MAYSER®

Innovative by tradition.

Safety bumper SB

EN | Product information

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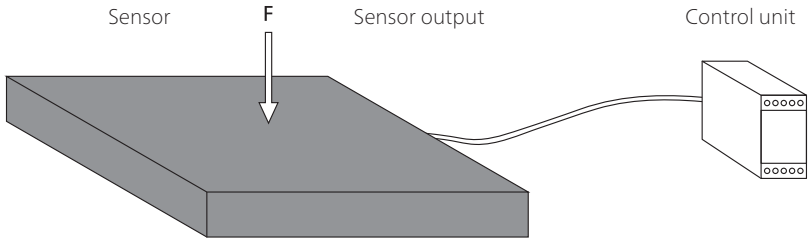
Definitions

Pressure-sensitive protection device

A pressure-sensitive protection device consists of one or more pressure-sensitive sensors, a signal processing unit, and one or more output signal switching devices. The control unit is made up of the signal processing unit and output signal switching device(s). The pressure-sensitive protection device is triggered when the sensor is activated.

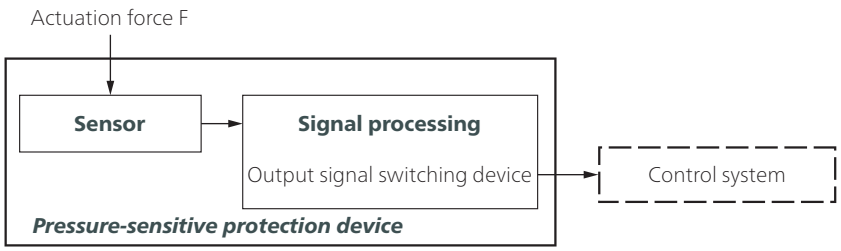


Sensor

The sensor is the part of the pressure-sensitive protection device that generates a signal when the actuation force F is applied. Mayser safety systems feature a sensor whose actuation area is deformed locally.

Signal processing

The signal processing unit is the part of the pressure-sensitive protection device that converts the output signal of the sensor and controls the status of the output signal switching device. The output signal switching device is the part of the signal processing unit which is connected to the downstream control system and which transmits safety output signals such as STOP.

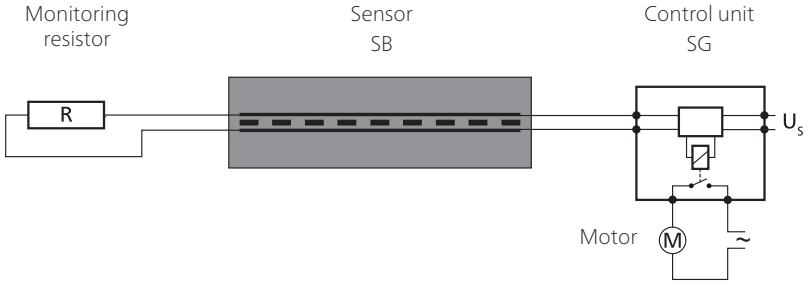


Tip: Terms are defined in ISO 13856-3 Section 3.

Criteria for selecting the sensor type

- Category according to ISO 13849-1
- Performance level of the pressure-sensitive protection device = at least PL_r
- Temperature range
- Degree of protection in accordance with IEC 60529:
  IP53 is standard for safety bumpers (it is important to pay attention to the installation position).
  Higher degrees of protection must be checked individually.
- Environmental influences such as swarf, oil, coolant, outdoor use…

Operation principle of 2-wire technology



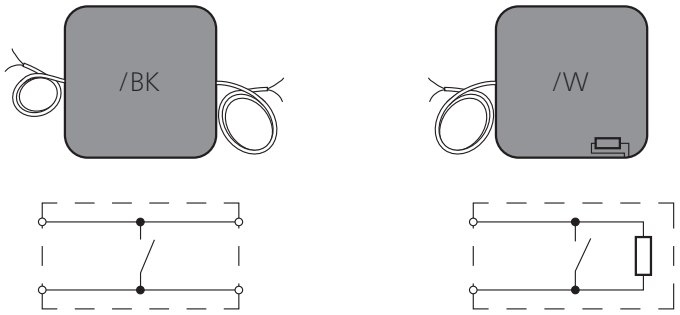
The monitoring resistor must be compatible with the control unit. The standard type is 8k2.

For your safety:
The sensor and connection cables are constantly monitored to ensure they are functioning correctly. Monitoring relies on controlled bridging of the contact surfaces with a monitoring resistor (closed-circuit principle).

Types

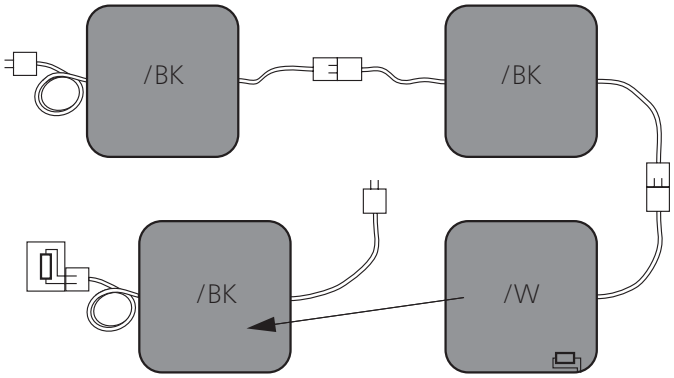
/BK With cables on both sides for use as a through sensor or with an external monitoring resistor for use as an end sensor

/W With an integrated monitoring resistor for use as an end sensor



Subject to technical modifications.

