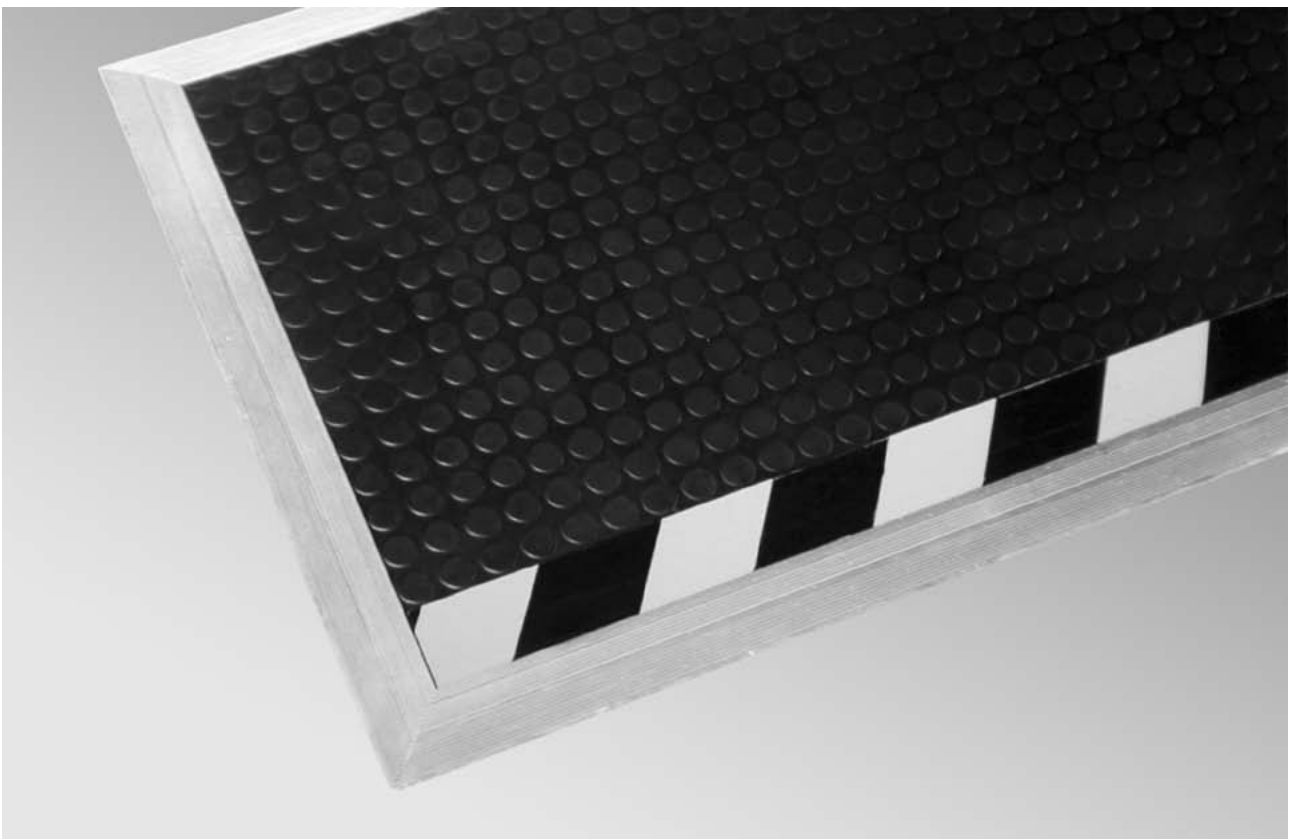




## Product information



## Safety Mats SM

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## Table of contents

<b>Definitions</b> .....	<b>2.3</b>
Intended use.....	2.3
Limits .....	2.3
Exclusions .....	2.3
Program selection .....	2.3
<b>Design</b> .....	<b>2.4</b>
Available sizes .....	2.4
Non-sensitive zone along edges .....	2.5
<b>Connection</b> .....	<b>2.5</b>
Cable exit.....	2.5
Wire colours.....	2.6
Cable connection.....	2.6
<b>Surface Toppings</b> .....	<b>2.7</b>
Rubber surface toppings .....	2.8
Resistances .....	2.8
<b>Weight</b> .....	<b>2.9</b>
<b>Fixing sensors</b> .....	<b>2.10</b>
Overview of fixing material .....	2.10
Ramp Edge AK 66.....	2.11
Ramp Edge AK 105 and AK 105/1.....	2.11
Underfloor Profile UP 80.....	2.11
<b>Calculation of the necessary actuation area</b> .....	<b>2.15</b>
Calculation examples .....	2.15
<b>Customised designs</b> .....	<b>2.16</b>
Customised shapes.....	2.16
Safety Mats in ATEX version .....	2.17
<b>Technical data</b> .....	<b>2.18</b>
<b>Technical data</b> .....	<b>2.19</b>
<b>Request for quotation</b> .....	<b>2.20</b>

### Important information

Read through the product information carefully. It contains important information on operation, safety and maintenance of the sensor. Retain the product information for later reference.

