might enter the danger area unnoticed via another safeguard. The compact safety locking device PSENmlock mini from Pilz, for example, provides such smart diagnostics: PSENmlock mini can be connected in series up to PL d, Cat. 3. This not only enables

comprehensive diagnostics, but also minimises wiring and simplifies commissioning.

Systematic safety gate guarding

Users always benefit when they use complete systems for safety gate guarding: when classic “safe guard locking” is combined with the “functions of control elements”, that's the state of the art. At Pilz, the safety gate system PSEnmgate combines the classic safety locking device PSEnmlck with the control elements of the pushbutton unit PITgatebox in one compact, complete solution. The core competency "safe guard locking" protects the process and the operator on accessible safety gates as well as covers and flaps, on enclosed robot applications for example. The compact safety gate system guarantees safe interlocking and safe guard locking up to the highest category PL e, Cat. 4. Several safety gates can be connected in series. As a “control element” it provides various pushbuttons and illuminated buttons as well as E-STOP pushbuttons and an escape release. What's more, users can choose the appropriate handle from a range of options. By combining guard locking and control elements you can open up a wide range of configuration options for different applications. PSEnmgate safeguards a wide variety of plant or machinery: machine builders and operators benefit because they can design their machines more flexibly.

Conclusion: The actual application takes the lead; taking into account important criteria such as manipulation prevention and the installation situation; ultimately, the sum of the specifications results in the appropriate safety gate solution, which offers the user the appropriate protection. When it comes to protecting human and machine, the rule of thumb must be this: the more dangerous the situation behind a safety gate, the more secure the guard protection or monitoring must be!

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Digital maintenance safeguarding system “Key-in-pocket”

With “Key-in-pocket”, Pilz offers an efficient digital maintenance safeguarding system. The solution consists of the access permission system PITreader, pushbutton unit PITgatebox and a Pilz controller such as the configurable small controller PNOZmulti 2 or automation system PSS 4000. This ensures that the machine does not restart while maintenance work is being carried out and that unauthorised persons do not gain access. In practice it works as follows: one or more users authorised for maintenance work authenticate themselves on the plant. After successful authentication, a personalised security ID is stored for each user in the Pilz controller, in a safe list. The machine can now be shut down, the safety gate opened and the machine accessed. During this time, the RFID keys remain with the respective users “in their pocket”. Once maintenance is complete and people have left the danger zone, everyone signs out. The security IDs are removed from the safe list on the Pilz controller and the machine can be restarted. In contrast to maintenance safeguarding with mechanical keys, it is possible to enter or exit the plant at any safety gate. In this way, “Key-in-pocket” offers personnel more flexibility and saves time during maintenance. Digital maintenance safeguarding is specifically designed for machines with danger zones that are protected via safety fences. At all times, the operator knows who

has access for which task; temporary permissions can also be assigned.

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Fig. “Key-in-pocket” box:

F_Press_Group_PIT_Key_in_pocket_solutions_P1_B8_2_cold.jpg (© Pilz GmbH & Co. KG)



Caption: The maintenance safeguarding system “Key-in-pocket” consists of the access permission system PITreader, pushbutton unit PITgatebox and a Pilz controller such as the configurable small controller PNOZmulti 2 or automation system PSS 4000.

Illustrations for the main text

Fig. 1:

F_Press_Group_4_PSEnslock2_6N000025_6N000001_6N000027_6N000005_P1_B8_2_cold (© Pilz GmbH & Co. KG)



Caption: Both individually and in series, the safety locking device PSENslock 2 from Pilz can be used universally to safeguard safety gates, and is designed for use up to the highest category PL e, Cat. 4 of EN ISO 13849.

Fig. 2:

F_Press_Group_2_PSEnmlock_mini_6K000009_PSEnmlock_570400_P1_B8_2_cold.jpg (©Pilz GmbH & Co. KG)



Caption: With its compact design of just 30x30x159 mm – 60 per cent smaller than the “large” PSENmlock – you’ll always find space for the safety locking device PSENmlock mini from Pilz, even in space-critical applications.

Fig. 3:

F_Press_Group_3PSENmgate_and_5PSENml_P1_B8_2_cold1 (© Pilz GmbH & Co. KG)



Caption: The safety gate system PSENmgate combines the classic safety locking device PSENmlock and the pushbutton unit PITgatebox from Pilz in a compact solution. Overall, PSENmgate saves important space on the machine, and offers a high degree of flexibility through a wide range of configuration options.

Fig. 4:
F_Press_Group_7_Modular_safety_gate_system_with_diagnostic_
and_evaluation_P1_B8_2_cold.jpg (© Pilz GmbH & Co. KG)



Caption: Pilz offers a wide selection of safety locking devices with appropriate door handles, control elements such as the pushbutton unit PITgatebox with integrated access permission system PITreader (top right), as well as the appropriate safety controllers such as the configurable small controller PNOZmulti 2 (bottom right) and the diagnostic solution Safety Device Diagnostics (bottom left), for a complete safety gate solution with access permission.

Pilz Group

Pilz is a global supplier of products, systems and services for automation technology. As a pioneer of safe automation, Pilz creates safety for human, machine and environment. Founded in 1948, today the family business with its head office in Ostfildern is represented worldwide with 2500 employees in 42 subsidiaries and branches.

The technology leader offers complete automation solutions for Safety and Industrial Security on the machine. These include sensor, control and drive technology – as well as systems for industrial communication, diagnostics and visualisation. An international range of services with consulting, engineering and training completes the portfolio. Pilz solutions are used in many industries beyond mechanical engineering, such as intralogistics, packaging, railway technology, or the robotics sector for example.

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