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more than automation
safe automation

PSEN op2/4

Safety light curtains with infrared beams



OPERATING MANUAL

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1. GENERAL INFORMATION



1.1. General description of the safety devices

Safety light curtains from the PSEN op 2/4 series are optoelectronic safety devices. They secure work areas in which operating personnel can come into contact with moving parts of machinery, robots and automated systems in general, which present a risk of physical injury.

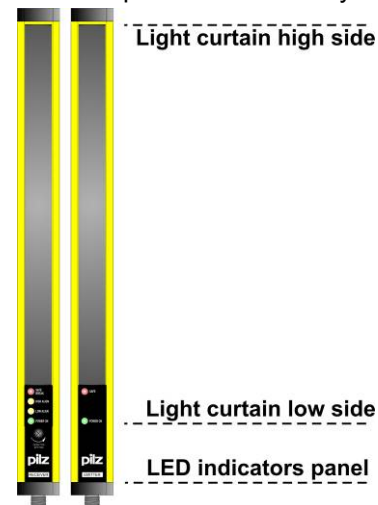
Safety light curtains in the PSEN series are designed as safe Type 2 or Type 4 systems, for accident prevention in accordance with applicable international standards, in particular:

EN 61496-1: 2004	Safety of machinery: Electrosensitive protective equipment. Part 1: General requirements and tests.
prEN 61496-2: 1997	Safety of machinery - Electrosensitive protective equipment. Part 2: Particular requirements for equipment using active optoelectronic protective devices.

The device, which consists of a transmitter and a receiver housed in robust aluminium profiles, secures the protected area by generating an infrared protected field, defined by the height and width of that protected field.

Both the control and evaluation logic are located inside the two units; the electrical connection is made via M12 connectors, which are positioned underneath the profiles. The transmitter and receiver are synchronised optically, so the two units do not have to be connected directly to each other.

The infrared beams are controlled and monitored via a microprocessor, which also provides the user with information about the operating status of the light curtain via LED indicators (see Chapter 7, "Diagnostic functions").



Two yellow LEDs simplify the alignment of the two units during installation (see Ch. 5 "Alignment").

As soon as an object, a limb or the operator's body interrupts the beams sent by the transmitter, the signals at both outputs (OSSD) immediately switch from High to Low and the machine connected to the corresponding OSSDs is stopped.

Note: This manual uses the following abbreviations as defined in the applicable standards:

<i>AOPD</i>	<i>Active optoelectronic protective device</i>
<i>ESPE</i>	<i>Electrosensitive protective equipment</i>
<i>MPCE</i>	<i>Machine primary control element</i>
<i>OSSD</i>	<i>Output signal switching device (switching output)</i>
<i>TX</i>	<i>Transmitter</i>
<i>RX</i>	<i>Receiver</i>

Some sections or paragraphs in this manual contain information of particular importance to those using or setting up the device. These sections are highlighted using the following symbols:



Detailed notes and descriptions of specific features on the PSEN op2/4 safety devices, designed to explain their operation more clearly.

Specific installation guidelines.



This warning must be heeded! It warns of a hazardous situation that could lead to serious injury and death and indicates preventive measures that can be taken.

This manual contains all the information required for the selection and operation of the PSEN op2/4 safety devices.





Specialised knowledge of safety issues is required to integrate a safety light curtain correctly on power-driven machinery.


As this manual is unable to provide such information in full, please contact the technical service department at PILZ for any information about the operation of the PSEN op 2/4 safety light curtains and the safety regulations relating to correct installation (see Ch. 8 "Regular checks and maintenance").

1.2. How to select a safety device

Three characteristic features should be taken into account when selecting a safety light curtain:

- **Resolution**, depending on the part of the body requiring protection.

R = 14mm	Finger protection	
R = 30 mm	Hand protection	
R > 40mm	Body protection	 

 The resolution (R) of a device is understood to be the minimum size an opaque object must be in order to obscure at least one of the beams that form the sensing area. As shown in Fig. 1, the resolution depends exclusively on the geometrical properties of the lenses, the diameter and the centre distance; it is independent of the ambient and operating conditions of the light curtain.

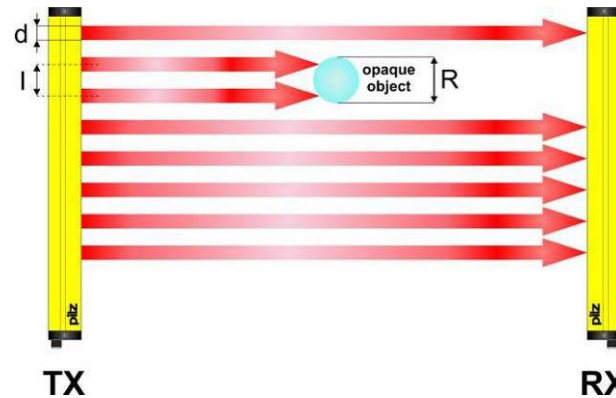


Fig. 1

The resolution can be calculated using the following formula:

$$R = l + d$$

Fig. 2 shows the optical axis (I) and the resolution (R) of the safety light curtain designed for body protection.

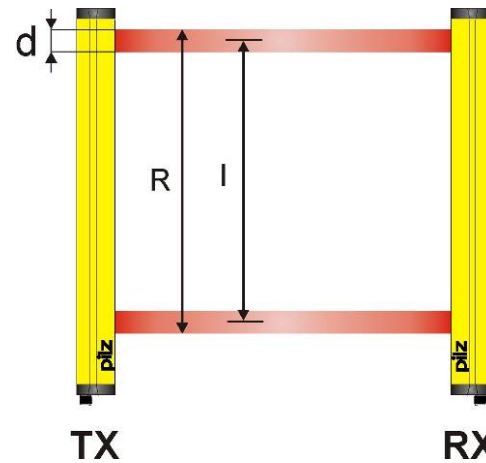


Fig. 2

The following overview shows the sizes available on standard light curtains suitable for body protection.

Model	Optical axis (mm) (I)	No. of optics (n)	Resolution (mm) (R)	Diameter of optics (mm) (d)	Op. distance (m)
PSEN op2B-2-050	500	2	515	15	50
PSEN op2B-3-080	400	3	415	15	50
PSEN op2B-4-090	300	4	315	15	50
PSEN op2B-4-120	400	4	415	15	50
PSEN op4B-2-050	500	2	515	15	25
PSEN op4B-3-080	400	3	415	15	25
PSEN op4B-4-090	300	4	315	15	25
PSEN op4B-4-120	400	4	415	15	25

PSEN op2... oder PSEN op4..., depending on the category.

English

- **Height of the protected area**

Here it is important to distinguish between the “Height of the sensing area” and the “Height of the protected area” (Fig. 3).

- The height of the sensing area is the distance between the upper limit of the first lens and the lower limit of the last lens.
- The height of the protected area is the effective protected area, in which an opaque object whose size is greater than or equal to the resolution of the light curtain will safely obscure the beam.

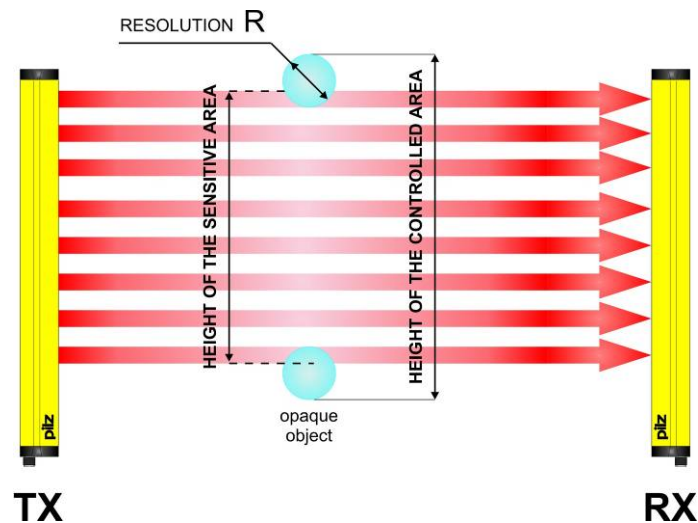


Fig. 3

- **Safety distance**


Great care must be taken when calculating the distance at which the safety device should be positioned in relation to the hazardous machinery. (Please see Ch. 2, “*Installation*”, for details of how to calculate the safety distance.)

1.3. Typical application areas

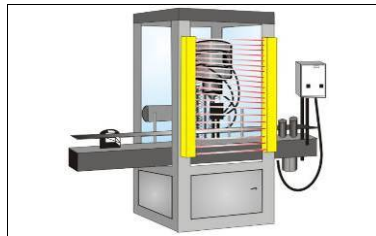
Safety light curtains from the PSEN op 2/4 series can be used in all areas of automation where it is necessary to control and guard access to danger zones.

In particular they are used to stop the hazardous movement of mechanical parts on:

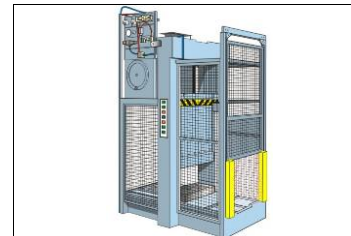
- Automatic machinery
 - Packaging, handling and storage machinery
 - Textile processing, woodworking and ceramic processing machinery
 - Automatic or semi-automatic assembly lines
- Automated high-bay racking

 With food industry applications, please contact customer services at PILZ to check whether the light curtain's housing material can withstand the chemical substances that may be used in the production process.