Always observe the safety instructions on the following pages under **ATTENTION**. Only use the sensor for the purpose described in the product information.

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## Definitions

See Definitions and Operation Principles in chapter 1 of the catalogue.

### Intended use

A safety mat detects a person that is standing on or stepping onto it. It is a protective device covering a certain area and monitoring the presence of a person on it as a safety function. Its purpose is to prevent possible hazardous situations for personnel within a danger zone.

Typical applications are in the area of moving units on machines and plants.

The sensor is suitable for detection of walking aids.

Safe operation of a safety mat depends entirely on

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

### Limits

for Safety Mat SM:

- max. 10 sensors on one Control Unit
- System size max. 15 m<sup>2</sup>  
= max. number × max. sensor size

### Exclusions

The sensor is not suitable for detecting people weighing under 35 kg. It is also not suitable for driving over with forklifts or other handling equipment

### Program selection

The Safety Mat SM range supplies individual solutions in terms of size and shape. Safety Mats SM are highly resistant to environmental influences and normal chemicals.

If you only require sensors that meet low demands, our Safety Steps TS may also be a suitable solution.

### Recommendation

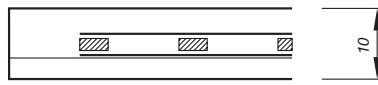
See Annex B of ISO 13856-1 and Annex B of EN 1760-1, especially Figures B1 and B2.

### ATTENTION

The categories according to EN 954-1 for safety mats and safety panels on machines are stated in type-C standards.

*Subject to technical modifications.*

## Design



### Standard version

moulded on PVC plate  
Degree of protection: IP65

### Note:

The standard version comes with a fully-bonded rubber surface topping GM1, GM4 or GM5 (see page 2.8).

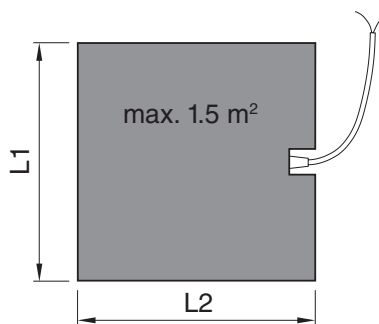
### Customised versions

Customised versions are available for special conditions, e.g. protection class IP68 or aggressive substances (fuels, solvents etc.).

## Available sizes

Sensors are available up to a max. size of 1.5 m<sup>2</sup>.

The side lengths must be within a range of 200 to 3,000 mm.



L1: cable side

L2: not cable side

$$L1 \times L2 \leq 1.5 \text{ m}^2$$

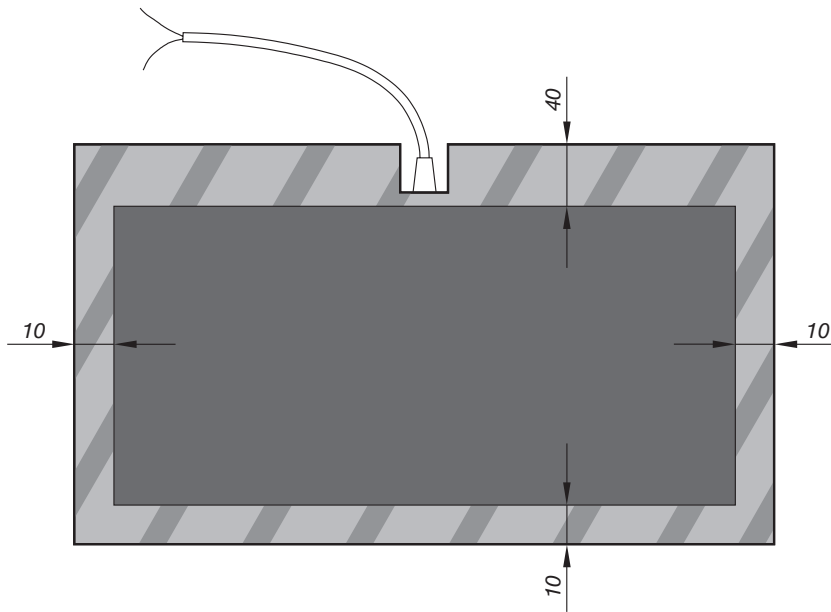
The cable exit on safety mats can be on the wide or the narrow side.

