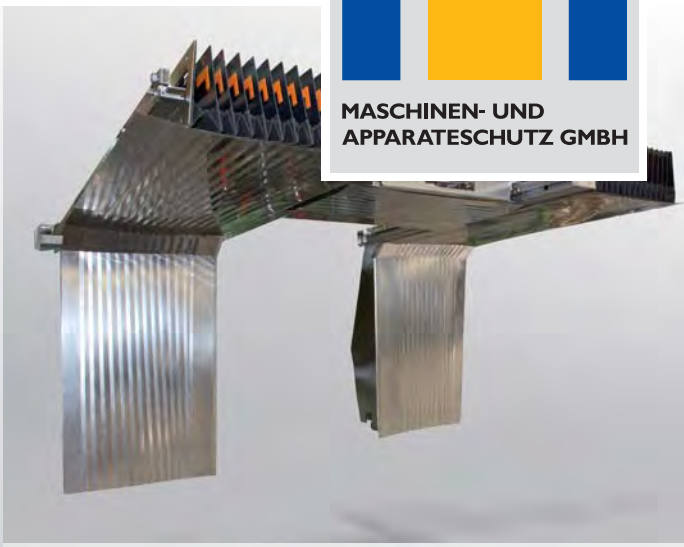
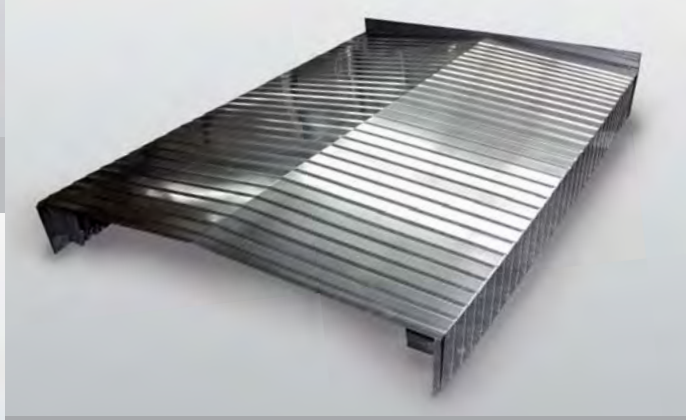
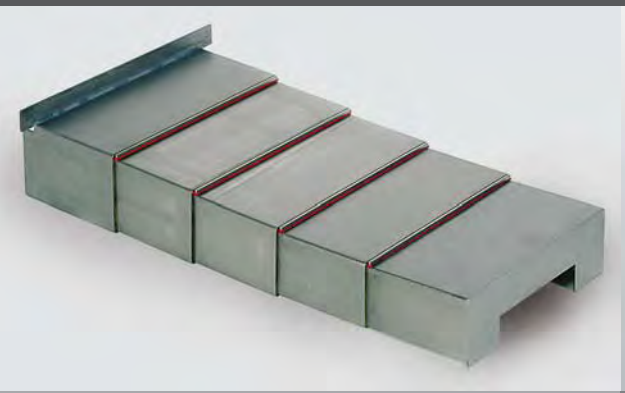
HEMA

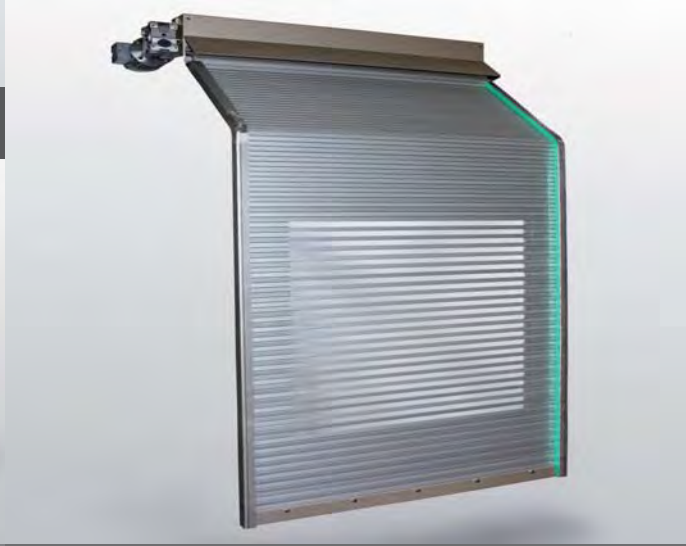
Protection & Viewing Systems

HEMA
MASCHINEN- UND APPARATESCHUTZ GMBH









PROTECTION | CLAMPING & BRAKING | VISION | SERVICE

We are there for you worldwide

Please find a detailed overview of our sales partners at www.hema-schutz.de

Index

Information

Request and order forms available in pdf format at www.hema-schutz.de

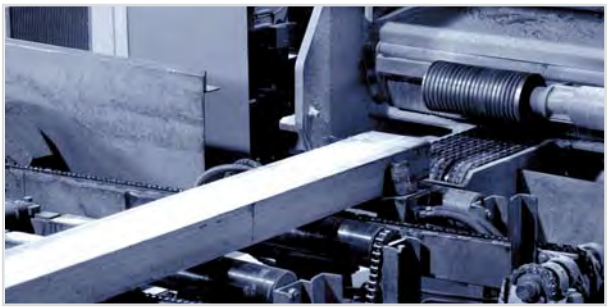
HEMA. Tailor made Protective Systems.

Machine tools and production systems

Precision, process reliability, and productivity thanks to robust system solutions and components
HEMA components protect machines and operators effectively and efficiently against flying chips, cooling lubricants, and injury from moving parts.
We raise the service life and availability of the machine and keep the operator safe from harm.

Laser cutting machines

Optical waveguides or deflecting mirrors guide laser beams to the machining optics. The beam path is protected with special bellows particularly on machines with moving optics.

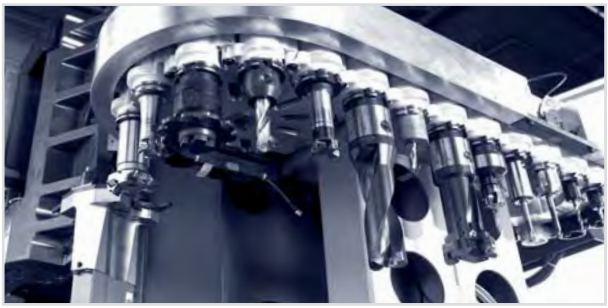


Machine tools for nonmetals

Special materials are matched to the requirements of non-metal machining types.
These can be for instance slats for the optimal protection against sharp chips or particularly smooth surfaces of teflon material for the enhanced runoff of powdery removal.

Testing and measuring systems

In the test room the task is to find the μ under climate controlled conditions. A low noise and low friction process coupled with a low compressing counterpressure are only two of the requirements for our bellows and shutter systems. Perfect systems, the optimal surface feel, and tight tolerance designs are the specifications for our production and quality assurance standards.



Robotics, automation, and handling

We utilise high strength materials with superior flex fatigue properties that safeguard fast, precise traverses on linear guide rails and the greatest possible flexibility for special designs.
Here we can provide the corresponding supplements to our rail and rod clamping systems.

Innovation never ends.

For more than thirty five years we have been manufacturing protective systems for the world's machinery building sectors.. Our first products were bellows and coil springs that we produced in Seligenstadt, which is still our head office today. Through consistent further development our range of bellows as protective covers for guides evolved into the SAMURAI product series with slat reinforced bellows and aprons and complete rear wall systems. Our spiral springs were joined by other product ranges like telescopic steel covers, shutter covers, segmented aprons, machine safety screens, and Visiport spin windows that today supplement our range of offers.

Our second field of competence concentrates on pneumatic clamping and braking systems for linear and rotary clamping. You can view extensive information on these products in an additional catalogue we have put together for you.

This product diversity is possible only with extensive research and development as well as intensive detailed work. In close collaboration e.g. with the Production Management, Technology, and Machine Tools Institute (PTW) at the Darmstadt University of Applied Sciences developments and structures are tested for their practicability and extreme situations simulated so that our products can also fulfil the high requirements in the field. This successful collaboration was crowned with the First Hesse Cooperation Award in 2005.

We also collaborate closely with other external institutes like the Production Engineering and Machine Tools Institute (IFW) at the Berlin University of Applied Sciences. By means of impact tests on protective covers and machine safety screens we assure their suitability for applications in machining environments. In addition we conduct extensive material and function tests at our location. The following pages present a selection.

Our own product and process quality is verified by regular certification procedures: all of our European production locations have been awarded DIN ISO 9001:2008 certifications. Kaizen teams at all works contribute towards continuous improvement.

What we can offer you:

extensive product knowhow and own production competence

- sheet metal working on thicknesses from 0.1 to 10 mm, CNC machining, precision grinding
- special plastics knowhow for pleating, milling, and welding at our own production locations
- high level of engineering competence for protective covers, end to end solutions, mechatronics, handling, and automation

low cost production for attractive prices

- state of the art production technologies and cost optimised production processes
- world spanning production sites in Germany, Romania, and China
- global materials purchasing and tightly channelled purchase quantities

standards for safeguarding conformity

- fulfilment of international standards
- unified quality management system under ISO 9001:2008
- compliance with ROHS, REACH, and safety standards
- collaboration in the development of safety standards

international supervision on site and on the web

- consultation with competent marketing technicians and project engineers
- worldwide commissioning and services
- the latest production information on the web for your current order
- all available documents can be retrieved online: catalogues, request and order forms, certificates, etc.

Innovation never ends - and in this respect we shall never cease working on innovations and improvements for your benefit.

With best regards

Steffen Walter

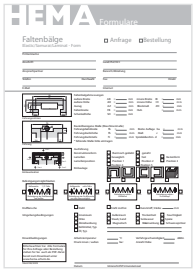
Managing Director

Research and development

Quality of products and processes

Continuous improvement

www.hema-schutz.de



Request and order forms
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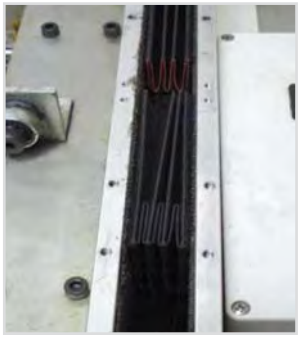
Hema Quality - Material Tests

Material load test - tensile test on textiles and strips

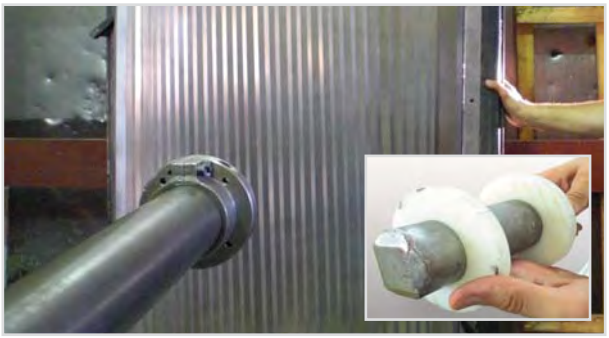
Material tolerance test on shearing components



Material load test - flex fatigue strength at the corners of bellows

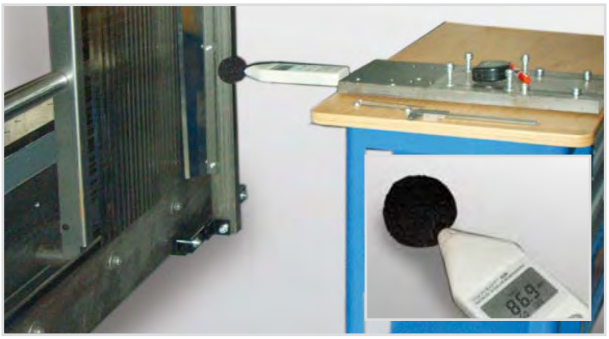
Impact test on safety screens under DIN EN 12415

Material load test - laser beam path and burning behaviour

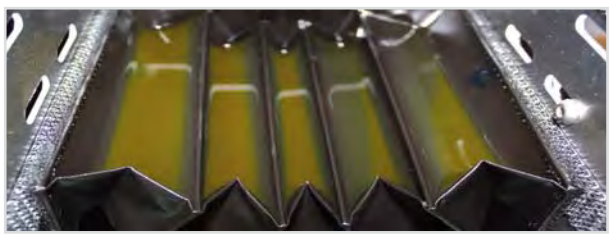


Impact test on covers under DIN EN 12417

Material load test - coolant spray test, rotating nozzles



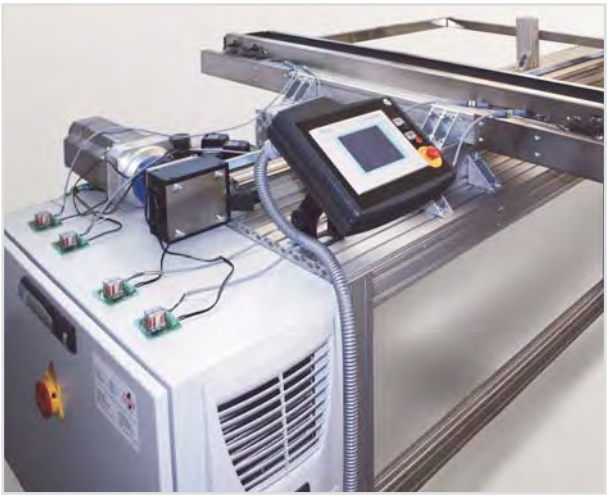
Noise emissions test on a traversing cover



Static material load test - tightness test

Hema Quality - Function Tests

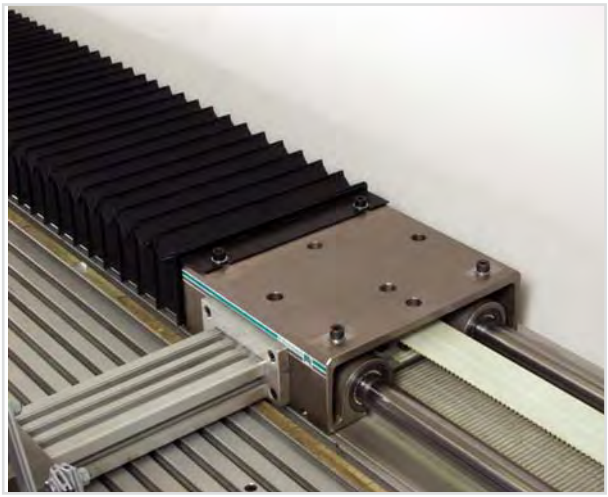
Function test for contact pressure and noise emissions from a complete rear wall on the PTW high speed test rig



Mechatronics test - test on mechanical system and sensors

Traverse test on a slat cover with shearing system at the PTW: force sensors measure the vibrations during traverses to block size.

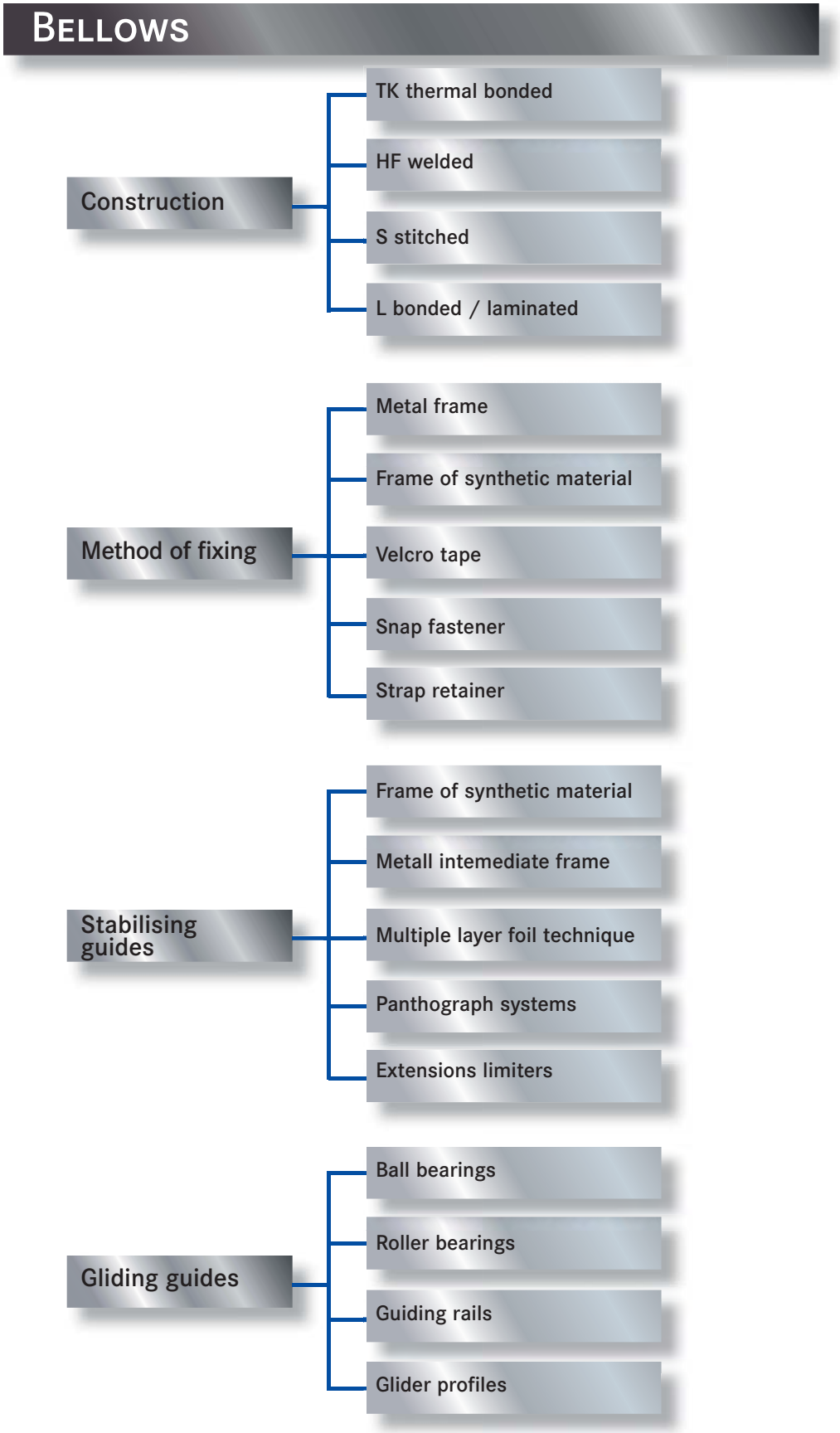
Traverse test on vector bellows with high accelerations up to 4 g



Traverse test on bellows service life and wearing with up to three million cycles

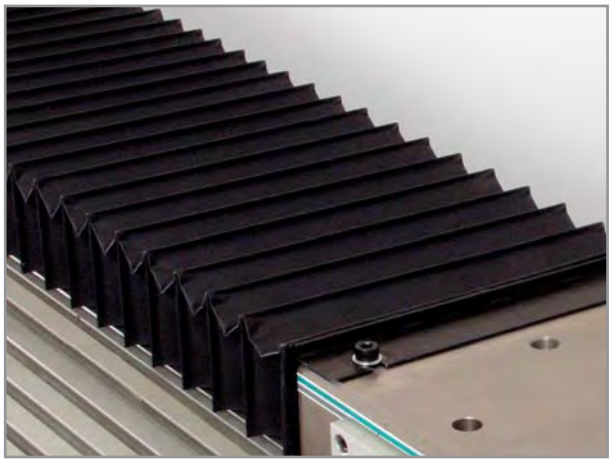
System test on the z axis with test on pneumatic components and guide rails

MODULAR CONCEPT



ELASTIC Bellows

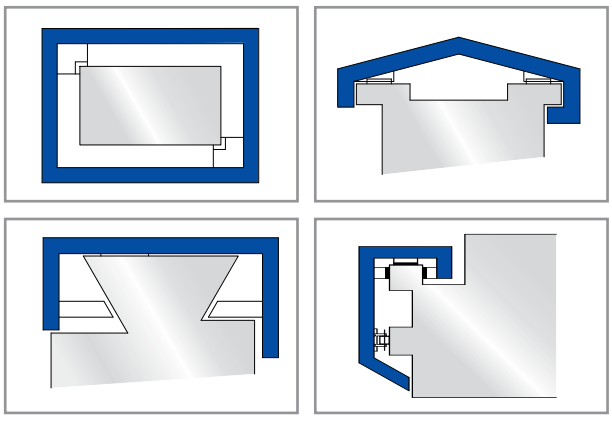
ELASTIC Bellows are commonly used for protecting machines and devices against debris and chips. They are also used in many variations for safety at work.
The experience resulting from the production of many thousands of ELASTIC Bellows and their use in working applications has been converted directly into product improvements, new developments, and enhanced product lifetime.



U shape ELASTIC Bellows mounted with metal frame

Constantly growing demands for ever greater machine speeds and ever lower noise emissions are consistently implemented by our engineers.

- Optimal use of space
- Machine size reduced with special materials and space saving designs
- Complete systems - bellows integrated in the machine's rear wall covering, complete with guides and mounting devices
- High temperature resistant materials up to 600°C for laser, plasma and welding applications
- Special designs with antistatic surfaces for medical technology and clean room conditions
- Special designs for HSC applications
- Impermeability to coolants

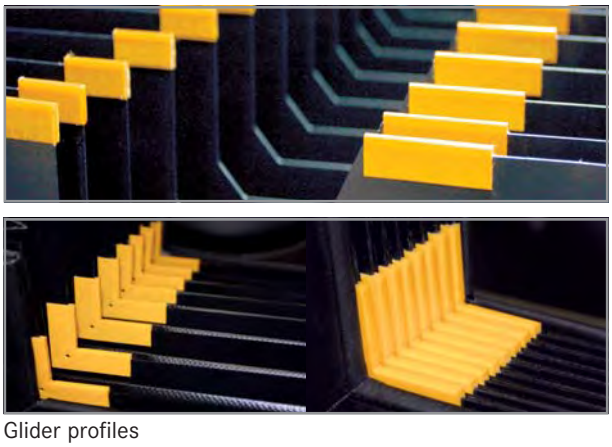


Types

Bellows for elevating platform

Design

ELASTIC Bellows are a series of products with many combinations and options. Their basic components, materials, forms, processing methods, and dimensions are easily adaptable.
For applications such as elevating platforms, bellows can be produced with up to 30 square meters. All ELASTIC Bellows may be deployed horizontally or vertically.
They can be easily attached to the machine with metal frames or Velcro tapes.
Efficient glider profiles and roller or ball bearings improve quiet running and also serve to extend life cycles and minimise friction during HSC applications as well.



Glider profiles

All dimensions in mm if not marked otherwise. Errors and omissions excepted.

ELASTIC BELLOWS

Roller bearing

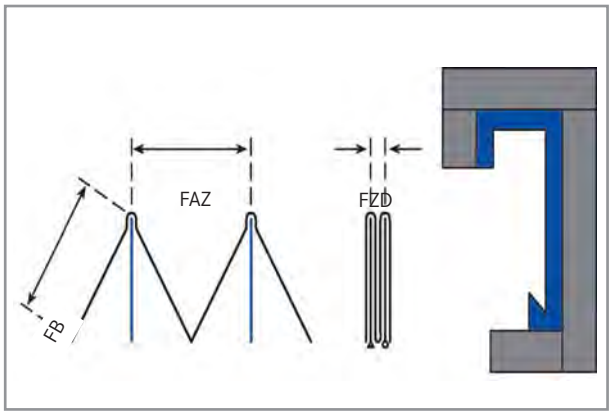
During high starting accelerations extension limiters help to reduce the load on the first folds, even out the extension, and stabilise travelling.

Material

Standard materials are black, but also signal colours such as yellow or white materials for medical applications are available.
The material is selected from a large range of products to match the intended use of the ELASTIC Bellows.
Also self extinguishing heat resisting materials under the UL 94 standard are available.

Design of ELASTIC Bellows

The essential component of the ELASTIC Bellows is a stabilising PVC frame inside every fold that lends the ELASTIC Bellows high dimensional stability. Reversion to the original shape is therefore assured after direct impacts.
Beside PVC frames PP and Polyamide can be offered as an alternative material for the support frames.



Bellows construction with stabilising PVC frame

ELASTIC bellows are available in the following versions depending on how their frames are permanently joined to the outer fold material:

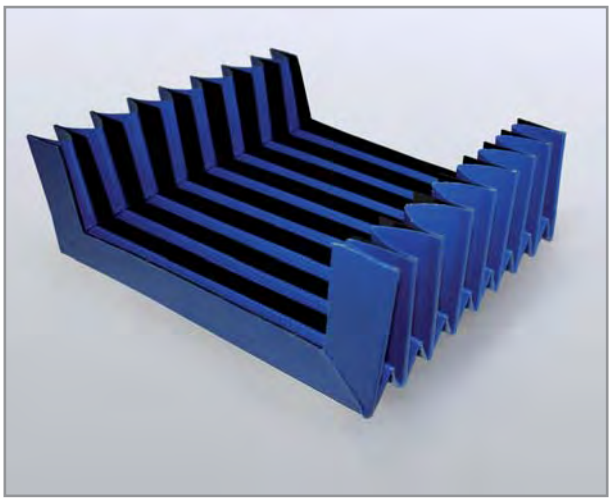
- thermal bonded version
- HF welded version
- sewn version

Thermal bonded version

Under the action of heat and a specially developed flux permanent bonding is achieved between the inner PVC frame and the outer fold material.
Thermal bonded ELASTIC Bellows are maintenance free, water and dust proof as well as oil resistant and, to a certain extent, acid resistant.

HF welded version

This type is used particularly for the production of large, shutter type ELASTIC Bellows.
High frequency welding is used to join the PVC frames with the outer bellow material for a perfect shape and a regular overall appearance.