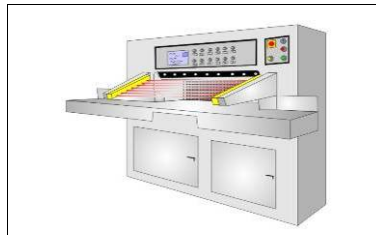
The following illustrations provide an overview of some of the main application areas:



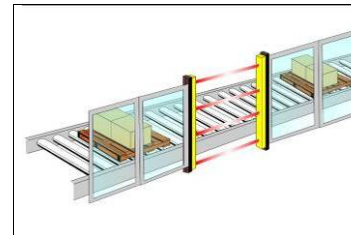
Automatic packaging machines



Presses and punching machines



Folding and cutting machines



Conveyors

1.4. Safety information



For the proper, safe use of PSEN op 2/4 safety devices in the PSEN op 2/4 series, the following guidelines must be followed:

- It must be possible to control the machine stop electrically.
- The control system must be able to stop the hazardous machine movement immediately at any stage of the operating cycle.
- The light curtain and its respective electrical connections must be installed by qualified personnel, in line with the guidelines stated in the relevant chapters (see *Ch. 2, 3, 4, 5, 6*).
- The light curtain must be positioned in such a way that the danger zone cannot be accessed without interrupting the beams (see *Ch. 2 "Installation"*).
- Personnel working in the danger zone must be appropriately trained with regard to the operation of the safety light curtain.
- The TEST/START button must be positioned outside the danger zone in such a way that operating personnel have a complete view of the danger zone during all reset, test or override operations.
- The external control lamps that display the activated muting function must be visible from all sides of the work area.

2 INSTALLATION

2.1. Precautionary measures when selecting and installing the device



- Make sure that the category guaranteed by the safety device (Type 2 or Type 4) matches the risk assessment for the machinery that is to be monitored, as defined in the standard EN 954-1.
- The outputs (OSSD) on the ESPE must be used as machine stop devices and not as command devices (the machine must have its own START command).
- The dimensions of the smallest object to be detected must not be less than the resolution level of the device.
- The environment in which the ESPE is installed must comply with the technical details stated for the light curtain in Ch. 9.
- Avoid installing the device, particularly the receiver, close to intense and/or flashing light sources.
- Avoid strong electromagnetic interference as this can adversely affect the proper operation of the device.
- Smoke, mist or dust within the operating environment can reduce the range of the safety device by up to 50%.
- Sudden temperature fluctuations beyond freezing point can cause condensation to form on the surface of the lenses, adversely affecting the proper operation of the safety device.
- Install and replace emitter and receiver only in pairs. Emitter and receiver have the same serial number.

2.2. General information on positioning the device

For effective protection it is necessary to proceed very carefully when positioning the device; in particular, the device must be installed in such a way that the danger zone cannot be accessed without interrupting the protected field.

To exclude the possibility of the machine being accessed from above or below (Fig. 4a), it is necessary to install a light curtain of sufficient length to completely cover access to the danger zone (Fig. 4b).

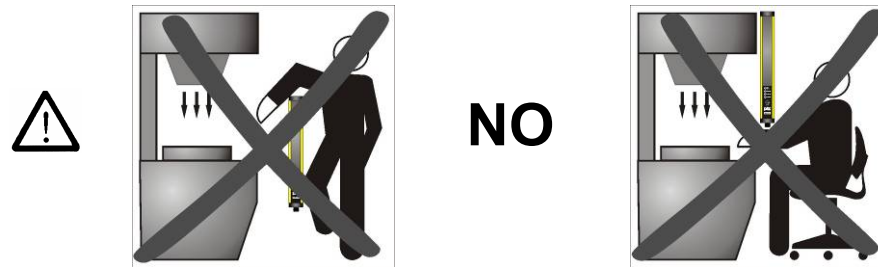


Fig. 4a

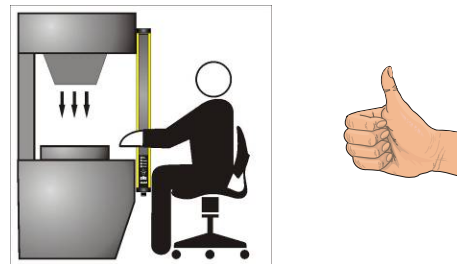


Fig. 4b

Also, under normal operating conditions, it must not be possible to start the machine until the operator is outside the danger zone. If it is impossible to install the light curtain in immediate proximity to the danger zone, a second light curtain must be installed, aligned horizontally, to exclude access from the side, as shown in Fig. 5b.

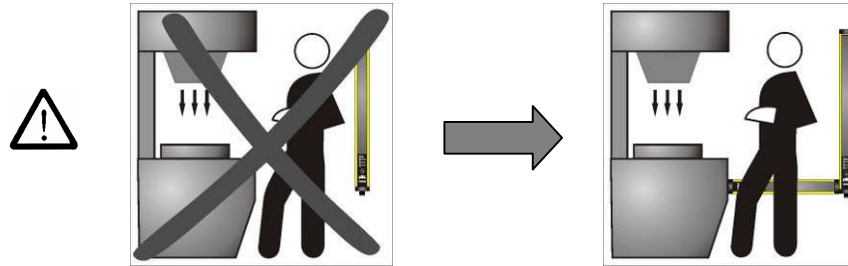


Fig. 5a

Fig. 5b



If the installation position of the safety device still enables an operator to access the danger zone without detection, an additional mechanical barrier must be installed to prevent this happening.

English

2.2.1. Minimum safety distance

The safety distance of the safety device should be such that the operator cannot reach the danger zone until the movement of the hazardous machine part has come to a standstill (see Fig. 6).

According to the standards EN 999, 775 and 294, this distance depends on four factors:

- 1 ESPE reaction time (time it takes for the signal at the OSSD contact to switch from High to Low once the beams have successfully been interrupted).
- 2 Machine's overrun time (time it takes for the machine to come to a standstill once the ESPE reaction time has elapsed).
- 3 Resolution of the ESPE.
- 4 Approach speed of the object requiring detection.

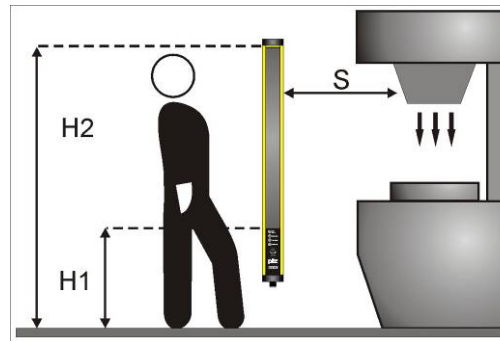


Fig. 6

The formula for calculating the safety distance is as follows:

$$S = K (t_1 + t_2) + C$$

where:

S = Minimum safety distance in mm between the protected field and the danger zone

K = The speed at which the object requiring detection (body or parts of the body) approaches the danger zone, in mm/s

t₁ = ESPE reaction time in seconds (Ch. 9 "Technical details").

t₂ = Machine's overrun time in seconds

d = The resolution of the safety device.

C = **8 (d - 14)** for a safety device with a resolution ≤ 40 mm

= **850 mm** for a safety device with a resolution > 40 mm

Note: The value of K is:

2000 mm/s, if the value calculated for S is ≤ 500 mm,
1600 mm/s, if the value calculated for S is > 500 mm.

If it is possible to access the danger zone from above and below (Fig. 6) and the devices used have a resolution of >40 mm, the upper beam must be positioned at a height of 900 mm (H2), starting from the reference plane (e.g. base of the machine), and the lower beam must be positioned at a height of 300 mm (H1).

Where the light curtain must be installed horizontally (Fig. 7), the distance between the danger zone and the most distant optical beam must equal the value calculated using the following formula:

$$S = 1600 \text{ mm/s } (t_1 + t_2) + 1200 - 0.4 H$$

where:

- S** = Minimum safety distance in mm between the protected field and the danger zone
- t₁** = ESPE reaction time in seconds (Ch. 9 "Technical details").
- t₂** = Machine's overrun time in seconds
- H** = The height of the beams above the floor. This height must always be less than 1000 mm.

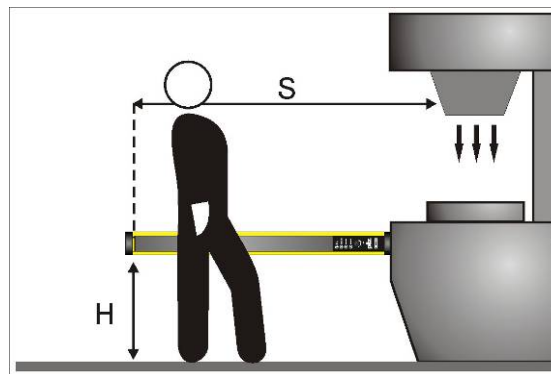


Fig. 7

2.2.2. *Minimum distance from reflective surfaces*

Reflective surfaces close to the light beams emitted from the safety device (whether above, below or to the side), may cause passive reflections and adversely affect detection of the object within the protected area (Fig. 8).