*Subject to technical modifications.*

## Non-sensitive zone along edges

The surrounding area of a sensor which does not have a sensing function:

- 40 mm = on cable exit side
- 10 mm = on remaining three sides



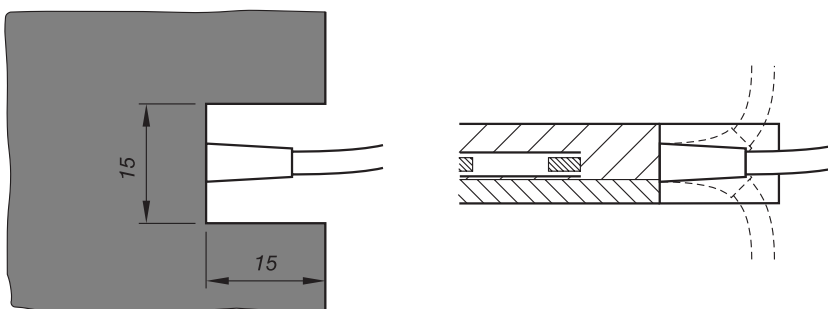
### Note

Where several sensors make up one contact area only the mat sides with 10 mm edges should lie next to one another.

## Connection

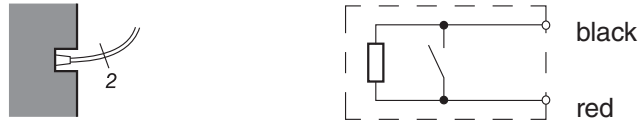
### Cable exit

The multifunctional cutout also allows the cable to be laid upwards or downwards.

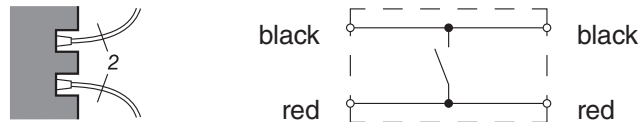


## Wire colours

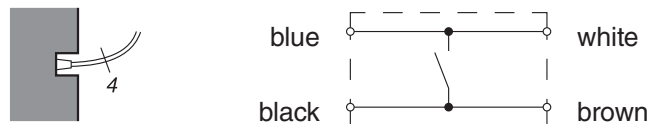
### Safety Mat SM/W



### Safety Mat SM/BK with 2 cables



### Safety Mat SM/BK with one cable



## Cable connection

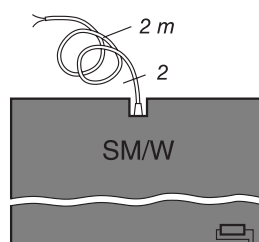
The cable connections are in the middle of the mat side.

### ATTENTION

The maximum overall cable length up to signal processing is 200 m.

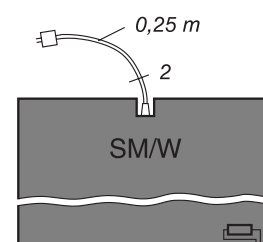
#### Without plug (standard)

- Universally applicable
- Variable cable length

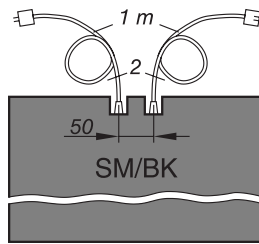
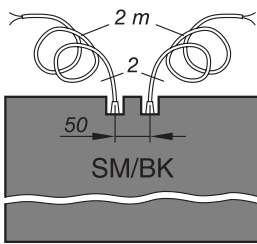


#### with plug

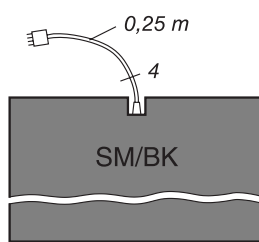
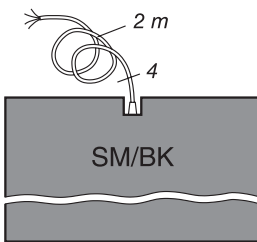
- Service-friendly
- Easy assembly
- Safe connection
- Watertight plug connection possible



- Individual sensor SM/W or end sensor SM/W
- Integrated resistor
- 2-wire cable (Ø 5 mm; 2× 0.5 mm<sup>2</sup> Cu)



- Feed-through sensor SM/BK
- Without resistor
- 2 two-wire cables (Ø 5 mm; 2× 0.5 mm<sup>2</sup> Cu)

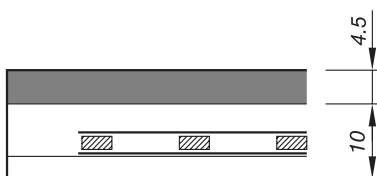


- Feed-through sensor SM/BK
- Without resistor
- 4-wire cable (Ø 5 mm; 4× 0.25 mm<sup>2</sup> Cu)

## Surface Toppings

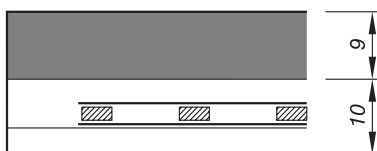
A rubber surface topping provides a non-slip surface and mechanical protection.

