

Type 2 vs. Type 4 Light Curtains

As machinery safety standards and safety light curtains evolve to meet new application demands, users are faced with more choices and responsibilities than ever before.

A new breed of light curtain is gaining recognition in the United States. Developed in Europe and classified as “Type 2,” it is a lower-cost, reduced-capability alternative to the more robust “Type 4” high safety performance level light curtains typically used to safeguard machinery in the United States. The terms and definitions of the product “Type” are derived from the international standard for light curtains, IEC 61496. Understanding the capabilities and differences between these two types of machine safeguarding devices will help users determine which is right for their application.

Three Differences

In most instances, Type 2 and Type 4 safety light curtains *look* much the same. However, these photoelectric safeguards are designed to satisfy vastly different safety requirements. Essentially, Type 2 products are designed to a lower level of safety integrity and must not be used in applications where a Type 4 control is the appropriate choice. Although the differences are technical and based on various industry standards, these devices differ in three significant areas:

1. Fault Detection Circuits

Type 2 light curtains lack the redundant automatic self-checking circuits employed in Type 4 light curtains. As a result, the Type 2 light curtain does not meet the OSHA or ANSI standard for the highest safety performance level. Type 4 safety light curtains are designed to immediately detect the failure of a single component within a defined response time. This is not true of Type 2 light curtains.

2. Optical Angle

Traditional Type 4 safety light curtains have an effective optical angle of ± 2.5 degrees, while Type 2 devices have an

Application Examples – Type 2 or Type 4?

Determining when to use a Type 2 or Type 4 safety light curtain may best be demonstrated by reviewing a couple of examples. While it is essential to perform a complete risk assessment on all machines, the severity of the potential injury is the overriding factor when deciding between a Type 2 and Type 4 safety light curtain.

First, a pharmaceutical company’s packaging department uses index tables, conveyors, filling and labeling equipment and a multitude of moving parts.

In the assessment process, the user determined that the size and force of the motors used on the index table and conveyor was insufficient to cause serious injury. The worst-case injury was defined as a potential bruise requiring simple first aid.

In this application, a Type 2 light curtain is the light curtain of choice. It serves as an appropriate safeguarding device, while doubling as a process control device.

In our second example, the assembly department of a gas and pneumatic regulator manufacturer requires that an operator continuously interface with the assembly equipment. The workstation consists of a small pneumatic press and an automatic self-feeding screwdriver. The operator must insert a multitude of parts that need to be compressed while the driver inserts screws.

The worst-case injury would require off-site medical attention. In this application a Type 2 device is not an appropriate safeguarding choice, but rather a Type 4 light curtain is recommended.

effective optical angle of ± 5 degrees. The wider optical angle increases the possibility of reflective surface interference, where a reflective object near the sensing field of the light curtain causes an optical “short circuit.” As a result, an object in the sensing field may not be detected, as the light “bends” or reflects around the object. This possibility demands users take great care during installation and alignment to ensure proper operation of the Type 2 device. Fortunately, there are simple tests to detect this potential hazard. The tests must be performed during installation and periodically afterwards for any light curtain.

3. Price

The third difference is price. Type 2 devices are typically 15% to 30% less expensive when compared to an equivalent Type 4 device. The cost difference stems from the less precise optical angle and fewer fault detection circuits. In addition, Type 2 light curtains typically have fewer available features, such as exact channel select, floating blanking, MPCE (Machine Primary Control Element) monitoring and MTS (Machine Test Signal).

Safety Performance

The Occupational Health & Safety Act (OSHA) and the American National Standards Institute (ANSI) both require the highest level of safety performance for safety-related machine control systems when serious injuries can occur.

Examples of machines that require the highest safety performance level include machine tools, such as power presses, shears, press brakes, robots, etc.

A Type 4 safety light curtain employs self-checking circuitry to monitor itself for internal faults. If it detects an internal fault, the Type 4 safety light curtain immediately sends a stop signal to the guarded machine and the light curtain enters a *lockout* condition. Only after replacement of the failed component, and an appropriate system reset, will the Type 4 light curtain

and the guarded machine be restored to operating condition.