Sensor combination

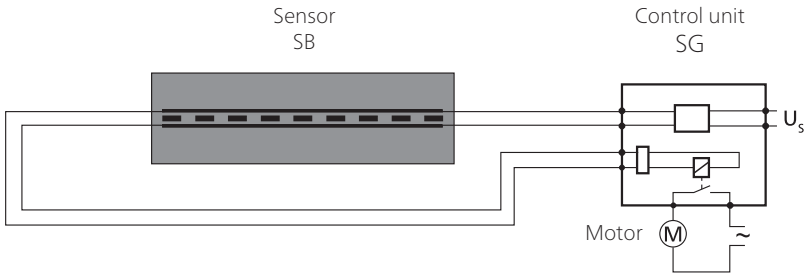


Version with external resistor, therefore no variety of models

Combination:

- Connection of more than one sensor
- Only one control unit required
- Bumper design can be customised in terms of depth and shape

Operation principle of 4-wire technology



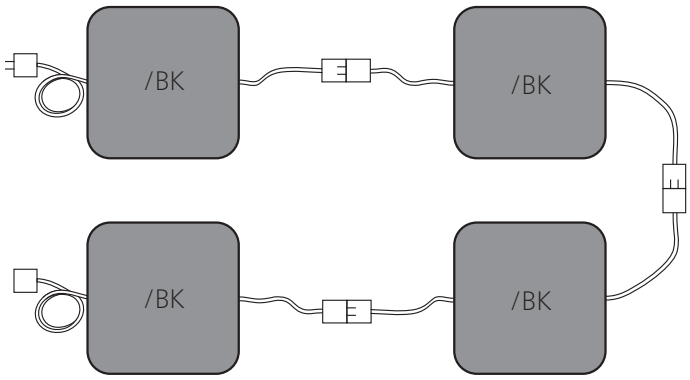
The 4-wire technology can only be used together with control unit SG-EFS 104/4L.

For your safety:
The sensor and connection cables are constantly monitored to ensure they are functioning correctly. Monitoring relies on signal transmission feedback – without a monitoring resistor.

Types

/BK With cables on both sides for use as a through sensor

Sensor combination



Combination:

- Connection of more than one sensor
- Only one control unit required
- Bumper design can be customised in terms of depth and shape

Subject to technical modifications.

Safety

Intended use

A safety bumper detects a person or part of the body when pressure is applied to the effective actuation area. It is a linear tripping device. Its purpose is to prevent possible hazardous situations that could affect someone within a danger zone, such as shearing and pinching edges.
Typical areas of application are: AGV systems, hangar doors, aerial platforms and gantry cranes.
Safe operation of a safety bumper depends entirely on

- the surface condition of the mounting surface,
- the correct selection of the size and resistance rating as well as
- correct installation.

For additional application guidance, please refer to ISO 13856-3 Annex D.

Due to the design, the actuation area is actually smaller than it looks because of the non-sensitive edges. Once these have been allowed for, what remains is the effective actuation area (see chapter *Effective actuation area*).

Limits

- No more than 10 /BK-type sensors can be connected to one control unit.
- No more than 9 /BK-type sensors and 1 /W-type sensor can be connected to one control unit.

Exclusions

The safety bumper is not suitable for:

- Detecting fingers

Other safety aspects

The following safety aspects relate to pressure-sensitive protection devices consisting of a sensor and a control unit.

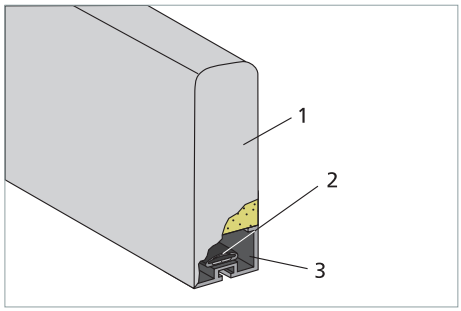
Performance Level (PL)
The PL has been determined using the procedure defined by ISO 13849-1.
Fault exclusion according to ISO 13849-2 Table D.8: Non-closing of contacts in the case of pressure-sensitive protection devices according to ISO 13856. In this case, the diagnostic coverage (DC) is not calculated or taken into account when determining the PL. Assuming a high $MTTF_D$ value for the control unit, a performance level of up to PL d can be achieved by the safety bumper system (pressure-sensitive protection device) as a whole.

Is the protection device suitable?
First, the integrator must decide what PL_r is required for the hazard. After that, they must select the protection device.
Finally, the integrator needs to check whether the category and PL of the selected protection device are appropriate.

Risk and safety assessment
For the risk and safety assessment of your machine, we recommend ISO 12100 "Safety of machinery — General principles for design".

Without reset function
When a protection device without reset function is used (automatic reset), the reset function must be provided in some other way.

Design

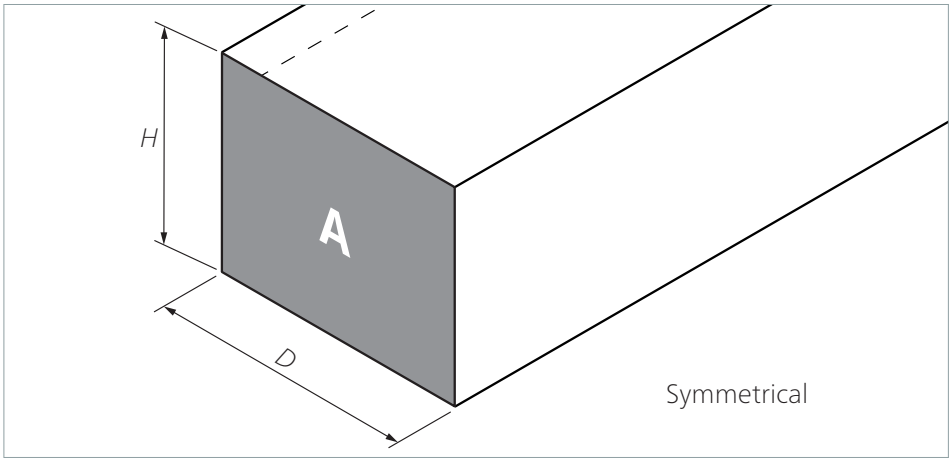


The safety bumper consists of a sensor (1 to 3) –
(1) foam with casing,
(2) switch element,
(3) aluminium mounting plate –
and an evaluating control unit SG.