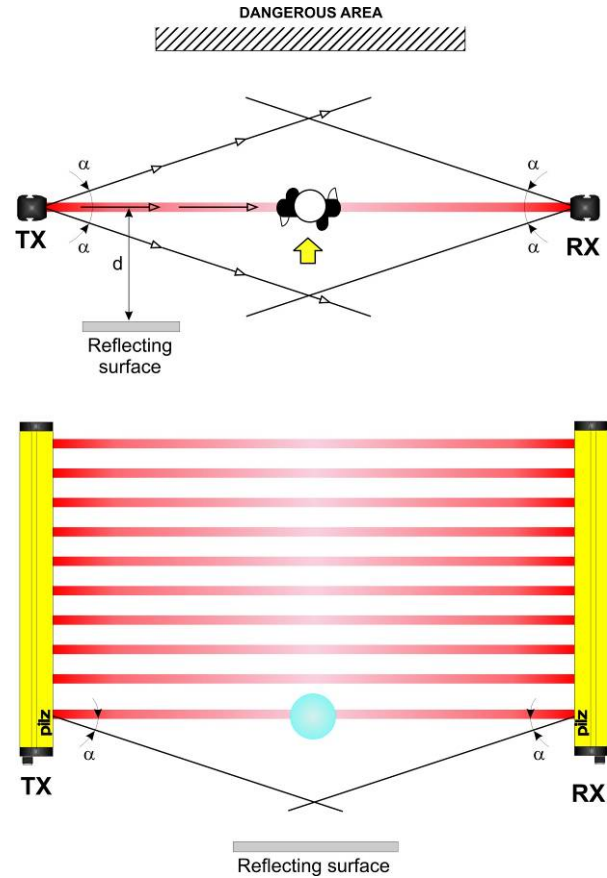



Fig. 8

 Improper installation could mean that a protected field is interrupted without detection, resulting in serious injury.

So, when installing the device close to reflective surfaces (metal walls, floors, ceilings or workpieces), it is vital that the minimum distance in relation to reflective surfaces is maintained, as shown in the diagram in Fig. 9.

This minimum distance depends on:

- The range between the transmitter (TX) and receiver (RX)
- The maximum open angle of the light beams emitted by the transmitter, in particular:
 - 5° for Type 4 ESPE ($\pm 2.5^\circ$ to light axis)
 - 10° for Type 2 ESPE ($\pm 5^\circ$ to light axis)

The values for the minimum distance in relation to the operating range can be taken from the illustration in Fig. 9.

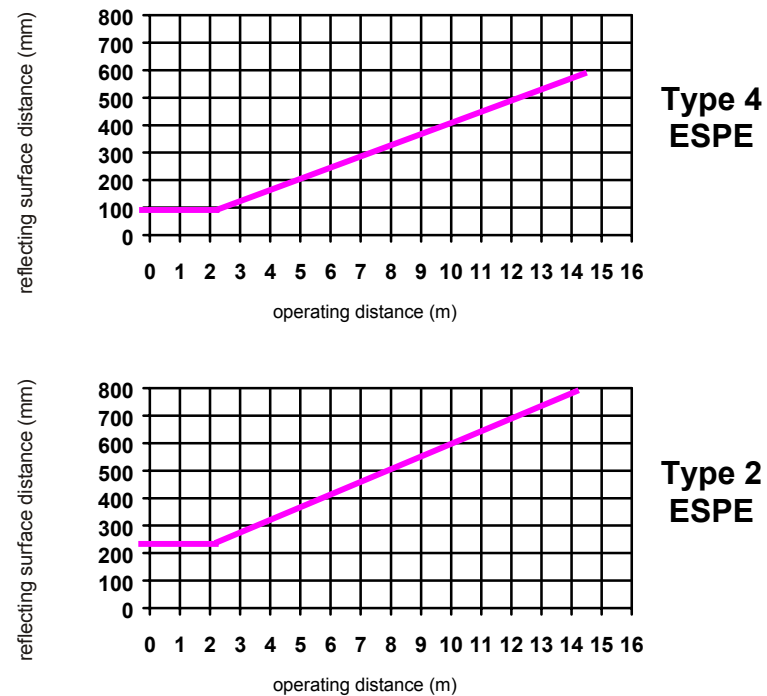


Fig. 9

2.2.3. *Installing several adjacent safety light curtains*

If it is necessary to install several safety devices in adjacent areas, you will need to ensure that the transmitter on one device cannot interfere with the receiver on another. To prevent this, the devices will need to be installed conversely or must be separated via screening (opaque surface).

Fig.10 gives an example of an installation that could lead to interference, plus two correct installations.

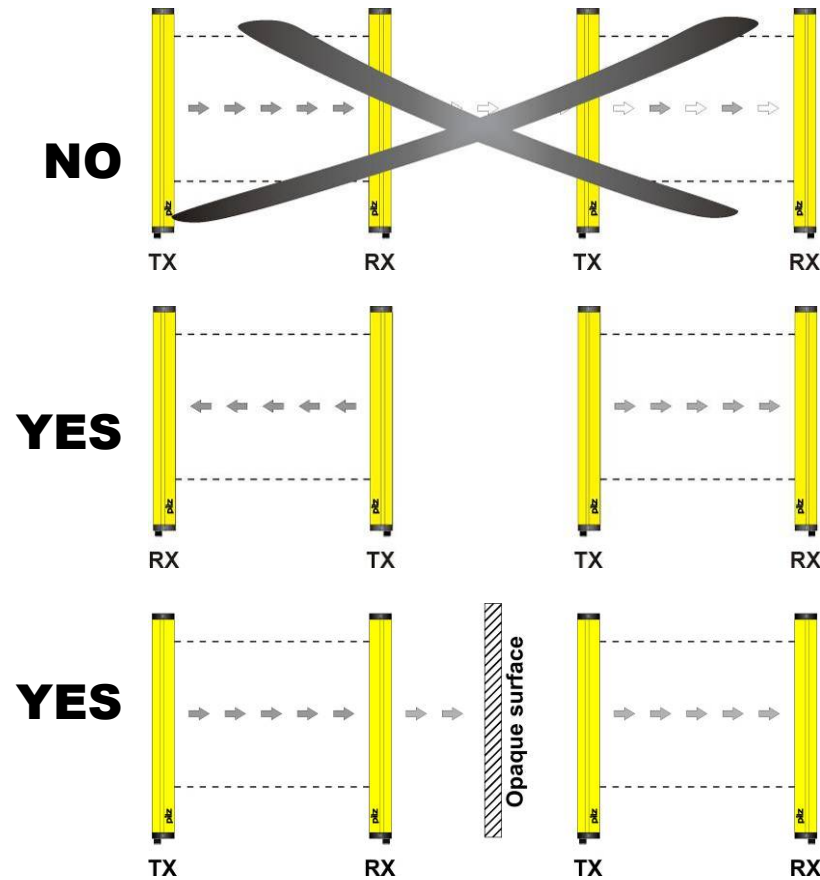


Fig. 10

3. MECHANICAL ASSEMBLY

The transmitter (**TX**) and receiver (**RX**) must be assembled so that the respective optical surfaces are arranged parallel to each other and the connectors are positioned on the same side. The distance between the transmitter and receiver must be within the operating range of the model you are using (see type label or Ch.9, "Technical details"). Align the devices precisely, following the guidelines given in Ch. 5, "Alignment". Use the supplied angle bracket to attach the device, as shown in Fig. 12.



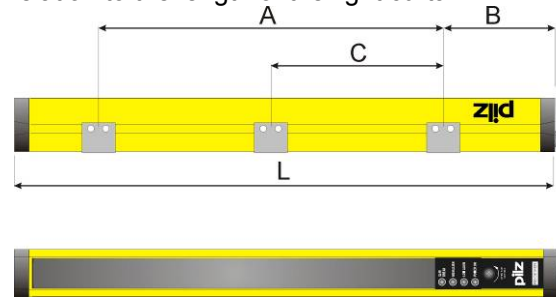
Depending on the application, both rails may either be screwed on using the fixing bolts supplied or by using a rigid mounting bracket, as shown in Fig.13.



Fig.13

Rigid mounting brackets are suitable for installations that require no large mechanical adjustments during alignment. Adjustable brackets enable the units to be inclined by $\pm 5^\circ$ and are available on request. Where applications are subject to particularly strong vibration we recommend the use of angle brackets with vibration dampers.

The drawing and table below indicate the recommended fixing points in relation to the length of the light curtain.



English

MODEL	L (mm)	A (mm)	B (mm)	C (mm)
PSEN op4F/op4H*-015	246	86	80	-
PSEN op4F/op4H*-030	393	193	100	-
PSEN op4F/op4H*-045	540	300	120	-
PSEN op4F/op4H*-060	687	387	150	-
PSEN op4F/op4H*-075	834	474	180	-
PSEN op4F/op4H*-090	981	581	200	-
PSEN op4H*-105	1128	688	220	-
PSEN op4H*-120	1275	875	200	438
PSEN op4H*-135	1422	1022	200	510
PSEN op4H*-150	1569	1121	220	565
PSEN op4H*-165	1716	1216	250	608
PSEN op2B-2-050	642	342	150	-
PSEN op2B-3-080	942	542	200	-
PSEN op2B-4-090	1042	602	220	-
PSEN op2B-4-120	1342	942	200	472
PSEN op4B-2-050	642	342	150	-
PSEN op4B-3-080	942	542	200	-
PSEN op4B-4-090	1042	602	220	-
PSEN op4B-4-120	1342	942	200	472

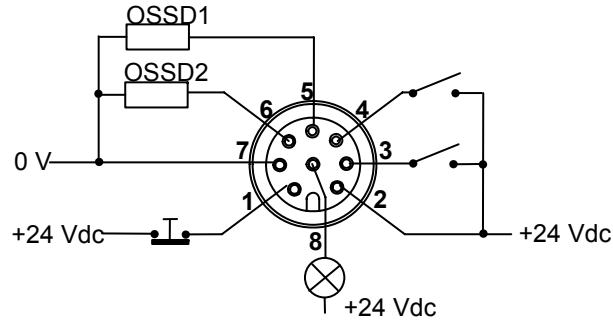
* op4F = Resolution 14 mm

op4H = Resolution 30 mm

4. ELECTRICAL CONNECTIONS

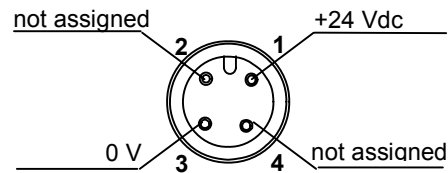
All electrical connections to the transmitter and receiver are made via an M12 connector, located on the bottom of both the units. The receiver uses 8-core cable and the transmitter 4-core cable.

