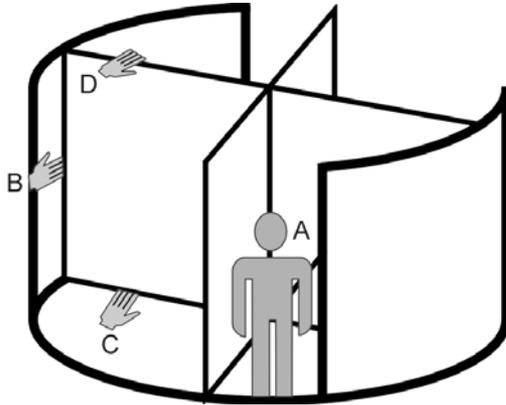


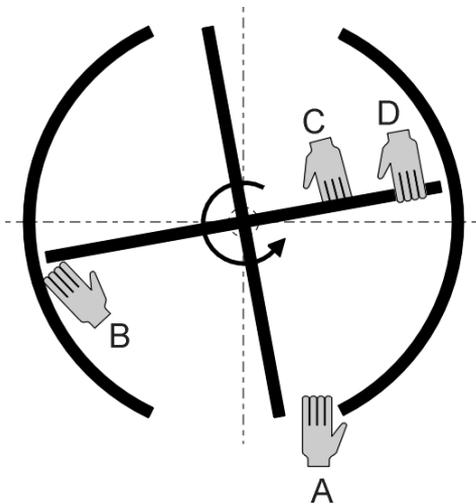
# Packages of measures (examples)

## ■ Hazard points



Hazard points on 2, 3 and 4-wing revolving doors:

- **Hazard point A:**  
Between main closing edge and opposing closing edge
- **Hazard point B:**  
Between main closing edge and inner wall
- **Hazard point C:**  
Between secondary closing edge and floor
- **Hazard point D:**  
Between secondary closing edge and ceiling



# ■ Packages of measures: remarks

### Remarks:

- 1) The deformation path of the pressure-sensitive edge must be selected such that it is greater than the braking distance of the revolving door. Should the deformation path be too short, the rotational velocity of the door must be reduced by means of electrosensitive protective equipment (ESPE) or by control measures (reduction of the speed during the approach by the main closing edge of the opposing edge).
- 2) The packages of measures comprise design, control and organizational measures.
- 3) The packages of measures described here serve only as examples, and can be adapted if required; the level of safety must however be retained.
- 4) According to EN 349 Table 1, fingers are not at risk of crushing at a distance of  $> 25$  mm. It is assumed that the hazard point D can be reached only with the fingers and not with the entire hand or other limbs.

### Further possible measures within the packages of measures:

- Mechanism for folding the door wings; the design of the mechanical safety must be comparable to the required control Category; if applicable, fault exclusion for example with encapsulation of the hinges.

## "Safety of power-operated revolving doors" project

### ■ Package of measures: hazard point A: trapping

Door type	Hazard	Safeguarding in Category	Example package of measures	Alternatively
2-wing	Trapping between main closing edge and right-hand opposing closing edge	<p><b>Category 4</b> Implementation by means of a package of measures comprising sensors of at least Category 2, in order to attain the level of safety of Category 4</p> <p>The <b>crushing</b> and <b>shear</b> hazards, which are to be safeguarded against by means of packages of measures to Category 2/3, are covered by the package of measures for the <b>trapping</b> hazard</p>	<p><b>Package of measures for attainment of Category 4:</b></p> <ol style="list-style-type: none"> <li>1. Installation on the right-hand opposing closing edge of a pressure-sensitive edge (Category 3, to DIN EN 1760-2), inclined (towards the wing of the door, range of action 180°) and with adequate deformation in consideration of the door velocity</li> <li>2. Installation on the main closing edge (on the door wing in the direction of rotation) of a pressure-sensitive edge (Category 3, to DIN EN 1760-2), inclined (towards the opposing closing edge, range of action 180°) and with adequate deformation in consideration of the door velocity</li> <li>3. Installation of testable, electrosensitive protective equipment (ESPE, Category 3, e.g. infrared light scanner (IR scanner) with background analysis, light curtain) in front of the right-hand opposing closing edge for reduction of the door velocity in the event of detection</li> <li>4. Inherent safety by limitation of the drive power</li> <li>5. Regular manual inspection of the safety equipment (visual and function checks) by means of checklists</li> </ol>	<p><b>Alternatively to 3.:</b> Reduction, for example by means of a frequency converter with monitored ramp function, of the rotational velocity of the door during approach by the main closing edge of the right-hand opposing closing edge at a distance from the opposing closing edge which is to be specified.</p>