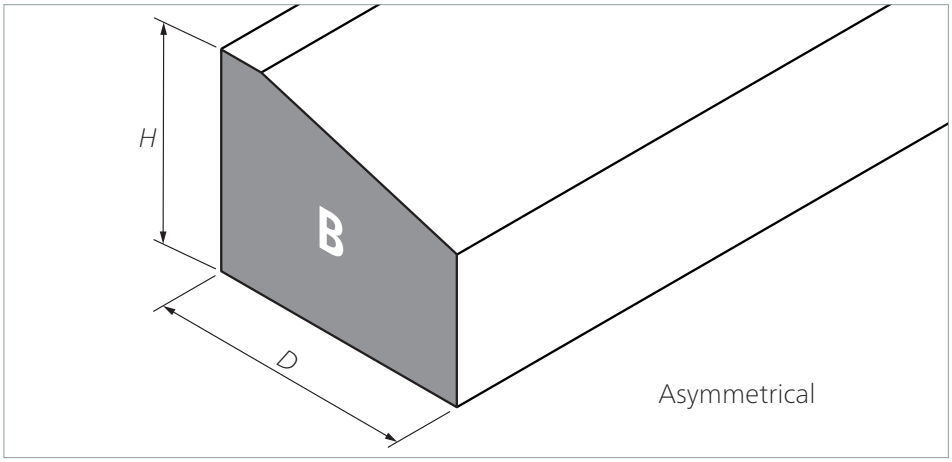
Subject to technical modifications.

Cross sections

Cross section A



Cross section B



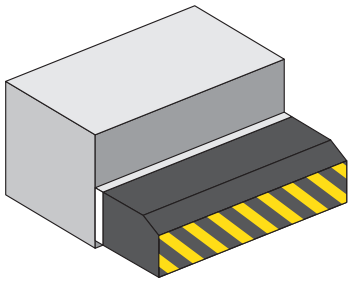
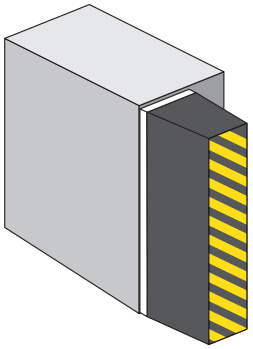
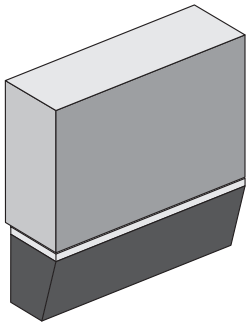
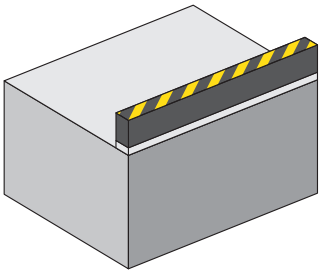
Cross section and aluminium mounting plate combinations

	Alum. mount. pl. C 40	Alum. mount. pl. C 100	Alum. mount. pl. C 150
Cross section A	●		
Cross section B		●	●
Height H	40 mm	100 mm	150 mm
Depth D (max.)	130 mm	250 mm	300 mm

Subject to technical modifications.

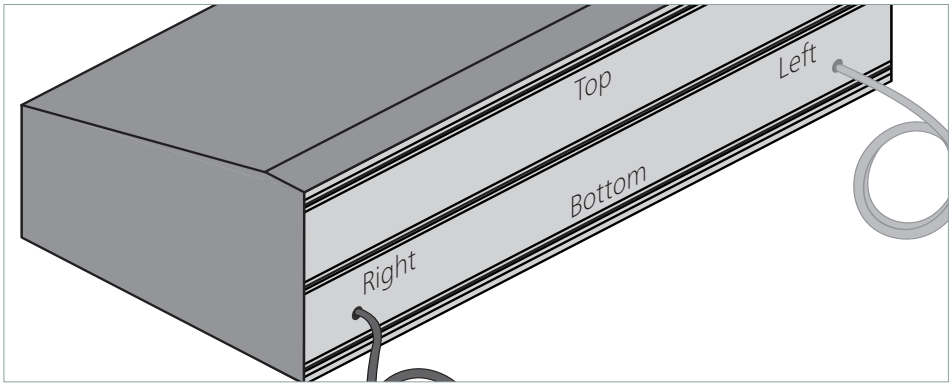
Installation position

The installation position can be selected as required, i.e. all installation positions necessitated by the application are possible.
The preferred installation positions are:

Horizontal	Vertical
	
Hanging down	**Standing upright**
	

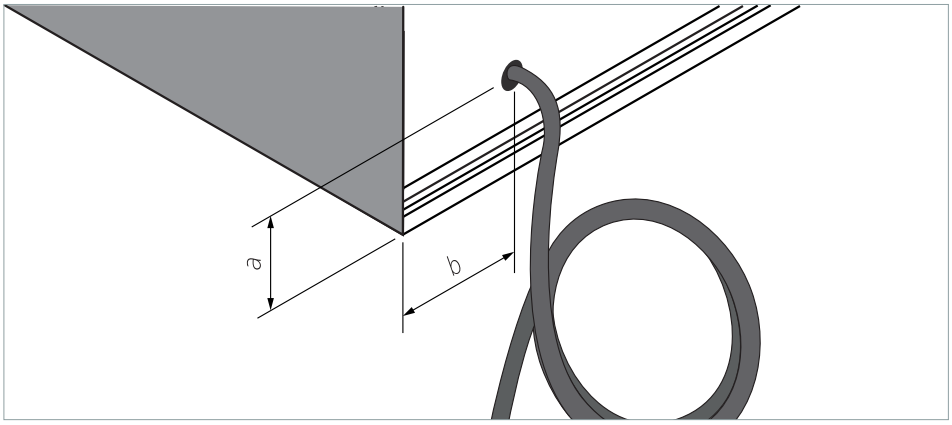
Connection

Cable exits



SB/W: cable exit located on bottom right (standard), optionally on bottom left
SB/BK: cable exits located on bottom right **and** bottom left (standard)

Standard cable exit: position



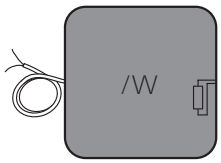
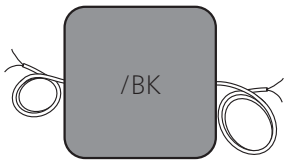
Distance from edges:

	C 40	C 100	C 150	
a	8 mm	25 mm	25 mm	
b	50 mm	50 mm	50 mm	

Other cable exits can be provided on request.