RECEIVER (RX):



- 1 = white = TEST/START
- 2 = brown = +24 Vdc
- 3 = green = MUTING 1
- 4 = yellow = MUTING 2
- 5 = grey = OSSD1
- 6 = pink = OSSD2
- 7 = blue = 0 V
- 8 = red = LAMP

TRANSMITTER (TX):



- 1 = brown = +24 Vdc
- 3 = blue = 0 V

4.1. Notes on connections

To ensure the correct operation of the PSEN safety device, please note the following:

- Use screened cable (accessories) to connect the transmitter and receiver.
- Fig.14 shows how to connect the transmitter/receiver correctly.

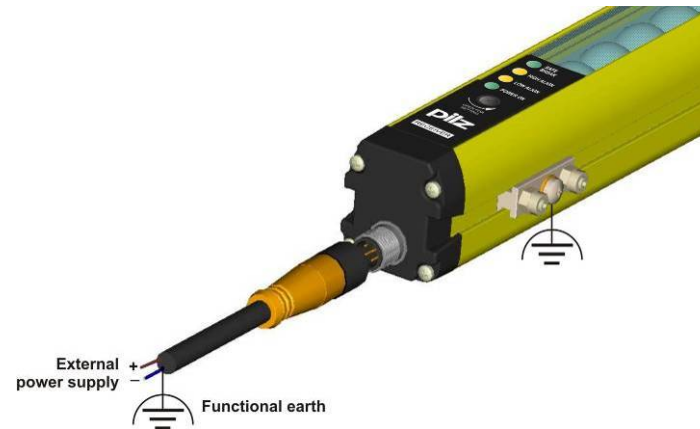


Fig. 14

- Under no circumstances should the connection cables come into contact with or be laid in proximity to cables that generate strong electromagnetic interference (e.g.: motor feeds, inverters etc.); these could compromise the device's ability to function.
- The TEST/START input should be connected to the supply voltage on the ESPE via a button with a N/C contact. The test should be performed manually (by pressing the button) at least once a day in order to check the proper operation of the safety device.
- Multicore cables may not be used to connect the outputs of more than one light curtain.
- The TEST/START button must be positioned in such a way that the operator has a clear view of the protected area when reset, test or override procedures are in progress (see Ch. 6 "Operating mode").



- A blow-out fuse with a rated interruption current of 500 mA should be fitted between the connection for the external control lamp for active muting and the receiver RX. The LED must be positioned in such a way that it is visible from all sides of the work area.
- If evaluation devices or a supply voltage are connected without safe separation, the light barrier must be operated in protection class 1.
- If evaluation devices are connected without safe separation, the sender (TX) must be operated in protection class 1 and connected to the protective earth. Use the fixing set supplied for the earthing (see Fig.15) and connect it to a cable with a cable cross section of min. 2.5 mm².

Installing the fixing set:

- Thread the grooved piece (threaded hole M4 x 0,7 mm) in a groove at the safety guard.
 - Screw the two set screws (M4 x 14) into the external threaded holes.
 - The torque setting should be 2,2 ... 2,5 Nm. This enables the cup point of the set screw to drill through the coat of lacquer and connection is made to the metal housing.
 - Fix two self-locking nuts M4 to the set screws to prevent them from backing out when there is strong vibration. Use a hexagonal spanner CH.7.
 - Attach the earth cable at the middle threaded hole to the tooth lock washer (M4) and the screw (M4).
- Information about the muting function, its application and the positioning of the sensors to activate the function can be found in Ch. 6 "Operating mode".

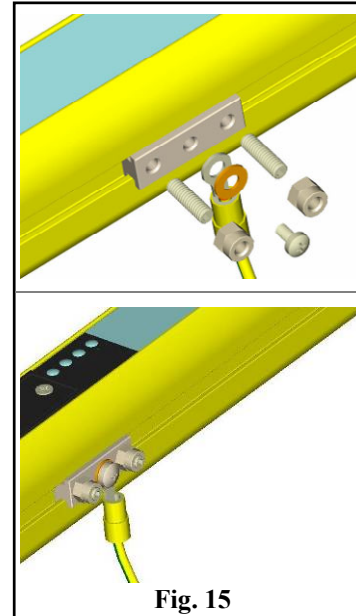


Fig. 15

NOTE: If muting is not required, the connection cable wires from Pins 3, 4 and 8 on the receiver must be isolated.

- Under no circumstances should safety outputs OSSD1 and OSSD2 be wired in series or in parallel (Fig. 17, 18, 19); both must be used separately, as shown in Fig. 16. Should one of these two configurations be used in error, a malfunction will occur (see Ch. 7, "Diagnostic function").
- If only one OSSD is used, the category will be reduced (from Type 4 to Type 2).

English

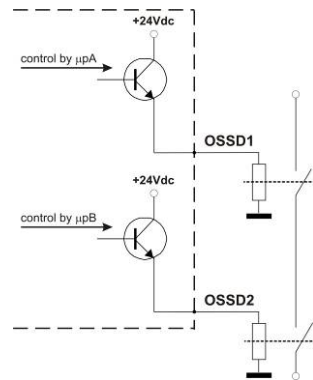


Fig. 16

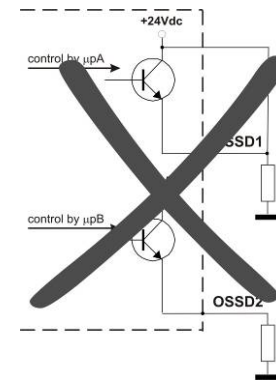


Fig. 17

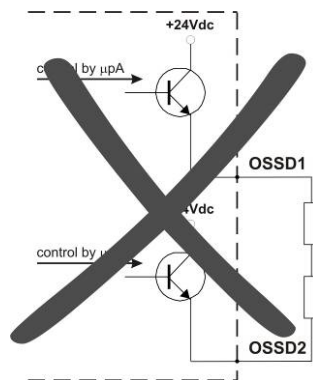


Fig. 18

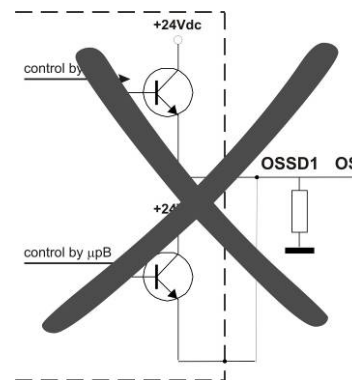


Fig. 19

5. ALIGNMENT



The transmitter and receiver must be aligned to ensure the proper function of the device.

Perfect alignment is achieved when the optical axes of the first and last beam from the transmitter meet the optical axes of the corresponding elements on the receiver.

Two yellow LEDs on the receiver, "HIGH ALIGN" and "LOW ALIGN", simplify the alignment process.

5.1. Correct alignment procedure

Once the mechanical assembly and the electrical connections have been completed as described in the previous sections, the light curtain can be aligned as described below:

- Disconnect the power supply to the PSEN safety device.
- Press the TEST/START button and keep it held down (opens the contact).
- Reconnect the power supply.
- You can now release the TEST/START button.
- On the transmitter (TX), ensure that the green LED "POWER ON" and the yellow LED "SAFE" are lit. This confirms that the transmitter is operating correctly.
- Make sure that the status of the receiver (RX) is one of the following:
 - BREAK Status: Green LED "POWER ON" is lit and LED "SAFE/BREAK" lights up red (BREAK).
 - -> the units are not aligned.
 - SAFE Status: Green LED "POWER ON" is lit and LED "SAFE/BREAK" lights up green (SAFE). The two yellow LEDs "HIGH ALIGN" and "LOW ALIGN" are both lit.
 - -> the units are aligned.

- Follow the steps below to align the units:
 - A** Hold the receiver steady and align the transmitter so that the lower yellow LED “LOW ALIGN” goes out, confirming that the first lower beam has been aligned.

 - B** Rotate the transmitter until the upper yellow LED “HIGH ALIGN” is lit. The LED “SAFE/BRAKE” switches from red (BREAK) to green (SAFE).

NOTE: Make sure that the green LED “POWER ON” is permanently lit.

- C** With a few small adjustments, define the area in which the LED “SAFE” permanently lights up green; do this first with one unit and then with the other. Place both units in the centre of this area.
- Use the pins and/or mounting brackets to firmly secure both the units.
 - Disconnect the power supply to the **PSEN** safety device.
 - Reconnect the power supply.
 - Make sure that the green LED on the receiver is lit (light beams are clear, “SAFE” operating status) and that this switches to red if just a single beam is interrupted (detected object, “BREAK” operating status).
 - Perform this test using a cylindrical “test rod” intended for this purpose; its diameter should correspond to the resolution of the device (14mm, 20mm, 30mm or 35 mm).

NOTE: If you pass the test rod from top to bottom along the length of the whole sensing area, at any distance from either unit, the LED “SAFE/BRAKE” must be permanently lit red, without interruption.

We recommend that you perform this test daily.

6. OPERATING MODE

6.1. Selecting the operating mode via DIP switches

On the front of the receiver RX there is a cover flap (Fig. 20), which is easy to open using a screwdriver and exposes a row of DIP switches used to set the following configurations:

- Manual / automatic start
- Total muting function
- Partial muting function

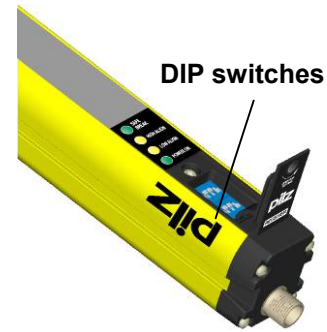


Fig. 20



The device will not accept any configuration changes during normal operation. If it is necessary to change the configuration, this can only be achieved by resetting the device.