U shape Bellows with stabilising PVC frame

Sewn version

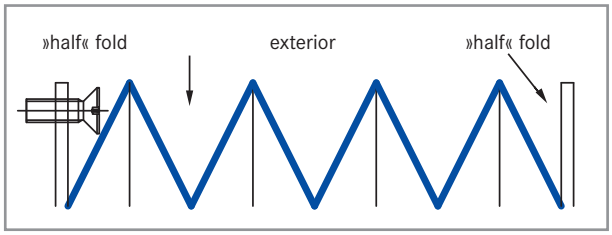
The sewn version consists primarily of high temperature materials. Strong fabrics therefore assure a long lasting solution even under extreme loads.

Mounting

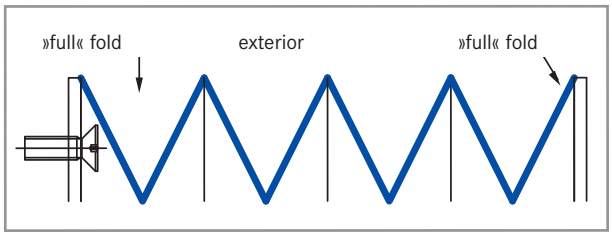
ELASTIC Bellows can be easily mounted on machines and devices with components such as:

- frames of metal or synthetic material attached to both ends and designed to customer specifications
- Velcro tape, easy and fast, maintenance friendly
- clip fasteners combined with metal frames

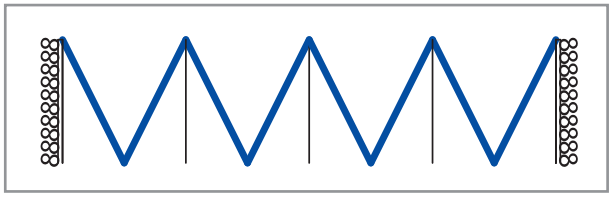
ELASTIC Bellows

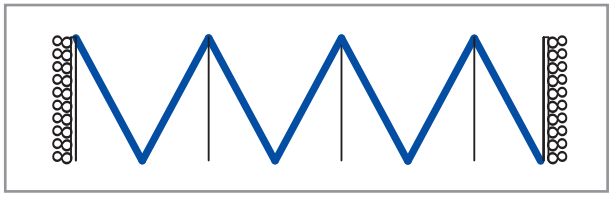


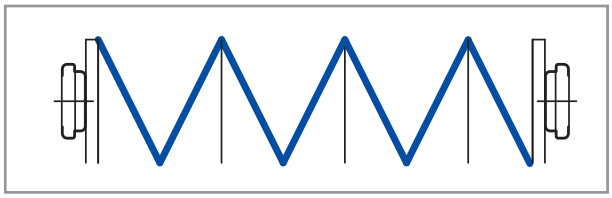
End flanges can also be mounted from the outside

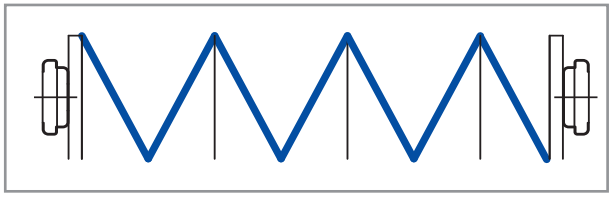


aEnd flanges can be mounted only from the inside


Mounted with velcro tape, both sides full fold


Mounting with velcro tape, one side half, one side full fold


Mounted with clip fasteners, both sides full fold


Mounted with clip fasteners, one side half, one side full fold

Legend and formulae for calculation

FB	Width of the fold
FZ	Number of folds
FZD	Compression per fold
FAZ	Extension per fold
BE	Width of the terminal fixture
AZ	Maximum extension
ZD	Minimum compression

Formulae for calculation

ZD	AZ-Hub
FZ	$\frac{AZ}{FAZ}$
ZD	$\frac{(AZ \times FZD) + BE}{FAZ}$
AZ	$\frac{(ZD - BE) \times FAZ}{FZD}$

FB (mm)	FAZ (mm)	FZD*(mm)
15	22	3 - 5
17,5	24	3 - 5
20	30	3 - 5
25	38	3 - 5
30	48	3 - 5
35	55	3 - 5
40	65	3 - 5
45	75	3 - 5
50	85	3 - 5

* depending on material


Rear view of complete solution, ELASTIC Bellows used for X axis

All dimensions in mm if not marked otherwise. Errors and omissions excepted.

LAMINAT Bellows

LAMINAT Bellows are characterized by several layers of foil bonded together. The LAMINAT bellows are used where flexible designs and inherent rigidity are important.

LAMINAT Bellows with octagon section and strap retainer

Application

LAMINAT Bellows are nowadays deployed in spindle-type lifting gear, for cameras, measuring and music instruments as well as for medicine and food technologies. They are used to protect columns, spindles and shafts.

All LAMINAT Bellows can be used vertically or horizontally, including hybrid forms. They allow smooth and very quiet running properties.
The surface structure and the regularity of contours present an appealing overall appearance.

Perfect surface of LAMINAT Bellows for medical devices

LAMINAT Bellows are not suited to applications with high temperatures and humidity. If these criteria should be relevant, models from our other lines may be considered, such as Rubber Disk Bellows or Fabric Bellows (see Special Bellows section).

Material

LAMINAT Bellows can be adapted through the choice of basic components, materials, shape, colours, and dimensions. The basic design concept of the LAMINAT Bellows is based on a two-component material.
A manufacturing technique developed to perfection combines the outer material requested by the customer with the appropriate interior material selected by the HEMA designer. For additional stability PVC or metal frames can be added.

Maintenance

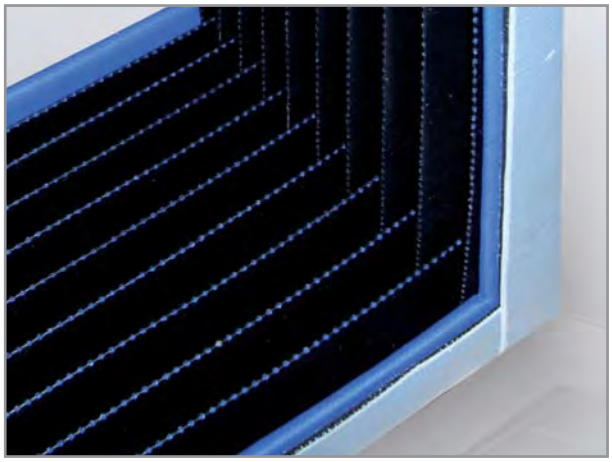
A further benefit of these bellows comes in the form of their segmented design. Damaged parts of the LAMINAT Bellows can be easily replaced, reducing significantly the costs for maintenance.

Design

Like the ELASTIC Bellows LAMINAT Bellows can also be designed and produced in a variety of forms.
LAMINAT Bellows are primarily used to cover and protect columns and spindles. Rectangular, hexagonal, octagonal and twelve-sided sections are available as well as roof and inclined shapes and Venetian blind style standards.

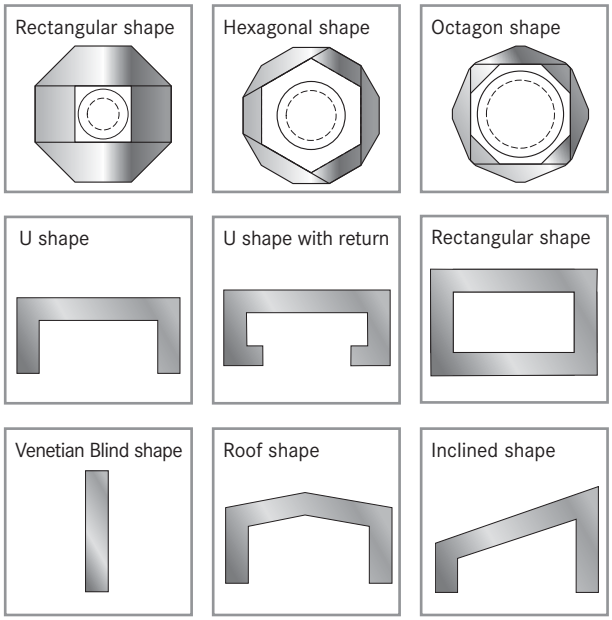
LAMINAT Bellows with intermediate frames

LAMINAT Bellows



LAMINAT Bellows, view of interior

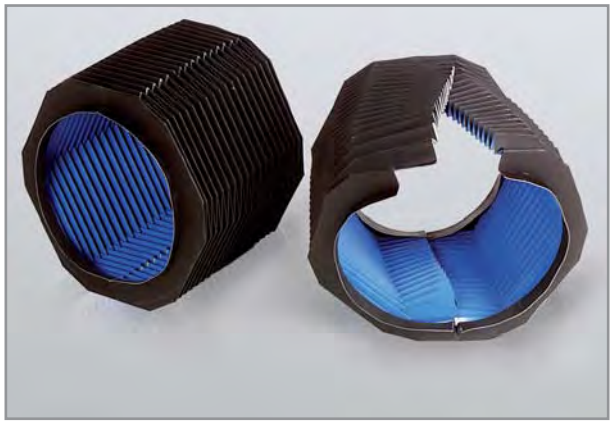
LAMINAT Bellows are available as split designs as well. The split type facilitates bellow replacement and maintenance, and so is perfect as a retrofit on machines. The bellows can afterwards be closed with adhesive tape, Velcro tape or bonding. The higher compression of these types must be taken into consideration.



Range of available shapes

Polygonal section with support elements

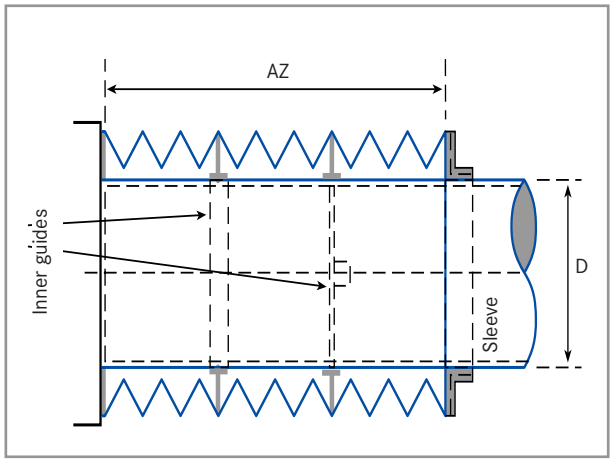
This sectional view shows an example of a design solution for horizontal applications.
Sub frames with guides or guide rings are used here to support the shaft or spindle.
These additional guiding elements ensure that the LAMINAT bellows run smoothly and with less friction



Split version for fast mounting or retrofitting

Characteristic

The stiffness of LAMINAT Bellows (standard designs) can be enhanced with an optional PVC frame or wire hoop in every second or third fold.



Sectional view of bellows with support elements

Furthermore they can be supported on special gliders or roller systems, recommend at speeds higher than 30 m/min. On the polygon sections, spacers and circular guide/support systems ensure the optimum gliding efficiency on columns, spindles and shafts.
Also extension limiters assure consistent extension after high acceleration impacts.

Mounting

LAMINAT Bellows can be easily mounted with metal end frames, clip fasteners, velcro tapes, or sleeves with strap retainer (for polygonal sections only).
Closed designs require adequate ventilation. We offer optional punching with or without filter.

LAMINAT BELLOWS

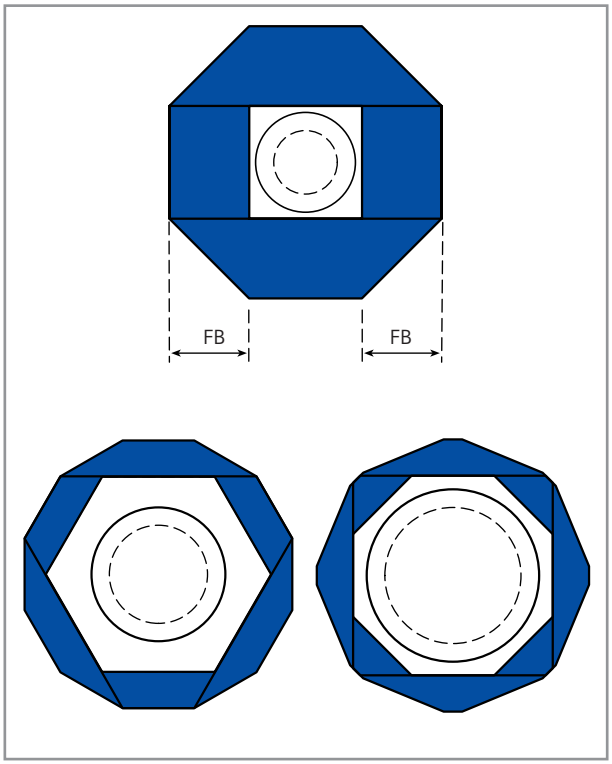
Legend	
FB	Width of the fold
FZD	Compression per fold, depending on material
FAZ	Extension per fold

FB	FAZ	FZD
7,5	9	3
10	15	3
12.5	18	3
15	20	3
17.5	25	3
20	30	3
25	37	3.5
30	45	3.5
35	55	4
40	60	4
45	65	4
50	70	4

Standard folds

FB	FAZ	FZD
7,5	8	3
10	13	3
12.5	15	3
15	20	3
17.5	23	3
20	25	3
25	30	3.5
30	35	3.5
35	40	4
40	45	4
45	50	4
50	55	4

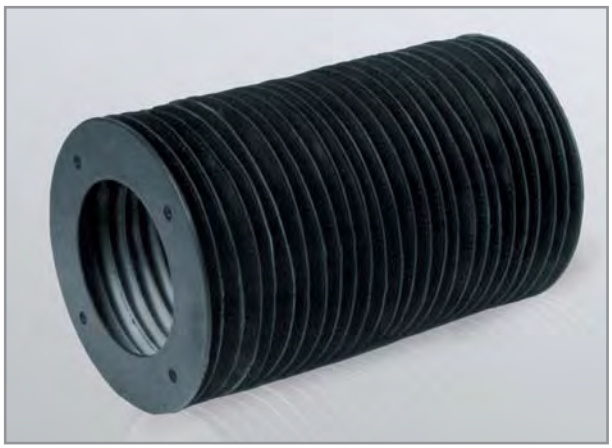
Alternating folds



Alternating folds

Circular-Stitched Bellows

The circular-stitched bellows consist of punched disks stitched inside and outside.
Stitching achieves particularly good shape stability and high transverse stiffness.



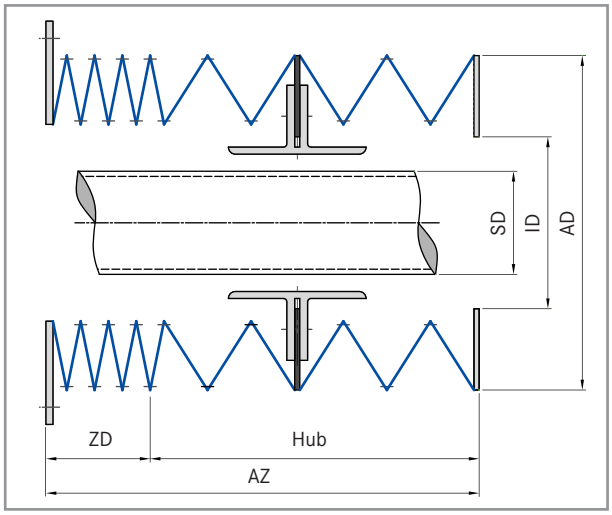
Circular stitched bellows

Material

Standard applications require material GN 807, and high temperature applications aluminium/glass fibre.
Circular-stitched bellows are extremely resistant and can even withstand impact from sharp edged chips, also in the smaller versions. They are suitable only to a limited extent as protection against liquids and oils.

Mounting position

Circular-stitched bellows can be used horizontally or vertically. Additional support and guide rings made of synthetics assure a uniform distance from the spindle and so increase operating life.
When with large extensions the stability of the bellows can be increased when a wire ring is installed in every fold.



Sectional view: Circular stitched bellows

The usual connecting and mounting elements are metal frames, but sleeves are an alternative.

Design information

The correct bellow diameter should be about 10 mm larger than the part they are to protect. Use the following formula for measurements.

Design and Legend

Extension = (Stroke / FStroke) x FAZ + 5

AD	Outside diameter
FB	Fold width
ID	Inside diameter
FAZ	Fold extension
FZD	Fold compression
FStroke	Stroke per fold
SD	Diameter of spindle

HEMA Type	AD	ID	FB	FAZ	FZD	FStroke
RF 50	52	25	12.5	10	2.5	7.5
RF 72	72	33	19.5	18	2.5	15.5
RF 85	85	45	20	18	2.5	15.5
RF 95	95	53	21	18	2.5	15.5
RF 100	100	63	18.5	18	2.5	15.5
RF 120	120	82	19	18	2.5	15.5
RF 122	122	76	23	15	2.5	12.5
RF 130	130	90	20	18	2.5	15.5
RF 135	135	85	25	15	2.5	12.5
RF 140	140	100	19	18	2.5	15.5
RF 145/1	145	93	26	15	2.5	12.5
RF 145/2	145	105	20	18	2.5	15.5
RF 150	150	110	20	18	2.5	15.5
RF 160	160	112	24	18	2.5	15.5
RF 170	170	125	22.5	18	2.5	15.5
RF 180/1	180	132	24	20	2.5	17.5
RF 180/2	180	141	19.5	18	2.5	15.5
RF 190	190	150	20	18	2.5	15.5
RF 200	200	152	24	18	2.5	15.5
RF 220	220	170	25	18	2.5	15.5
RF 235	235	190	22.5	18	2.5	15.5
RF 245	245	200	22.5	20	2.5	17.5
RF 260	260	202	29	18	2.5	15.5
RF 266	266	216	25	20	2.5	17.5
RF 300	300	250	25	18	2.5	15.5
RF 365	365	320	22.5	18	2.5	15.5
RF 400	400	340	30	20	2.5	17.5

All dimensions in mm if not marked otherwise. Errors and omissions excepted.

BELLOWS FOR JET CUTTING MACHINES

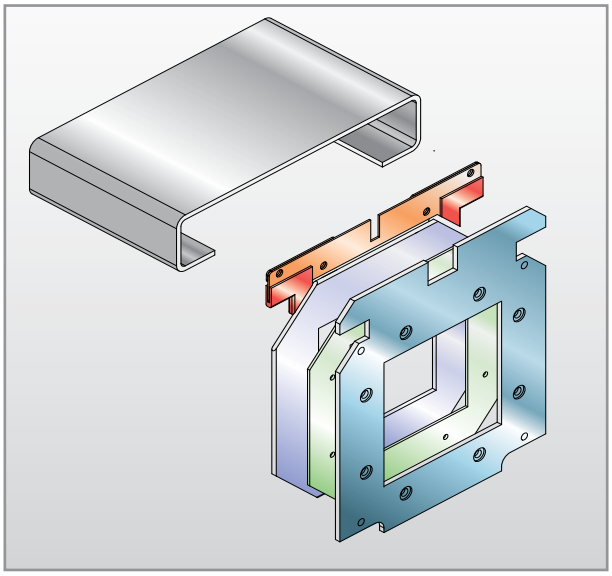
Modern jet cutting machines (with lasers, plasma or water) are fitted with bellows to protect the jet channel and the mechanical components such as spindles and guides.

Guided bellows for laser cutting

These types of bellows require a high level of tightness and long life.
Bellows for jet cutting machines are primarily made of self extinguishing materials such as Preotex.
The materials selected have been extensively tested with various impact cycles.

At all stages from production to packaging and shipment our bellows are maintained in a particularly clean state and free of dust, e.g. with special packing.

Bellows in operation

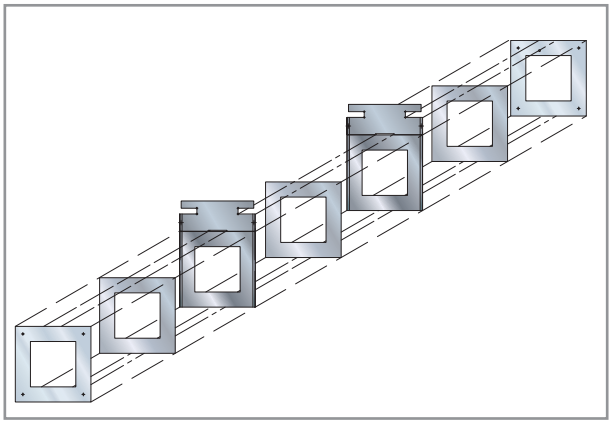


Structure of synthetic material frames and guiding frames

- High temperature resistance of bellow material
- No outgassing of materials
- Gas-tight for minimised flushing gas losses
- Superior clean state during production and shipment

Construction

For better stability the bellows used for jet cutting machines are fitted with stabilizing synthetic material frames.
These frames are customized to each guidance type, e.g guiding bars. Normally these bellows are mounted with metal end frames.
Especially important is a separate guiding system that keeps the bellows material intact.

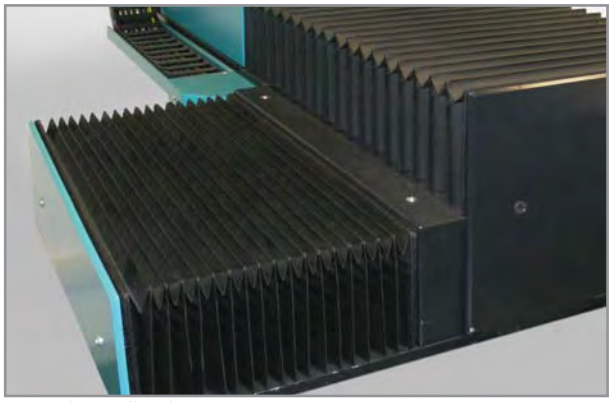


External guide for laser cutting bellows

Bellows for Linear Guides

Linear drives can be either retrofitted by the customer or fitted with bellows before they leave the factory.
HEMA has specialised in this field and offers bellows tailored to the leading international manufacturers, e.g. INA, NSK, Schneeberger, Bosch-Rexroth, THK or NSK.

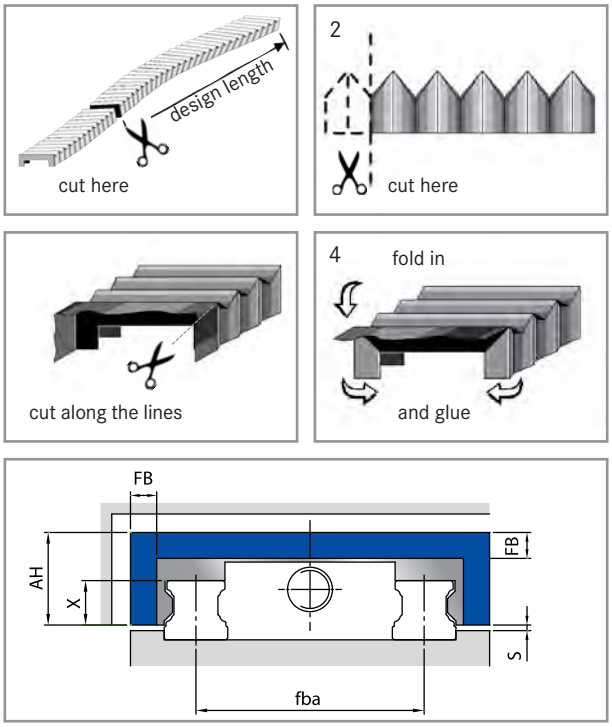
On the basis of precise type denominations the bellows and their guiding components can be manufactured correctly to size.



Example application

Material

Standard applications require PU coated materials, but heat resistant and self extinguishing materials are also available.
For the best services and immediate replacements these bellows are also available as »endless versions« with 200 or more folds in total. The required dimensions can easily be configured by the customer.