Cable connection

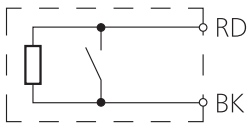
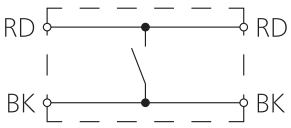
- Standard cable lengths
  L = 2.5 m
- Maximum total cable length to the control unit
  L_{max} = 100 m
- Cable ends: stripped wires
  Optional: cable ends available with plug and coupling

/W-type sensor with 1 line	/BK-type sensor with 2 lines
• As an individual /W-type sensor or a /W-type end sensor • Integrated resistor • 1 two-wire cable	• As a /BK-type through sensor • Without resistor • 2 two-wire cables
	

Wire colours

Colour coding

BK	Black
RD	Red

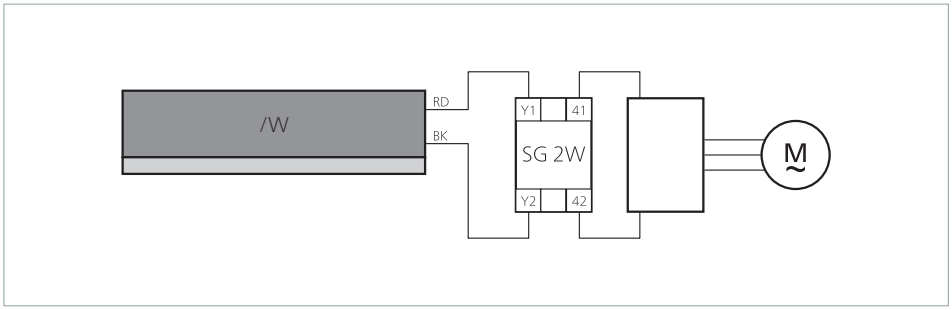
/W-type sensor with 1 line	/BK-type sensor with 2 lines
	

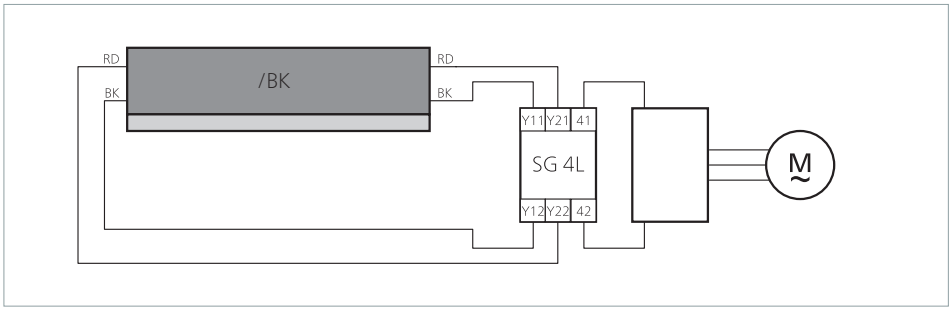
Subject to technical modifications.

Connection examples

Key:

SG 2W	Evaluation with 2-wire technology
SG 4L	Evaluation with 4-wire technology





Subject to technical modifications.

Sensor surface

Each sensor has a sleeve for mechanical protection. This protects the foam structure and inner parts, and prevents the ingress of dirt and moisture.

Polyester sleeve (standard)

Areas of application:

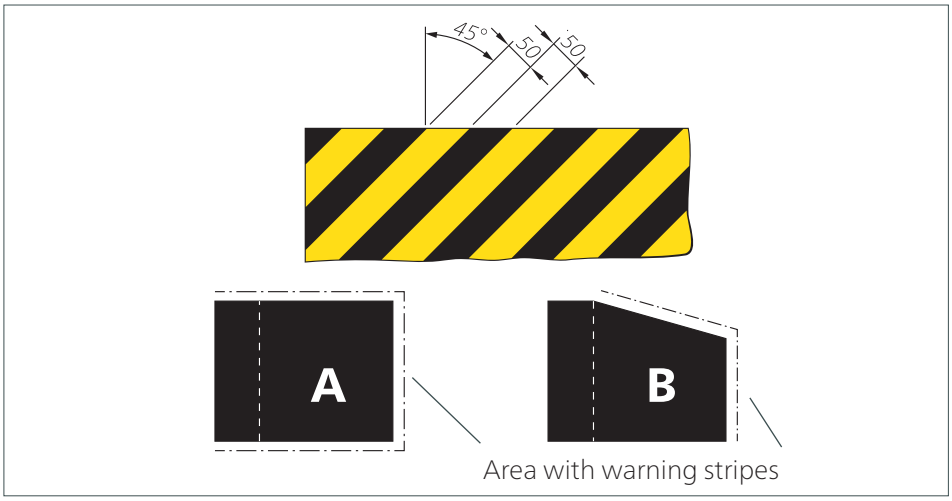
- Indoors
- Outdoors with additional sealing
- Heavy mechanical loads

Colour

- Standard: plain yellow

Optional:

- Black warning stripes
- Red "No entry" symbol



Subject to technical modifications.

Optional sleeves

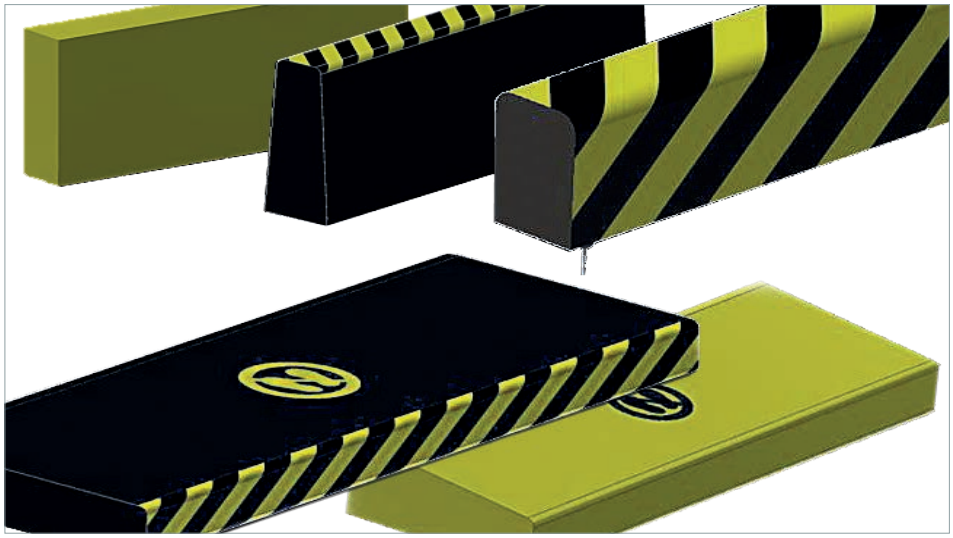
PUR skin

- For dry indoor environments
- Normal mechanical loads
- Tight-fitting skin around foam

Colour:

- Black (similar to RAL 9005)
- Yellow (similar to RAL 1021)
- Black and yellow warning stripes
- Black or yellow "No entry" symbol

Optional: other colours, colour combinations, logos or symbols (including in RAL colours)



Additional sleeve options

- Synthetic leather: for environments with high aesthetic requirements
- Welding protection sleeve: good resistance to flying sparks and hot swarf

Resistance

The resistance ratings listed below (at a room temperature of 23 °C) depend on the sensor having an undamaged surface.

