Use of electrosensitive protective equipment: What you must know…

Part 1 of standard IEC / EN 61496:

increase resistance to failure

⇩

need to detect breakdowns

⇩ ⇩

cyclical control — *dynamic self-control*

⇩ ⇩

opening of one NO output linked to the machine's controls — *opening of 2 NO outputs linked to the machine's controls*

⇩

detection of the breakdown

MODERATE TO LOW RISK: Type 2 — **HIGH RISK: Type 4**

Standard
IEC / EN 61496:

Minimum requirements for design, manufacturing and evaluation of electrosensitive protective equipment for the detection of the human body, **whatever technology** is used for body part detection.

Part 2 of standard IEC / EN 61496:

Some requirements specific to the technology used by the sensor for the detection of human body parts are covered by either another standard (like EN 1760-1 for safety mats) or by another part of standard IEC/EN 61496 (*laser scanners will be covered by: pr IEC / EN 61496-3).*

This is the case for all protective equipment using optoelectronic devices for the detection of human body parts.

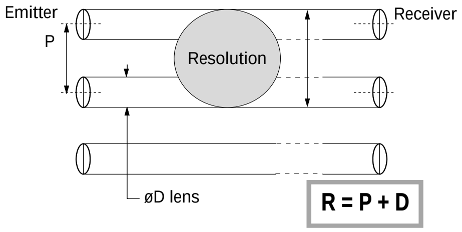
The second part of standard IEC/EN 61496 defines the **characteristics specific to optoelectronic devices**, composed of emitters and receivers detecting the interruption of an optic signal generated by the device itself. Light curtains and multiple individual beams are part of this equipment and are referred to as "**active optoelectronic protective devices"(AOPD).**

Resolution:

The resolution of an optoelectronic protective device is defined as being the minimum diameter of the object always detected in any location within the controlled field.

Honeywell defines it as the sum of the center-to-center distances between 2 consecutive beams and the diameter of the optics used at transmission and reception.

Thus, the resolution of the **Honeywell** safety light curtains does not depend on the distance between the transmitter and the receiver, nor on environmental pollution, but only on **the geometry of the sensors.**

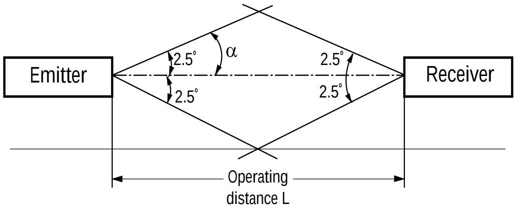


Angles of aperture and reflective surfaces:

Optics used on optoelectronic devices define a cone within which beams are emitted by emitters and received by receivers.

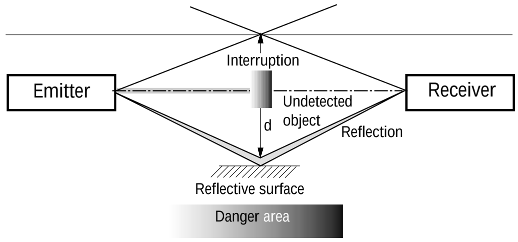
This cone has an aperture angle α formed between the optical axis and the beams located on the edge of the optic cone.

The presence of reflective surfaces between the sensing field



α = Angle of aperture of the beam.
L = Distance between transmitter and receiver.

and the dangerous zone can bring about false reflections of the beams farthest from the optical axis and thus delay the detection of an object entering the dangerous zone.



In order to limit any risk posed by this, standard IEC/EN 61496 - 2 voluntarily limits the angle of aperture of the optoelectronic devices within the following values:

For Type 2 equipment:

The angle of aperture α cannot exceed 5° in relationship to the optical angle for any distance between emitter and receiver greater than 3 m. For distances between 0,5 m and 3 m, the angle of aperture must obey the rule:

$$\boxed{L \times \tan(\alpha) \leq 262\ \text{mm}}$$

where L is the distance between the emitter and the receiver.