Particular care should therefore be taken when setting the DIP switches.

6.2. Standard configuration

The device is supplied with the following standard configuration:

- Automatic start
- Total muting activated

NOTE: The muting function can only be activated if muting inputs 1 and 2 and the muting lamps are connected correctly.

Detailed information on these functions can be found in Ch. 6.3 and 6.4.

6.3. Restart

If the beams between the receiver and transmitter are interrupted by an opaque object, the OSSD outputs will switch and the safety contacts will open ("BREAK" operating status).

There are two different ways to restart normal ESPE mode (close safety contacts, "SAFE" operating status):

- **Automatic start**, after the protected field has been interrupted, the ESPE returns to normal mode as soon as the detected object has been removed from the protected field.
- **Manual start**, after the protected field has been interrupted, the ESPE does not return to normal mode until the restart button (TEST/START button) has been operated and the object has been removed from the protected field.

English

Temporal diagram (Manual Restart)

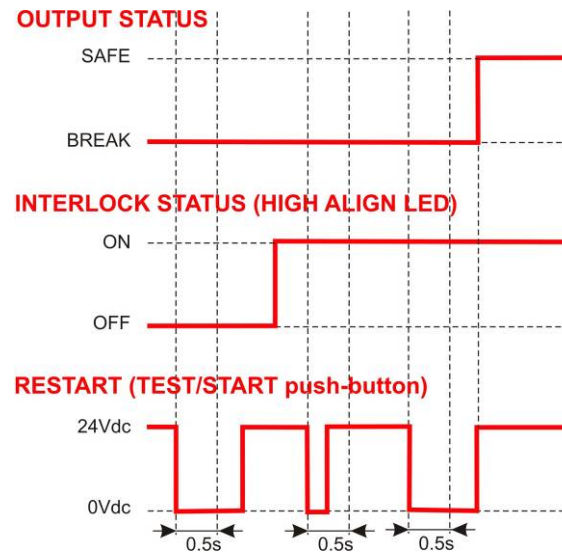


Fig. 21 illustrates both operating modes.

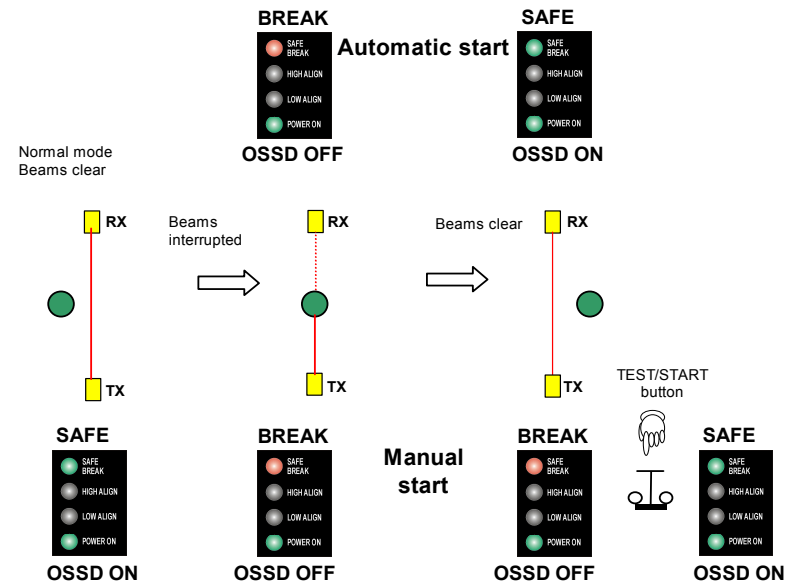
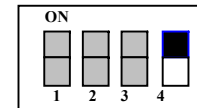
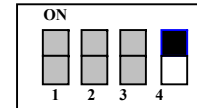


Fig. 21

Automatic or manual start can be selected via the DIP switches on the receiver (Fig. 20). Automatic start: Switch position 4 on both DIP switches to ON Manual start: Switch position 4 on both DIP switches to OFF



NOTE: The DIP switches not used for this function are grey.

NOTE: PSEN op4F, PSEN op4H, PSEN op4B: The top and bottom DIP switches must be set at the same position.

PSEN op2B: It is only necessary to configure the bottom DIP switch. The position of the top DIP switch does not affect the function.

6.4. Muting function

- The muting function can be selected via DIP switches; it enables the safety device to be suspended temporarily while material is transported through the protected field (Fig. 22).

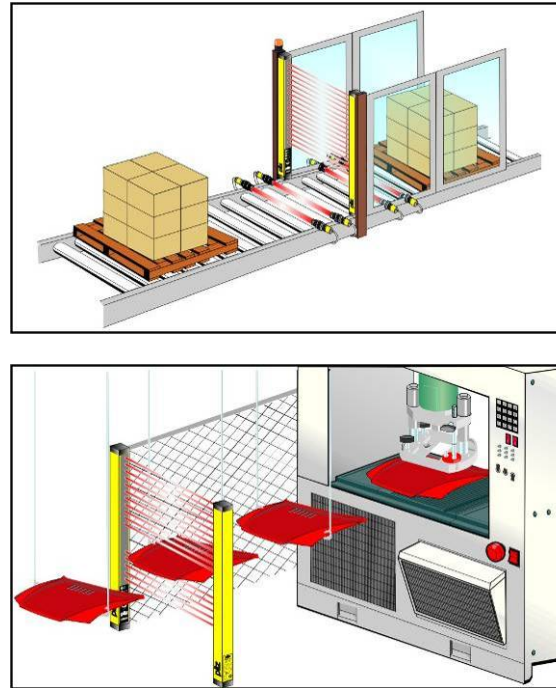


Fig. 22

- To comply with current regulations the safety device has two inputs (muting 1 and muting 2) for activating the muting function.
- The muting function is particularly appropriate where operating conditions require an object to pass through the danger zone, but not a person.
- It is important to remember that the muting function represents a forced situation for the whole system, and as such should be applied with due care.

English

- Both muting inputs must be activated by two or four muting sensors which have been properly connected and positioned to ensure that personnel are not exposed to unwanted muting activations or hazardous situations.
- ⚠ If you are using the muting function you will also need to connect the external muting control lamp (muting lamp), otherwise it will not be possible to activate this function.
- Should the muting lamp not be connected, activating muting or override would cause the safety contacts to open and the device would be disabled on account of a muting lamp malfunction (see Ch. 7.4 "Error messages and diagnostics").
- Fig. 23 shows the muting operating modes.

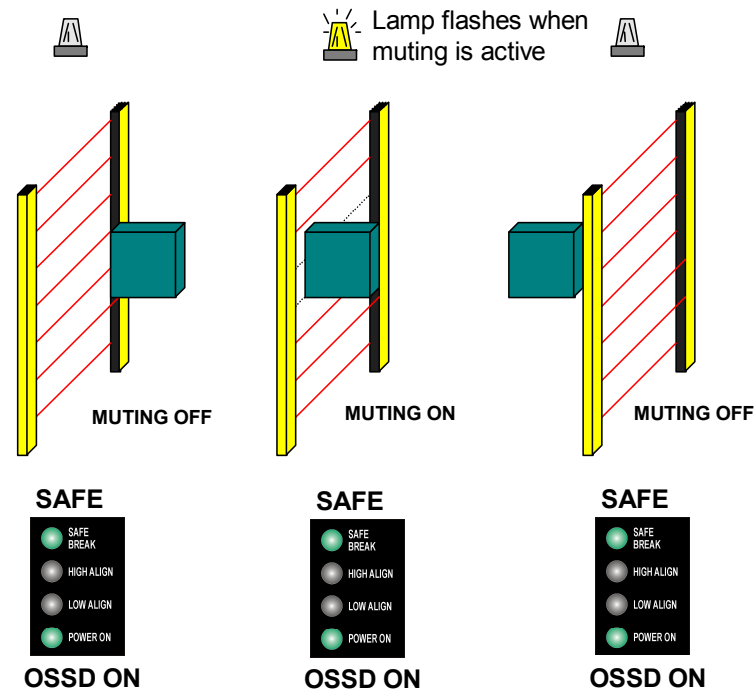


Fig. 23

6.4.1. Partial muting function

Safety curtains in the PSEN op2/4 series have an additional partial muting function, which permits the blanking of selected zones within the protected field.

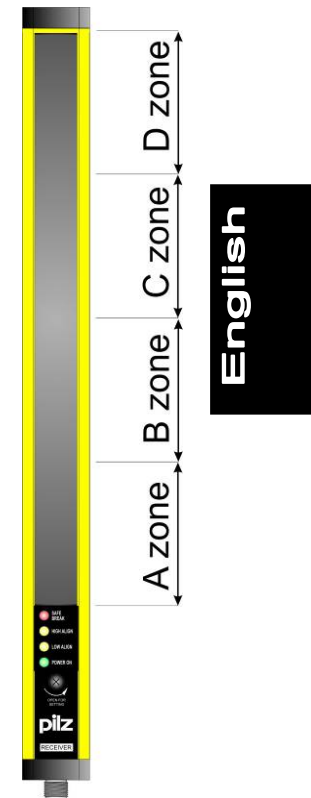
This function enables the blanking of up to 4 zones (optical groups). The width of the blanking depends on the height of the protected field (partial or total muting) and the resolution of the respective safety device.

Monitoring and blanking of the 4 zones enables a range of configurations:

- Blanking any one of the 4 individual zones (Zone A only, Zone B only, Zone C only, Zone D only, see diagram). The uppermost optic in Zone D will not switch to partial muting but will maintain normal operation, as it is responsible for optical synchronisation between the transmitter and receiver.
- Blanking zone groups; in particular: Zone A+B; Zone A+B+C; Zone A+B+C+D.
- Blanking the whole of the protected field = total muting.