Physical resistance

	PE / PES	PUR
UV resistance	Yes	Yes
Impregnation (fluorocarbons)		
Water, oil and dirt-repellent	Yes	No

Chemical resistance

The sensor is broadly resistant to normal chemical influences such as diluted acids and alkalis, as well as alcohol, over an exposure period of 24 hrs.

The values in the table are the results of tests carried out in our laboratory. You must always conduct your own practical tests to verify that our products are suitable for your specific area of application.

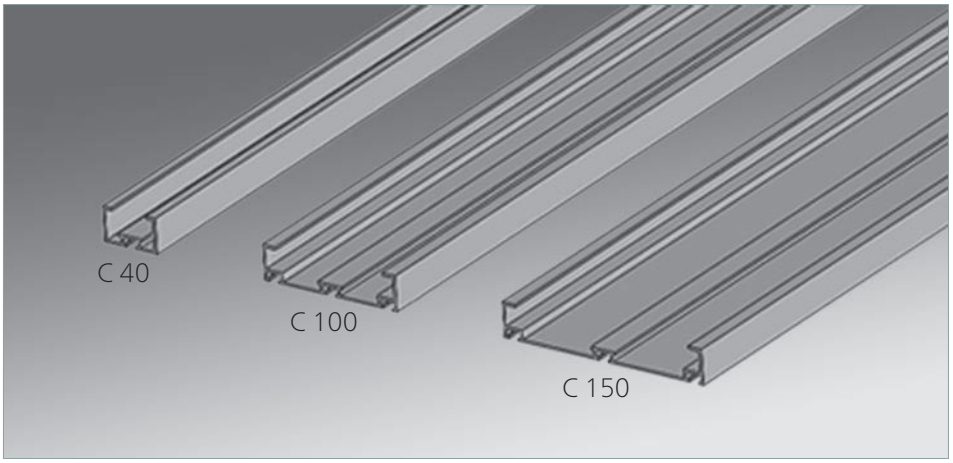
Explanation of symbols:
+ = resistant
± = resistant to a certain extent
– = not resistant

	PE / PES	PUR	Synthetic leather	Welding protection sleeve
Acetone	±	–	–	+
Formic acid 10%	+	+	±	–
Petrol	+	+	–	+
Disinfectant	+	–	–	+
Diesel fuel	+	+	–	+
Acetic acid 10%	+	±	±	–
Ethanol 95%	+	–	–	+
Ethyl acetate	±	–	–	+
Gearbox oil	+	+	–	+
Hydraulic oil	+	+	±	+
Isopropanol	+	+	–	+
Cooling lubricant	+	+	–	+
Tap water	+	+	+	+
Engine oil	+	+	–	+
Sodium hydroxide 10%	–	–	–	–
Sulphuric acid 10%	+	+	±	–
Washing-up liquid	+	+	+	+

Subject to technical modifications.

Fixing

Safety bumper SB products are mounted directly on the impact surfaces that pose a danger. Aluminium mounting plates are used to support them and fix them in place. The aluminium mounting plates can be fixed in place by using T-nuts, hammer nuts, or M6 hexagon bolts in conjunction with the integrated 6 mm groove. The following rule applies: the higher the aluminium mounting plate, the greater the depth (D) possible for the safety bumper.



Material properties

- AlMgSi0.5 F22
- Wall thickness: at least 2.0 mm, extruded
- Hot hardened
- Tolerances as per EN 755-9

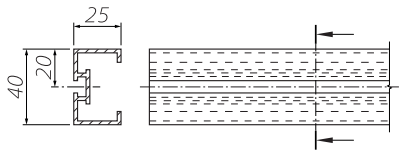
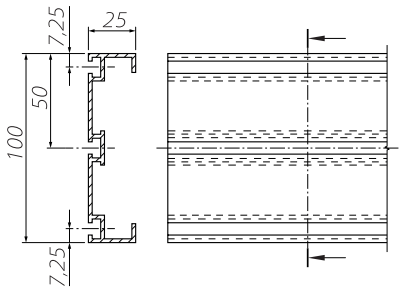
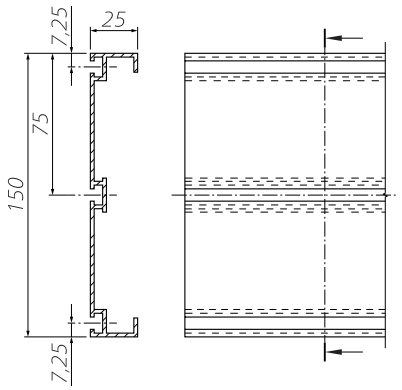
Aluminium mounting plates: Fixing types