Legend	
FB	Fold width
FAZ	Extension per fold
fba	Width of guiding way
AH	Exterior height
X	Interior height
S	Play

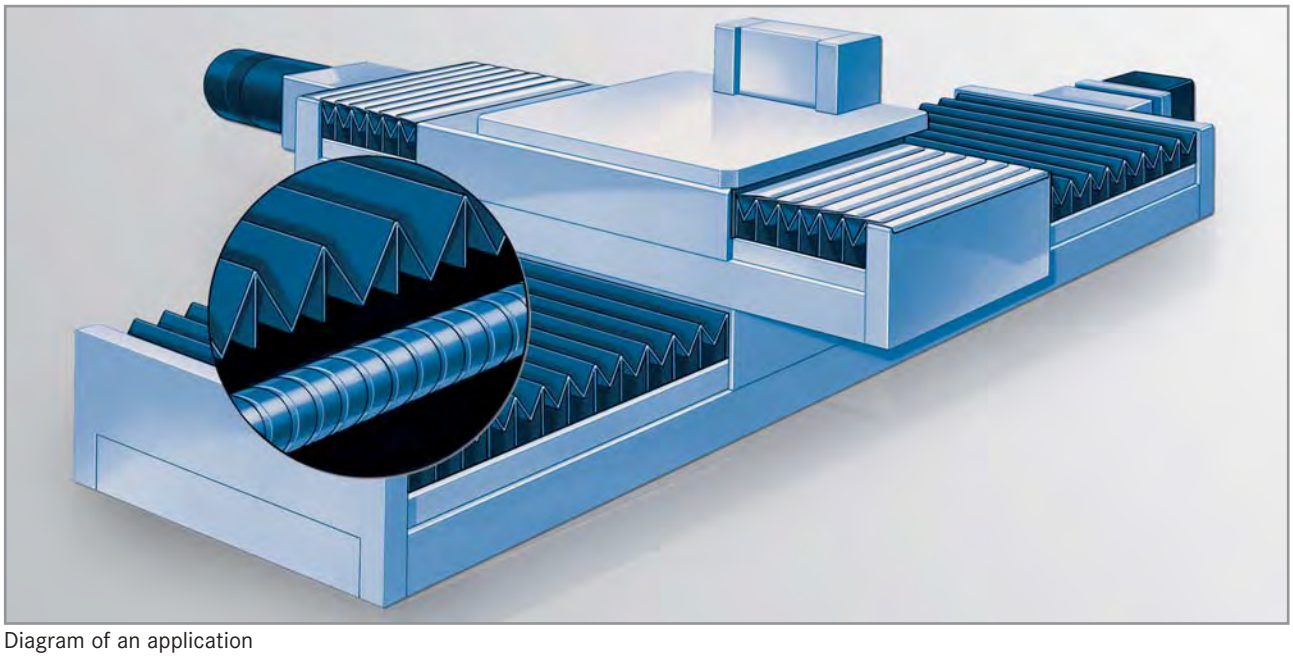
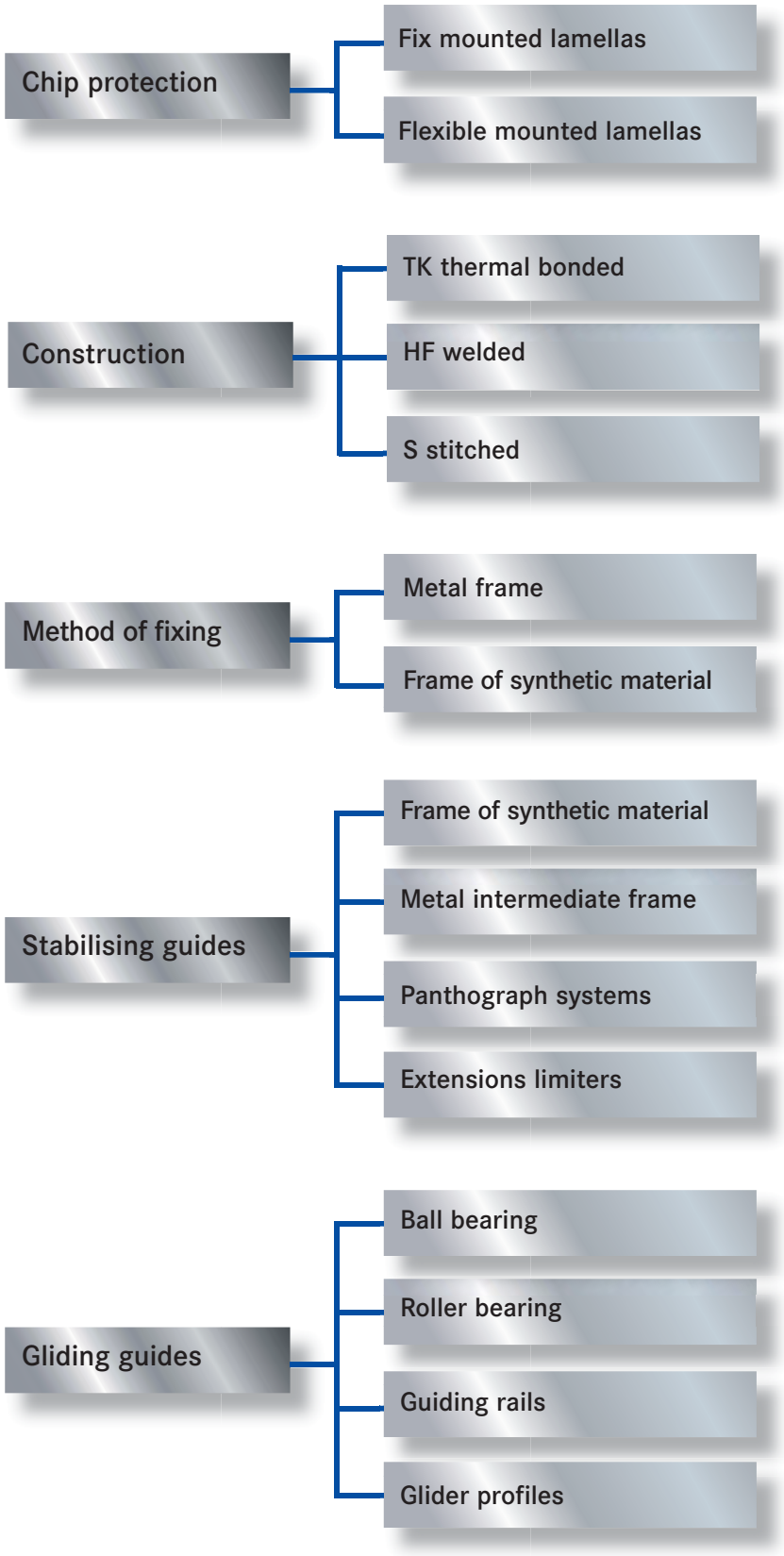


Diagram of an application

All dimensions in mm if not marked otherwise. Errors and omissions excepted.

Modular Concept

SAMURAI



SAMURAI Bellows

SAMURAI Bellows are an advancement of the ELASTIC Bellows product line. Characteristic for this type of bellows are their lamellas.

The lamellas are fixed at the upper edge of the bellows, which also reinforces them. They provide excellent protection against fast, very hot and sharp chips.

SAMURAI Bellow

SAMURAI Bellows are ideal for HSC applications. Solutions for machining centres with speeds greater than 100 m/min and accelerations greater than 2 g have been successful realized.

Type of bellow	heavy swarf impact	X/Y axis	Z axis	less space
ELASTIC		■		■
FASTAF	■	■	■	
FASTAM			■	■
FASTAC	■			
Vector C²	■	■		
FASTLAP			■	■

Design

Similar the ELASTIC range of products, all materials, shapes, processing methods, and measurements for the SAMURAI Bellows can be combined in any variation. Also a PVC frame is built into each fold of this bellow for assured stability.

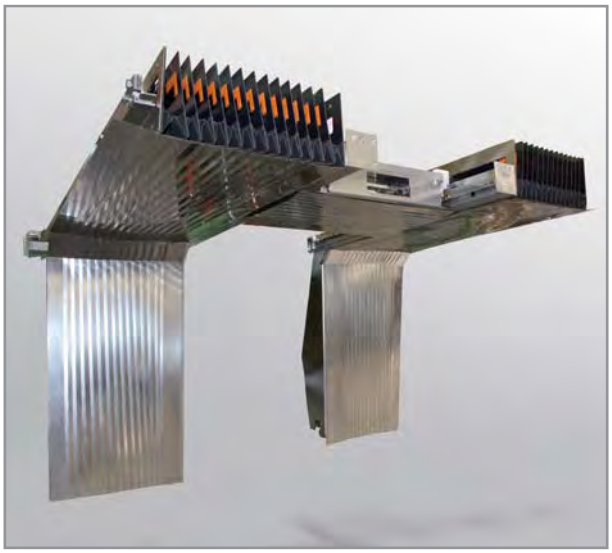
Lamellas

The position of each lamella can be individually chosen. The lamellas can be fixed to the front of the bellows, each side, or in any combination.
In addition, our in house production of lamellas means we can provide them in nearly all forms, such as inclined or roof types. Stainless steel is used for the material.

Excellent closing and sealing on the top side

Usually the basic lamella type is flat with its end formed into a wiper profile, for excellent contact and sealing on the top side of the SAMURAI Bellow.

There is a high contact pressure across the whole lamella area. With their efficient wiper edge the lamellas prevent debris from entering the interior.



Example SAMURAI Bellows type Vector C²; a ready to install solution including interlocking system for loading through the roof. Combination with optional mechatronics system »CoverShutter« possible.

All dimensions in mm if not marked otherwise. Errors and omissions excepted.

SAMURAI Bellows

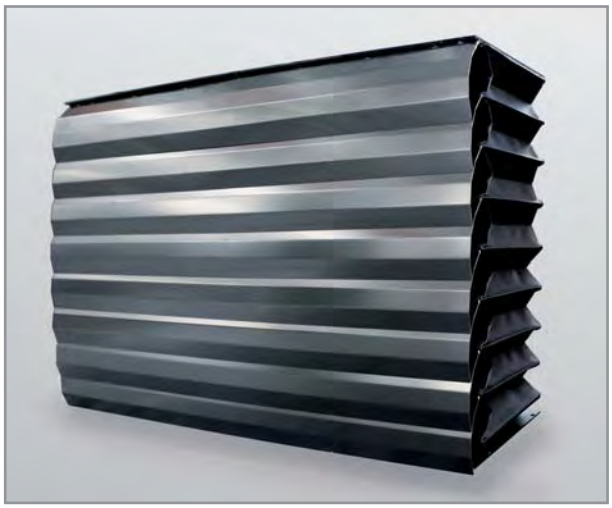
Application of lamella bellows

When in use the lamellas develop a regular formation of stripes on their surfaces. This is normal and caused by their edges and has no effect on their functionality or service life.

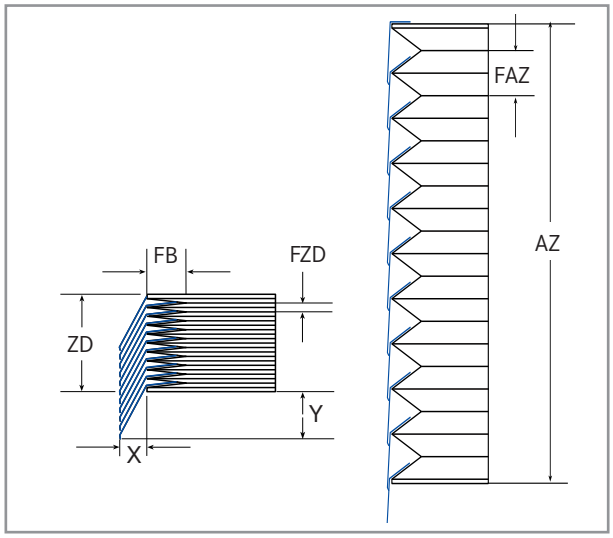
The lamellas are corrosion and acid proof, but not accessible.

SAMURAI Bellows are available in three basic types.
These main types are based on how the lamellas are fixed:

- FASTAF - fixed lamellas
- FASTAC - fixed telescopic lamellas
- FASTAM - flexible lamellas
- FASTAF Vector C² - special type for multi axis protection



SAMURAI FASTAM



Drawing of FASTAF/FASTAC

Legend	
FB	Width of fold
FZD	Compression per fold
2FZD	Compression per two folds
FAZ	Extension per fold
2FAZ	One sheet of lamella protects two folds
FHub	Stroke per fold
AZ	Maximum extension
ZD	Minimum compression
X	Horizontal space required for the lamellas
Y	Vertical space required for the lamellas

FB	FAZ	FZD	X	Y
17,5	20	5	20	40
20	25	5	20	45
25	32	5	25	50
30	40	5	25	65
35	45	5	30	75
40	60	5	35	80
45	65	5	35 - 40	85
50	75	5	45 - 50	95

FASTAF/FASTAC

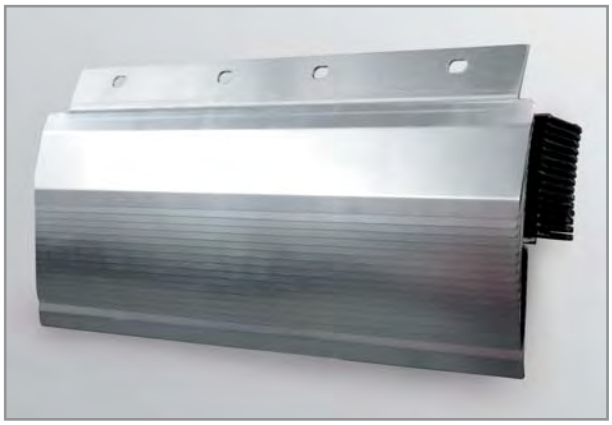
FB	2FAZ	2FZD	Y
15	40	5-10	65
17,5	45	5-10	75
20	55	5-10	75
25	70	5-10	90
30	85	5-10	105
35	100	5-10	120
40	125	5-10	155

FASTAF 2-folds (one sheet of lamella protects two folds)

SAMURAI Bellows

FASTAF

FASTAF types are SAMURAI Bellows with fixed lamellas. Owing to this design the lamellas overlap. The lamellas are hinged or clipped. When damaged they can be replaced.

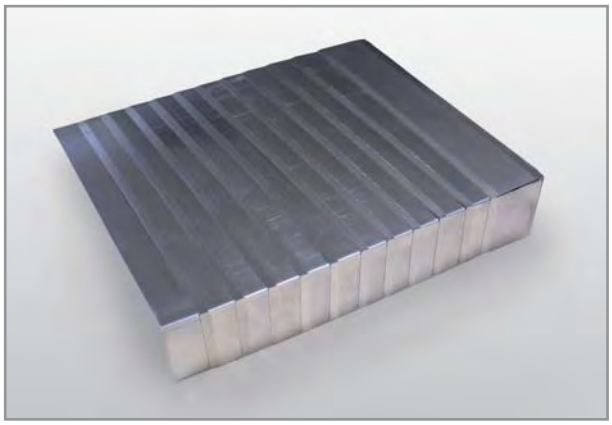


SAMURAI FASTAF, demonstration of »overlapping«

FASTAC

FASTAC types are SAMURAI Bellows with fixed telescopic lamellas (boxes).

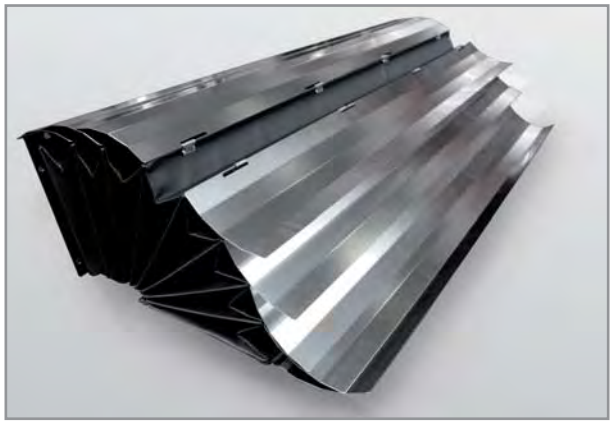
The lamellas cover the front and also the side parts of the bellows, forming an enclosed surface. These »closed« FASTAC lamella bellows are primarily used in a vertical operating position as an alternative to telescopic steel covers.



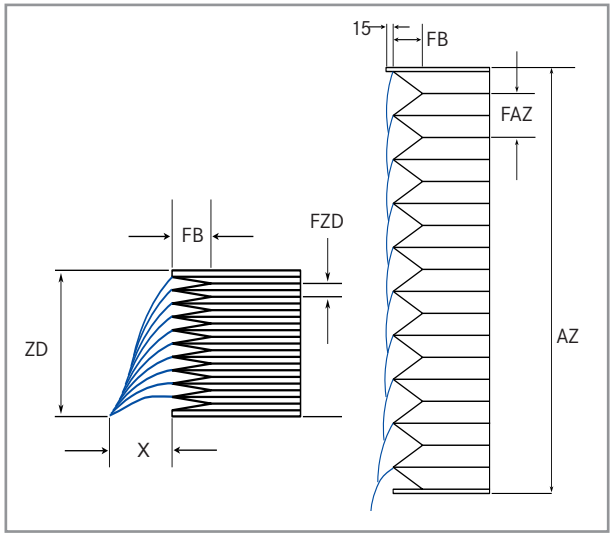
SAMURAI FASTAC

FASTAM

SAMURAI Bellows of the FASTAM type are equipped with flexible fixed lamellas, so lamella projection must be taken into consideration. The lamellas "stack" when the cover is compressed.
The lamellas are hinged or clipped. When damaged they can be replaced.



SAMURAI FASTAM, flexible fixed lamellas



Drawing of FASTAM

Legend	
FB	Width of fold
FZD	Compression per fold
FAZ	Extension per fold
ZD	Minimum compression
AZ	Maximum extension
X	Horizontal space required for the lamellas

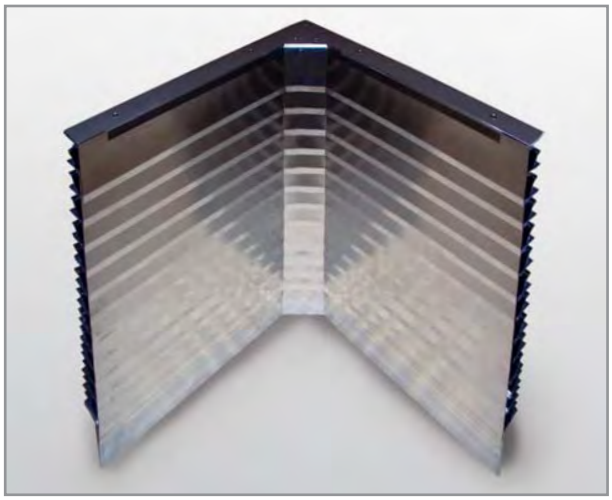
FB	FAZ	FZD	X
17,5	22	5	50
20	30	5	50
25	38	5	65
30	48	5	75
35	55	5	85
40	65	5	85
45	75	5	100
50	85	5	110

All dimensions in mm if not marked otherwise. Errors and omissions excepted.

SAMURAI Bellows

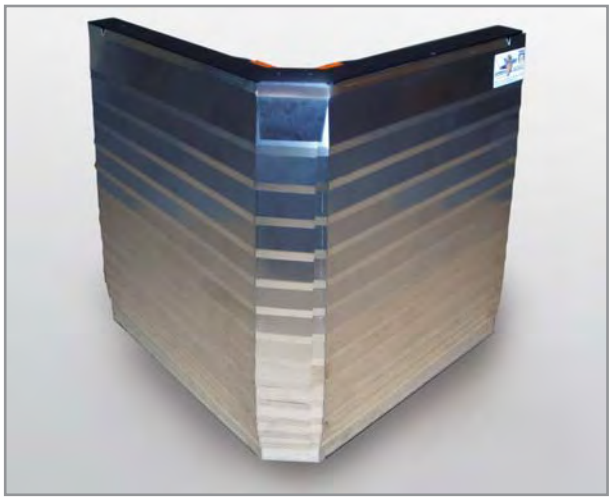
VECTOR C² type

The FASTAF type VECTOR C² is a special type for machining centres where continuous covering of the working space (e.g. rear wall, upper roof area) is required.



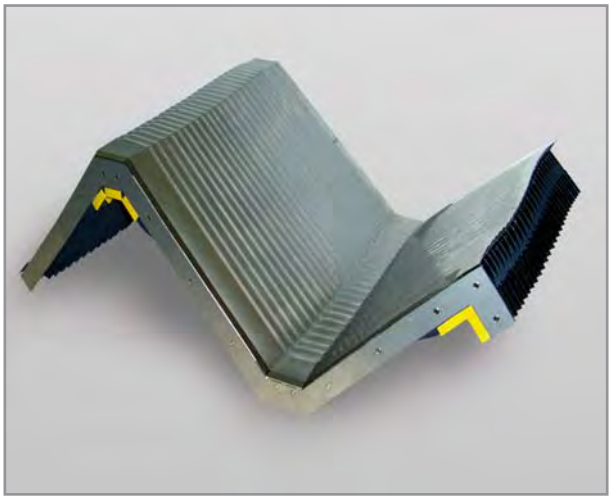
SAMURAI Vector C², interior angle

With its unique design of fixed mounted lamellas only one bellow unit is needed to cover the corner areas.
The space allocated to the covering can be used very efficiently, and machining dust is significantly reduced.
For swarf protection the VECTOR C² type is equipped with two overlapping, bended metal sheets mounted securely on each fold.



SAMURAI Vector C², exterior angle

The VECTOR C² corner lamella is available as a bended or rounded version providing both a stable structure and reliable functionality.
Even at high operating speeds and accelerations this stable and reliable concept responds flexibly to all interior and exterior angles and combinations of angles.



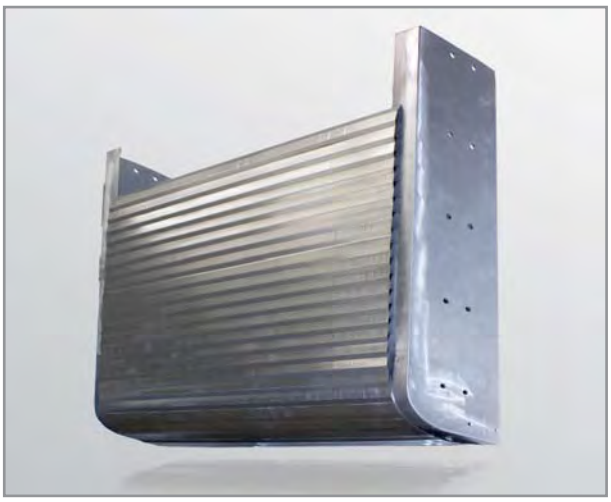
SAMURAI Vector C², combination of interior and exterior angle

The lamellas for this type of SAMURAI Bellows are available in four shapes:

- Outside
- Inside
- Inside round
- Inside Outside

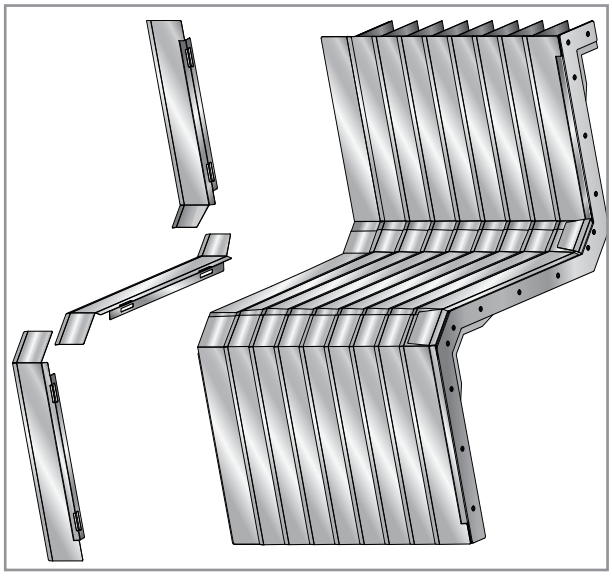
SAMURAI FASTAF TW for limited space

The SAMURAI FASTAF TW has been developed as an alternative to the classic design of protective covers.
This lamella cover »bends around the corner« and is therefore perfectly suited to machines with limited space below the cover.
The compressed cover is turned through 90° allowing more design opportunities. The preload of the lamella's in the area of the radius is maintained through innovative design.

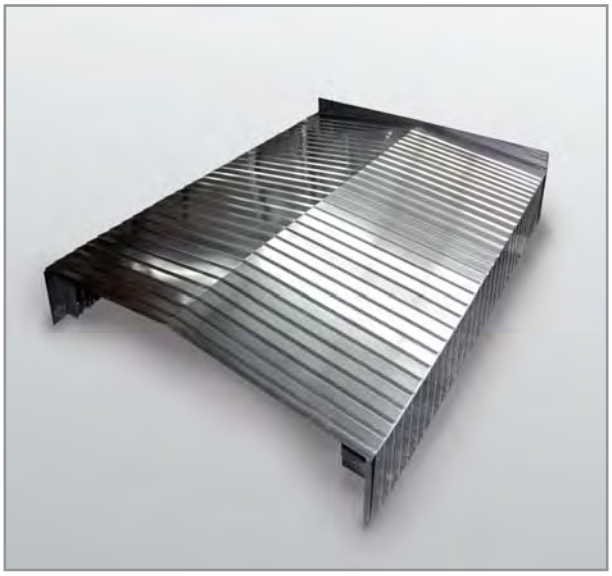


SAMURAI FASTAF TW

SAMURAI Bellows



VECTOR C² Inside Outside

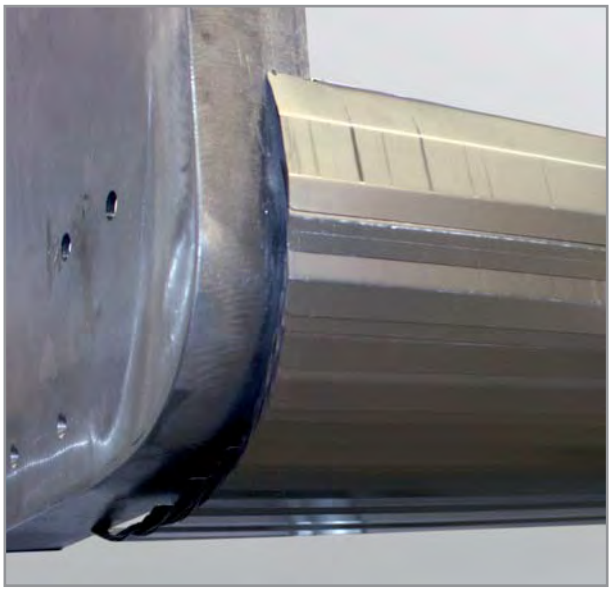


SAMURAI FASTAC, special solution

Legend	
FB	Width of fold
FZD	Compression per fold
FAZ	Extension per fold
X	Horizontal space required for the lamellas
Y	Vertical space required for the lamellas

FB	FAZ	FZD	X	Y
17,5	20	5	20	40
20	25	5	20	45
25	32	5	25	50
30	40	5	25	65
35	45	5	30	75
40	60	5	35	80
45	65	5	35 - 40	85
50	75	5	45 - 50	95

Vector C²



SAMURAI FASTAF TW for limited space

View into operating machining centre. Result: SAMURAI FASTAF proves reliable even with large chip volumes.

All dimensions in mm if not marked otherwise. Errors and omissions excepted.

SAMURAI Lamella Aprons

SAMURAI FASTLAP lamella aprons are a variation of the SAMURAI bellows. They were designed for Z axis covers in machining centres.
The substructure does not consist of ELASTIC bellows but only a carrier material to which the lamellas are fixed.