The required configuration can be set using the DIP switches on the receiver.

The following overview illustrates the configuration options on the different safety light curtain models.



Muting configuration

PSEN op4F, PSEN op4H, PSEN op4B: The top and bottom DIP switches must be set at the same position.

PSEN op2B: It is only necessary to configure the bottom DIP switch. The position of the top DIP switch does not affect the function.

Muting zones for partial/total muting	A	B	C	D	A+B	A+B+C	A+B+C+D	TOTALE
DIP SWITCH setting for the control of partial/total Muting								
Model	Length (mm) from...to	Length (mm) from...to	Length (mm) from...to	Length (mm) from...to	Length (mm) from...to	Length (mm) from...to	Length (mm) from...to	Length (mm) from...to
PSEN op4F-14-015	0...21	21...42	42...83	83...84	0...44	0...63	0...84	0...147
PSEN op4F-14-030	0...42	42...84	84...126	126...168	0...84	0...126	0...168	0...294
PSEN op4F-14-045	0...63	0...126	126...189	189...252	0...126	0...189	0...252	0...441
PSEN op4F-14-060	0...84	84...168	168...252	252...324	0...168	0...252	0...324	0...588
PSEN op4F-14-075	0...105	105...210	210...315	315...420	0...210	0...315	0...420	0...735
PSEN op4F-14-090	0...147	147...294	294...441	441...588	0...294	0...441	0...588	0...882
PSEN op4H-30-015	0...37	37...74	74...110	110...129	0...74	0...110	0...147	0...147
PSEN op4H-30-030	0...74	74...147	147...221	221...276	0...147	0...221	0...294	0...294
PSEN op4H-30-045	0...110	110...221	221...331	331...423	0...221	0...331	0...441	0...441
PSEN op4H-30-060	0...147	147...294	294...441	441...570	0...294	0...441	0...588	0...588
PSEN op4H-30-075	0...147	147...294	294...441	441...588	0...294	0...441	0...588	0...735
PSEN op4H-30-090	0...147	147...294	294...441	441...588	0...294	0...441	0...588	0...882
PSEN op4H-30-105	0...147	147...294	294...441	441...588	0...294	0...441	0...588	0...1029
PSEN op4H-30-120	0...294	294...588	588...882	882...1158	0...588	0...882	0...1176	0...1176
PSEN op4H-30-135	0...221	221...441	441...662	662...882	0...441	0...662	0...882	0...1323
PSEN op4H-30-150	0...294	294...588	588...882	882...1158	0...588	0...882	0...1176	0...1470
PSEN op4H-30-165	0...404	404...809	809...1213	1213...1599	0...809	0...1213	0...1617	0...1617
	inhibited optics	inhibited optics	inhibited optics	inhibited optics	inhibited optics	inhibited optics	inhibited optics	inhibited optics
PSEN op4B-2-050	1°	-----	-----	-----	1°...2°	-----	-----	1°...2°
PSEN op4B-3-080	1°	2°	-----	-----	1°...2°	1°...3°	-----	1°...3°
PSEN op4B-4-090	1°	2°	3°	-----	1°...2°	1°...3°	1°...4°	1°...4°
PSEN op4B-4-120	1°	2°	3°	-----	1°...2°	1°...3°	1°...4°	1°...4°
PSEN op2B-2-050	1°	-----	-----	-----	1°...2°	-----	-----	1°...2°
PSEN op2B-3-080	1°	2°	-----	-----	1°...2°	1°...3°	-----	1°...3°
PSEN op2B-4-090	1°	2°	3°	-----	1°...2°	1°...3°	1°...4°	1°...4°
PSEN op2B-4-120	1°	2°	3°	-----	1°...2°	1°...3°	1°...4°	1°...4°

6.5. Installing the muting sensors

The muting sensors must allow the protected field to be interrupted without shutting down the plant by identifying the conveyed material (pallets, vehicles...), based on length measurements and speed.



Where there are variable transport speeds within the muting area, you must consider the effect this will have on the overall duration of the muting process.

Fig. 24 shows an installation example for a PSEN op2/4 safety device on a conveyor with the relevant muting sensors.

As the package passes through, the ESPE is temporarily suspended via the muting activation sensors A1, A2, B1 and B2. The outputs on these sensors are connected to muting inputs 1 (A1; A2) and 2 (B1; B2) of the receiver on the ESPE.

The contacts for these sensors are monitored via the receiver.

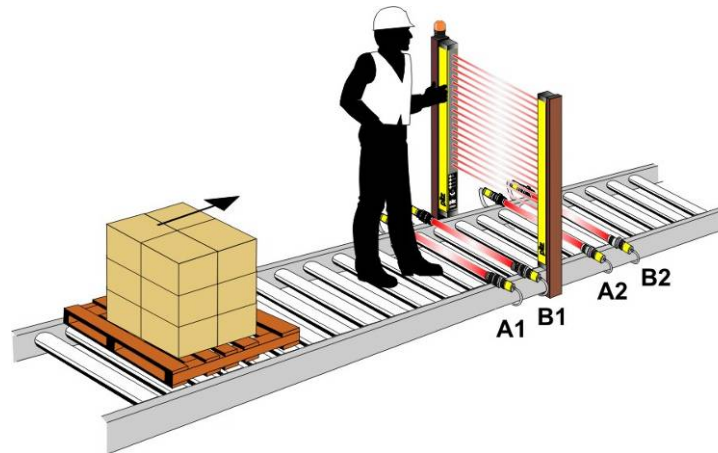
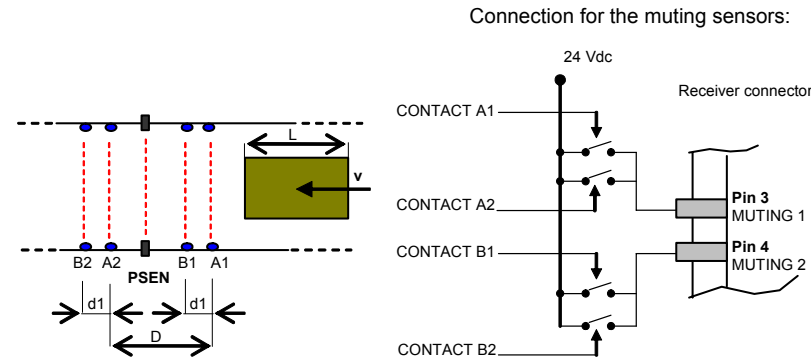


Fig. 24

Optoelectronic, mechanical, proximity sensors etc. can be used as muting sensors, using a closed contact when the object requiring detection is present.

The following configuration examples illustrate the application of the muting function:

- Application with four optoelectronic sensors:



D : Minimum distance for the muting sensors to maintain activation; the length of the package is the key factor: $D < L$.

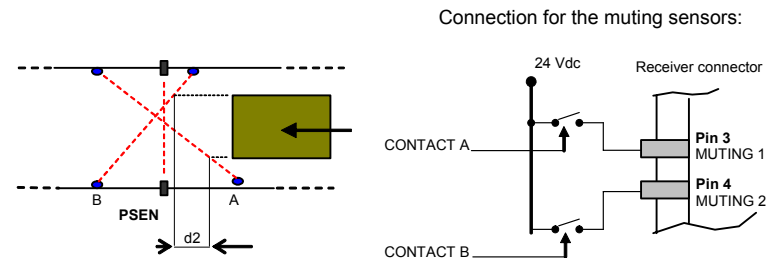
d₁ : Distance required for the muting activation to be accepted; the approach speed of the package is the key factor for this distance:

$$d_{1max.} [cm] = v[m/s] * 0.5[s] * 100$$

$$d_{1min.} [cm] \geq 0.1$$

The cable of the muting sensors must be laid in separate multicore cables.

- **Application with two optoelectronic sensors:**



d_2 : Distance required for the muting activation to be accepted; the approach speed of the package is the key factor for this distance:

$$d_{2max.} [cm] = v[m/s] * 0.5[s] * 100$$

$d_{2min.}$ Should be arranged so that both the muting sensors cross within the monitored area.



- In each case, the muting sensors must be positioned so that a muting function cannot be activated as the result of an operator unintentionally passing by.
- Muting can be activated in 2 ways:
 - Activation of both muting inputs simultaneously
 - Activation of Muting 1 first and then Muting 2, or vice-versa.
- Both activations should occur in a precise time sequence, in which no more than 0.5 s is allowed to elapse between the first and second activation, otherwise muting will not be activated.
- Muting cannot be activated when the ESPE is in "BREAK" mode (red LED is lit, protected field is interrupted).
- The maximum muting period is restricted to 10 minutes. Even if the muting sensors are still activated when this time has elapsed, the muting function will be cancelled and the safety device will return to its normal operating status. The muting function can only be reactivated by repeating the muting activation process described above.

6.6. Override function

This function can be used to force a muting condition, should the machine need to be restarted even though material is interrupting one or more beams. The aim is to clear the danger zone of any material that may have accumulated due to a fault in the operating cycle.

For example, a pallet is in the protected field and the conveyor cannot be switched on because the ESPE (one or more of the beams are interrupted) will not enable its outputs, so the accumulated material cannot be transported away.

Activating the override function enables this type of intervention.

- *Activating the override function*

- Switch the device off.
- Switch the device on.
- Activate the override function: Press the TEST/START button within 10 seconds of switching on the device and keep it held down for about 5 seconds.
- Maximum duration of the override function is 120 seconds. After this time the ESPE will return to its normal operating status, even if the TEST/START button is still pressed. If the button is released before this time has elapsed, the override function will of course switch off immediately.