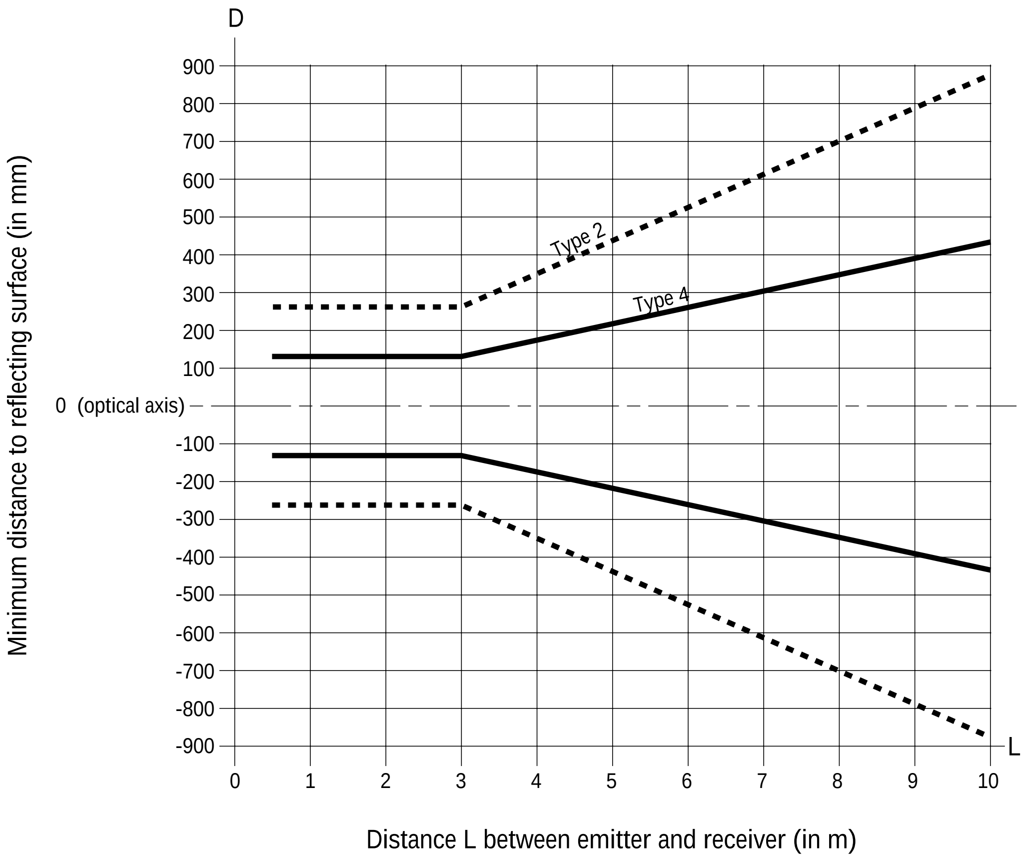
For Type 4 equipment:

The angle of aperture α cannot exceed 2,5° in relationship to the optical angle for any distance between transmitter and receiver greater than 3 m. For distances between 0,5 m and 3 m, the angle of aperture must obey the rule:

$$\boxed{L \times \tan(\alpha) \leq 131\ \text{mm}}$$

where L is the distance between the transmitter and the receiver.

In addition to the design requirement, there is an installation requirement. The minimum distance for installing an optoelectronic protective device in relation to a reflective surface can be determined from the following table:



General rules for installation

The selection of a safety solution is not limited to the simple selection of equipment according to the estimated level of safety, the type of machine to protect or the cost of installation. Some rules about installation will help you choose.

Three primary rules:

1 - Your machines can stop only after a certain length of time and the proposed safety equipment has a response time that you must take into account, even if it is small. You will thus be required to put your equipment at a minimum “safety distance”.