SAMURAI lamella apron

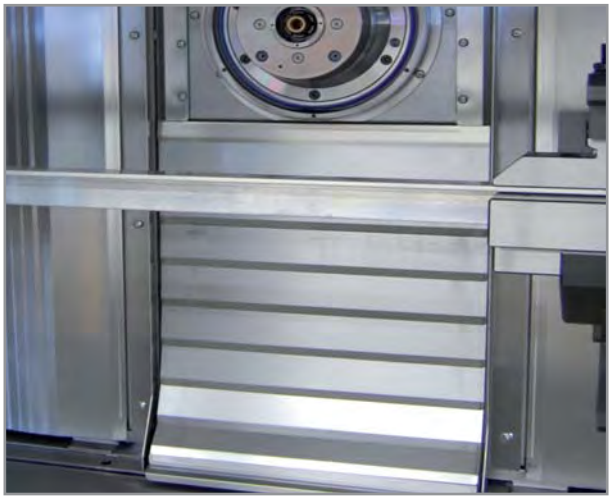
These cover types are called FASTLAP, and the product line consists of three models. They vary according to how their lamellas are fixed to the carrier material. Special types are available on request.

FASTLAP

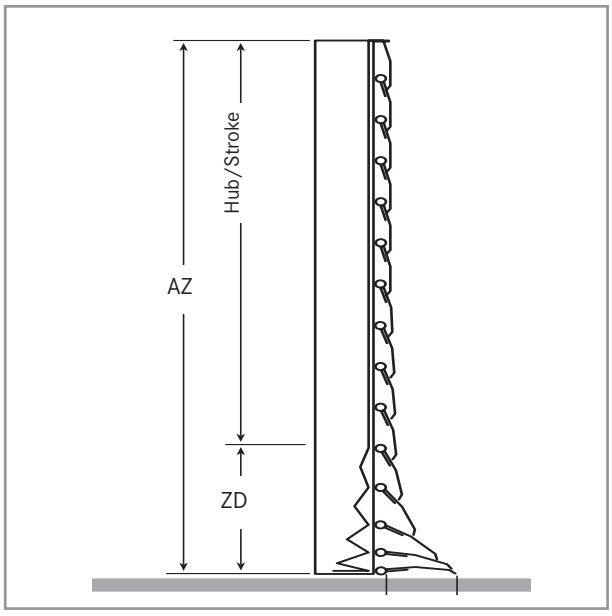
The SAMURAI FASTLAP lamella apron is available in two variants:

- lamellas clipped
- lamellas secured with or without preloading

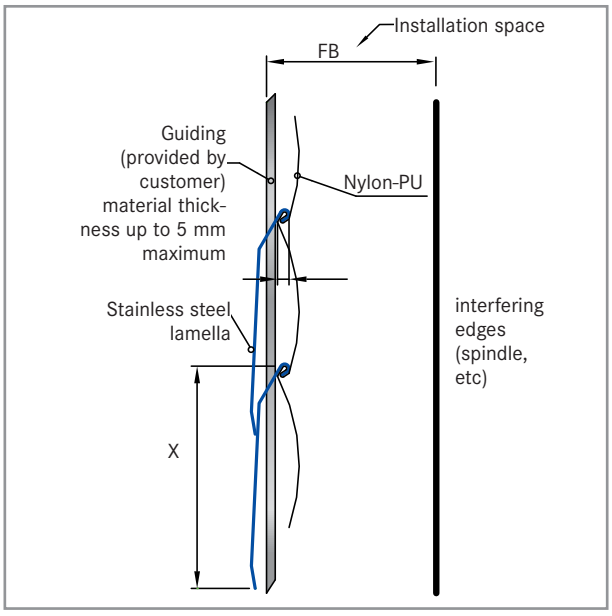
The lamellas are made of stainless steel of 0.5 mm thickness up to a maximum width of 4,000 mm, and mounting is simple. The compression per fold is about 4 mm.
The lamella apron requires a guide on both sides that must allow for a side length of 25 mm.
The lamella apron is secured to a tear-proof Nylon-PU material selected specifically for each application.



SAMURAI Lamella apron

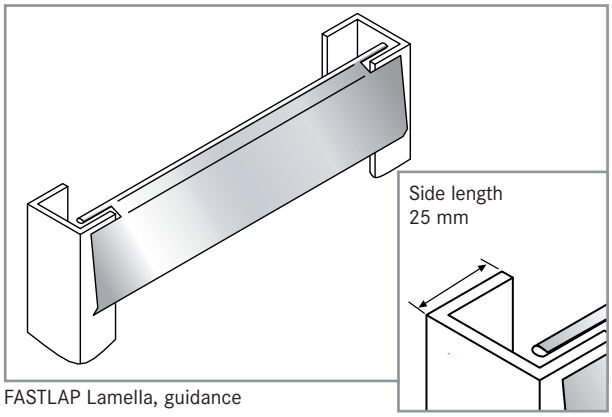


FASTLAP Lamella apron



FASTLAP Lamella apron

SAMURAI Lamella Aprons



FASTLAP Lamella, guidance

Legende	
FB	Width of fold
FZD	Compression per fold
FAZ	Extension per fold
X	Horizontal space required for the lamellas

FB	FAZ	FZD	X
25	38	4	65
30	48	4	75
35	58	4	85
40	68	4	95
45	78	4	105
50	88	4	115

FASTLAP

Special types of lamella aprons

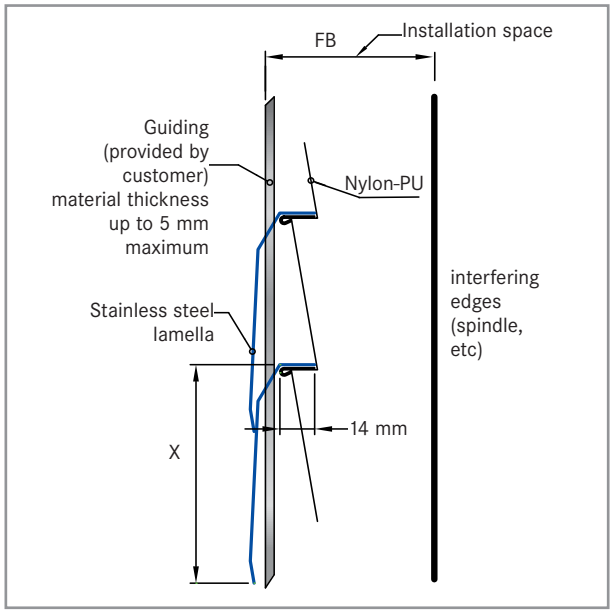
- FASTLAP SA
- FASTLAP SB

FASTLAP SA

The SAMURAI FASTLAP SA lamella apron is also fitted with flexible mounted lamellas. These hinged without preloading. The lamellas are made of stainless steel 0.5 mm thick up to a maximum length of 4,000 mm. Within these dimensions the length of lamellas and width of folds can be individually chosen. For compression 4 mm per fold must be considered.

The FASTLAP SA type exhibits a greater lateral stability, especially for widths in excess of 1,000 mm, when compared with the standard FASTLAP type.

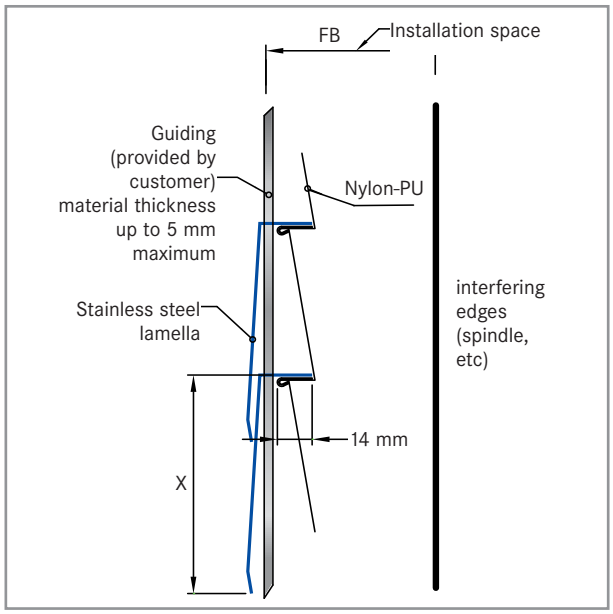
Therefore this type is suitable for higher travelling speeds. The higher surface pressure also effectively prevents the lamellas from »lifting off«. At the machine there must be guides on both sides of the lamella apron over a side length of 25 mm; the thickness can be up to 5 mm.



Lamella apron FASTLAP SA

FASTLAP SB

Compared with FASTLAP SA this type exhibits a higher lateral stability, which becomes particularly necessary on widths greater than 1000 mm. At the machine there must be guides on both sides of the lamella apron over a side length of 25 mm. Unlike FASTLAP and the FASTLAP SA types for the FASTLAP SB apron the thickness of the guides can be up to 6 mm. The vertical lamella overlap requires an additional space of 15 mm. Owing to this design the lamellas cannot be lifted. The lamella apron is secured to a tear-proof Nylon-PU material selected specifically for each application.



Lamella apron FASTLAP SB

Soft PVC Bellows

Soft PVC Bellows occupy a special position among the different types of bellows. ELASTIC Bellows (see Chapter ELASTIC Bellows) offer extremely flexible design options with regard to material, dimensions and shape and can nevertheless also be produced economically in very small quantities.

Soft PVC Bellows in standard colour black

Soft PVC Bellows on the other hand are moulded parts, i. e. a certain minimum quantity or corresponding tooling must be available to justify economic production.
Correspondingly, cost reduction can be achieved with larger quantities which makes these parts particularly well suited for large series use.
Tooling is already available for many configurations, therefore attractive prices can be offered even for smaller quantities.
The dimensions and shapes shown in the catalogue are available as standard forms. In addition we would be pleased to assist you in the design of special types.

Large variety of forms and colours

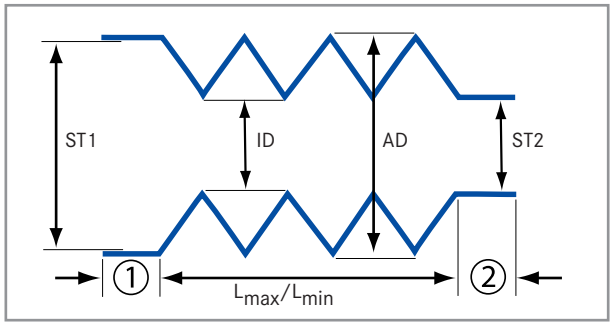
Split version

Material

We use a special PVC as standard material. The bellows are resistant to alkalis and acids; they are water and dust-proof. The standard colour of these bellows is black, but other colours as well as a version in transparent material are also possible.

Temperature

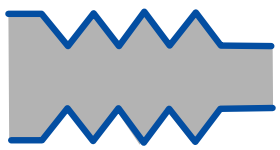
The operating temperature range is between -20°C and +80°C. For a short time a maximum operating temperature up to +120°C is possible.



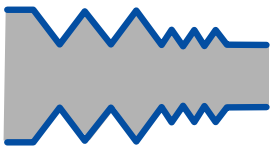
Legend	
ID	Inside diameter
AD	Outer diameter
FAZ	Extension per fold
FZD	Compression per fold
Customer specification resp. incidental by parameter	
L_{min}	Compression of bellow
L_{max}	Extension of bellow
①	Width of sleeve 1
②	Width of sleeve 2
FAZ	Extension per fold
FZD	Compression per fold

Soft PVC Bellows

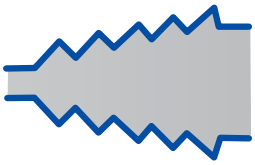
Type AB



Type APB



Type ABC



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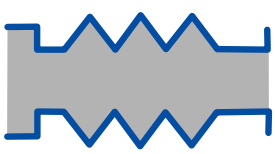

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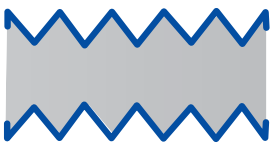

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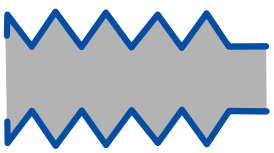

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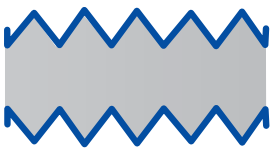
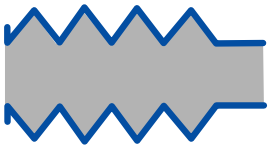


Type JB



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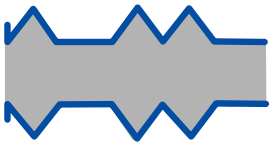

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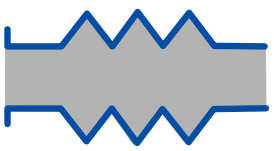

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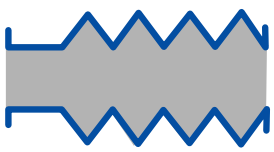

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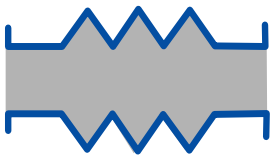

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10	10	20	4	12
18	18	28	4	12
20	20	36	4,5	18
22	22	40	5	20
25-1	25	36	5	15
25-2	25	45	5,5	24
28-1	28	40	5,5	19
28-2	28	50	5,5	23
32-1	32	46	5	16
32-1	32	56	6,5	26
36-1	36	50	5	17
36-1	36	63	7	28
40-1	40	56	6	21
40-1	40	71	7,5	34
45-1	45	63	6,5	22
45-2	45	80	7	34
50-1	50	71	6	23
50-2	50	89	8	39
56-1	56	80	6,5	27
56-2	56	89	7,5	36
56-3	56	100	8,5	45
63-1	63	89	6,5	26
63-2	63	100	7,5	36
63-3	63	110	7,5	40
63-4	63	125	7,5	48
71	71	100	7	30
75-1	75	100	7	28
75-2	75	110	7	32
75-3	75	125	7,5	42
75-4	75	140	7,5	55
75-5	75	150	7,5	58
80-1	80	100	7	24
80-2	80	110	7,5	32
80-3	80	125	7,5	44
80-4	80	140	7,5	53
80-5	80	150	8	58
80-6	80	160	8	65
89-1	89	110	7,5	24
89-2	89	125	8	36

All dimensions in mm if not marked otherwise. Errors and omissions excepted.

Soft PVC Bellows

Type	ID	AD	FZD	FAZ
89-3	89	140	8	46
89-4	89	150	8	55
89-5	89	160	8	60
89-6	89	170	8,5	65
100-1	100	128	7,5	29
100-2	100	140	8	40
100-3	100	150	8	46
100-4	100	160	8	55
100-5	100	170	8,5	60
100-6	100	180	9	65
110-1	110	130	7,5	24
110-2	110	140	7,5	30
110-3	110	150	8	40
110-4	110	160	8	47
110-5	110	170	8	56
110-6	110	180	8,5	60
110-7	110	190	9	65
110-8	110	200	9	70
120-1	120	140	7,5	24
120-2	120	150	8	30
120-3	120	160	8	40
120-4	120	170	8	47
120-5	120	180	8,5	55
120-6	120	190	9	60
120-7	120	200	9	65
125-1	125	150	7,5	28
125-2	125	160	8	38
125-3	125	170	8,5	42
125-4	125	180	8,5	52
125-5	125	190	8,5	57
125-6	125	200	8,5	62
125-7	125	210	9	68
140-1	140	160	7,5	24
140-2	140	170	8	30
140-3	140	180	8,5	40
140-4	140	190	9	47
140-5	140	200	10	56
140-6	140	210	10	60
140-7	140	220	10	65

Type	ID	AD	FZD	FAZ
150-1	150	170	8	24
150-2	150	180	8,5	30
150-3	150	190	9	40
150-4	150	200	9	47
150-5	150	210	10	56
150-6	150	220	10	60
150-7	150	230	10	65
150-8	150	240	10	70
160-1	160	190	8,5	30
160-2	160	200	9	40
160-3	160	210	10	47
160-4	160	220	10	56
160-5	160	230	10	60
160-6	160	240	10	65
160-7	160	250	10	70
170-1	170	200	9	30
170-2	170	210	10	40
170-3	170	220	10	47
170-4	170	230	10	56
170-5	170	240	10	60
170-6	170	250	10	65
170-7	170	260	10	70
180-1	180	210	9	30
180-2	180	220	10	40
180-3	180	230	10	47
180-4	180	240	10	56
180-5	180	250	10	60
180-6	180	260	10	65
190-1	190	220	9	30
190-2	190	230	10	40
190-3	190	240	10	47
190-4	190	250	10	60
190-5	190	260	10	70
190-6	190	280	10	75
200-1	200	230	9	30
200-2	200	240	10	40
200-3	200	250	10	47
200-4	200	260	10	57
200-5	200	280	10	70

Order and request forms available at: www.hema-schutz.de

Soft PVC Bellow

Type	ID	AD	FZD	FAZ
210-1	210	240	10	30
210-2	210	250	10	40
210-3	210	260	10	47
210-4	210	280	10	65
210-5	210	300	10	75
220-1	220	250	10	30
220-2	220	260	10	40
220-3	220	280	10	57
220-4	220	300	10	70
220-5	220	320	10	80
230-1	230	260	10	30
230-2	230	280	10	48
230-3	230	300	10	65
230-4	230	320	10	75
240-1	240	280	10	40
240-2	240	300	10	58
240-3	240	320	10	70
240-4	240	360	10	90
250-1	250	280	10	30
250-2	250	300	10	45
250-3	250	320	10	60
250-4	250	360	11	85
280-1	280	320	10	40
280-2	280	360	10	72
280-3	280	400	11	90
300-1	300	360	10	60
300-2	300	400	10	80
320-1	320	360	10	40
320-2	320	400	10	72
320-3	320	450	11	100
360-1	360	400	10	40
360-2	360	450	10	80
360-3	360	510	11	110
400-1	400	450	10	50
400-2	400	510	10	85
400-3	400	530	11	100
450-1	450	490	10	40
450-2	450	510	10	55
450-3	450	530	11	75

Type	ID	AD	FZD	FAZ
450-4	450	560	12	85
510	510	650	12	105
560	560	650	12	75
650	650	770	12	90

Soft PVC bellows in circular and rectangular form

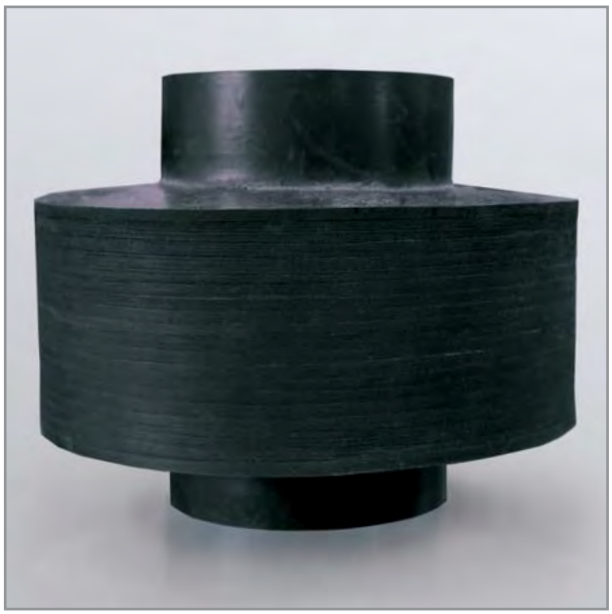
All dimensions in mm if not marked otherwise. Errors and omissions excepted.

Rubber Disk Bellows

Rubber disk bellows are of the highest quality and visually the most attractive protective covers for pistons and spindles. They are completely leak proof. Since each rubber disk lies flat on the other, excellent compression dimensions are achieved.
The production of rubber parts depends directly upon the control and monitoring of the production processes. Each process step, from mixing up to rolling out the material, from punching the disks up to the vulcanization process, is performed under the most accurate observation and attention. Stringent quality criteria leads to high process reliability. After vulcanizing, the rubber disk bellows are ground on the outside, so that they have an absolutely smooth surface when closed.

Material

Good resistance to light and atmospheric conditions and are well suited to outside use. If emphasis is on oil or coolant protection in your area of application, then we recommend the use of NBR rubber foil. Alternative materials are available for high temperature requirements.



Compression of Rubber disk bellow

Types

For standard types of this bellow round profiles will be used. As an alternative, square, rectangular or oval profiles can also be produced.

Dimensions

Rubber disk bellows are supplied in standard sizes with inside diameters of 20 to 400 mm and outside diameters of 40 to 480 mm.

Rubber disk bellow

We supply the bellows in 5 mm graduation up to a diameter of 200 mm and in 10 mm graduation above this.
The extended length of the rubber disk bellows can be up to 10 metres.

Mounting

Rubber disk bellows are fastened the same as other bellow types with sleeve or metal flange.

Design

With large extension length and horizontal installation, it is usually necessary to use additional guide elements. In the most simple case, the bellows are stabilized by internal wire rings.
In more complex applications, guiding systems with rods or cables can be incorporated internally externally to the bellows.
When mounting these bellows please pay attention to sufficient aeration.

Construction

Calculation formulae

L_{max}	FZ x FB
L_{min}	FZ x 2,5
FB	$\frac{(AD - ID)}{2}$
FZ	$\frac{L_{max}}{FB}$
FZ	$\frac{Hub}{(FB - 2,5)}$

Fabric Bellows

If bellows are subject to especially heavy wear, high pressure conditions or high temperatures up to 200°C, fabric bellows can be used.

Fabric bellow coated with synthetic material

Typical fields of application are piston rods with high ambient temperatures, or cardan shafts. Fabric bellows consist of a laminted structure, whereby the supporting fabric is coated with a synthetic material.

In contrast to the rubber disk bellows, the fabric bellows have a structural reinforcement which withstands the mechanical forces acting. The external protective effect of the rubber is maintained completely.
Nevertheless, the supporting fabric changes the character of the surface, so that the smoothness of the rubber disk type is lost.

Fabric bellow coated with Alu/Glass fibre coating

Material

Fabric bellows are delivered as standard in CR rubber coated fabric. All materials can be laminated with Teflon foil.
A speciality are fabric bellows made from leather and carbon fibre with Aramid or Alu/Glass fibre.

Types

The fabric bellows will be normally produced in round shapes. As an alternative, square, rectangular or oval profiles can also be produced.
The bellows are fastened like the rubber disk bellows.

Construction

Calulation formulae (material with 1 mm thickness)

Lmax	=	FZ x FB x 1,4
Lmin	=	FZ x 6
FB	=	$\frac{(AD - ID)}{2}$
FZ	=	L_{max} : FB : FZ

Legend

FB	Fold width/depth
FZ	Number of folds
L_{min}	Minimum Compression of bellow
L_{max}	Maximum extension of bellow
AD	Outer diameter
ID	Inner diameter

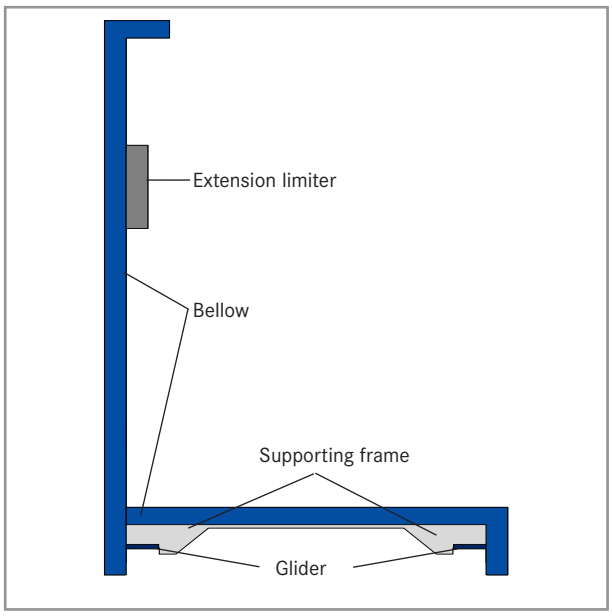
Fabric bellow - sample of larger size

Dimension

We manufacture fabric bellows in the standard sizes with inside diameters of 30 to 2900 mm and an outside diameter of 50 to 3000 mm.

Covers for Moving Column Machines

These machines with their large travel and working space areas require a special solution.
For the workspace area, both backwall systems and large bellows with or without lamellas are suitable.



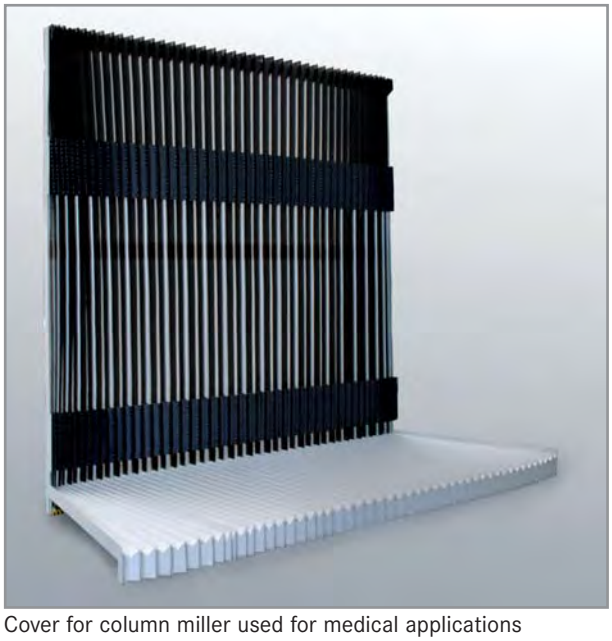
Typical backwall cover

Depending on the machine type and its concept two design principles are applicable:

- Column type cover
- Venetian blind type

Column type cover

This design principle is used if a guiding rail is not possible. The column milling cover type is L-shaped and runs on gliders.