Standard profile

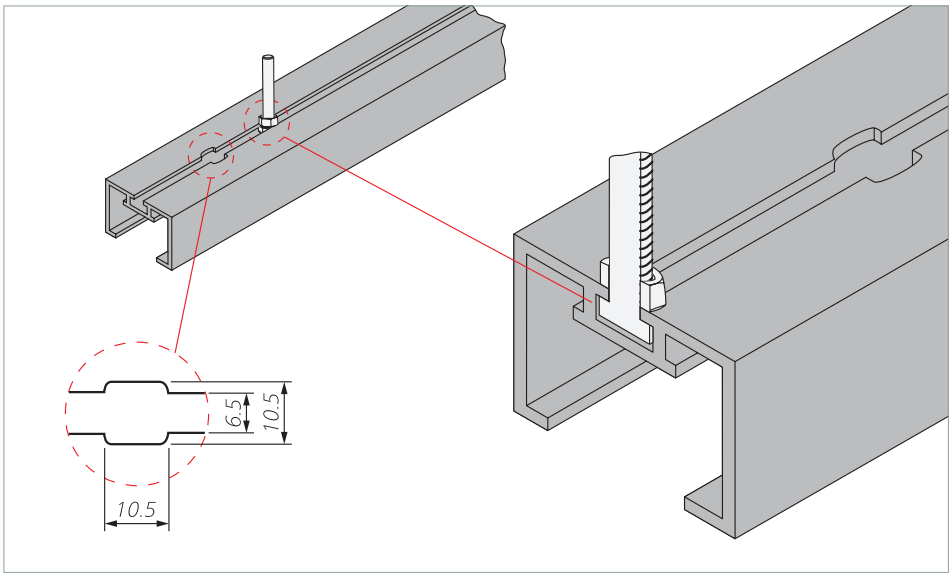
C 40	C 100	C 150
		

Subject to technical modifications.

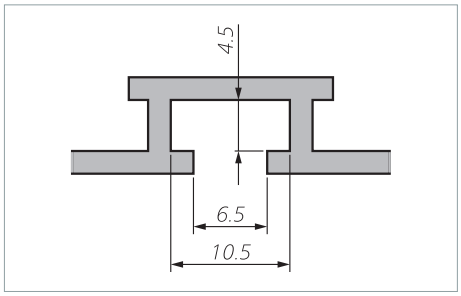
Aluminium mounting plates: Dimensions

Standard profile	1:2
C 40 	C 100 
C 150 	

Fixing groove



Dimensions and quantities



	Quantity
C 40	1×
C 100	3×
C 150	3×

Standard: fixed using T-nut, hammer nut, M6 hexagon bolt or M6 nut.

SB: Making the right selection

Calculation for selecting the safety bumper depth

The stopping distance of the dangerous movement is calculated using the following formula:

$s_1 = 1/2 \times v \times T$ where: $T = t_1 + t_2$

- s_1 = Stopping distance of the dangerous movement [mm]
- v = Velocity of the dangerous movement [mm/s]
- T = Follow-through time of the complete system [s]
- t_1 = Safety bumper response time
- t_2 = Stopping time of the machine
- s = Minimum overtravel distance of the safety bumper to ensure that the stipulated limit forces are not exceeded [mm]
- C = Safety factor; if components susceptible to failures (braking system) exist in the system, a higher factor must be selected.

In accordance with ISO 13856-3, the minimum overtravel distance of the safety bumper is calculated using the following formula:

$s = s_1 \times C$ where: $C = 1.2$

A suitable safety bumper can now be selected based on the result.
For details of the overtravel distances for safety bumpers, see chapter "Technical data".

Calculation examples

Calculation example 1

The dangerous movement on a 1.5 m wide vehicle has a velocity of v = 0.25 m/s and can be brought to a standstill within t_2 = 1.2 s. The safety bumper response time (sensor + control unit*) is t_1 = 220 ms.

$s_1 = 1/2 \times v \times T$ where: $T = t_1 + t_2$
$s_1 = 1/2 \times 250$ mm/s $\times$ (0.22 s + 1.2 s)
$\mathbf{s_1} = 1/2 \times 250$ mm/s $\times$ 1.42 s = **178 mm**

$s = s_1 \times C$ where: $C = 1.2$
s = 178 mm $\times$ 1.2 = **213 mm**

The safety bumper must have a minimum overtravel distance of s = 213 mm. A safety bumper with a depth of 250 mm ensures the required overtravel distance.
Result: A safety bumper measuring 1500 × 100 × 250 mm (W × H × D) is **suitable** for this case.

Calculation example 2

The same conditions apply as in calculation example 1 with the exception of the velocity and the stopping time. Instead, these are now v = 0.3 m/s and t_2 = 1.3 s. The safety bumper response time (sensor + control unit*) is t_1 = 220 ms.

$s_1 = 1/2 \times v \times T$ where: $T = t_1 + t_2$
$s_1 = 1/2 \times 300$ m/s $\times$ (0.22 s + 1.3 s)
$s_1 = 1/2 \times 300$ m/s $\times$ 1.52 s = 228 mm

$s = s_1 \times C$ where: $C = 1.2$
s = 228 mm $\times$ 1.2 = **274 mm**

The safety bumper must have a minimum overtravel distance of s = 274 mm.

* Assumption: Typical reaction time of a control unit = 20 ms

The safety bumper selected in calculation example 1 is unable to provide this minimum overtravel distance.
Result: A safety bumper measuring 1500 × 100 × 250 mm (W × H × D) is **not suitable** for this case.

Calculation example 3
The same conditions apply as in calculation example 2. Instead of the safety bumper measuring 1500 × 100 × 250 mm (W × H × D), a safety bumper measuring 1500 × 150 × 300 mm (W × H × D) is selected. The safety bumper response time (sensor + control unit*) is t_1 = 220 ms.

$s_1 = 1/2 \times v \times T$ where: $T = t_1 + t_2$
$s_1 = 1/2 \times 300$ m/s × (0.22 s + 1.3 s)
$\mathbf{s_1} = 1/2 \times 300$ m/s × 1.52 s = **228 mm**

$s = s_1 \times C$ where: C = 1.2
s = 228 mm × 1.2 = **274 mm**

The safety bumper must have a minimum overtravel distance of s = 274 mm. A safety bumper with a depth of 300 mm ensures the required overtravel distance.
Result: A safety bumper measuring 1500 × 150 × 300 mm (W × H × D) is **suitable** for this case.