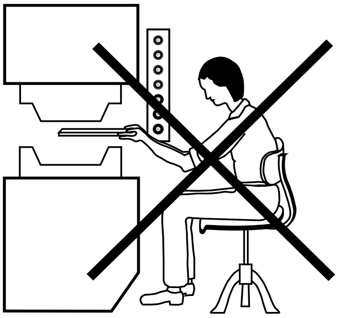
Standard **EN 999** supplies the formulae to calculate this distance.

2 - You may be required to add additional protective devices in order to prevent individuals from entering the “non detection zone”. Between the detection zone covered by sensors and the dangerous zone, there may be sufficient space to let an arm through, for example.

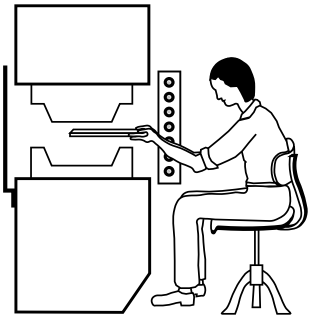
These devices are regulated by standards **EN 294, EN 811** and **ANSI B11.19**.

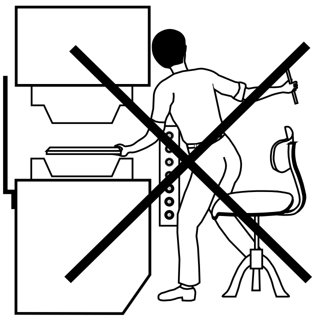
3 - You cannot be satisfied just by designing or installing equipment achieving the required safety level. The control circuit of the machine also requires an equivalent safety level. Standards **EN 954-1, IEC / EN 61496 - 1, ANSI B11.19 and type C standards explain these requirements**.

Installation examples

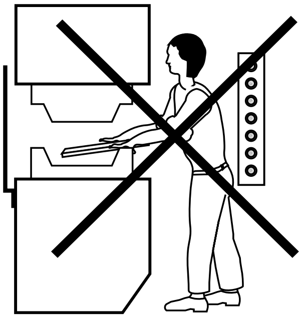


Penetration in danger zone under the barrier

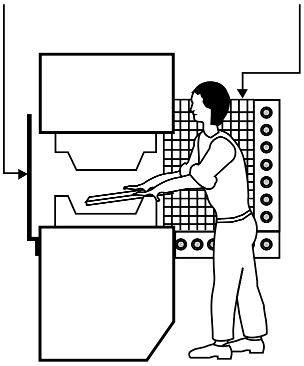




Penetration in danger zone over the barrier



Penetration between the barrier and the danger zone



Mechanical protective on the back and sides

Observe a sufficient safety distance:

The distance between the safety equipment and the dangerous zone is an inviolable safety element. If no type C standard specific to the machine exists, standard EN 999 is applicable.

This standard supplies the necessary elements to compute the minimum distance to be respected between the equipment and the machine.

The formula takes the following general form:

$$\boxed{S = K (t1 + t2) + C}$$

S: Minimum safety distance	between the detection field and the dangerous zone (in mm)
K: Approach speed	of the parts of the human body directly exposed (in mm / ms). Depending on the type of approach and the type of protective device used, *K takes 2 values*: *1,6 or 2 mm / ms*
t1: Response time	of the protective equipment (in ms)
t2: Time necessary	for the machine to stop the dangerous motion (in ms)
C: Safety zone	depending on the sensing ability of the protective equipment (in mm)

The EN 999 standard supplies the values for the K and C parameters for each of the three groups of safety devices being considered.