The toppings are bonded flat to the sensors in the factory.



GM1 or GM4

Sensor



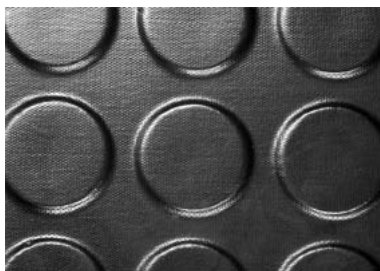
GM5

Sensor

## Rubber surface toppings

### Note

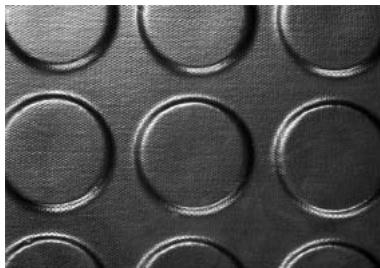
Physical resistances:  
see table on page 2.8 and  
chemical resistance: see table  
on page 2.9



### GM 1 SBR

Round nap topping, black  
Round nap topping, yellow

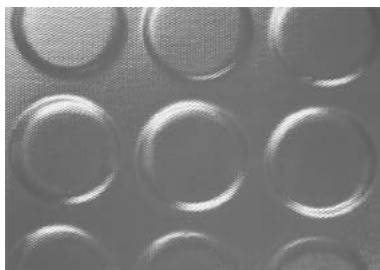
Thickness: 4.5 mm  $\pm 0.5$   
max. size: 1.0 m × 10 m  
1.2 m × 10 m



### GM 4 NBR

Round nap topping, black  
Round nap topping, yellow

Thickness: 4.5 mm  $\pm 0.5$   
max. size: 1.0 m × 10 m  
1.2 m × 10 m



### GM 5 NBR

Round nap topping, green  
with high mechanical strength

Thickness: 9 mm  $\pm 0.5$   
max. size: 1.2 m × 10 m

## Resistances

The condition for the resistances listed in the following (at room temperature 23 °C) is a sensor with a rubber surface topping adhered over the entire area and with an undamaged surface.

### Physical resistance

Rubber surface topping	GM 1	GM 4	GM 5
Degree of protection (IEC 60529)	IP65	IP65	IP65
Hardness as per Shore A	70 +5	70 +5	70 $\pm 5$
Abrasion (DIN 53516)	120 mg	120 mg	120 mg
Max. load capacity (8 h)	800 N/cm <sup>2</sup>	800 N/cm <sup>2</sup>	1200 N/cm <sup>2</sup>
Behaviour in fire (DIN 4102)	B2	B2	B2
Smouldering tobacco products	+	+	+
Flammability class (DIN 5510)	S3	S3	S3

Explanation of symbols:  
+ = resistant

*Subject to technical modifications.*



### Chemical resistance

The sensor is resistant against 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 results of tests carried out in our laboratory to the best of our knowledge and belief. Liability cannot be derived from this information. The suitability of our products for your special area of application must always be verified with your own practical tests.

Rubber surface topping	GM 1	GM 4	GM 5
Acetone	+	+	+
Ammonia	+	+	+
Brake fluid	-	±	±
Cutting emulsion	-	±	±
Acetic acid	±	±	±
Greases	±	+	+
Caustic potash solution	+	+	+
Cooling lubricant	-	+	+
Metal working oil	-	+	+
Methyl alcohol	±	±	±
Sodium hydroxide	+	+	+
Cellulose thinner	±	±	±
Hydrochloric acid 10 %	±	+	+
Suds	+	+	+
White spirit (ethyl alcohol)	+	+	+
UV-resistance	+	+	+
Water	+	+	+
Petroleum ether / petrol	-	+	+
Citric acid	+	+	+
Drawing compound	-	±	±

Explanation of symbols:

+ = resistant

± = resistant to a certain extent

- = not resistant

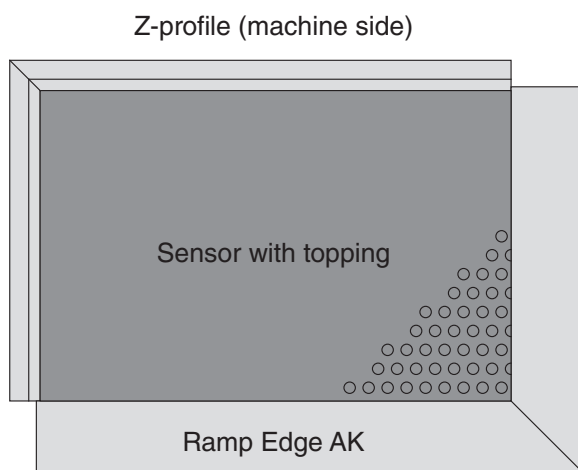
## Weight

Sensor with variable rubber surface topping GM and cable without plug

SM without GM	11.4 kg/m <sup>2</sup>
SM with GM 1	17.4 kg/m <sup>2</sup>
SM with GM 4	17.4 kg/m <sup>2</sup>
SM with GM 5	24.0 kg/m <sup>2</sup>

## Fixing sensors

Ramp Edges can be installed quickly and easily.

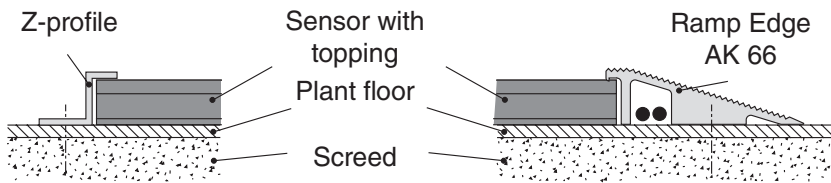


## Overview of fixing material

Sensor	Sensor height	Fixing material	Catalogue page
SM/W or SM/BK + GM 1 or GM 4	14.5 mm	Z-profile	2.12
		AK 66	2.12
		AK 105	2.13
		UP 80	2.14
SM/W or SM/BK + GM 5	19 mm	Z/1-profile	2.12
		AK 105/1	2.13

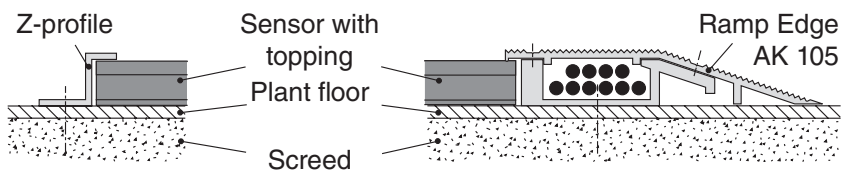
*Subject to technical modifications.*

## Ramp Edge AK 66



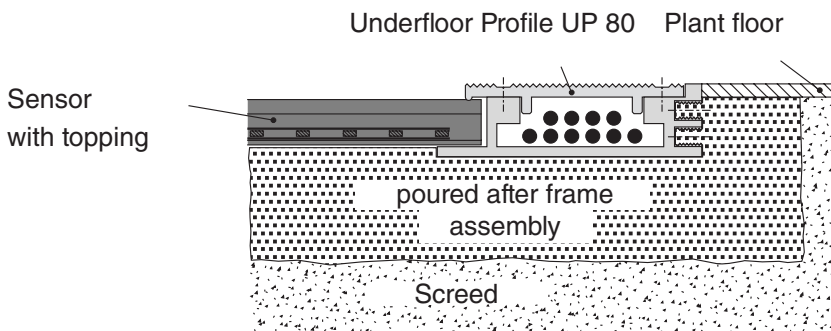
- Not suitable for plug-in cable connections
  - Cable conduit for max. 2 cables
- For dimensions, see page 2.12

## Ramp Edge AK 105 and AK 105/1

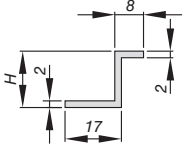
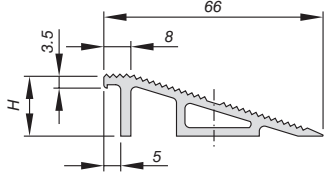
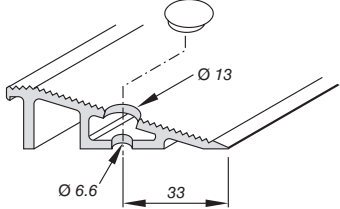
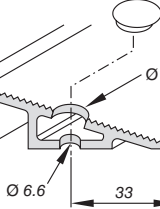
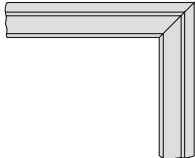