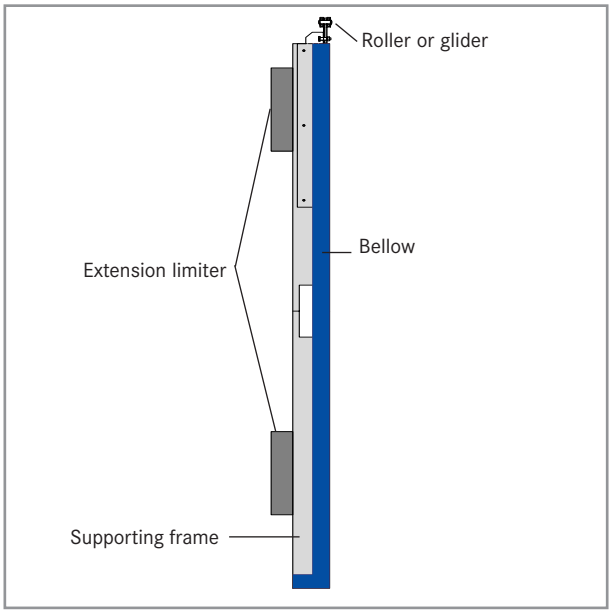

Cover for column miller used for medical applications

Venetian blind type

If a guiding frame is available, the bellow can be supported using profiles, roller or rail systems.

The guiding system has been successfully tested on a high speed test machine at the PTW under worst conditions. Over one million cycles were recorded.


Venetian blind type cover with SAMURAI Bellows for moving column machine



Design of venetian blind cover

CUBE Backwall Systems

Milling machine centres are fitted with complete backwall systems.
The design of an individual solution is time and cost intensive, and these can be reduced only if larger piece numbers are produced.
A modular built-up rear wall system can reduce the engineering efforts even for a single backwall - and the CUBE Backwall system was developed.

- Suitable for protection systems for two axes
- Significant reduction of engineering time
- Fast and detailed information for machine engineering
- The costs for each CUBE rear wall system are well below the costs of an individually designed concept

CUBE Backwall system

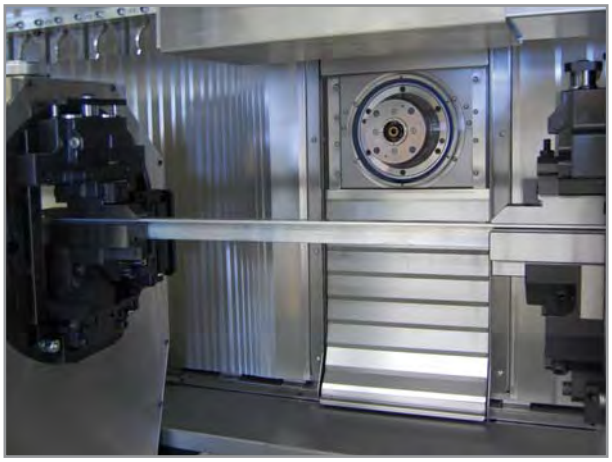
These features benefit machine builders with smaller production numbers and special machines.
The great savings in time and money compared with previous construction requests and orders could otherwise only be managed with large production numbers of identical design.

Design

Using the straightforward formulas we can determine the width and the height of the outside frame of the cover and for the sheet metal design and then provide these for the machine construction. The covers in the CUBE model consist of bellows which are incorporated along the X and Y axis fitted individually for the perfect match. Depending on the loads and machine travel speeds we select suitable bellow guiding:

- CUBE 60: standard profiled glider guide for speeds up to 60 m/min
- CUBE 80: Backwall system with rail glider guide for speeds up to 80 m/min
- CUBE 80+: High load roller rail guide for speeds over 80 m/min
- CUBE X: Customized solutions

For backwall protection SAMURAI Bellows are used. Fixed mounted stainless steel lamellas protect the bellows against hot and sharp edged swarf.



Through spindle

The spindle opening is designed to the customer's requirements.
The frame construction is made of solid warp resistant steel sheet. The mounting options for the rear wall can be integrated in the frame construction, but the force transmission along the X axis requires connections to the machine in the upper and lower areas.

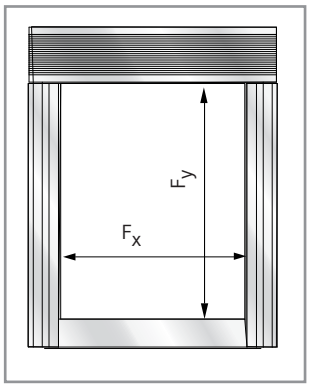
For an optimum load transmission to the X axis cover protection, this cover must be connected at the top and bottom with the moving column or other supporting machine parts.

Versions of CUBE X with large extensions up to five meters long and three meters high have already been realized.
Additional concepts such as DynaSynchro or pantographs can absorb the dynamic loads. Therefore a travelling speed up to 120 m/min can be realized.

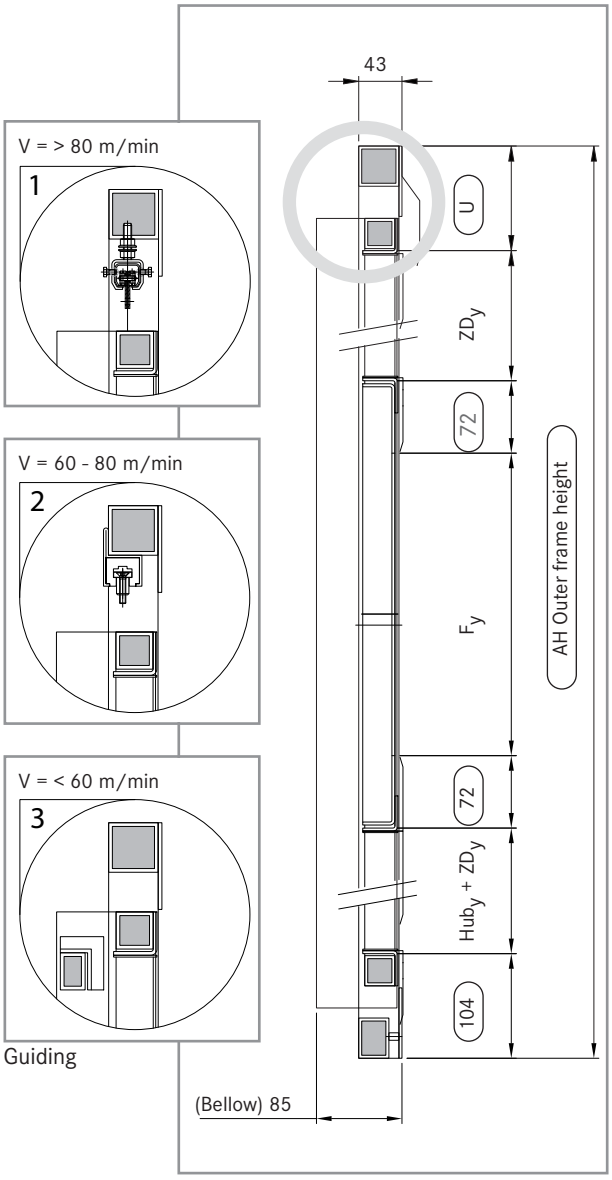
All dimensions in mm if not marked otherwise. Errors and omissions excepted.

CUBE Backwall Systems

CUBE

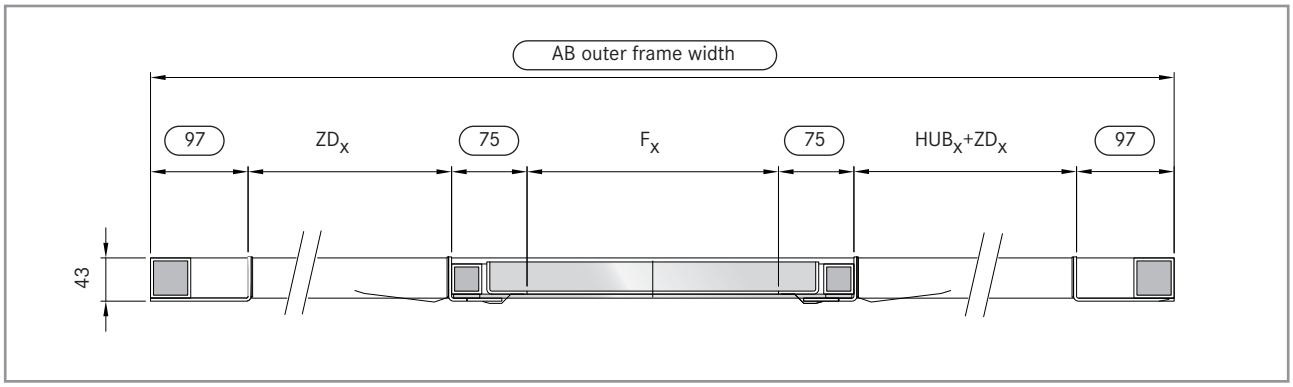


Calculation of spindle opening



Guiding

Calculation of outer frame height



Calculation of outer frame width

CUBE Backwall Systems

CUBE	Guiding (V m/min)	Application area
CUBE 60	Standard glider guiding	up to 60 m/min
CUVE 80	Rail glider guiding	up to 80 m/min
CUBE 80+	Roller glide guiding	up to 80 m/min
CUBE X	customized	customized

Design

Data to be provided by customer

V_x	Travel speed in X direction
V_y	Travel speed in Y direction
Hub_x	Required working area travel in X direction
Hub_y	Required working area travel in Y direction
F_x	Width of opening for spindle lead-through
Fy	Height of opening for spindle
ZD_x	Required compression length X axis
ZD_y	Required compression length Y axis
AB	Frame width CUBE
AH	Frame heigth CUBE
U	Fixed dimensions upper bar
⬭	HEMA specification values

Factors of compression

CUBE 60

ZD $Faktor_{60x}$	0.12
U_{60}	104 mm

CUBE 80

ZD $Faktor_{80x}$	0.155
U_{80}	137 mm

CUBE 80+

ZD $Faktor_{80+}$	0.165
U_{80+}	137 mm

Allgemeinfaktor Y-Achse

$ZDFaktor_y$	0.075

Basic principle for calculation

These data also cover extreme situations. If less space is available in the customer's machine construction, the data are adapted accordingly.

Calculation example

Example calculation for CUBE 80+

V_x	80 m/min
V_y	80 m/min
Hub_x	800 mm
Hub_y	650 mm
F_x	200 mm
F_y	200 mm

Calculation of the compression

$ZD_x = Hub_x \times ZD_{Factor80+}$ = 800 mm x 0.165 = [132 mm]
$ZD_y = Hub_y \times ZDFy$ = 650 mm x 0.075 = [49 mm]
[ ] = values rounded up without decimal place

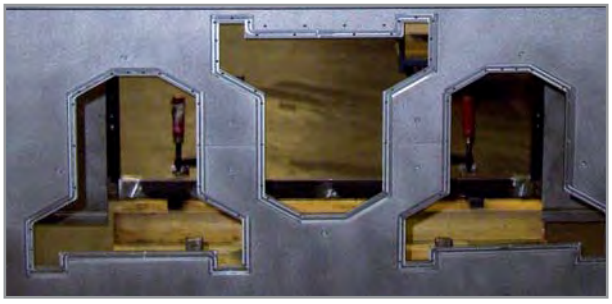
Calculation the results for $CUBE_{80+}$

Outside frame width in X direction:
AB = (System spec. value*) + Hub_x + F_x + 2 x ZD_x
AB = (97 + 75 + 75 + 97) + 800 + 200 + 2 x 132 =1.608 mm

Outside frame heigth in Y direction

AH = (System spec. value*) + U_{80}+ Hub_y + F_y + 2 x ZD_y
AH = (104 + 72 + 72) + 137 + 650 + 200 + 2 x 49 =1.333 mm

*HEMA system specification values



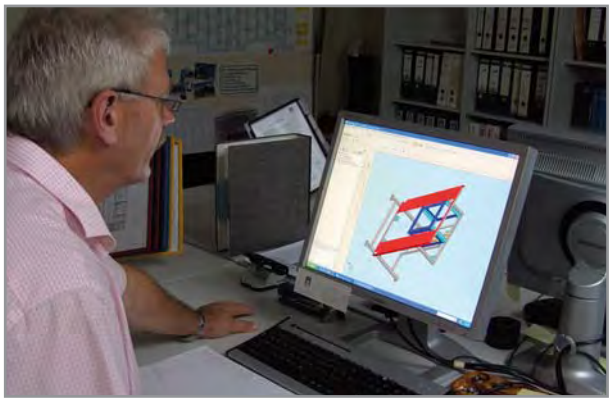
Types of spindle openings

Project team

The design and realisation of large protection systems and complete backwall systems is supervised by an experienced team during all stages of manufacture.

Engineering and design

All important details of the machine for the design of new protection systems are integrated in the engineering stages. Every cover is individually designed to meet the specific requirements and to fit perfectly for each machine tool.



Design of new protection systems

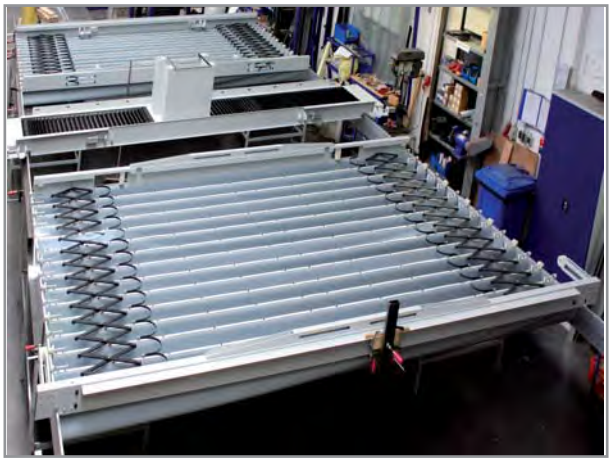
Production of components

All components are produced with modern machines. Sheet metal components are accurately cut to fit by laser. Other parts of the covers, such as pantographs or gliders for smooth running, are chosen individually depending on the area of application and travelling speed.
During each production step all parts and materials are regularly checked for accurate dimensions and proper functioning. Visible surfaces are polished to a special finish.

Test set up

Before shipping all parts are checked for accurate visual appearance and perfect functionality.

Functional test for prototyping



Roof cover with a length of more than nine meters, and a self-supporting width of more than five meters

Backwall system for XY-axis

Shipment

To be as cost efficient as possible all parts are shipped in compact and protective packaging. Customers' internal processes are given special consideration.

Compact returnable shipping unit for backwall systems (optional)

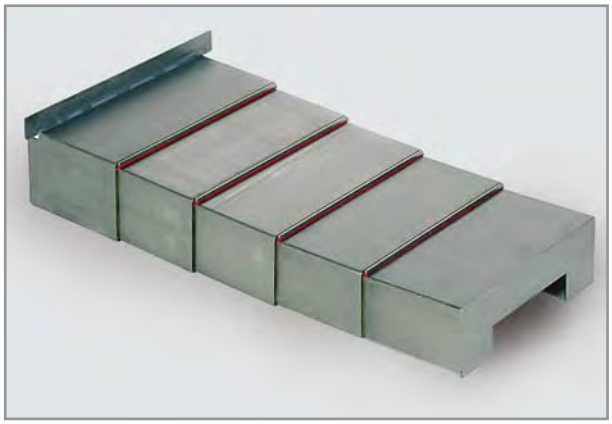
CUBE Backwall Systems

All dimensions in mm if not marked otherwise. Errors and omissions excepted.

GLADIATOR Telescopic Steel Covers

Telescopic steel covers are used to protect slideways in certain machine tool applications. They offer effective protection against swarf and other debris.
Liquid or coolant ingress can be effectively reduced by feature design and the use of suitable wiper systems.

The benefits:
- Cost efficient production
- Efficient wiper systems
- High quality production
- Repair service and spare parts ex stock
- Fast design and delivery times

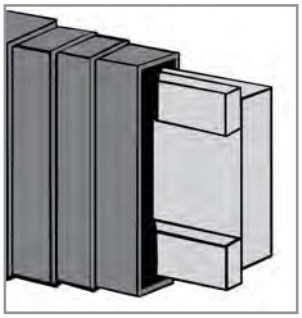


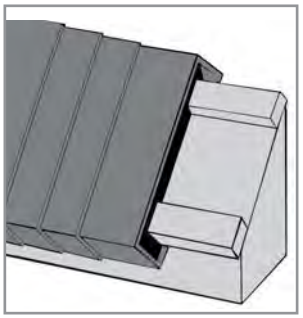
Design
- The depth of one individual box section should not be larger than 750 mm
- The cover height should not be larger than the length of the cover because of the danger of it falling over.
- The relation of box depth to box width should not exceed 1:6
- Principally use only graded types where each wiper rests on the adjacent box section. Designs where wiper overhang can result in swarf ingress.
- With coolant, the top of the covers should be inclined at an angle of 5°
- In principal, allow space for an underside return of the box sections, as this will stiffen the structure and will provide a constant pretension
- The minimum distance of the smallest box to the guiding position should be 12 mm
- For calculating the travel of the cover, add 5 mm of reserve per box to the travel of the machine
- For covers used in vertical position, gliders should be used for the underside return, which should be screwed on at least to one side for later (dis)mounting
- As a general rule is: maximum extension and minimum compression should be at maximum in the ratio 10:1

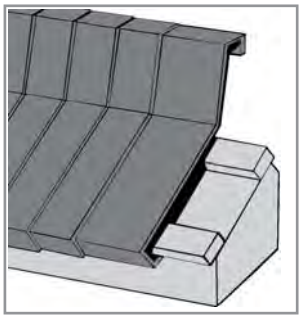
Material
The steel covers are produced from high quality cold-worked sheet steel in material thickness from 1.5 to 3 mm, or if required in stainless steel.
For all common types of machines a suitable type of cover (e.g. horizontal, vertical, inclined; transversed) together with the corresponding guide way solutions is available.

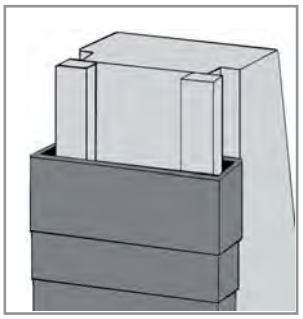
Samples of cover type


Horizontal


Transversed


Inclined


Inclined, folded


Vertical

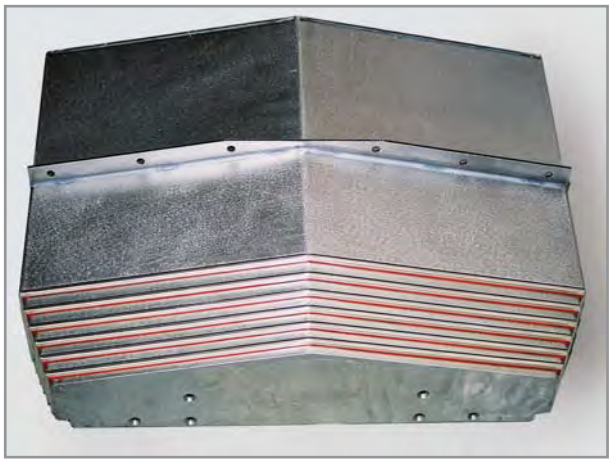
Impermeability of telescopic steel covers to coolant
Due to the design of steel covers a complete sealing against fluids cannot be guaranteed.
The standard types generally provide sufficient coolant protection. For high coolant flow rates, additional internal drainage channels, or a thermally bonded ELASTIC bellow underneath can offer additional protection.

GLADIATOR Components

Telescopic Steel Covers can be custom built to suit any application by adding further individual components.

Wiper profiles

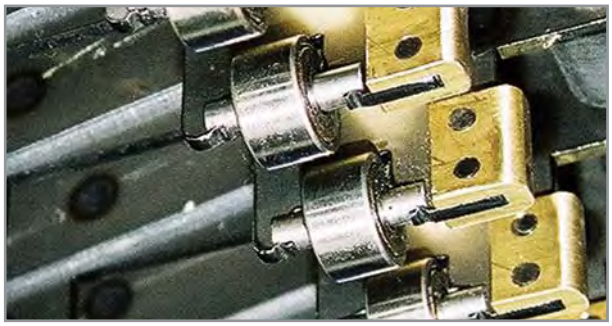
For Telescopic Steel Covers different wiper systems are available. In addition to standard wipers also wiper systems with replaceable lips or additional lip protection are available.
All systems come with optimised wiper profiles and differing degree of hardness for dry and wet machining. For more detailed information of these systems please see the following pages.



Wiper

Support and guideway gliders

Telescopic Steel Covers up to a weight of approx. 50 kg can be supported by guideway gliders. Special profiled brass parts with sufficient contact width (appr. 5 mm) suitable for hardened and soft guideways, or with PUR inserts.



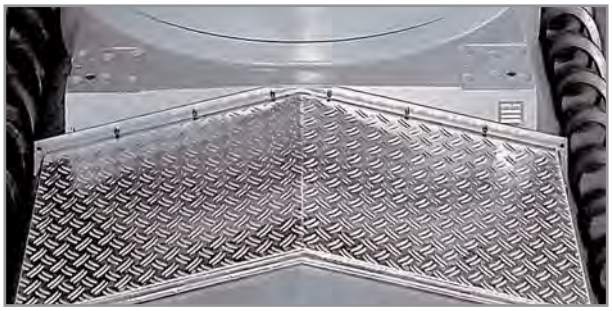
Supporting rollers with lateral brass guides

Supporting rollers

For covers greater than 50 kg unloaded weight supporting rollers are recommended. Hardened guideways (>58 HRC) or separate support/guideways are required, no matter how large the total number of rollers, assume that the total weight is supported on no more than for rollers.

Walk-on area

As an option a chequered plate to walk on can be added to the largest box section for easier maintenance of the machine.



Walk on area on largest box

Access window

By building in access windows (an option) into the largest box, the maintenance and repair of the machine parts underneath can be achieved without having to remove the complete cover.

Pantograph systems

For high speed of more than 30m/min we build in pantograph systems (graded versions as well).
The space required will be increased in this case.

Telescopic steel cover with pantograph

Glider and damper systems

Glider and damper systems reduce impact, noise and friction. Optionally, wipers with dampers can be used as well.

Mounting

For mounting/dismounting and transport, suitable lifting lugs can be fitted.

GLADIATOR Realization

GLADIATOR Telescopic steel cover

GLADIATOR Telescopic steel covers are individually designed for each machine to meet special requirements.

For special requirements, covers greater than 5 metres width and expansion more than than 15 metres can be realized

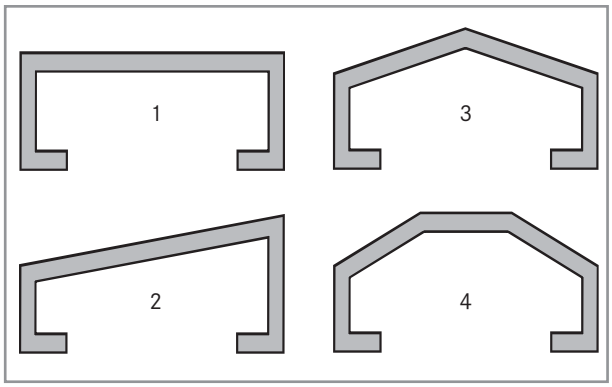
All parts of this construction are individually designed and checked for smooth operation.

GLADIATOR Designs

Designs

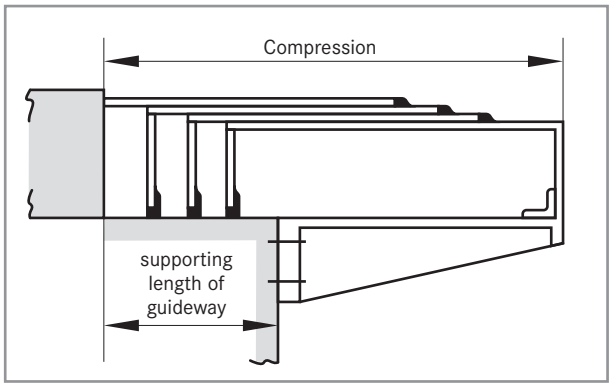
Telescopic steel covers can be produced in different designs:

- Standard design (1): cost-efficient, suitable for most standard applications. It can be used without problem up to a width of 900 mm
- Inclined shape (2): provides optimal drainage of liquids
- Roof shape with single edges (3): for larger widths, additional returns are required to increase the cover stiffness. Provides optimal drainage of coolants.
- Roof shape with double edges (4): for larger widths, additional returns to increase the cover stiffness, optimal drainage of fluids.



If the compression exceeds the available supporting length, a support box section has to be added.

For the opposite case, the largest front box section may be extended by a plate. The problem here is that chips and dirt may accumulate impairing the functioning of the cover.

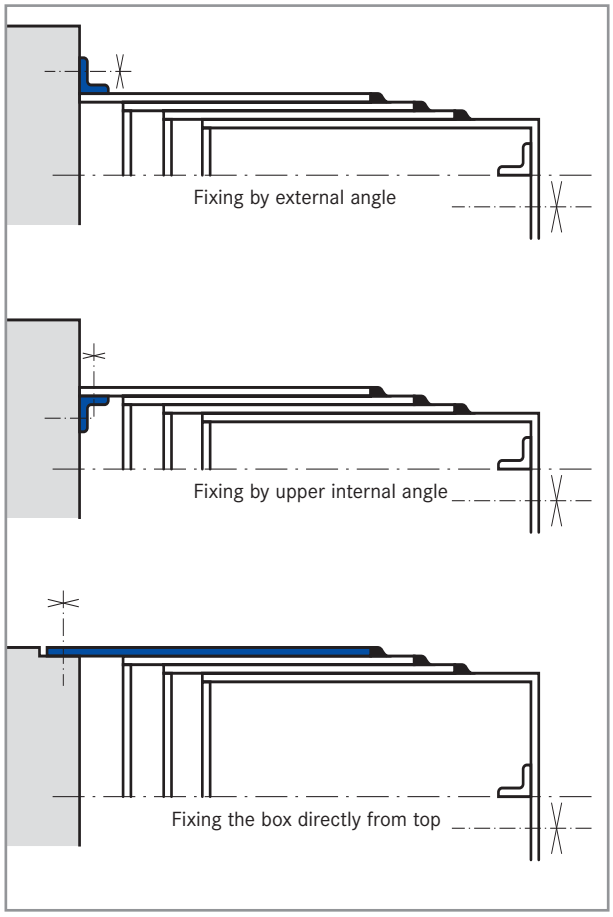


Pay attention to a smooth transition from the guideway to the machine bed extension.
Extensions are required only in the area of the support gliders. They can be manufactured from common steel (i.e. St37K).