NOTE: The external control lamp for the active muting or override function should be positioned at a point where it is clearly visible from all sides of the work area.

7. DIAGNOSTIC FUNCTIONS

7.1. Function indicators

4 LEDs on the receiver and 2 LEDs on the transmitter provide the user with information about the operating status of the PSEN safety device (Fig. 25).



Fig. 25

The key to the LEDs on the receiver (RX) depends on the operating mode.

English

7.2. Alignment

In this condition the outputs are OFF.

- **LED SAFE/BREAK:**
 - GREEN LED SAFE is lit;** indicates that the transmitter and receiver are aligned and the protected field is clear.
 - RED LED BREAK is lit;** indicates that the transmitter and receiver are not aligned or an object is breaking the protected field.
- **LED HIGH ALIGN: (yellow) is lit;** indicates optimum alignment between the last transmitter optic and the corresponding receiver optic (top beam on the device).
- **LED LOW ALIGN: (yellow) is lit;** indicates optimum alignment between the last transmitter optic and the corresponding receiver optic (bottom beam on the device).
- **LED POWER ON: (green) is lit;** indicates that power supply to the device is correct.

7.3 Operating mode

- **LED SAFE/BREAK:**
 - GREEN LED SAFE is lit;** indicates that the protected field is clear.
 - RED LED BREAK is lit;** indicates that the protected field is interrupted. In this condition the outputs are OFF.
- **LED HIGH ALIGN: (yellow) permanently lit;** when using an operating mode with reset lock, indicates that the TEST/START button must be operated to restart the device / reset after the protected field has been interrupted.
- **LED LOW ALIGN: (yellow) permanently flashing;** indicates a short circuit at the outputs. This signal is only a warning, the safety device will continue to operate.

The key to the LEDs on the transmitter (**TX**) is as follows.

- **LED SAFE (yellow): is lit;** indicates that the unit is transmitting correctly.
- **LED POWER ON (green): is lit;** indicates that power supply to the device is correct.

7.4. Error messages and diagnostics







The LEDs that display the function can also be used to show operators the main causes of a device failure or defect.

RECEIVER:

	Fault	Possible cause	Checks/remedy
SAFE BREAK HIGH ALIGN LOW ALIGN POWER ON	Red blinking Yellow blinking Green ON	Output malfunction	- Check the output connections. - Check the load on the outputs to make sure it complies with the specifications in the technical details (see Ch. 9).
SAFE BREAK HIGH ALIGN LOW ALIGN POWER ON	OFF Yellow blinking Green ON	Microprocessor malfunction	- Check the correct position of the DIP switches. - Switch the device off and then on again; if the fault persists, contact PILZ.
SAFE BREAK HIGH ALIGN LOW ALIGN POWER ON	OFF OFF Yellow blinking Green ON	Optical fault	- Check the alignment of transmitter and receiver - Switch the device off and then on again; if the fault persists, contact PILZ.
SAFE BREAK HIGH ALIGN LOW ALIGN POWER ON	Green blinking Yellow blinking Green ON	Malfunction of the external muting lamp	- Check the lamp - Check the connections.
SAFE BREAK HIGH ALIGN LOW ALIGN POWER ON	OFF OFF OFF OFF	Power supply failure	- Check the operating voltage; if the fault persists, contact PILZ.
SAFE BREAK HIGH ALIGN LOW ALIGN POWER ON	OFF OFF OFF Green ON	The power supply voltage is out of the allowed range	- Check the operating voltage; if the fault persists, contact PILZ.

English

TRANSMITTER:

	Fault	Possible cause	Checks/remedy
 SAFE  POWER ON	Yellow blinking Green ON	Communication failure	- Check the operating voltage; if the fault persists, contact PILZ.
 SAFE  POWER ON	OFF OFF	Power supply failure	- Check the operating voltage; if the fault persists, contact PILZ.
 SAFE  POWER ON	OFF Green ON	The power supply voltage is out of the allowed range	- Check the operating voltage; if the fault persists, contact PILZ.

8. REGULAR CHECKS AND MAINTENANCE

Qualified personnel must carry out the following checks regularly.
Ensure that:

- Therod is carried out, and remains in the BREAK condition as the rod is passed across the whole protected field.
- The PSEN safety device switches to an OFF state when the TEST/START button is operated (red LED BREAK is lit – signal at the OSSD outputs switches from High to Low - monitored machine switches to a safe condition).
- The reaction time at a machine stop, incl. ESPE reaction time and machine overrun time, is within the limits defined through the calculation of the safety distance (see Ch. 2 “Installation”).
- The minimum safety distance between the danger zone and the protected field is in accordance with the details stated in Ch. 2 “Installation”.
- Nobody can access and remain in the danger zone between the PSEN safety device and the hazardous machine parts.
- The danger zone cannot be accessed from any unprotected area.
- There is no visible damage to the PSEN safety device and/or the external electrical connections.

The interval between such checks depends on the respective application and on the conditions under which the light curtain is operated.

8.1. Maintenance

Safety light curtains in the PSEN series require no particular maintenance, except for cleaning the optical covers. Moist cotton cloths should be used for cleaning.



We recommend that you do not use:

- Alcohol or solvents,
- Cloths made of wool or synthetic material.

8.2. General information and useful data



Safety devices are only beneficial if they are installed correctly, in accordance with the regulations.

If you find that you do not have the necessary expertise to install the safety devices correctly, please contact our technical support.

The devices are protected against short circuit through electronic fuses. Once these have reacted you will need to disconnect the power supply for at least 20 seconds and rectify the short circuit. When you reconnect the power supply the fuses will have reset and the safety device can automatically resume normal operation.

Faults that result in a failure of the power supply may cause the outputs to open temporarily, but do not adversely affect the safe operation of the light curtain.

Install and replace emitter and receiver only in pairs.

Emitter and receiver have the same serial number.

Guideline for repair: Always send both emitter **and** receiver for repair.

(During repair, both units are programmed with the current software version).

9. TECHNICAL DETAILS

Supply voltage:	24 Vdc \pm 20% (SELV/PELV)
Current consumption transmitter (TX):	max. 70 mA / 2.1 W
Current consumption receiver (RX):	100 mA max. (excl. load) / 3 W
Outputs:	2 PNP outputs Short circuit protection 0.68A
Output current:	max. 0.7 A (total for both outputs) max. 0.5 A (for a single output) max. 0.25 A total in the range 45 ... 55°
Output voltage ON min.:	- 2 V of the operating voltage at T=25 °C and nominal load of 50mA per channel
Output voltage OFF max.:	0.1 V
Leakage current:	< 1 mA
Capacitive load (pure):	50 nF max at 24 Vdc + 20% [65 nF at 24 V]
Resistive load (pure):	56 Ω min. at 24 Vac + 20%
Reaction time:	(See table: "Available models")
Transmitter, wavelength:	Infra-red (880 nm)
Resolution:	14 mm finger protection (PSEN op4F) 30 mm limb protection (PSEN op4H) 300...500mm body protection (PSEN op2B/op4B)
Operating range:	0.2...6 m (PSEN op4F), 0.2...15 m (PSEN op4H) 0.5...50 m (PSEN op2B), 0.5...25 m (PSEN op4B)
Category:	Type 2 for PSEN op2 / Type 4 for PSEN op4
Available functions:	Total muting/ partial muting/ override Automatic/manual reset
Time limits:	Muting: 10 minutes / override: 2 minutes
Operating temperature:	-10...+55 °C
Storage temperature:	-25...+70 °C
Humidity:	15...95 % (non-condensing)
Protection class:	Class 1 / Class 3 (** see note)
Protection type:	IP65 (EN 60529)
Ambient brightness:	IEC-61496-2
Vibration:	Amplitude 0.35 mm, frequency 10 ... 55 Hz, 20 sweeps for all axes; 1 octave/min., (EN 60068-2-6)
Shock resistance:	16 ms (10 G) 1,000 shocks for all axes (EN 60068-2-29)
Reference standards:	EN 61496-1; prEN 61496-2
Housing material:	Varnished aluminium (yellow RAL 1003)
Material of upper and lower cover:	PC MAKROLON
Material for optics:	PMMA
Connections:	4-pin M12 connector on TX 8-pin M12 connector on RX
Cable runs:	50 m max. (*see note) (at 50 nF capacitive load and Vdc = 24 V)
Muting control lamp:	Lamp 24 V 3W min. (125 mA) / 7W max. (300 mA)
Weight:	1.2 Kg max. / m per unit

* = The same specifications must be met if a longer cable is used.

