SICK AG WHITEPAPER

SAFETY LASER SCANNERS VS. SAFETY MATS – WHICH ONE DO I CHOOSE?

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ABSTRACT

Since 1990, safety mats are facing an increasing competition from safety laser scanners. Because the price for safety laser scanners is continuously decreasing, the user might face the decision whether to replace his safety mat with a safety laser scanner. This paper aims to explain the functions and advantages of safety laser scanners.

The main advantages are the highly reduced replacement costs through the non-contact functionality and the principle of the configuration memory in the system plug of the scanner. Moreover the safety laser scanner can be easily adjusted to the machine design thanks to the configurable fields. Further advantages are the upstreamed warning fields which reduce the machine down time significantly by warning an approaching person before the machine needs to be stopped for reasons of safety. Besides these advantages, however, the limitation of the scanner technology is also explained.

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Safety Laser Scanners vs. Safety Mats – Which One Do I Choose?

For over half a century, safety mats have been used in virtually every industry as the standard form of area protection in the plant environment. For an old technology safety mats have proven quite resilient.

Typically, safety mats operate using an open switch. When a specified minimum weight is brought to bear on the safety mat, the switch closes. This sends a signal to the mat controller that subsequently sends a safe stop signal to the machine being guarded by the mat, stopping its operation. The worker that accidentally came too close to the hazardous area and stepped on the mat is safe. However, safety mats are subject to physical wear, both environmental and operational. This is so, as to perform their designed function there must be a direct contact.

Since the introduction of safety mats in the 1950s, a host of new technologies have emerged for safety applications, including safety laser scanners in the 1990s. Initially, the argument for safety mats has been that scanners are four times the cost. But now, the initial price point of safety laser scanners has fallen significantly; when total cost-of-ownership is considered, the overall ROI for safety laser scanners is significantly better than safety mats. If you have to replace a safety mat once or twice, you've exceeded the cost of a safety scanner; this doesn't even factor the higher productivity scanners enable. These latter factors are the principal reasons laser scanners have largely supplanted safety mats in the European Union.

Fig. 1 The Safety Laser Scanner S300 Mini

A Closer Look at Scanner Technology

State-of-the-art safety laser scanners use time-of-flight technology. A pulsed laser beam is emitted and reflected if it meets an object. The scanner's receiver registers the reflection. The time between transmission and reception of the impulse is directly proportional to the distance between the scanner and the object. This method represents time-of-flight technology that is best in its class. An internal rotating mirror deflects the pulsed laser beam so that a fan-shaped scan is made of the surrounding area. The position of the target object is determined from the sequence of impulses received. The measurement data is also made available in real time for evaluation via a data interface.

Fig. 2 Typical area guarding at a rotary table

Safety laser scanners define protective and warning fields, also referred to as zones or areas. These zones are freely programmable (with configuration access rights) and can be changed easily. When an object enters the protective field, a safety stop can be initiated to safely stop the hazardous motion of the machine. Once an object is detected in the defined warning field, the scanner initiates a warning output signal (an audible or visible indicator) that can be used to notify someone in the area that they are entering an area where there are potential hazards.

Powerful Advantages

Safety laser scanners provide a number of key advantages over safety mats:

- Non-contact functionality
- Easy replacement
- Adjustability
- Warning field protection

Non-contact functionality

One of the biggest issues with safety mats is that they stop working, either because people repeatedly step on them (after all, that's what they're designed to do) or because tools, products, lubricants, vehicles e.g. fork trucks, or other environmental "hazards" come into contact with them. This causes downtime and increases the frequency of replacement.

Fig. 3 Safety mats are exposed to continuous wear

In contrast, safety laser scanners function without needing physical object contact by providing protection through infrared lasers.

If a mat fails because of physical contact, a machine will likely have to be shut down, depending on a company's internal processes and procedures regarding safeguarding. This shut down will remain in effect until the safety mat is replaced by one in stock or another is shipped and mounted. This process takes time and disrupts production, in addition to incurring capital costs. Laser safety scanners are not subject to this risk.