## "Safety of power-operated revolving doors" project

### ■ Package of measures: hazard point A: crushing/shearing

Door type	Hazard	Safeguarding in Category	Example package of measures	Alternatively
3-wing/ 4-wing	Crushing between main closing edge and right-hand opposing closing edge	Category 2/3	<b>Package of measures for attainment of Category 2/3:</b> <b>1.</b> Installation on the right-hand opposing closing edge of a pressure-sensitive edge (Category 3, to DIN EN 1760-2), inclined (towards the wing of the door, range of action 180°) and with adequate deformation in consideration of the door velocity <b>2.</b> Installation on the main closing edge (on the door wing in the direction of rotation) of a pressure-sensitive edge (Category 3, to DIN EN 1760-2), inclined (towards the opposing closing edge, range of action 180°) and with adequate deformation in consideration of the door velocity <b>3.</b> Inherent safety by limitation of the drive power <b>4.</b> Regular manual inspection of the safety equipment (visual and function checks) by means of checklists	<b>Alternatively/supplementary to 1. and 2.:</b> Should the deformation path of the pressure-sensitive edges not be sufficient, testable, electrosensitive protective equipment (ESPE, Category 3) can be employed for reduction of the rotational speed <b>Alternatively/supplementary to 1. and 2.:</b> Should the deformation path of the pressure-sensitive edges not be sufficient, the rotational velocity of the door can be reduced during approach by the main closing edge of the right-hand opposing closing edge by the use of control equipment (e.g. a frequency converter)
	Shearing between main closing edge and right-hand opposing closing edge	Category 2/3 or by design (avoidance of shear points)		If the deformation path of the pressure-sensitive edge on the main closing edge is sufficiently great, installation of a rubber section on the right-hand opposing closing edge would be sufficient

## "Safety of power-operated revolving doors" project

### ■ Package of measures: hazard point B

Door type	Hazard	Safeguarding in Category	Example package of measures	Alternatively
2-wing/ 3-wing/ 4-wing	<b>Crushing between main closing edge and inner wall</b>	<b>Category 2</b> Implementation by means of a package of measures, sensors of at least Category 2	<b>Package of measures for attainment of Category 2:</b> <ol style="list-style-type: none"> <li>1. Installation on the main closing edge in the direction of rotation of a pressure-sensitive edge (Category 3, to DIN EN 1760-2), inclined (towards the inner wall, range of action 180°) and with adequate deformation in consideration of the door velocity</li> <li>2. Avoidance of shear points (Category 4 is otherwise required)</li> <li>3. Inherent safety by limitation of the drive power</li> <li>4. Regular manual inspection of the safety equipment (visual and function checks) by means of checklists</li> </ol>	<b>Alternatively to 1. (when braking distance of door &gt; deformation path of pressure-sensitive edge):</b> <ol style="list-style-type: none"> <li>1. Use on the main closing edge in the direction of rotation of a pressure-sensitive edge (Category 3, to DIN EN 1760-2), inclined (towards inner wall, range of action 180°)</li> <li>2. Use of testable electrosensitive protective equipment (ESPE, Category 3) for reduction of the door velocity in the event of detection</li> </ol>
	<b>Shearing between main closing edge and inner wall</b>	<b>Category 4</b> or by design (avoidance of shear points. The distance between the profile and wing must be $\geq 25$ mm in this case).		

## "Safety of power-operated revolving doors" project

### ■ Package of measures: hazard point C

Door type	Hazard	Door diameter	Safeguarding in Category	Example package of measures	Alternatively
2-wing/ 3-wing/ 4-wing	Crushing between door wing and floor	All	<b>Category 2</b> Implementation by means of a package of measures, sensors of at least Category 2	<b>Package of measures for attainment of Category 2/3:</b> <b>1.</b> Installation of a pressure-sensitive edge (Category 3, to DIN EN 1760-2), inclined (towards the floor, range of action 180°) and with adequate deformation in consideration of the door velocity <b>2.</b> Use of testable, electrosensitive protective equipment (ESPE, Category 3) for reduction of the door velocity in the event of detection <b>3.</b> Avoidance of shear points (Category 4 is otherwise required) <b>3.</b> Inherent safety by limitation of the drive power <b>4.</b> Regular manual inspection of the protective equipment (visual and function checks) by means of checklists	
	Shearing between door wing and floor	All	<b>Category 4</b> or by design (avoidance of shear points, for example by shoe-cleaning mats with a grid interval of $\leq 4$ mm)		
	Impact by the door wing	>3000 mm	<b>Category 2/3</b>		
$\leq 3000$ mm		Measures are to be defined on a case-by-case basis			