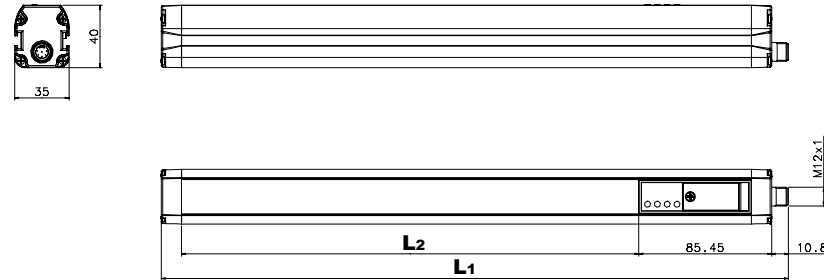
** Protection class	Class 1	Class 3
Protective earth	Mandatory	Not permitted
Symbol for protective earth	Mandatory	Not permitted
Protection through low voltage power supply (SELV and PELV)	Recommended	Mandatory

10. LIST OF AVAILABLE MODELS

Model	Length of sensing area	Length of protected area	No. of beams	Resolution (mm)	Reaction time (ms)	Operating range (m)
PSEN op4F-14-015	147	161	21	14	18	0.2...6
PSEN op4F-14-030	294	308	42		22	0.2...6
PSEN op4F-14-045	441	455	63		26	0.2...6
PSEN op4F-14-060	588	602	84		31	0.2...6
PSEN op4F-14-075	735	749	105		35	0.2...6
PSEN op4F-14-090	882	896	126		40	0.2...6
PSEN op4H-30-015	147	180	8	30	15	0.2...15
PSEN op4H-30-030	294	327	16		17	0.2...15
PSEN op4H-30-045	441	474	24		18	0.2...15
PSEN op4H-30-060	588	621	32		20	0.2...15
PSEN op4H-30-075	735	768	40		22	0.2...15
PSEN op4H-30-090	882	915	48		23	0.2...15
PSEN op4H-30-105	1029	1062	56		25	0.2...15
PSEN op4H-30-120	1176	1209	64		27	0.2...15
PSEN op4H-30-135	1323	1356	72		28	0.2...15
PSEN op4H-30-150	1470	1503	80		30	0.2...15
PSEN op4H-30-165	1617	1650	88	32	0.2...15	
PSEN op2B-2-050	515	n.a.	2	515	14	0.5...50
PSEN op2B-3-080	815	n.a.	3	415	14	0.5...50
PSEN op2B-4-090	915	n.a.	4	315	14	0.5...50
PSEN op2B-4-120	1215	n.a.	4	415	14	0.5...50
PSEN op4B-2-050	515	n.a.	2	515	14	0.5...25
PSEN op4B3-080	815	n.a.	3	415	14	0.5...25
PSEN op4B-4-090	915	n.a.	4	315	14	0.5...25
PSEN op4B-4-120	1215	n.a.	4	415	14	0.5...25

11. OVERALL DIMENSIONS

All dimensions are stated in mm.



English

MODEL	L1 (mm)	L2 (mm)
PSEN op4F-14-015	256	147
PSEN op4F-14-030	403	294
PSEN op4F-14-045	550	441
PSEN op4F-14-060	697	588
PSEN op4F-14-075	844	735
PSEN op4F-14-090	991	882

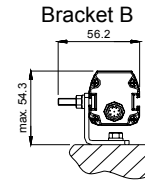
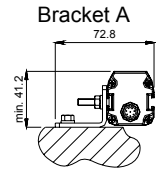
MODEL	L1 (mm)	L2 (mm)
PSEN op2B-2-050	652	543
PSEN op2B-3-080	952	843
PSEN op2B-4-090	1052	943
PSEN op2B-4-120	1352	1243
PSEN op4B-2-050	652	543
PSEN op4B-3-080	952	843
PSEN op4B-4-090	1052	943
PSEN op4B-4-120	1352	1243

MODEL	L1 (mm)	L2 (mm)
PSEN op4H-30-015	256	147
PSEN op4H-30-030	403	294
PSEN op4H-30-045	550	441
PSEN op4H-30-060	697	588
PSEN op4H-30-075	844	735
PSEN op4H-30-090	991	882
PSEN op4H-30-105	1138	1029
PSEN op4H-30-120	1285	1176
PSEN op4H-30-135	1432	1323
PSEN op4H-30-150	1579	1470
PSEN op4H-30-165	1726	1617

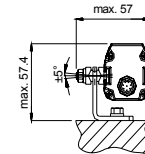
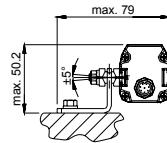
12. ACCESSORIES

Mounting bracket

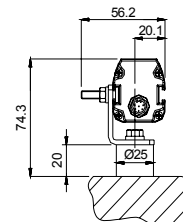
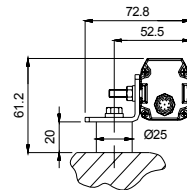
MODEL	DESCRIPTION
Bracket kit PSEN 4	(1) Angle bracket (4-part kit)
Bracket kit PSEN 4 anti vibr.	(2) Anti-vibration brackets (4-part kit)
Bracket kit PSEN 4 adjust.	(3) justable brackets (4-part kit)



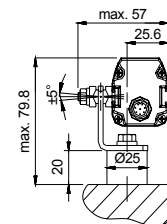
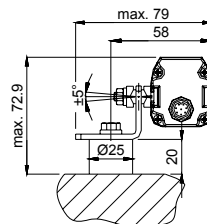
Standard angle bracket (1)



Standard angle bracket + adjustable bracket (1+3)



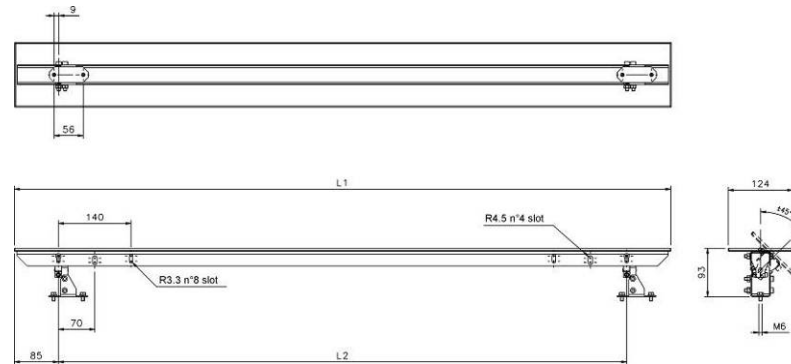
Standard angle bracket + anti-vibration bracket (1+2)



Standard angle bracket + adjustable bracket + anti-vibration bracket (1 + 2 + 3)

Deviating mirrors

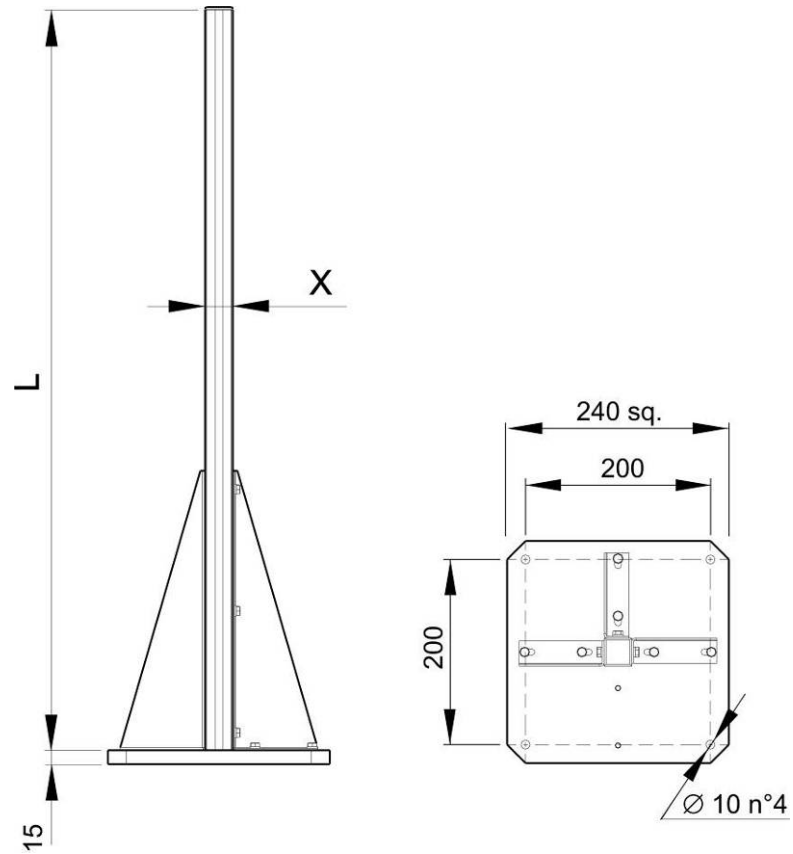
MODEL	DESCRIPTION	L ₁ (mm)	L ₂ (mm)
Mirror 550mm	Deviating mirror H= 550 mm	554	384
Mirror 700mm	Deviating mirror H= 700 mm	704	534
Mirror 900mm	Deviating mirror H= 900 mm	904	734
Mirror 1000mm	Deviating mirror H= 700 mm	1004	834
Mirror 1270mm	Deviating mirror H= 1270 mm	1264	1094



English

Floor brackets

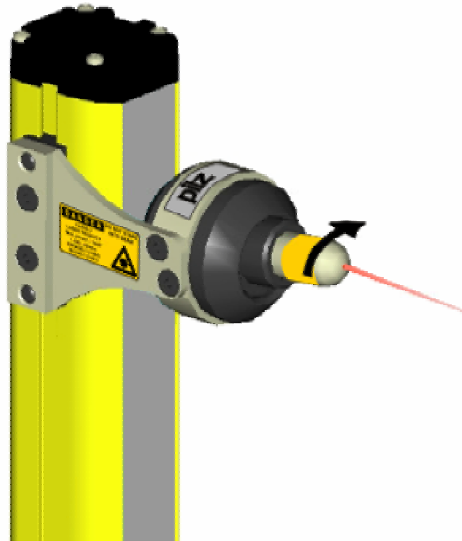
MODEL	DESCRIPTION	L (mm)	X (mm)
Stand 1000mm	Floor brackets H= 1000 mm	1000	30x30
Stand 1200mm	Floor brackets H= 1200 mm	1200	30x30
Stand 1500mm	Floor brackets H= 1500 mm	1500	45x45
Stand 1800mm	Floor brackets H= 1800 mm	1800	45x45



Laser pointer

The laser pointer in the PSEN op2/4 series is a valuable guide when aligning and installing the safety light curtains. The pointer can be moved along the light curtain profile to check the whole alignment of the safety device.

MODEL	DESCRIPTION
LaserPointer for PSEN 4/2	Laserpointer for alignment



English