Easy replacement

If a safety laser scanner is damaged, it is still quick and easy to replace. Most types consist of a scanner head and a system plug with an integrated memory plug — basically, a memory module, which contains the configuration of the scanner and all settings, including the field dimensions. If a safety laser scanner is damaged only the scanner head needs to be replaced. The system plug is permanently mounted on the machine. This is important, since this prevents the loading of an incorrect configuration into the device. The new scanner head will be attached to the system plug. This will immediately download the configuration from the system plug and assume the safety tasks of its predecessor. From a replacement perspective, there's no fudging or re-programming. It is a simple plug-and-play principle, which reduces machine downtimes to a minimum.

Also most types of safety mats have multiple parts: the mat and a control box. If a safety mat needs to be replaced, sometimes the control box will need to be changed, too. This is the case, when the machine operator buys new safety mats, and there has been a change in version, there may be an incompatibility problem with some control boxes.

Because safety mats are not "one-size fits all", mats also present stocking issues. For example, if a manufacturer has 20 machines, he might have to stock various sizes of mats for the different machines and floor plans.

Adjustability

Safety mats are often limited in use by their initial application. In manufacturing facilities, safety mats are purchased to cover specific machines: for example, one machine setup may require 4 x 4 m mats, while another uses 6 x 6 m mats. In other cases, such as when new machines are bought, an existing operation is moved into new facilities, or floor plans are adjusted within existing facilities. An original safety mat designed for a 4 x 4 m area may then no longer satisfy the requirement. A new safety mat must be purchased or a different one has to be secured from stock.

Fig. 4 Safety fields of scanners are freely adjusted to changing surroundings

Another problem with safety mats is the standardized rectangular shape. If other shapes are needed because of the structural design e.g. a column is in the hazardous area, a special form is needed. The special form causes not only additional costs, but increasing lead times may also occur.

On the other hand, with the safety laser scanner and its warning and protective fields, everything is freely programmable. Using the original scanner, a user can easily configure the fields to whatever size and shape needed for operations, however the environmental conditions change.

Warning field protection

The importance of the warning field is that it provides an indication – a warning – to persons moving through the area that they are getting too close to the machine, before the operation has to be stopped due to safety reasons. Like the protective field, the warning field is freely programmable. If the scanner senses somebody in the described warning field, it gives a discrete output, typically attached to a flashing light or some sort of horn.

Consider this alternative: a machine is running, producing parts. In a typical safety mat situation, you can see where the safety mat is if you are paying attention. If you are not paying attention—reading prints or watching the machine—and step on the mat, you will stop the machine.

From a company standpoint, production is lost for the time it takes to reset the machine. Depending on the machine, this can be a complicated process. This would not occur if a warning field has been activated, warning beforehand the unfortunate worker to not come any closer.

Fig. 5 Person infringes the fields of the scanner.

Limitations of the Scanner Technology

Despite the powerful advantages of safety laser scanners, limitations of the scanner technology exist due to their non-contact functionality. Although the safety laser scanner is designed for reliable operation in optically challenging environments, especially polluted environment can lead to availability problems. Leaking oil, grease or dust can cause the laser scanner to trip although there is no danger. In order to counteract this problem, the parameters of the scanner can be adjusted so that the device ignores these types of issues. But this works only with the simultaneous increase of the response time of the scanner.

However, this applies only for specific conditions. Normal operating conditions are never a problem for laser scanners – and therefore the basis for their worldwide distribution in modern industry.

Conclusion: A Smart Choice

There was a time when safety mats made sense, but safety laser scanners are relegating that period to history. By ensuring continuity of production at less cost over the life of a machine or facility, safety laser scanners have become the component of choice for machine safeguarding and other safety applications within the plant environment.

Maximum productivity and protection at minimum cost over time.

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