## "Safety of power-operated revolving doors" project

### ■ Package of measures: hazard point D

Door type	Hazard	Safeguarding in Category	Example package of measures	Alternatively
2-wing/ 3-wing/ 4-wing	Crushing between door wing and ceiling	<b>Category 2</b> <b>The canopy of the door system does not rotate with the wings:</b> No measures required if: - Distance between door wing and max. projection on the ceiling (e.g. light fittings) $\geq 25$ mm - The ceiling is free of recesses or	<b>Package of measures for attainment of Category 2/3:</b> <b>1.</b> Installation of a pressure-sensitive edge (Category 3, to DIN EN 1760-2), inclined (towards the ceiling, range of action $180^\circ$ ) and with adequate deformation in consideration of the door velocity <b>2.</b> Inherent safety by limitation of the drive power <b>3.</b> Regular manual inspection of the protective equipment (visual and function checks) by means of checklists	
	Shearing between door wing and ceiling	<b>Category 2/3</b> or by design (avoidance of shear points. The distance between the profile and wing must be $\geq 25$ mm in this case).		

## ■ Package of measures: control system

- **Category 3 to EN 954-1 (redundant design with fault detection)**
- **Testing of the ESPE once per rotation of the door**
- **Monitoring of the redundant de-energization paths**
- **Braking with monitored overtravel**
- **Short response and signal processing times**
- **Closed-circuit current principle for the detection of wire breakage, power failure, ageing, etc.**
- **Minimization and monitoring of the motor torque**
- **Electrical equipment to EN IEC 60204**
- **Microprocessor-controlled systems to DIN EN 61508 Part 3, Section 7**
- **In the event of a fault (in the sensor, the control system or the drive), the door drive must be halted permanently**

## ■ Package of measures: protective devices

- **Pressure-sensitive edges are subject to DIN EN 1760-2**  
In order to ensure early tripping by the pressure-sensitive edges, the release contact must be located 8 mm above the floor (enabling it also to be tripped by children's hands on the floor)
- **ESPE is subject in general to EN IEC 61496-1**
- **Light barriers and light curtains are also subject to EN IEC 61496-2**
- **Other ESPE (capacitive, PIR sensors, light scanners) is generally unsuitable for the protection of persons, unless its suitability has been demonstrated by a notified body (type examination for safety components in accordance with Annex IV of the Machinery Directive).**
- **The safe operation of a protective device is also conditional upon the safe processing of signals from it in the downstream control system.**
- **It must not be possible for protective devices to be defeated by simple means.**



## ■ Package of measures: safety functions

- **START, renewed delayed START with wait time following relief of pressure upon the tactile protective device**
- **STOP following tripping of a protective device, in the event of blockage of the door or in the event of a fault**
- **Emergency-stop, Off (e.g. at the main switch)**
- **Operating mode selection**
- **Safe muting of protective devices, especially ESPE**
- **Processing of safety-related parameters**
- **Locking of night doors**
- **- Safe position**
  - Safe rated rotational speed
  - Safely reduced speed
- **Fitting of a button for reduced speed**

■ **Package of measures: informatory measures**

- **Transparent glass panes must be labelled**
- **Affixing of labels with instructions for use of the door**

## ■ Package of measures: operator information

- **Technical data**
  - **Revolving door (dimensions, overtravel distances, door type, etc.)**
  - **Door control system (Category, drive type, etc.)**
  - **Protective devices (manufacturer, type, test certificate, etc.)**
- **Description of the overall safety concept:**
  - **Block diagram of the control system including all safety functions**
  - **Protective devices employed**
  - **Information on the hazards and on the protective measures taken**
- **Information on the intended use**
- **Declaration of conformity with the Machinery Directive**
- **Checklist for regular testing by the operator**
- **Information on regular testing and maintenance by the manufacturer**
- **Test book**



■ **Package of measures: avoidance of shear points**

- **A shear hazard does not exist:**
  - **Bevelled profile with a maximum angle of 45° taken from the inner wall/ceiling**
  - **Rounded profile**
  - **Profile with radii of  $\geq 3$  mm**
  - **Protection for fingers: the distance must be  $\geq 25$  mm**