* Assumption: Typical reaction time of a control unit = 20 ms

Customised designs

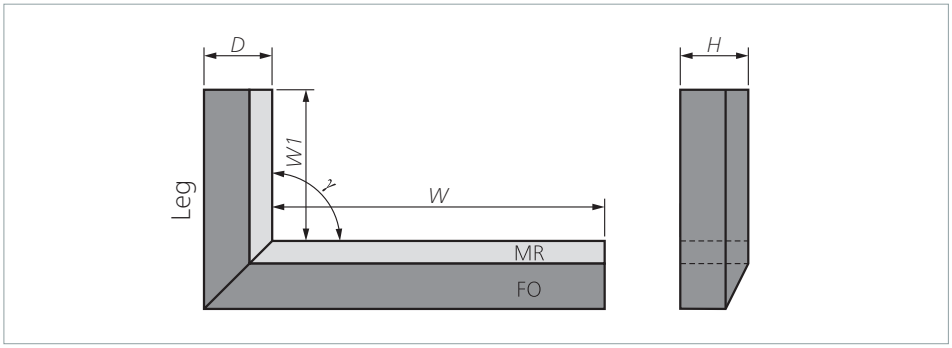
In addition to the standard range, special solutions are also possible, such as:

L shape

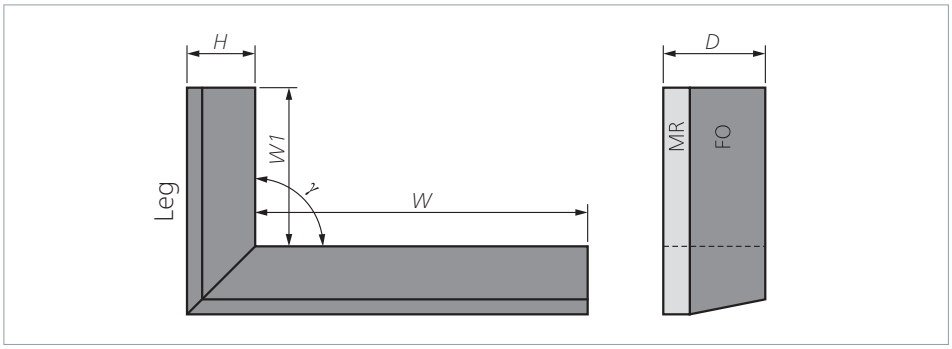
- Depth (D) is the same in the case of W and W1
- Leg angle γ : 90°/120°/135°/150°

Horizontal

MR = mounting plate
FO = foam



Vertical



Possible installation positions

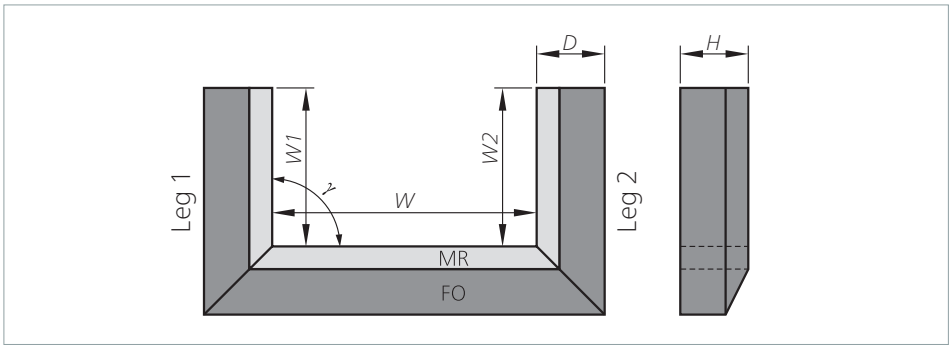
	L shape
Horizontal	●
Vertical	●
Hanging down	●
Standing upright	●

U shape

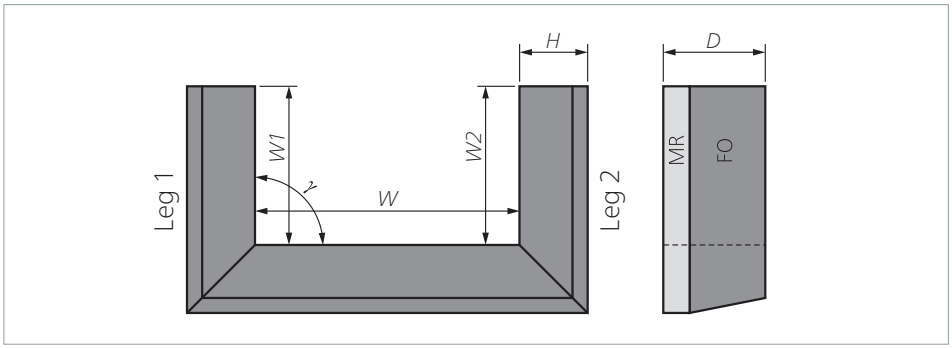
- Depth (D) is the same in the case of W, W1 and W2
- Leg angle γ : 90°/120°/135°/150°