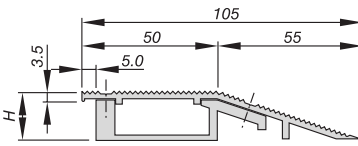
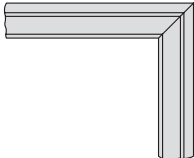
- Suitable for plug-in cable connections
  - Cable conduit for max. 10 cables
- Ramp Edge AK 105/1 only for sensors with GM 5 surface topping.  
For dimensions, see page 2.13

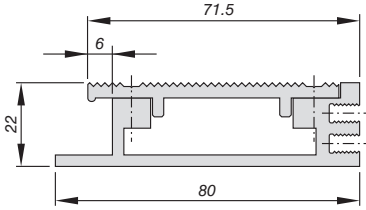
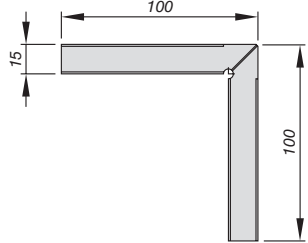
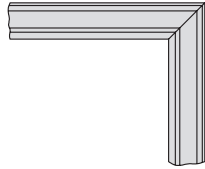
## Underfloor Profile UP 80



- Suitable for plug-in cable connections
  - Cable conduit for max. 10 cables
- For dimensions, see page 2.14

<p><b>Aluminium Z- and aluminium Z/1-profile</b></p> <ul style="list-style-type: none"> <li>- Edging at the machine or wall side</li> <li>- Aluminium Z-profile for sensor GM 1 and GM 4: H = 17.0 mm</li> <li>- Aluminium Z/1-profile for sensor with GM 5: H = 21.0 mm</li> <li>- Aluminium Z-profile: Rod, 3 m (7500054), Rod, 6 m (1000011) or fixed length</li> <li>- Aluminium Z/1-profile: Rod, 3 m (7500738), Rod, 6 m (1001478) or fixed length</li> </ul>	
<p><b>Aluminium Ramp Edge AK 66</b></p> <ul style="list-style-type: none"> <li>- 1-part with cable conduit</li> <li>- Combinations up to max. 2 sensors</li> <li>- Sensor without plug</li> <li>- Aluminium Ramp Edge for sensors with GM 1 and GM 4: H = 18.7 mm</li> <li>- Rod, 3 m (7500053), Rod, 6 m (1000008) or fixed length</li> </ul>	
<p><b>Threaded hole for AK 66</b></p> <ul style="list-style-type: none"> <li>- For fixing aluminium Ramp Edge AK 66</li> </ul>	
<p><b>Stopper</b></p> <ul style="list-style-type: none"> <li>- Closes threaded hole (1000615)</li> </ul>	
<p><b>Mitre cut</b></p> <ul style="list-style-type: none"> <li>- For corner connections</li> </ul>	

<p><b>Aluminium Ramp Edge AK 105 and AK 105/1</b></p> <ul style="list-style-type: none"> <li>- 2-part with cable conduit</li> <li>- For combination of several sensors</li> <li>- Sensors with or without plugs</li> <li>- Aluminium Ramp Edge AK 105 for sensors with GM 1 and GM 4: H = 17.5 mm</li> <li>- Aluminium Ramp Edge AK 105/1 for sensors with GM 5: H = 21.0 mm</li> <li>- Aluminium Ramp Edge AK 105: Rod, 3 m upper and lower sections (7500052), Rod, 6 m upper section (1000009), Rod, 6 m lower section (1000010), or fixed length</li> <li>- Aluminium Ramp Edge AK 105/1: Rod, 3 m upper section and lower section (7500224), Rod, 6 m upper section (1000992), Rod, 6 m lower section (1000010), or fixed length</li> </ul>	
<p><b>Mitre cut</b></p> <ul style="list-style-type: none"> <li>- For corner connections</li> </ul>	

<p><b>Aluminium Underfloor Profile UP 80</b></p> <ul style="list-style-type: none"> <li>- Edge profile with top cover</li> <li>- For installation flush with the floor</li> <li>- For individual sensors or a combination of sensors</li> <li>- Sensors with or without plugs</li> <li>- For GM1 and GM4</li> <li>- Rod, 3 m upper and lower sections (7500134), Rod, 6 m upper section (1000025), Rod, 6 m lower section (1000026), or fixed length</li> </ul>	
<p><b>UP corner connecting section</b></p> <ul style="list-style-type: none"> <li>- For corner connections of the UP profiles when installing (1000599)</li> </ul>	
<p><b>Mitre cut</b></p> <ul style="list-style-type: none"> <li>- For corner connections</li> </ul>	