Mounting

For mounting and fixing of the steel covers we offer you solutions specifically to the customer's individual requirement. The covers are fixed either directly to the corresponding first or final box section or by additional fixing brackets which may be attached internally or externally.

- Fixing by lateral external angle (recommended)
- Fixing by upper internal angle.
- Fixing the box directly from the top - high positional accuracy is required.

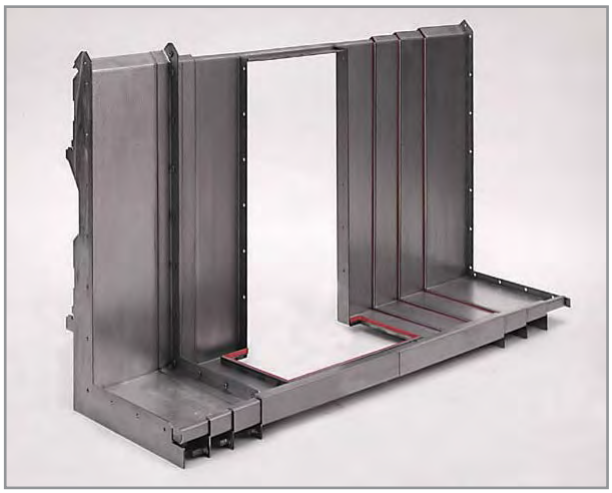


Transport

The covers are transported in the closed position; additionally they should be stored in an environment without humidity.
Before shipping, the telescopic steel covers are sprayed with an anti-corrosion oil and wrapped into plastic foil.
This will protect the steel cover against corrosion during transport and longer storage periods.
Please lubricate the entire steel cover from the outside before operation.

Maintenance and care

GLADIATOR Telescopic steel covers require regular maintenance during use. To avoid damage, they should be inspected and cleaned regularly, depending on the degree of contamination.



GLADIATOR Telescopic steel cover, sample

Surface of the steel covers

Please extend the steel covers and clean off any dirt. Next you should rub the steel cover with an oil-soaked cloth. This will prevent early wear and corrosion.

GLADIATOR Telescopic steel cover, extended

Do not clean by compressed air, because foreign particles may be forced into the interior of the steel cover.

Steel covers and chip exposure

When heavily exposed to chip, the steel cover should be checked frequently and regularly for ingress of swarf.
If swarf is found on the inside, the steel cover should be disassembled and cleaned carefully.
Chips located in between the boxes will cause rapid deterioration of the steel cover.

Maintenance

Regular preventive maintenance is the basis for long-term and reliable operation.
Please ensure that the following wearing parts are exchanged at regular intervals, depending on wear:

- Guideways
- Wipers
- Gliders and rollers
- Pantographs
- Seals

Guideways

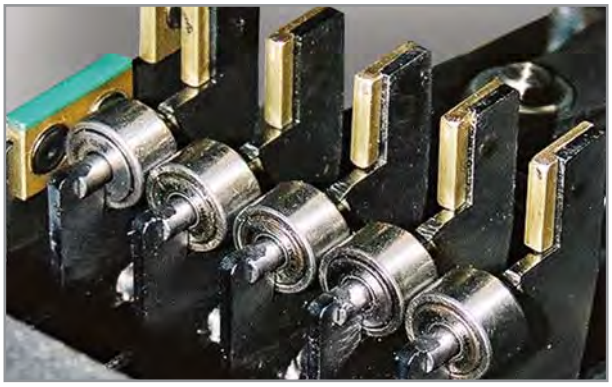
To inspect the guideways of the machine, compress the steel cover and disconnect at the largest box.
Take this opportunity to spray the underside of the cover with oil.

Wipers

Wipers and their lips should be inspected frequently and regularly. Please renew the wipers and lips if the adjoining box sections are no longer in proper contact.
This can be recognised by smear formation or remaining deposits of coolant and chips.

Gliders

Please renew the gliders when their bearing surfaces show heavy wear or deformation or when chips have penetrated.



Roller and glider

Seals

Regularly check joints which had been treated with sealant. Should these seals detach or dissolve, e.g. by aggressive coolants, they have to be replased with appropriate sealant (e.g. PU or silicon).

Safety information

Please consider the safety information in the service and maintenance manual included with each delivery.

Wipers for Telescopic Steel Covers

The wiper systems for steel covers can be sub-divided into three main groups:

- Types P 01/P 02/P03 - wiper lip cannot be replaced
- Types DSP/DV/LP - wiple lip can be replaced
- Types LV - wiper system can be replaced. Replacing of wiper lip **without dismantling of cover**

Wiper type P 01/P 02/P03

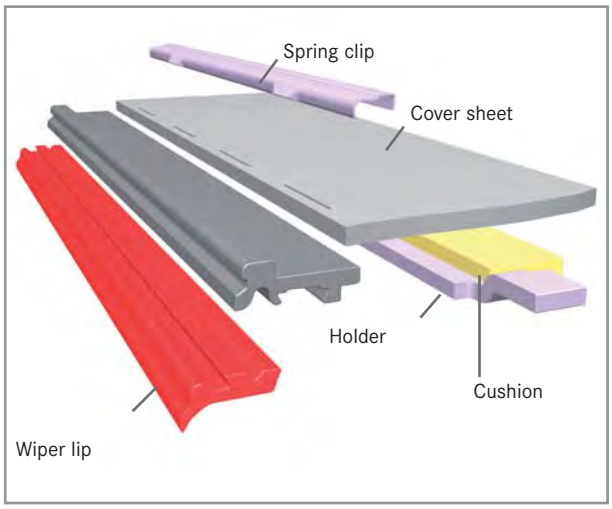
Wiper of types P 01/P 02 can be used universally. They can be used horizontally for telescopic steel covers or vertically for guideway wipers. A polyurethane wiper lip is vulcanised onto one or two steel profiles and thus permanently bonded. An additional support by steel frame is available as an option. When worn, the complete wiper must be replaced. These wipers lips are available in lengths of 500 mm.

Wiper Type DSP/DV/LP

Wiper lips of these types can be replaced when worn. The service should be done by professional service personnel. They are fixed by spot welding. These wipers are compatible with many systems common in the marketplace. The metal profiles are produced from stainless steel.
Wiper lips are available in lengths from 1,000 to 10,000 mm, metal profiles from 1,000 to 3,000 mm length. Wiper lips and metal profiles can be ordered separately.

Wiper Type LV

This innovative system enables a significant reduction of maintenance time and costs. The wiper lips of type LV can easily be changed when worn. Replacement can be made by customers own personnel. For replacement of the wiper lip, only the spring clips have to be loosened, and the profile with wiper removed and replaced.
There is no further dismantling of the cover required.
In comparison to standard wiper systems, machine down time can be reduced by up to 15%.



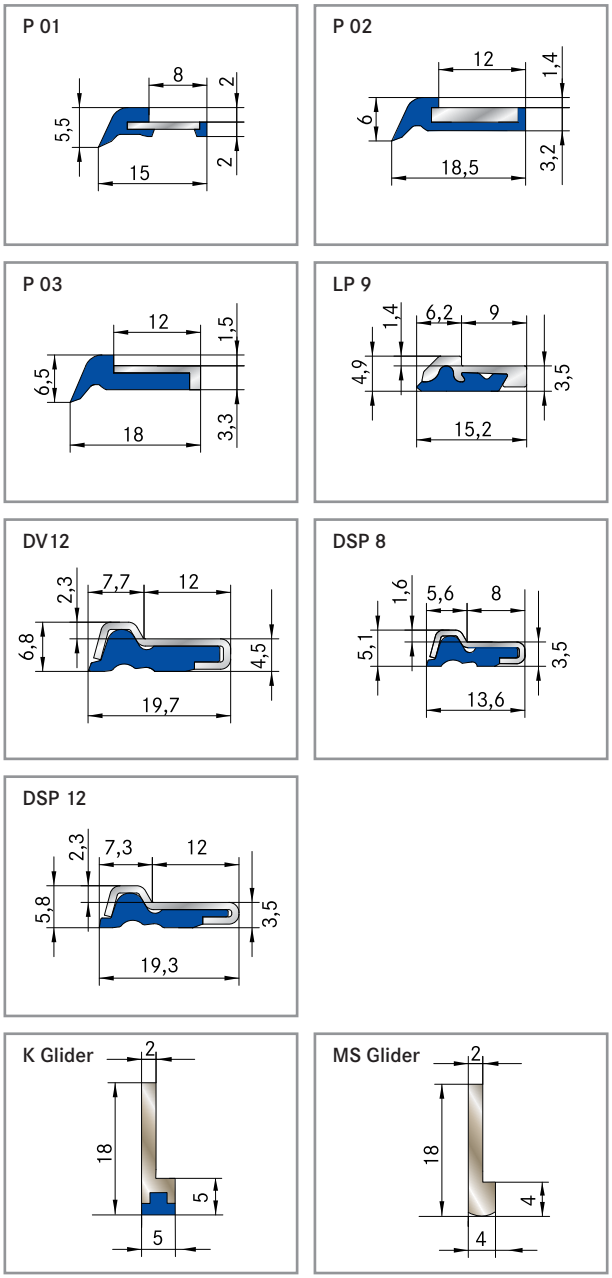
LV Wiper System

Wiper lips are available in lengths from 1,000 to 10,000 mm, metal profiles from 1,000 to 3,000 mm.

Material of wiper lips

The wiper lips are manufactured from high-grade polyurethane and offer good mechanical and chemical properties.
They are temperature resistant up to a maximum of 130°C (natural rubber up to 135°C), continuously up to 90°C (natural rubber up to 100°C).

Wiper profiles for Telescopic Steel Covers



All dimensions in mm if not marked otherwise. Errors and omissions excepted.

Wipers for guideways

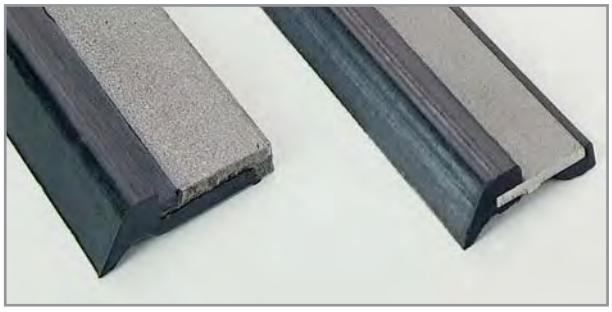
The guideways of machine tools must be kept free of chips and debris. Therefore wipers are important.
Wipers for guideways are designed specifically to occupy minimum space.

These wipers can be produced in different forms, dimensions, and in different materials. For each application there will be an optimal version available.

For guideway wipers there are four different types available:
- Wiper Type P
- Wiper Type L
- Wiper Type S - for welded wiper
- Individual designed, vulcanised wiper

Wiper type P

Wipers of this type can be used universally. They can be mounted horizontally for Telescopic Steel Covers or vertically for guideways.
A polyurethane lip with a steel core is vulcanised to a steel profile. An additional steel band reinforcement is available as an option.



Wiper type P

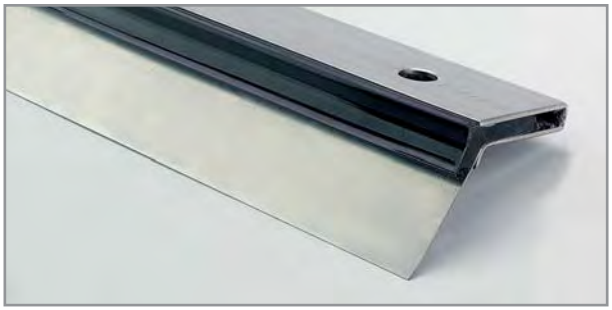
Wiper type L

This wiper type is produced as an insert with a lip of natural rubber. This lip possess's excellent mechanical qualities and a high resistance to abrasion.
The material is resistant to mineral oils, coolants, and micro-organisms

Wiper type L

Wiper type S

These wipers are equipped with a special two-sided lip, providing rear sealing to coolant.
Its outer support of nickel chromium steel offers high rigidity and stability under load.



Wiper type S with additional metal wiper

Individual wiper

Vulcanised wiper systems are available according to customer's drawing. They can be produced in many forms.
For economic production a minimum of 20 pieces must be ordered.

Individually designed type with vulcanised wiper lip

Design

Standard wipers are available in the following lengths:
- Wiper Type P: 500 mm
- Wiper Type L: 500 mm
- Wiper Type S: 530 and 1,000 mm

Wipers according to customer's specification can be produced. Additionally they can be equipped with an extra steel wiper. Preload of wiper is generally 1 mm.

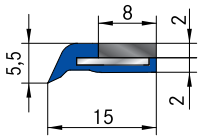
Material wiper

- Polyurethane
- Temporary temperature resistant up to 130°C
- Permanent temperature resistant up to 90°C
- Resistant to mineral oils and coolants
- Excellent resistance to absorbtion
- High resistance to micro-organism's

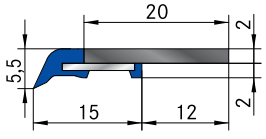
Wipers for guideways

Wipers for guideways

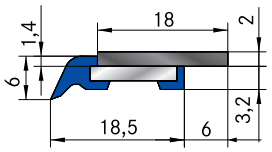
P 01 8x2



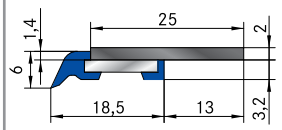
P 01 20x2



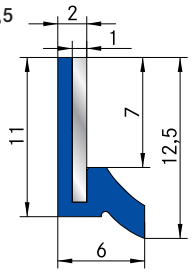
P 02 18x2



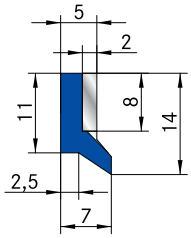
P 02 25x2



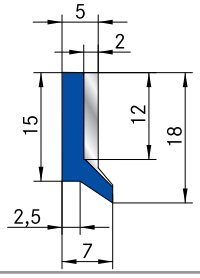
L 12,5



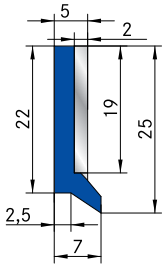
L 14



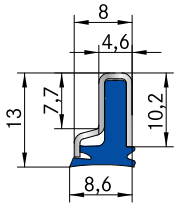
L 18



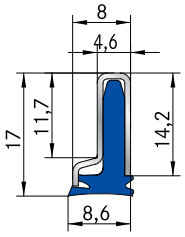
L 25



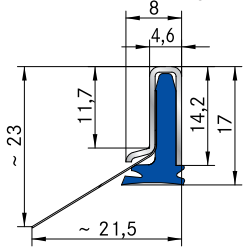
S 14



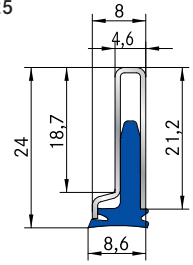
S 18

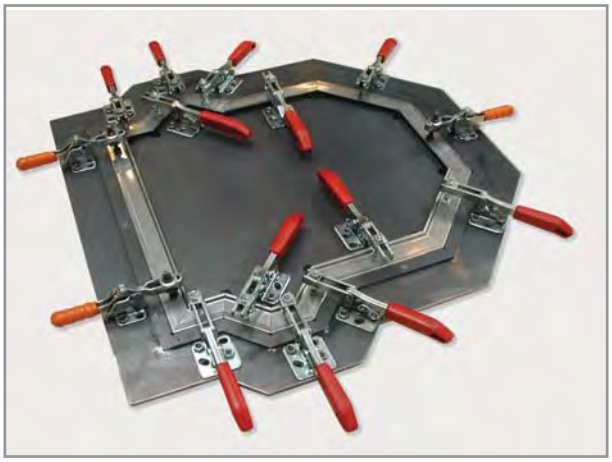


S 18 with additional wiper



S 25





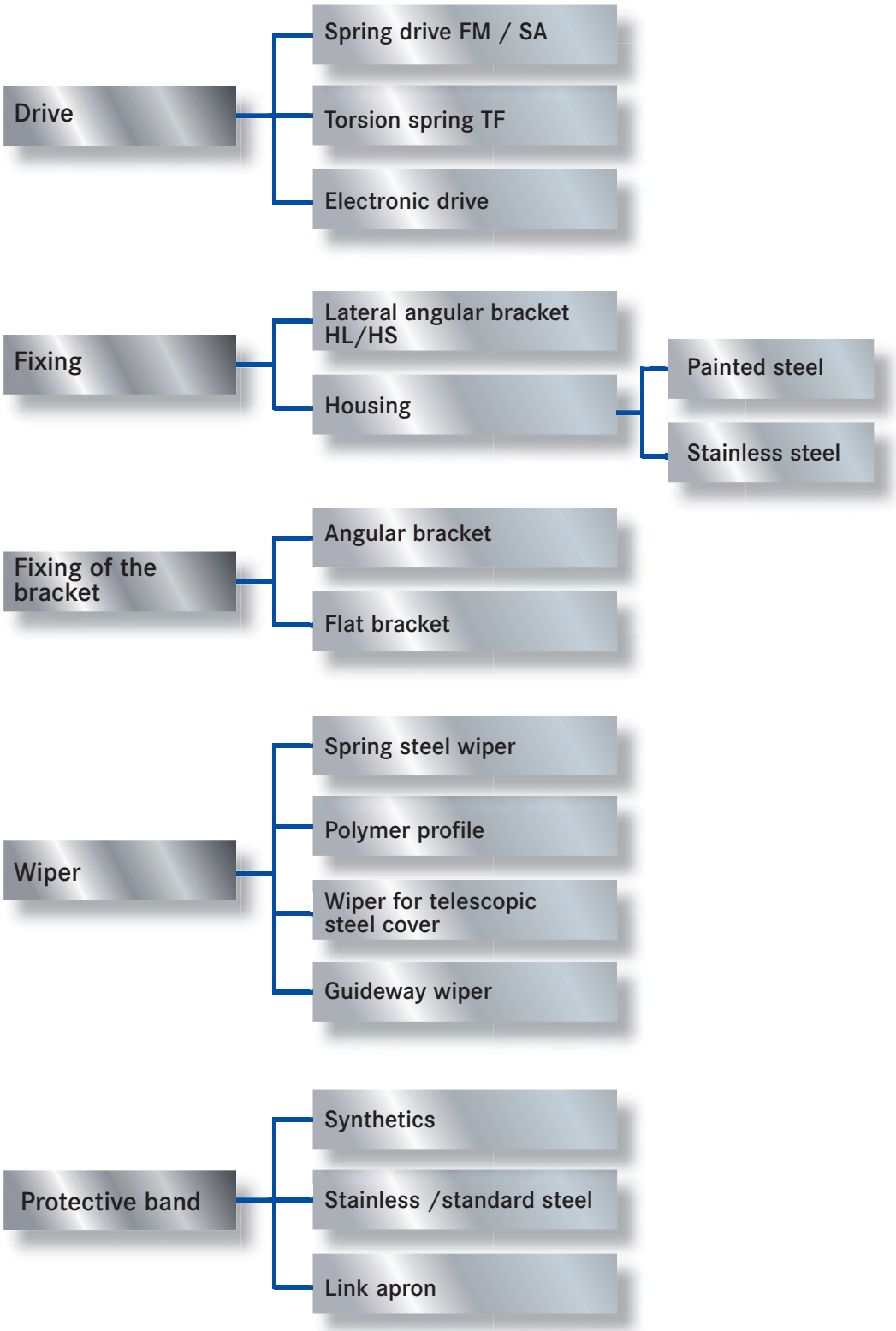
Preparation of wiper

Individual designed wiper according to customer's requirements

All dimensions in mm if not marked otherwise. Errors and omissions excepted.

MODULAR CONCEPT

ROLLER COVER

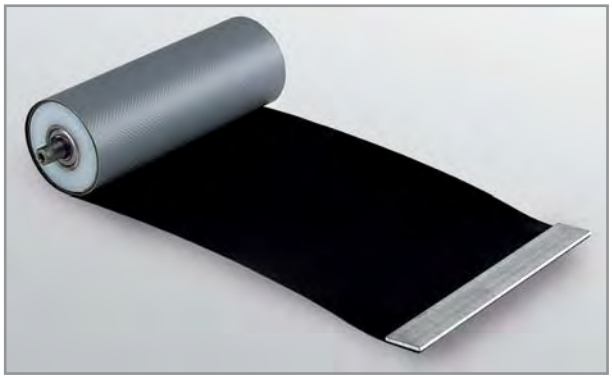


ROLLER Covers

ROLLER cover systems are a possible substitute for bellow covers in very narrow spaces when only general sealing is required.

Two different types are available:

- ROLLER blind without housing - this type needs less space, best used with smaller diameters and short extensions
- ROLLER blind with housing - we recommend this type for safety reasons when longer extensions are used and especially when steel is used for the band material. They are available in many variants.



ROLLER blind cover without housing

ROLLER blind cover with steel band and housing

Drives

The ROLLER systems come with different drive concepts:

- Torsion springs TF: Drive separate to cover band
- Steel band drives SA: Cover band forms drive
- Steel band spring drive FM: Drive separate to cover band
- Electrical drive: to customers specifications (see page 62)

Torsion springs TF

Torsions springs are very well suited for a long working life performance at low loads. We recommend torsion spring drives primarily with synthetic material covers.
The torsion springs are manufactured from a high quality alloyed wire. This wire material has been proved to reach ten times the service life of a conventional wire spring.

Steel band drive SA

For higher tension forces we recommend SA steel band drives. The steel band for the outer cover also serves as a spring motor. Steel is selected for the band.

Steel band spring drive FM

Also suitable for higher tension forces are the FM steel band spring drives.

Design option	ROLLER with TF drive	ROLLER with SA drive	ROLLER with FM drive
Housing available	■	■	■
Side mount available	■		■
Link Apron available	■ (limited)		■
Outer band synthetic material	■		■
Outer band stainless steel	■ (limited)		■
Outer band normal steel		■	■
Maximum band width in mm	1,500*	300	1,500*
Maximum band extension in mm	3,000	7,500	6,000*
Maximum travelling speed	60 m/min	30 m/min	40 m/min
Rapid change of direction	■	■	limited
Continous load	very high	average	high
Resistance to dust/dirt	low	average	low
Tension forces	slightly increased when fully extended	increased when fully extended	slightly increased when fully extended
Product costs	low	low	average

*other dimensions on request

All dimensions in mm if not marked otherwise. Errors and omissions excepted.

ROLLER COVERS

Band width#	extension	ROLLER, drive torsion spring (TF) without housing Ø Roller	ROLLER,drive torsion spring (TF) with housing housing LxW	ROLLER, drive spring motor (FM) without housing Ø Roller	ROLLER, drive spring motor (FM) with housing housing LxW	ROLLER drive steel band (SA) with housung housing LxW
over 150	bis 300	21 / 28* ●	40 x 40 ●	50 ●	60 x 60 ●	40 x 40 ■
over 150	bis 500	21 / 30 ●	50 x 50 ●	50 ●	60 x 60 ●	50 x 50 ■
over 150	bis 1.000	40 ●	60 x 60 ●	45 / 50 ●	70 x 70 ●	60 x 60 ■
over 150	bis 1.500	-	-	50 / 60 ●	80 x 80 ●	70 x 70 ■
over 150	bis 2.000	-	-	60 / 70 ●■	90 x 90 ●■	75 x 75 ■
over 150	bis 2.500	-	-	70 / 80 ●■	110 x 110 ●■	80 x 80 ■
over 150	bis 3.000	-	-	80 / 90 ●■	120 x 120 ●■	90 x 90 ■
over 150	bis 4.000	-	-	90 / 100 ●■	130 x 130 ●■	100 x 100 ■
over 150	bis 5.000	-	-	100 / 120 ●■	140 x 140 ●■	110 x 110 ■
over 150	bis 7.000	-	-	120 / 133 ●■	150 x 150 ●■	120 x 120 ■
over 150	bis 9.000	-	-	120 / 133 ●■	160 x 160 ●■	120 x 120 ■
special dimensions	on request					
up to 300	up to 300	21 / 28 ●	40 x 40 ●	45 ●■	60 x 60 ●■	40 x 40 ■
up to 300	up to 500	21 / 28 ●	50 x 50 ●	50 / 60 ●■	70 x 70 ●■	50 x 50 ■
up to 300	up to 1,000	30 / 32 ●	60 x 60 ●	60 ●■	70 x 70 ●■	60 x 60 ■
up to 300	up to 1,500	40 / 45 ●	70 x 70 ●■	60 ●■	80 x 80 ●■	70 x 70 ■
up to 300	up to 2,000	-	80 x 80 ●■	60 / 70 ●■	90 x 90 ●■	75 x 75 ■
up to 300	up to 2,500	-	80 x 80 ●■	70 / 80 ●■	100 x 100 ●■	80 x 80 ■
up to 300	up to 3,000	-	90 x 90 ●■	80 / 90 ●■	110 x 110 ●■	90 x 90 ■
up to 300	up to 4,000	-	100 x 100 ●■	90 / 100 ●■	120 x 120 ●■	100 x 100 ■
up to 300	up to 5,000	-	120 x 120 ●■	90 / 100 ●■	130 x 130 ●■	110 x 110 ■
up to 300	up to 7,000	-	-	100 / 120 ●■	150 x 150 ●■	120 x 120 ■
up to 300	up to 9.000	-	-	100 / 120 ●	160 x 160 ●	140 x 140 ■
special dimsions	on request					
over 300 up to1,000	up to 300	21 / 28 ●	40 x 40 ●■	40 / 45 ●■	60 x 60 ●■	-
over 300 up to1,000	up to 500	21 / 28 ●	50 x 50 ●■	45 / 50 ●■	70 x 70 ●■	-
over 300 up to1,000	up to 1,000	30 / 32 ●	60 x 60 ●■	45 / 50 ●■	70 x 70 ●■	-
over 300 up to1,000	up to 1,500	45 ●	70 x 70 ●■	50 / 60 ●■	80 x 80 ●■	-
over 300 up to1,000	up to 2,000	60 ●■	80 x 80 ●■	60 / 70 ●■	90 x 90 ●■	-
over 300 up to1,000	up to 2,500	50 / 60 ●■	80 x 80 ●■	70 / 80 ●■	110 x 110 ●■	-
over 300 up to1,000	up to 3,000	60 / 70 ●■	90 x 90 ●■	80 / 90 ●■	120 x 120 ●■	-
over 300 up to1,000	up to 4,000	70 / 80 ●■	100 x 100 ●■	80 / 100 ●■	130 x 130 ●■	-
over 300 up to1,000	up to 5,000	80 / 90 ●■	120 x 120 ●■	90 / 100 ●■	140 x 140 ●■	-
over 300 up to1,000	up to 7,000	90 / 100 ●■	130 x 130 ●■	100 / 120 ●■	150 x 150 ●■	-
over 300 up to1,000	up to 9,000	100 / 120 ●■	150 x 150 ●■	100 / 120 ●■	160 x 160 ●■	-
special dimensions	on request					

All dimensions in mm.