C is computed as a function of **R** (**resolution of the equipment**) and is therefore a function of each type of equipment and type of approach. Thus, depending on the case, C takes the following values:

- **For light curtains with resolution 14 mm ≤ R ≤ 40 mm:**

  C = 8 (R-14), in normal approach, and for an approach angle greater than or equal to 30°

- **For light curtains with resolution R > 40 mm:**

  C = 850, in normal approach, and for an approach angle greater than or equal to 30°

- **For safety floors, barriers or for multiple individual beams, with a parallel approach or floors:**

  C = 1200-0,4 H, **H being the height of the detection plane from the ground (in mm)**

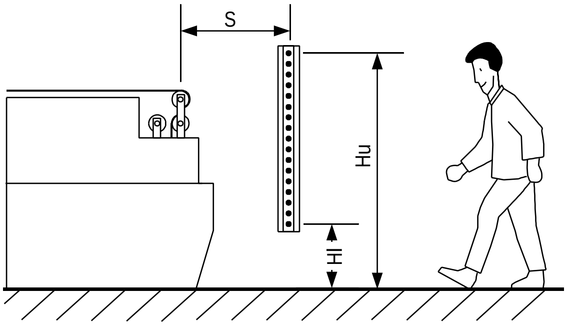
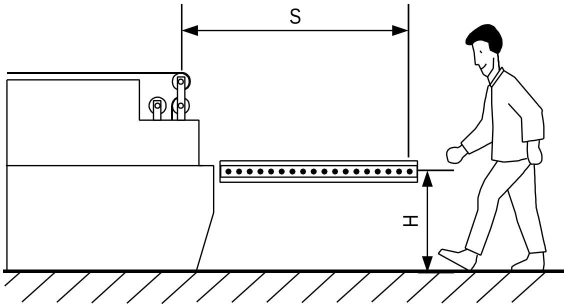
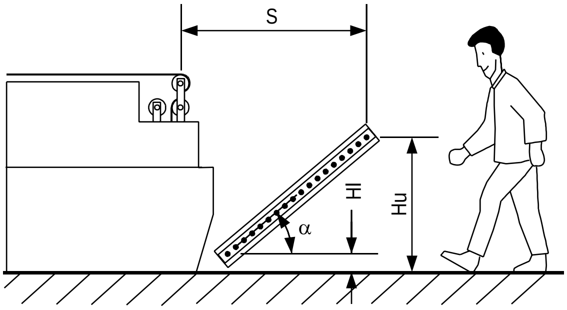
- **For two-hand controls:**

  C = 250

- **For safety laser scanners:**

  C = (1200 - 0,4 H) + E, E being the additional error margin and H the height of the detection plane from the ground (in mm)

Safety distances (in mm, 100 mm = 3.9 in)

European EN 999 standard	R ≤ 40	R > 40
Perpendicular approach		
	$S \geq 2000\,(t1+t2) + 8\,(R-14)$ with $S \geq 100$ If $S \geq 500$, then use: $S \geq 1600\,(t1 + t2) + 8\,(R-14)$ with $S \geq 500$	$S \geq 1600\,(t1+t2) + 850$, with $Hu \geq 900$ $Hl \leq 300$ m
Parallel approach		
	$S \geq 1600\,(t1+t2) + (1200 - 0.4\,H)$, with $H \leq 875$ or $S \geq 1600\,(t1 + t2) + 850$, with $875 \leq H \leq 1000$ with $H \geq 15\,(R-50)$ where R is the light curtain resolution	
Angled approach		
	if $\alpha \geq 30°$, then use one of the formula given for a perpendicular approach, with $Hu \geq 900$ and $Hl \leq 300$ if $R > 40$ if $\alpha \leq 30°$, then use one of the formula given for a parallel approach, with $Hu \leq 1000$ and $Hl \geq 15\,(R-50)$ where R is the light curtain resolution	

S	minimum safety distance (in mm, 100 mm = 3.9 in)
t1	light curtain response time (in s)
t2	machine stopping time (in s)
H	height of the detection plane above the reference floor (in mm, 100 mm = 3.9 in)
Hu	height of the uppermost beam above the reference floor (in mm, 100 mm = 3.9 in)
Hl	height of the lowest beam above the reference floor (in mm, 100 mm = 3.9 in)