*Subject to technical modifications.*

## Calculation of the necessary actuation area

In accordance with EN 999, the necessary effective actuation area in relation to the danger area is calculated according to the following formula:

$$S = (K \times T) + C$$

where:

$$K = 1600 \text{ mm/s}$$

$$T = t_1 + t_2$$

$$C = 1200 \text{ mm} - 0.4H$$

S = Minimum distance between the danger zone and the furthest edge of the Safety Mat [ mm ]

K = Approximation parameters [ mm/s ]

T = Follow-through of the complete system [ s ]

t<sub>1</sub> = Response time of the Safety Mat

t<sub>2</sub> = Stopping time of the machine

C = Safety tolerance [ mm ]

H = Step height [ mm ]

### With installation at floor level

H = 0; hence:

$$S = (1600 \text{ mm/s} \times T) + 1200 \text{ mm}$$

### With installation on a step

H ≠ 0; hence:

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

## Calculation examples

### Example 1

A safety mat detects non-permitted access to the danger zone of an automated movement. The mat is installed flush to the floor, i.e. H = 0. The follow-through time of the movement is 300 ms, the response time of the protective device is 35 ms.

$$S = (1600 \text{ mm/s} \times (300 \text{ ms} + 35 \text{ ms})) + 1200 \text{ mm}$$

$$S = 536 \text{ mm} + 1200 \text{ mm}$$

$$S = 1736 \text{ mm}$$

### Example 2

The same conditions as Example 1, however, a step with a height of 100 mm must be negotiated to the danger zone.

$$S = (1600 \text{ mm/s} \times (300 \text{ ms} + 35 \text{ ms})) + (1200 \text{ mm} - 0.4H)$$

$$S = 536 \text{ mm} + 1160 \text{ mm}$$

$$S = 1696 \text{ mm}$$

## Customised designs

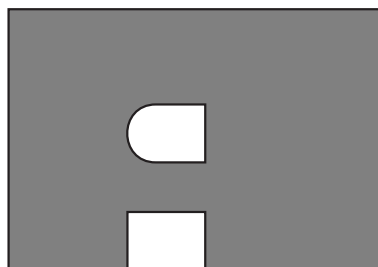
### Customised shapes

e.g. different corner shapes



Different shapes such as circles, circle segments, trapeze shapes etc. are possible.

e.g. cut-outs



Mats can be ready-manufactured with cut-outs, e.g. for machine feet, switch cabinets etc.



## Safety Mats in ATEX version

The safety system Safety Mat ATEX SM consists of a sensor – incl. anti-static topping GM8 and Ramp Edges AK 105 –, safety barrier and control unit.

Safety Mats of type ATEX SM are exclusively designed for equipment group II, i. e. for all potentially explosive environments except mining. The potentially explosive medium splits the area of application into the atmospheres G and D:

### Atmosphere G

Gases, vapours, mists  
Equipment categories 2 and 3  
for zones 1 and 2  
Ignition protection class “intrinsic  
safety ib” for zones 1 and 2  
Explosion group IIC  
incl. groups IIA and IIB  
Temperature class T4  
-20 °C ≤ Ta ≤ +55 °C

Marking:



II 2 G Ex ib IIC T4

Complies with IEC 60079-11

### Atmosphere D

Dusts  
Equipment category 3  
for zone 22  
Ignition protection class “intrinsic  
safety ibD 22” for zone 22  
Temperature class T85°C max.  
surface temperature +85 °C

Marking:



II 3 D Ex ibD 22 T85°C

Complies with IEC 61241-11

For further information on  
“**Safety Mats in ATEX version**,”  
contact Mayser Support:  
Phone +49 731 2061-0

## Technical data

Safety Mat consisting of sensor SM/W or SM/BK  
and Control Unit **SG-EFS 1X4 ZK2/1**