The band with is depending on the kind of drive FM or TF), a FM drive requests a band width of 50 mm min., a TF type 50 mm min.

* 21/28 means a roller diameter of 21 mm for regular load and 28 mm for high load. Other types and sizes on request. Square outer housing, rollo size is equivalent to outer dimension of the tube. Type without housing: first number: standard spring force/second numer: enlarged spring force is required.

● non-metallic band possible ■ steel band possible

Order and request forms available at: www.hema-schutz.de

ROLLER Covers

Dimensions of housings

The measurements for the ROLLER System housings must take into account the band width, length of extension and also type of drive.

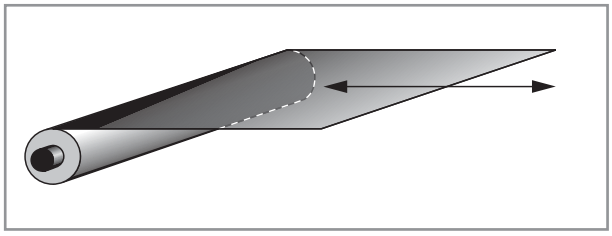
Design data for calculation

For the design of the ROLLER covers the following factors should be considered:

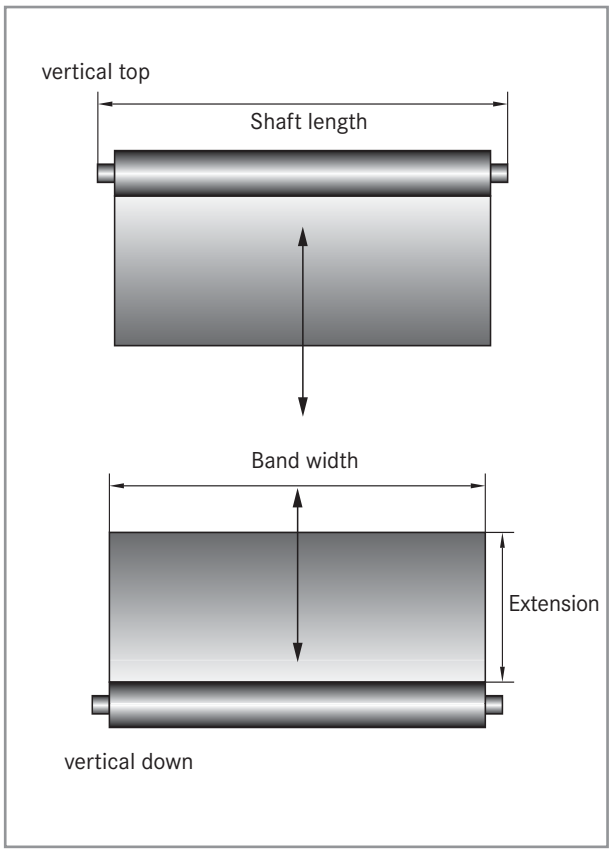
- speed of travel
- intended total number of cycles, working life
- frequency and speed of changes in travel direction
- mounting position, direction of swarf

Operating position

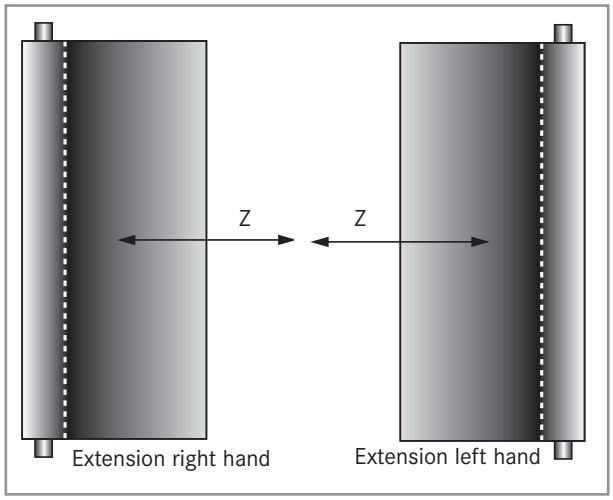
The operating position can be vertical, horizontal or transverse, with an extension to the left, right, top or bottom side.



Operating position: horizontal flat



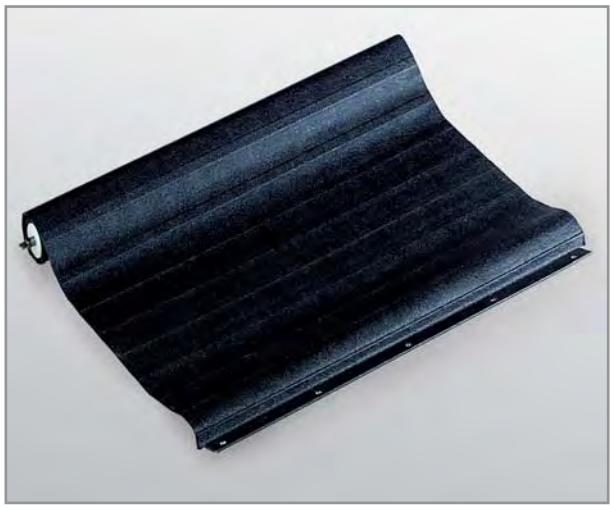
Operating position: vertical flat



Operating position: horizontal upright, e.g. for X axis covers

Pre-loading

- ROLLER systems with housing are pre-loaded at the factory to customer or HEMA specifications and are ready to install.
- ROLLER systems without housing are not pre-loaded.



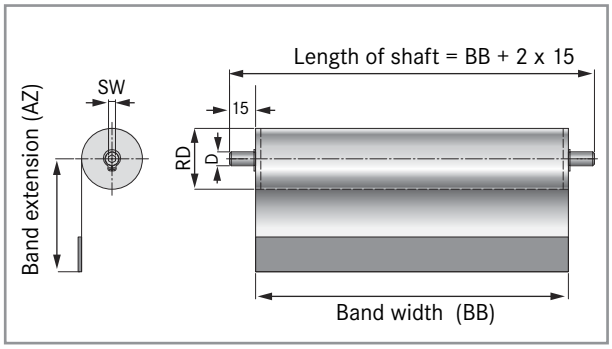
Roller blind with cover band

Cover material

The outer band is subjected to a wide variety of stresses; the material chosen depends on the field of application:

- Steel bands with rounded edges (standard and stainless steel): Protection from cold and hot chips, coolants. Maximum width of steel band standard 300 mm, steel band stainless 1000 mm
- Synthetic bands, e.g. Preotex, awning cloth, Neoprene, etc., Protection from dust, coolants, contact guard
- Link aprons: Protection from large chips, coolants: Recommended for applications requiring additional lateral stability

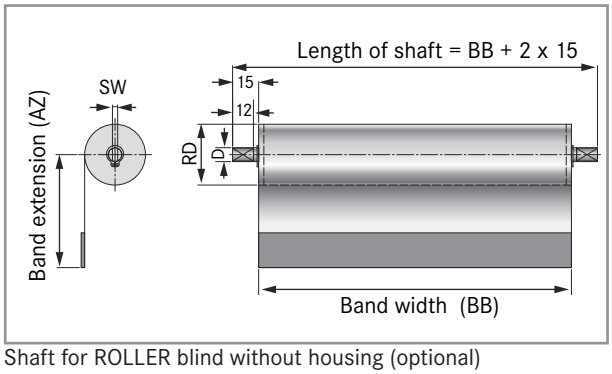
ROLLER COVERS



Standard shaft for ROLLER blind without housing

Type of shaft	inner hexagon (SW)	Projecting
E1-08	4	2 x 15
E1-10	4 / 6 optional	2 x 15
E1-12	6	2 x 15

Standard shaft for ROLLER blind without housing



Shaft for ROLLER blind without housing (optional)

Type of shaft	inner hexagon (SW)	Maximum width across flats
E2-08	4	3 x 12
E2-10	4 / 6 optional	4 x 12
E2-12	6	6 x 12

Shaft for ROLLER blind without housing (optional)

Mounting

A variety of mounting positions is available. ROLLER covers with housing can be mounted at the standard positions shown in the next column.

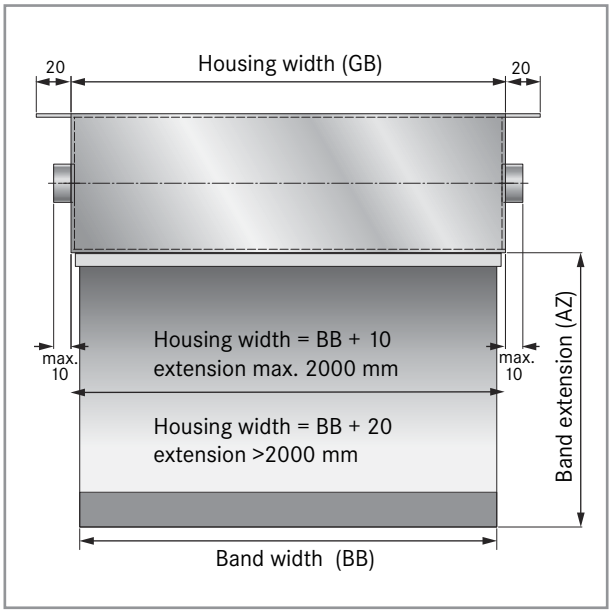
For mounting roller covers without housing two holder types are available for easy and permanent fixing:

- Standard holder (HL)
- Heavy duty holder (HS)

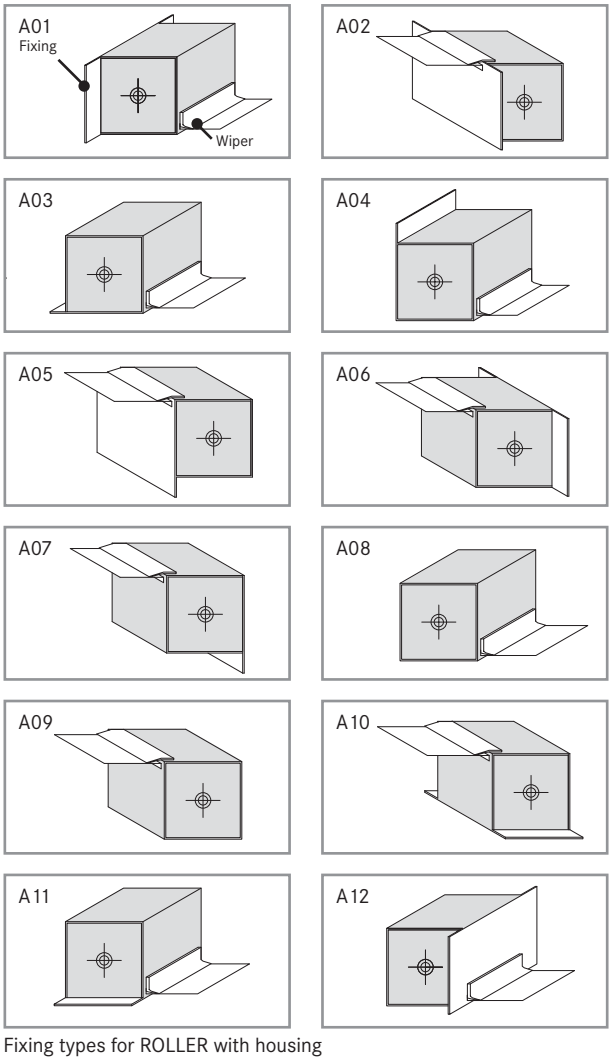
Customized holders can be produced for special requirements.

Please note

ROLLER covers ordered without housing are produced with round shafts as standard.

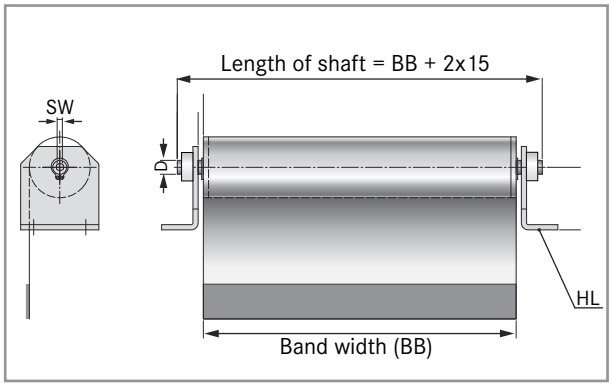


Calculation of housing dimension

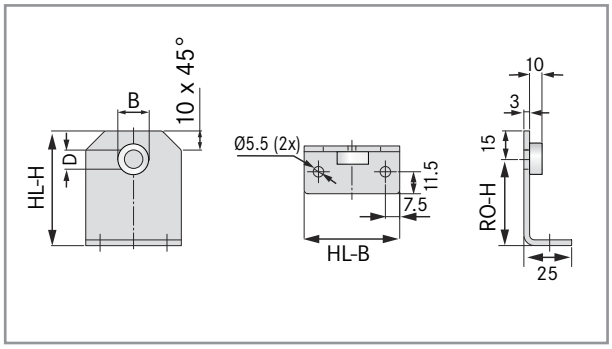


Fixing types for ROLLER with housing

ROLLER Covers



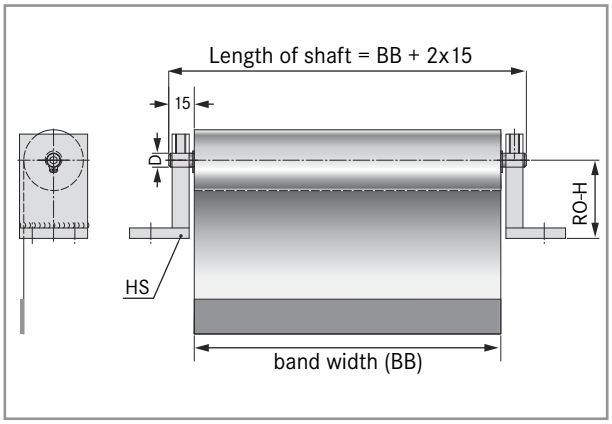
Standard holder (HL)



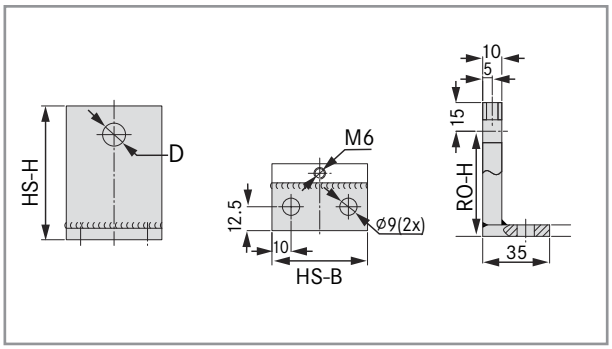
Standard holder (HL)

Legend	
D	Diameter of axle
B	Collar
SW	Wrench size
RO-H	Space axis to holder
HL-B/HS-B	Width holder standard/holder heavy duty
HL-H/HS-H	Height holder standard/holder heavy duty

Halter-Typ	RO-H	D	B	HL-B	HL-H
HL-30/8	30	8	16	40	45
HL-30/10	30	10	20	40	45
HL-30/12	30	12	22	40	45
HL-40/8	40	8	16	45	55
HL-40/10	40	10	20	45	55
HL-40/12	40	12	22	45	55
HL-45/8	45	8	16	50	60
HL-45/10	45	10	20	50	60
HL-45/12	45	12	22	50	60
HL-50/8	50	8	16	65	65
HL-50/10	50	10	20	65	65
HL-50/12	50	12	22	65	65
HL-60/10	60	10	20	65	75
HL-60/12	60	12	22	65	75
HL-70/10	70	10	20	65	85
HL-70/12	70	12	22	65	85
HL-80/10	80	10	20	65	95
HL-80/12	80	12	22	65	95



Heavy duty holder (HS)



Heavy duty holder (HS)

Type of holder	RO-H	D	HS-B	HS-H
HS-45/10	45	10.2	50	60
HS-45/12	45	12.2	50	60
HS-50/10	50	10.2	50	65
HS-50/12	50	12.2	50	65
HS-60/10	60	10.2	70	75
HS-60/12	60	12.2	70	75
HS-70/10	70	10.2	70	85
HS-70/12	70	12.2	70	85
HS-80/10	80	10.2	90	95
HS-80/12	80	12.2	90	95
HS-90/10	90	10.2	90	105
HS-90/12	90	12.2	90	105
HS-100/10	100	10.2	100	115
HS-100/12	100	12.2	100	115
HS-120/10	120	10.2	100	135
HS-120/12	120	12.2	100	135
HS-140/10	140	10.2	100	155
HS-140/12	140	12.2	100	155
HS-150/10	150	10.2	100	165
HS-150/12	150	12.2	100	165

All dimensions in mm if not marked otherwise. Errors and omissions excepted.

ROLLER Covers

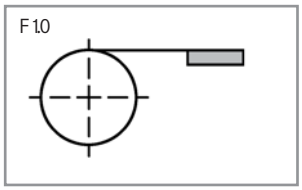
Fixing the band

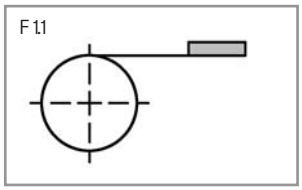
The band is fixed to your requirements with flat or angular steel brackets bonded or riveted to the band on one or both sides.

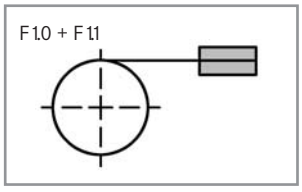
ROLLER with bonded fixing bracket F1.1

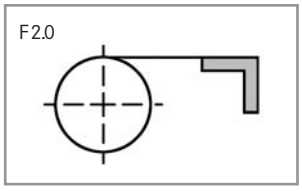
Link Apron with fixing bracket F2.1, riveted

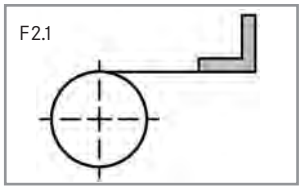
Variety of band fixing types

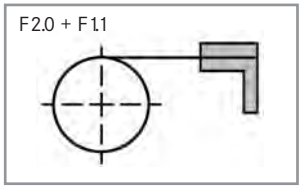


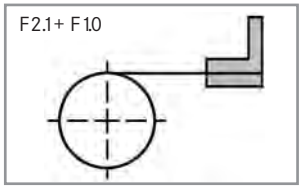












Wiper

In order to keep the case as clean as possible, we use wiper systems as a standard feature.
For special applications we offer wipers for guideways and telescopic covers and brush wipers.

Replacement

When ordering replacement rollers please quote the serial number for the ROLLER cover.
This number can be found either on the roller blind itself or on a label on the housing.

Rollo with housing and HEMA serial number

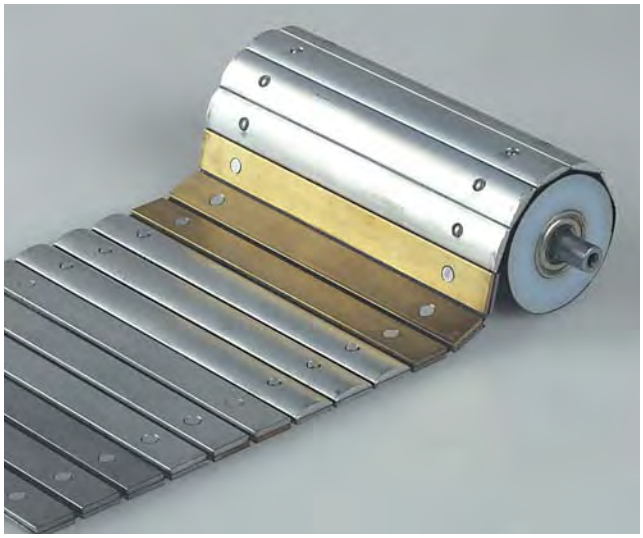
Security information

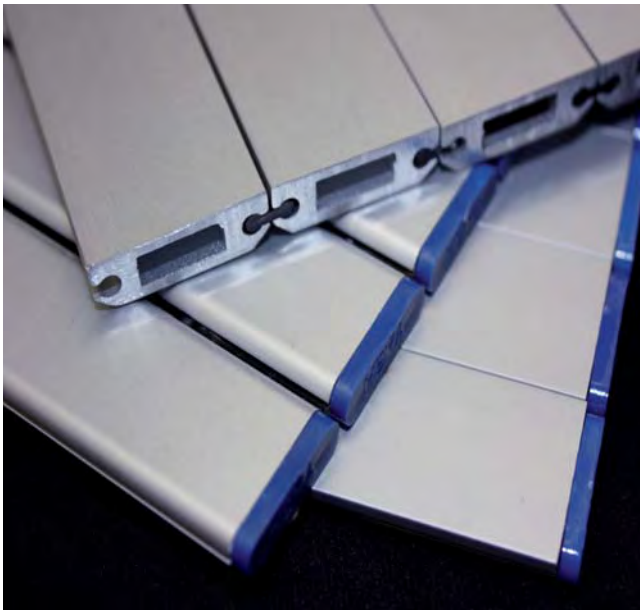
Please observe the mounting and maintenance information supplied with each ROLLER cover.

Mounting and maintenance information for ROLLER

Order and request forms available at: www.hema-schutz.de

ROLLER Covers and Link Aprons

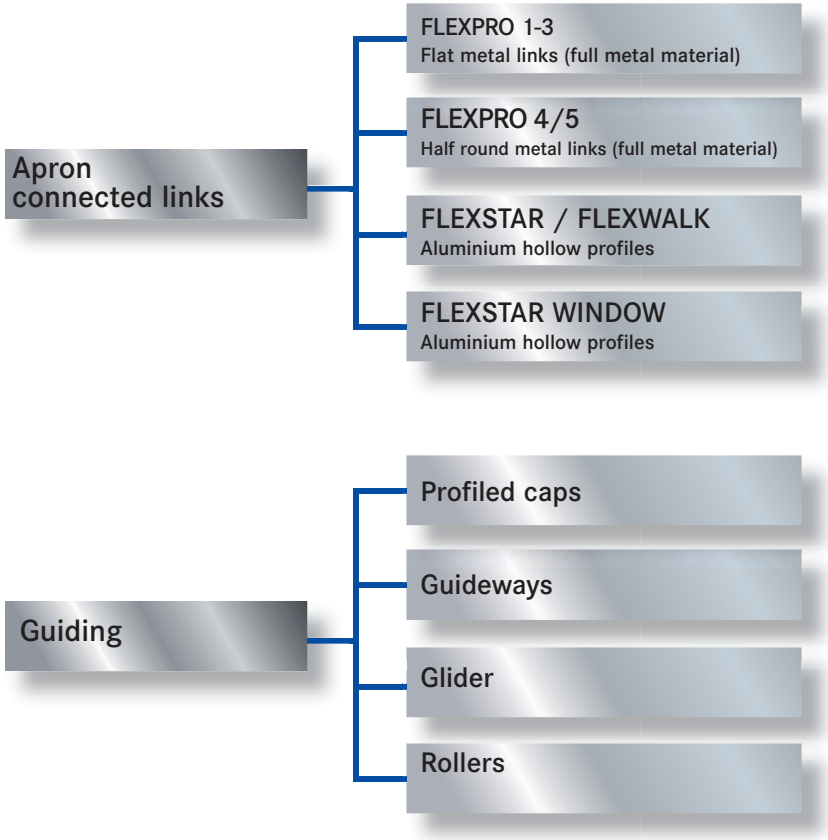




All dimensions in mm if not marked otherwise. Errors and omissions excepted.