Because Type 2 light curtains lack the redundancy of internal fault detection circuits, they cannot achieve a sufficiently high safety performance level and therefore are not suitable as a safeguarding option on machinery where OSHA or ANSI requirements or risk assessments require control reliability. Remember also that a Type 2 light curtain is not protected against dangerous failures when exposed to extreme levels of electrical interference sometimes found in industrial environments.

Don't Roll the Dice — Perform a Risk Assessment

Conducting a thorough risk assessment requires the user follow a formal procedure that considers many factors when looking at machinery hazards. A risk assessment must be applied in a consistent manner across all plant machinery. This will enable the user to logically evaluate safety hazards and hazard-guarding solutions. The process considers all hazards and each type of safety hazard on a given machine.

The risk assessment analyzes each hazard and estimates the risk level by breaking it down into three components: Frequency of exposure, Probability of injury, and Severity of the potential injury.

An operator, for instance, typically has a high level of exposure, while someone performing maintenance does not. Probability considers machinery speed, and compares it to a person's typical reaction time - so a fast-cycling machine will have a higher probability of injury than one that is a relatively slow. The user must also estimate the type of potential injury in terms of severity, ranging from a simple pinch on the low end, to loss of a digit or even life at the other extreme.

Severity of injury should always dictate the assessed risk level. If the severity of potential injury is high, but exposure and probability are low, a Type 2 device is not an appropriate safeguarding option. Type 2 devices are not intended for use where ANSI B11.19, OSHA 1910.212 or 217 apply, and should never be used on a mechanical power press. Type 2 devices are not and cannot be made Control Reliable.

A Question of Interpretation

Because of these differences, Type 2 light curtains are intended for use in machine-guarding applications where the worst-case injury resulting from an accident may be remedied by simple first aid.

The social, legal and political cultures of Europe and the United States are distinct, resulting in different interpretations of “simple first aid.” These differing interpretations impact a user’s decision as to whether to apply a Type 2 or Type 4 device in a given application.

In Europe, first aid is measured, in part, on the amount of time an employee misses from work. For example, if a worker is injured and must go to the hospital for stitches or other medical procedures, yet returns to work the same day or the next day, it would be considered simple first aid.

In the U.S. these injuries would be considered much more serious due to the nature of the injury itself, lost machine and worker productivity (the “gawk” factor, lower employee morale, investigating the cause of the injury, etc.), required injury reports, preparing insurance claims and so on.

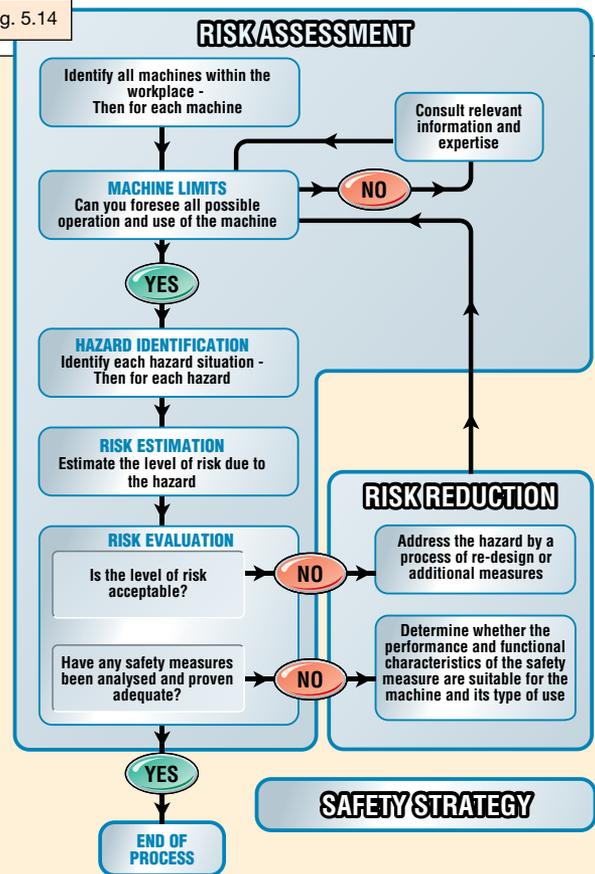
In the U.S., first aid is defined in OSHA 1904.12. as any one-time treatment, and any follow-up visit for the purpose of observation of minor scratches, cuts, burns, splinters, and so forth, which do not ordinarily require medical care. Such one-time treatments and follow-up visits are considered first aid, even though they are provided by a physician or registered professional personnel.