MR = mounting plate
FO = foam

Horizontal



Vertical

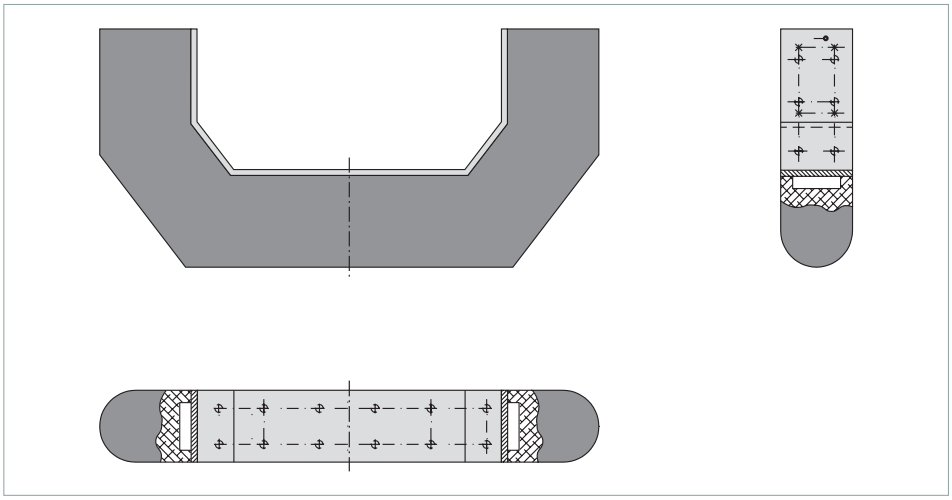


Possible installation positions

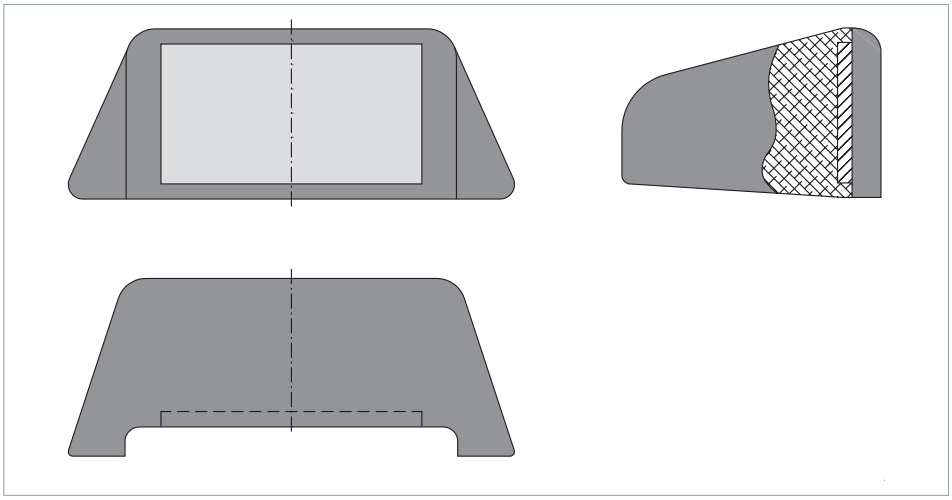
	U shape
Horizontal	●
Vertical	●
Hanging down	●
Standing upright	●

Additional options

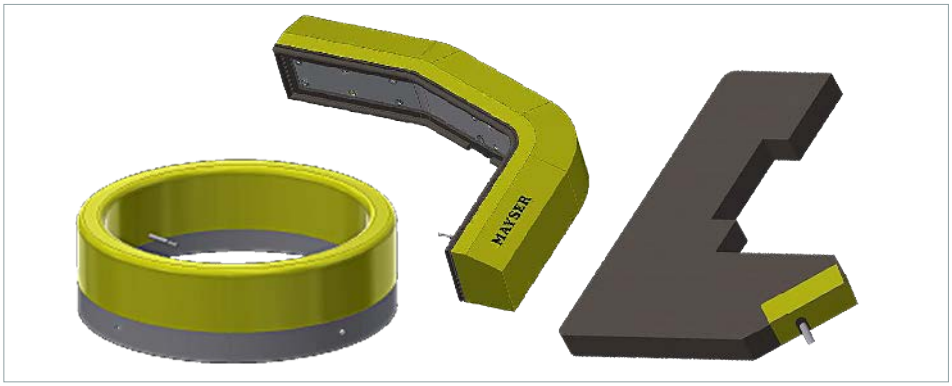
Extended U shape



Trapezium shape



Additional shapes



Other mounting plates

Optional: Customer-specific mounting plates can be provided on request.

Maintenance and cleaning

The sensor is virtually maintenance-free.
The control unit also monitors the sensor at the same time.

Regular inspection

Depending on the operational demands, the sensors must be inspected at regular intervals (at least monthly)

- for proper functioning,
- for damage and
- for correct mounting.

Cleaning

If the sensors become dirty, they can be cleaned with a mild cleaning product.

Technical data

	Safety bumper SB/W with control unit SG-EFS 104/2W	Safety bumper SB/BK with control unit SG-EFS 104/4L	Sensor* SB/W or SB/BK (without control unit)
Testing basis	EN 12978, ISO 13849-1, ISO 13856-3		ISO 13856-3
Switching characteristics at v_{test} = 100 mm/s			
Switching operations at 0.1 A	> 1× 10^5	> 1× 10^5	> 1× 10^5
Actuation forces			
Test piece (rod) □ 45 mm	< 600 N	< 600 N	< 600 N
Test piece (cylinder) Ø 80 mm	< 150 N	< 150 N	< 150 N
Actuation angle	±45°	±45°	±45°
Response time	215 ms	230 ms	200 ms
Actuation distance	21.5 mm	23 mm	20 mm
Overtravel distance	94.5 mm	93 mm	96 mm
Safety classifications			
ISO 13856: reset function	With/without	With/without	–
ISO 13849-1:2015	Category 3 PL d	Category 3 PL d	Category 1
$MTTF_D$ (pressure-sensitive protection device)	257 a	73 a	–
B_{10D} (sensor)	6× 10^6	6× 10^6	6× 10^6
n_{op} (assumption)	52560/a	52560/a	–
Mechanical operating conditions			
Sensor length	100 to 3000 mm		100 to 3000 mm
Sensor depth	70 to 300 mm		70 to 300 mm
Cable length (min./max.)	10 cm / 100 m		10 cm / 100 m
IEC 60529: degree of protection			
Sensor (outdoors with lip seal)	IP54		IP54
Control unit	IP20		–
Operating temperature			
Individual sensor	–20 to +55 °C		–20 to +55 °C
Electrical operating conditions			
Terminal resistance (standard)	8k2 ±1%	–	/W: 8k2 ±1%; /BK: –
Nominal output (max.)	250 mW	–	/W: 250 mW; /BK: –
Contact transition resistance	< 400 ohms (per sensor)		< 400 ohms (per sensor)
Number of sensors	Max. 10 in series (9× /BK + 1× /W)	Max. 10 in series (10× /BK)	Max. 10 in series (9× /BK + 1× /W)
Dimensional tolerances			
Length dimension	General tolerances as per Mayser company standard MWN003		

* If you combine sensors with control units and thereby place pressure-sensitive protection devices on the market, you should observe the basic requirements according to ISO 13856.
As well as meeting technical requirements, this also means – in particular – observing any that relate to marking and information for use.
Declarations of Conformity only apply to pressure-sensitive protection devices. In the case of sensors that are going to be used to make pressure-sensitive protection devices, Declarations of Incorporation are issued instead.

Conformity

CE

The CE symbol indicates that this Mayser product complies with the relevant EC directives and that the stipulated conformity assessments have been carried out.

The design type of the product complies with the basic requirements of the following directives:

- 2006/42/EC (Safety of Machinery)
- 2011/65/EU (RoHS)
- 2014/30/EU (EMC)

The Declaration of Conformity is available in the Downloads section of our website: www.mayser.com/de/download.