<b>SG-EFS 1X4 ZK2/1</b>	
Test principle:	EN 1760-1, ISO 13856-1
<b>Switching characteristics at <math>v_{\text{test}} = 250 \text{ mm/s}</math></b>	
Switching operations at 0.1 A	$> 4 \times 10^6$
Actuation forces	
Test piece (cylinder) Ø 11 mm	$< 300 \text{ N}$
Test piece (cylinder) Ø 80 mm	$< 300 \text{ N}$
Test piece (cylinder) Ø 200 mm	$< 600 \text{ N}$
Response time with Control Unit	18 ms
<b>Safety classifications</b>	
EN 1760: Reset command	with/without
ISO 13849-1:2006	category 3
MTTF <sub>d</sub>	1142 years
B <sub>10d</sub>	$6 \times 10^6$
n <sub>op</sub> (acceptance)	52560 per year
IEC 61508: PFH <sub>s</sub>	$9,99 \times 10^{-8} \text{ 1/h (SIL3)}$
<b>Mechanical operating conditions</b>	
Sensor size	max. 1.5 m <sup>2</sup>
Side length (min./max.)	200 mm / 3000 mm
Static load (up to 8 h)	max. 800 N/cm <sup>2</sup>
Driving on with industrial trucks	not suitable
Degree of protection as per IEC 60529	IP65
max. humidity (23 °C)	95% (non-condensing)
Operating temperature	
individual sensors	-20 °C to +55 °C
combined sensors	+5 °C to +55 °C
Storage temperature	-20 °C to +55 °C
<b>Electrical operating conditions</b>	
Switching current	max. 100 mA
<b>Maintenance and service</b>	
Maintenance	The sensor is maintenance-free.
Monitoring	Joint monitoring by control unit.
Inspection	Depending on the load, the sensors are to be tested at regular intervals (at least monthly) for correct function and visible signs of damage by walking on or by applying the relevant test piece (cylinder).
<b>Chemical resistance</b>	
	The sensor is resistant against normal chemicals over an exposure period of 24 hours. (see page 2.9)
<b>Dimensional tolerances</b>	
Length dimension	ISO 2768-c
Perpendicularity	ISO 2768-c

## Technical data

Safety Mat consisting of sensor SM/BK  
and Control Unit **SG-EFS 104/4L**

<b>SG-EFS 104/4L</b>	
Test principle:	EN 1760-1, ISO 13856-1
<b>Switching characteristics at <math>v_{\text{test}} = 250 \text{ mm/s}</math></b>	
Switching operations at 0.1 A	$> 4 \times 10^6$
Actuation forces	
Test piece (cylinder) Ø 11 mm	$< 300 \text{ N}$
Test piece (cylinder) Ø 80 mm	$< 300 \text{ N}$
Test piece (cylinder) Ø 200 mm	$< 600 \text{ N}$
Response time with Control Unit	40 ms
<b>Safety classifications</b>	
EN 1760: Reset command	with/without
ISO 13849-1:2006	category 3
MTTF <sub>d</sub>	1142 years
B <sub>10d</sub>	$6 \times 10^6$
n <sub>op</sub> (acceptance)	52560 per year
IEC 61508: PFH <sub>L+S</sub>	$3.25 \times 10^{-8} \text{ 1/h (SIL2)}$
<b>Mechanical operating conditions</b>	
Sensor size	max. 1.5 m <sup>2</sup>
Side length (min./max.)	200 mm / 3000 mm
Static load (up to 8 h)	max. 800 N/cm <sup>2</sup>
Driving on with industrial trucks	not suitable
Degree of protection as per IEC 60529	IP65
max. humidity (23 °C)	95% (non-condensing)
Operating temperature	
individual sensors	-20 °C to +55 °C
combined sensors	+5 °C to +55 °C
Storage temperature	-20 °C to +55 °C
<b>Electrical operating conditions</b>	
Switching current	max. 100 mA
<b>Maintenance and service</b>	
Maintenance	The sensor is maintenance-free.
Monitoring	Joint monitoring by control unit.
Inspection	Depending on the load, the sensors are to be tested at regular intervals (at least monthly) for correct function and visible signs of damage by walking on or by applying the relevant test piece (cylinder).
<b>Chemical resistance</b>	
	The sensor is resistant against normal chemicals over an exposure period of 24 hours. (see page 2.9)
<b>Dimensional tolerances</b>	
Length dimension	ISO 2768-c
Perpendicularity	ISO 2768-c

## Request for quotation

**Fax:**

**+49 731 2061-222**

**Submitted by**

Company

Department

Surname, first name

P.O. Box

Postcode

Town/city

Street

Postcode

Town/city

Phone

Fax

E-mail

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column! ↓

For internal notes only

**Area of application**

(e. g. metalworking, textile machines, timber processing, tube drawing, local public transport, ...)

**Environmental conditions**

Dry

Water

Oil

Aggressive

substances:

Coolant, type: \_\_\_\_\_

Solvent, type: \_\_\_\_\_

Other: \_\_\_\_\_

Room temperature

Other: from \_\_\_\_\_ °C to \_\_\_\_\_ °C

**Mechanical conditions**

Only adults

Also children

Falling objects with \_\_\_ kg maximum weight

Vehicles with \_\_\_\_\_ kg maximum weight

Vehicle type: \_\_\_\_\_

**Area to be secured:**

(Diagram incl. edge profiles and cable routing)