Based on the risk assessment results and the type of hazard, the user can work with a safety expert to determine the most appropriate machinery safeguards for each application.

Remember that a light curtain, whether Type 2 or Type 4, may not be right for every machine safety application. Other safety equipment, such as safety mats, safety switches, hard guards or a combination of equipment may offer the optimum solution.

Machine users should reference ANSI B11.TR3, ANSI/RIA R15.06-1999, and/or ISO 14121-1 prior to beginning their formal risk assessment. A comprehensive discussion of safety strategy and risk assessment, including formal procedure documentation, is available at www.sti.com/safety/index.htm.

Fig. 5.14



Application Considerations

Both Type 2 and Type 4 devices have a role to play in keeping workers and their machinery safe and productive. But it is important to review each application, and its potential for injury, when applying these, or any other machine safeguard.

Differences in safety performance demand that the decision to use a Type 2 or Type 4 safeguard be based on a thorough and complete risk assessment for each machine. Users must also consider the interpretation of an injury based on the type of first aid required and possibilities of infrequent exposure, as described in The

American National Standard for Industrial Robots and Robot Systems ANSI/RIA R15.06 and ANSI Technical Report for Machine Tools ANSI B11.TR3.

Type 2 light curtains offer an effective, low-cost safety solution in applications where a thorough and complete risk assessment determines that injuries can be remedied by simple first aid and require no professional medical attention.

After low risk has been assessed, Type 2 light curtains have a number of potential safety and non-safety applications, including semiconductor equipment, storage and conveying equipment, small textile equipment, packaging equipment (with the exception of palletizers), process protection, parts counting, tooling guarding and inspection equipment.

As a general rule, if a risk analysis determines that the severity of the potential injury is high, regardless of its probability, a Type 2 device is never an appropriate machine safeguard. In addition, a Type 2 device must not be used where regulations require the use of control reliability circuits. Any potential for an accident that will result in a severe injury should be treated with the most conservative approach to safety equipment selection and application.

Finally and simply, when considering the application of a Type 2 light curtain, ask "Would I think twice about putting my hand in this area?" If the answer is yes, then by U.S. standards any resulting accident would require more than simple first aid, and should qualify the use of a Type 4 safety light curtain in the application.

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Fig. 5.15

Type 2 and Type 4 Comparison

A side-by-side comparison of Omron STI's MP2100 (Type 2) protective light curtain and Omron STI's MiniSafe MS4800 (Type 4) safety light curtain demonstrates that Type 4 devices deliver superior performance and additional operating features. Type 4 devices typically cost 15% to 30% more than Type 2 devices.

Specifications	MP2100	MS4800
ESPE* Type	Type 2	Type 4
Resolution	30 mm	14, 20, 30, or 40 mm
Coverage Height	147 - 1470 mm	280 - 2040 mm
Max. Operating Range	15 m	7 m (14 mm) 20 m (20, 30, & 40 mm)
Safety Outputs	2 PNP, 500 mA @ 24 VDC	2 PNP 625 mA @ 24 VDC
Auxiliary Outputs	NONE	1 PNP 100 mA @ 24 VDC

* Electro-sensitive protection equipment

Features	MP2100	MS4800
Performance Level PL = e	NO	YES
Channel Select	NO	YES
Floating Blanking	NO	YES
MPCE	NO	YES
MTS	NO	YES