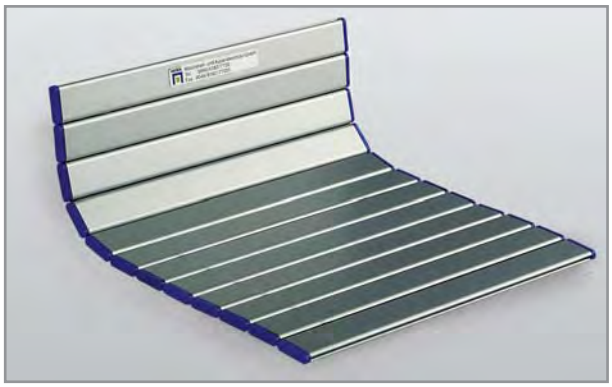
MODULAR CONCEPT

LINK APRONS

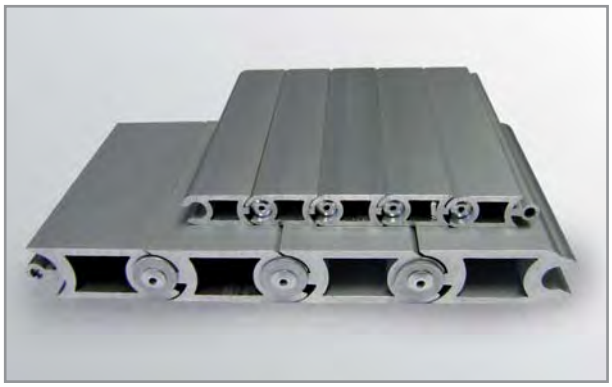


Link Aprons

Link aprons are a low-priced type of cover, providing excellent service in front line protection against chips and coolant. In many cases, link aprons serve as a protective hanging curtain or run over a guide roller for especially smooth running. They offer good flexibility, are mounted easily and require little space.



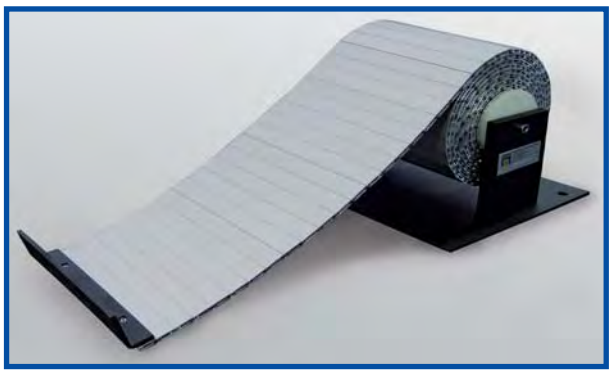
FLEXSTAR Link apron aluminium



FLEXSTAR ALC Aluminium-Profil

Combination with ROLLER system

For more demanding solutions, the link aprons are combined with a system of roller blinds.
The link apron is wound on top of the ROLLER standard system. The ROLLER diameter is considerably increased in its wound-up state.The drive unit is exactly matched to the additional weight and forces. We offer complete guide systems based on travel rails, steel cables or aluminium profiles.



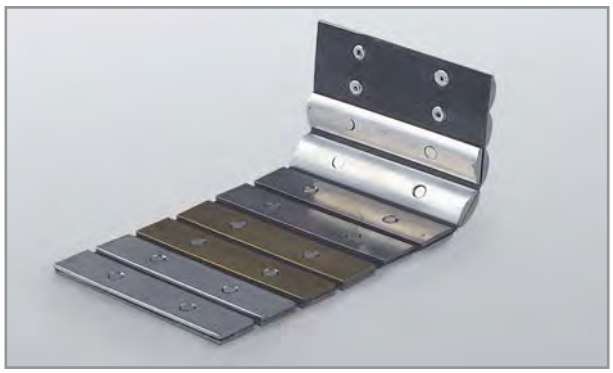
FLEXSTAR Link apron with holder and fixing bracket

HEMA link aprons are subdivided into the basic types:

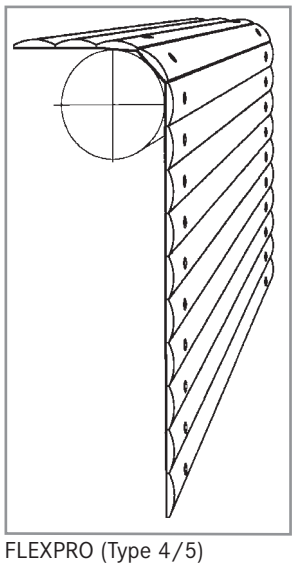
- FLEXPRO aprons
- FLEXSTAR aprons
- FLEXWALK
- FLEXSTAR Windows

Link aprons

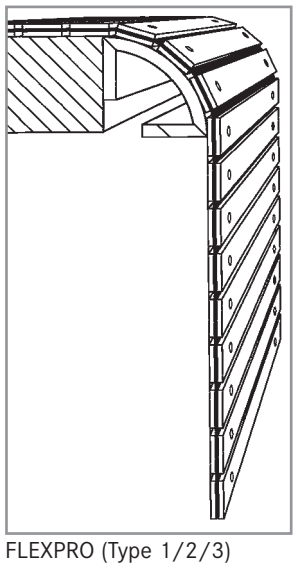
The metal sections are flat or semi-circular aluminium, brass or steel sections. They are bonded and riveted on a very tear resistant synthetic carrier material
The sections have a standard width of 15 or 16 mm, the height of the rods is between 2.0 mm (flat) and 3.0mm (semi-circular). The link aprons are manufactured in a width up to 3000 mm.



FLEXPRO link apron, different combinations



FLEXPRO (Type 4/5)

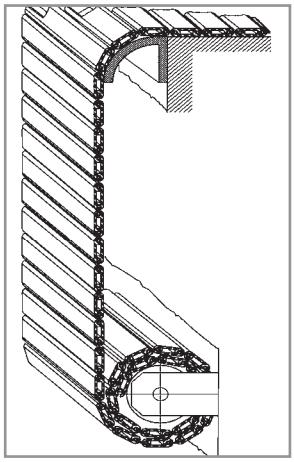


FLEXPRO (Type 1/2/3)

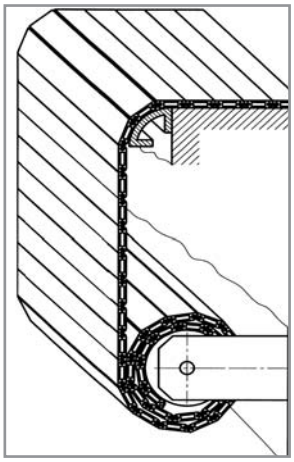
FLEXSTAR aprons

These aprons are made up of anodised hollow aluminium sections joined with a polyurethane strip. On the visual side the glider elements are rounded at the edges (FLEXSTAR-S) or straight (FLEXSTAR-C/CR).

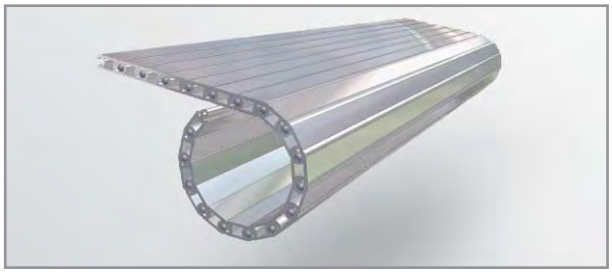
Link Aprons



FLEXSTAR-S



FLEXSTAR-C/CR



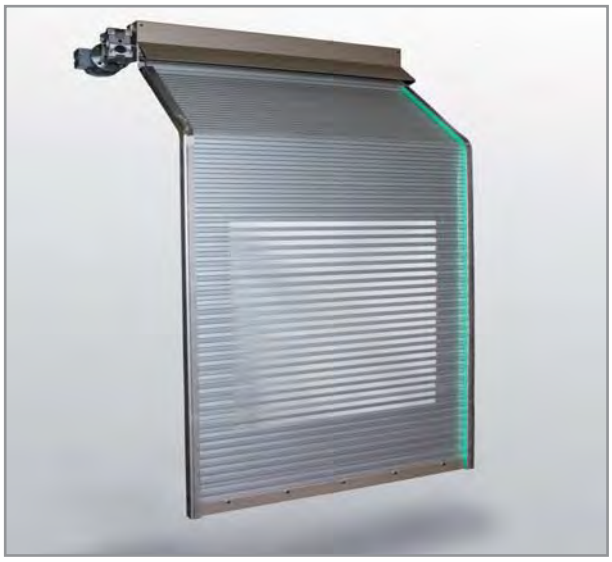
FLEXSTAR ALC14/ALC25

Both extrusion have bending restraints

- FLEXSTAR-S can move freely in both directions
- FLEXSTAR-C/CR permits only one-way bending, adopting a stable flat position in the other direction

Example for a customized solution

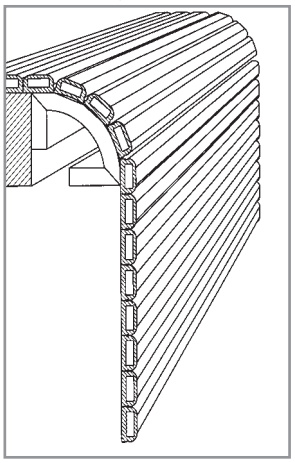
For an application in the packaging industry a combination of electric drive, FLEXSTAR apron covers, and steel band was designed as a kind of Faraday cage. A mechanical drive can be integrated as an option.



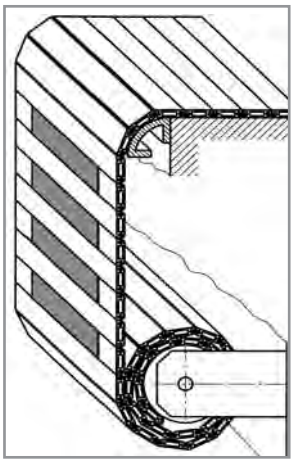
Example of link apron with electric drive

FLEXWALK

The FLEXWALK type is available in two section sizes. It is a combination of extremely stable hollow aluminium sections and a carrier fabric of synthetic or stainless steel band.
This is used when the customer requires an accessible solution. The aprons with a steel band as carrier material are joined with a high-performance bond of the required flexibility. These steel band aprons can therefore be used permanently on roller blind systems as well.



FLEXWALK



FLEXSTAR-Windows

FLEXSTAR Windows

FLEXSTAR aprons combined with vision inserts are very popular on the assembly sectors. We offer different types with rigid polycarbonate inserts or flexible see-through foil

FLEXSTAR Windows with see-through foil

FLEXSTAR Windows with polycarbonate inserts

Material

These link aprons consist of hollow section solutions manufactured to the greatest precision. The gap dimensions between the sections provide the best possible protection for the polyurethane strip. End caps improve the gliding properties. The standard colour of these caps is blue, but other colours are available on request.

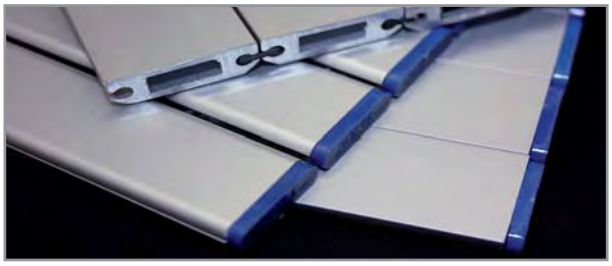
Link Aprons

Mounting

The link aprons can be fastened with

- hollow aluminium section angles
- metal ledges
- metal angles at the end of the apron

Customers are free to choose the shape or fixing hole pattern.



FLEXSTAR with synthetic band connection, end caps blue

link apron type exterior / interior section fixing	connecting material	section with in mm	section height in mm	smallest unwind radius in mm	profile type
FLEXPRO 1 steel/steel bonded and riveted	synthetic carrier band	15/15	2.0/2.0	40	
FLEXPRO 2 steel/brass bonded and riveted	synthetic carrier band	15/15	2.0/2.0	40	
FLEXPRO 3 steel/aluminium bonded and riveted	synthetic carrier band	15/15	2.0/2.0	40	
FLEXPRO 4 half round aluminium bonded and riveted	synthetic carrier band	16	3.0	21	
FLEXPRO 5 semicircular alu./aluminium bonded and riveted	synthetic carrier band	16/15	3.0/2.0	35	
FLEXWALK 1 Hollow alu. section, anodised bonded and riveted	synthetic carrier band or stainless steel	22 22	10.0 10.0	40 100	
FLEXWALK 2 Hollow alu. section, anodised bonded and riveted	synthetic carrier band or stainless steel	18 18	8.0 8.0	40 100	
FLEXSTAR-S Alu. hollow profile, anodised* indentation	synthetic band connection end caps available	20	5.5	35	
FLEXSTAR-C Hollow alu section, anodised* indentation	synthetic band connection end caps available	20	5.5	35	
FLEXSTAR-CR Hollow alu section, anodised* indentation	synthetic band connection	25	8.0	70	
FLEXSTAR ALC14 Hollow alu section, anodised indentation	rivet aluminium	25	14.0	40	
FLEXSTAR ALC25 Hollow alu section, anodised indentation	rivet aluminium	50	25.0	90	

*Inserts of see-through foil or polycarbonate (Windows) possible

All dimensions in mm if not marked otherwise. Errors and omissions excepted.

DURASPRING Spiral Springs

Spiral Springs are commonly used for the durable protection of ballscrews and shafts. DURASPRING Spiral Springs are produced using spring steel. The steel strip is roll formed to produce the spiral spring.
The advantages of DURASPRING are:

- High quality spring steel
- Tandem installation of multiple springs is possible
- Retrofit possible
- Special oil for enhanced life
- Production certified according to ISO 9000:2008
- Anti-corrosive packaging

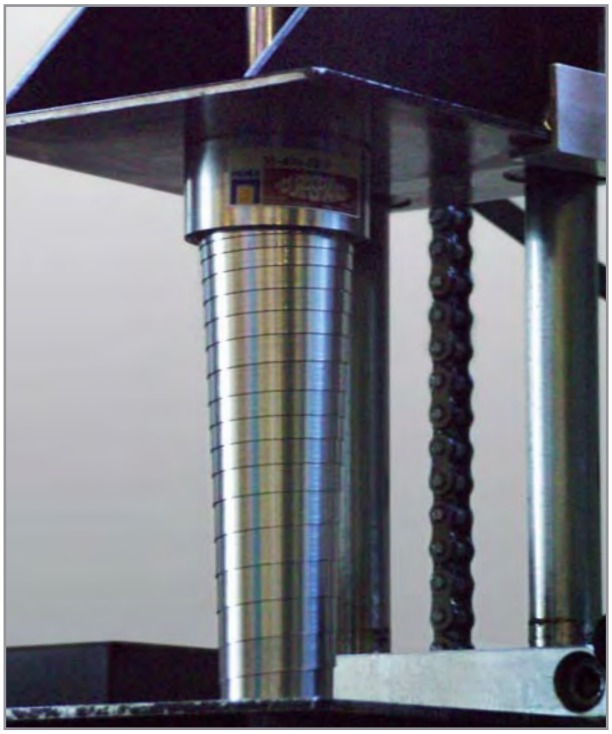
DURASPRING in standard and stainless steel

DURASPRING Spiral Springs are available in two versions:

- **DURASPRING BLUE** - standard spring, blue steel
- **DURASPRING SILVER** - stainless steel version

If the spiral springs are exposed regularly to coolants with a high proportion of water, then stainless steel band should be used. Stainless spiral springs have lower spring forces and therefore cannot be manufactured in all sizes. We use spring band steel of extreme hardness (55-58 Rockwell) with chamfered edges and a strength of up to 1800 N/mm² for our standard spiral springs. Band steel in thicknesses from 0.2 to 1.0 mm will be selected in accordance to size and application. Since this is docucumented within our quality system, reproducibility is also guaranteed when re-ordering.

DURASPRING lable with article number



Testing of DURASPRING Spiral Springs

Dimensions

The standard range now comprises springs in dimensions from 15 mm up to 160 mm internal diameter. Special dimensions are available on request. Spiral springs for vertical use can be produced up to an extended length of 4500 mm.

Speed

DURASPRING is designed as standard for speeds up to 40 metres/minute. Special solutions with almost twice the speed are achieved in individual robotics applications.
The optimum operating conditions for DURASPRING is in applications with oil. Bellows should be used alternatively for fine particles and dust.

Maintenance/Cleaning

Decisive factors in assessing the quality of spiral springs are the smoothness of travel, and even consistency of the overlapping turns. The quality of each DURASPRING is assured with the aid of our testing machines. Each spring is tested for its running properties prior to despatch.
Maintenance of the springs is necessary. Cleaning the springs according to the degree of contamination and then applying a light oil film is recommended. Available for this purpose is DURASPRING LONGLIFE special oil.

Please pay attention to the mounting and maintenance information supplied with each shipment.

DURASPRING Spiral Springs

Installation/operating position

DURASPRING Spiral springs can be installed in both, horizontal and vertical applications:

- Horizontal installation
- Vertical installation

Our DURASPRING Spiral Springs are manufactured specifically to suit horizontal or vertical operation.
For horizontal applications, the extension is reduced (see tabulations).

Horizontal installation

Springs used horizontally are formed for particularly for uniform running in that the overlap between coils is increased. In this way »sagging« is reduced, particularly for longer extension lengths, and transverse stability is significantly improved.
In the case of horizontal installation of the springs, placing the larger diameter adjacent to the area of swarf production is recommended.

Vertical installation

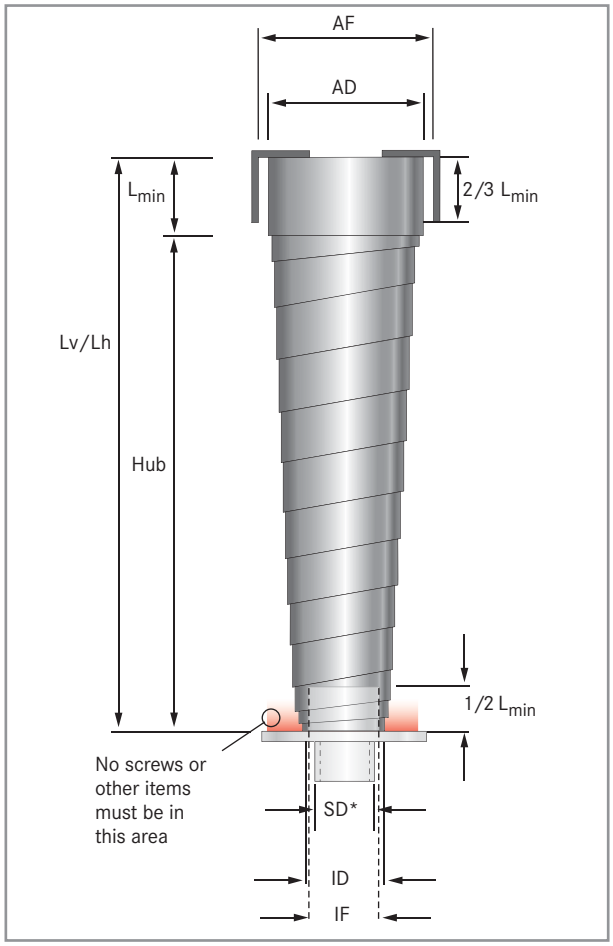
As a matter of principle, vertically installed DURASPRING achieve larger extension lengths than horizontal types.
The critical design factor for this type is the force produced, as the springs must also work against gravity.
Vertical types therefore have a high starting force, guaranteeing that the DURASPRING draws out rapidly when starting/ extending with the machine movement.
For efficient protection and optimum operation, vertical spirals should be mounted with the large diameter at the top.

Flanges (optional)

Simple centring flanges are required at both ends of the DURASPRING for installation (see order sheet).
These flanges must permit rotary movements of the spring that may occur, in order to prevent damage to the springs.
The springs must be guided so that they can move freely.
It is not permitted to screw and/or rivet them.

When using flanges, the spindle diameter SD is reduced by 6 mm compared to the values given on the following pages.

DURASPRING Silver in stainless steel



Legend	
SD	Maximum outside diameter of the part to be covered *value is reduced by 6 mm when using flanges
ID	Inside diameter of spiral spring (±1 mm)
AD	Outside diameter of spiral spring (±2 mm)
Lh	Maximum extension length for horizontal installation position
Lv	Maximum extension length for vertical installation position
BB	Band width, corresponds to L_{min}
SILVER	sizes also in **DURASPRING Silver available**
na	not available

Caculae for flanges	
Centering flange (deliverable on demand):	
AF	Interior diameter of the larger centering flange AD + 4mm
IF	Outer diameter of the smaller centering flange ID - 2mm
Option	through-boring of the flange SD + 2mm

DURASPRING Spiral Springs

DURASPRING	SD*	ID	AD	Lh	Lv	BB
15-70-20	11	15	22	na	70	20
15-100-20	11	15	22	60	100	20
15-120-20	11	15	22	90	120	20
15-150-20	11	15	28	110	150	20
15-200-20	11	15	31	160	200	20
15-300-20	11	15	32	260	300	20
20-100-20 SILVER	16	20	30	60	100	20
20-150-20 SILVER	16	20	33	110	150	20
20-200-20 SILVER	16	20	36	160	200	20
20-250-20 SILVER	16	20	39	210	250	20
20-300-20 SILVER	16	20	41	260	300	20
20-250-30	16	20	36	210	250	30
20-300-30 SILVER	16	20	39	260	300	30
20-350-30 SILVER	16	20	41	310	350	30
20-400-30 SILVER	16	20	43	360	400	30
20-400-40	16	20	35	360	400	40
20-450-40	16	20	41	410	450	40
20-500-40 SILVER	16	20	48	460	500	40
25-100-20 SILVER	21	25	36	60	100	20
25-150-20 SILVER	21	25	38	110	150	20
25-200-20 SILVER	21	25	40	160	200	20
25-250-20 SILVER	21	25	44	210	250	20
25-300-20	21	25	46	260	300	20
25-300-30 SILVER	21	25	42	240	300	30
25-350-30 SILVER	21	25	45	290	350	30
25-400-30	21	25	48	340	400	30
25-450-30 SILVER	21	25	49	390	450	30
25-450-40 SILVER	21	25	48	370	450	40
25-500-40 SILVER	21	25	49	420	500	40
25-450-50	21	25	41	390	450	50
25-550-50 SILVER	21	25	43	490	550	50
25-600-50	21	25	44	540	600	50
25-650-50 SILVER	21	25	45	590	650	50
25-750-50	21	25	47	690	750	50
25-900-50 SILVER	21	25	57	840	900	50
30-150-30	26	30	39	90	150	30
30-200-30 SILVER	26	30	42	140	200	30
30-250-30 SILVER	26	30	44	190	250	30
30-300-30 SILVER	26	30	46	240	300	30
30-350-30 SILVER	26	30	49	290	350	30
30-400-30 SILVER	26	30	50	340	400	30

DURASPRING	SD*	ID	AD	Lh	Lv	BB
30-450-30 SILVER	26	30	53	390	450	30
30-450-40	26	30	53	370	450	40
30-500-40 SILVER	26	30	55	440	500	40
30-550-40 SILVER	26	30	58	490	550	40
30-600-40	26	30	58	540	600	40
30-650-40	26	30	60	590	650	40
30-700-40 SILVER	26	30	64	640	700	40
30-150-50 SILVER	26	30	40	90	150	50
30-250-50 SILVER	26	30	42	190	250	50
30-350-50	26	30	45	290	350	50
30-450-50 SILVER	26	30	46	390	450	50
30-550-50 SILVER	26	30	48	490	550	50
30-650-50 SILVER	26	30	55	590	650	50
30-750-50 SILVER	26	30	58	690	750	50
30-650-60	26	30	58	590	650	60
30-750-60 SILVER	26	30	55	690	750	60
30-900-60	26	30	58	840	900	60
30-1000-60	26	30	60	940	1000	60
35-100-20	31	35	45	60	100	20
35-100-30	31	35	44	60	100	30
35-150-30 SILVER	31	35	48	90	150	30
35-200-30 SILVER	31	35	50	140	200	30
35-250-30	31	35	52	190	250	30
35-300-30 SILVER	31	35	55	240	300	30
35-350-30 SILVER	31	35	61	290	350	30
35-400-30 SILVER	31	35	63	340	400	30
35-300-40 SILVER	31	35	48	240	300	40
35-350-40 SILVER	31	35	50	290	350	40
35-400-40 SILVER	31	35	54	340	400	40
35-450-40 SILVER	31	35	58	390	450	40
35-500-40	31	35	60	440	500	40
35-550-40	31	35	62	490	550	40
35-350-50	31	35	51	290	350	50
35-400-50 SILVER	31	35	52	340	400	50
35-450-50	31	35	54	390	450	50
35-500-50 SILVER	31	35	55	440	500	50
35-550-50 SILVER	31	35	57	na	550	50
35-650-50 SILVER	31	35	60	590	650	50
35-750-50 SILVER	31	35	64	690	750	50
35-850-50	31	35	65	790	850	50
35-450-60	31	35	53	390	450	60

Standard sizes, other sizes on request. All dimension in mm.

Order and request forms available at: www.hema-schutz.de

DURASPRING Spiral Springs

DURASPRING	SD*	ID	AD	Lh	Lv	BB
35-550-60	31	35	56	490	550	60
35-650-60 SILVER	31	35	59	590	650	60
35-750-60	31	35	60	690	750	60
35-850-60 SILVER	31	35	65	790	850	60
35-550-75	31	35	54	490	550	75
35-650-75	31	35	55	590	650	75
35-750-75	31	35	57	690	750	75
35-850-75 SILVER	31	35	59	790	850	75
40-150-30 SILVER	36	40	51	90	150	30
40-250-30 SILVER	36	40	56	190	250	30
40-350-30 SILVER	36	40	60	290	350	30
40-450-30 SILVER	36	40	64	390	450	30
40-350-40	36	40	61	290	350	40
40-400-40	36	40	63	340	400	40
40-450-40 SILVER	36	40	64	390	450	40
40-500-40 SILVER	36	40	65	440	500	40
40-550-40 SILVER	36	40	68	490	550	40
40-350-50 SILVER	36	40	56	250	350	50
40-450-50 SILVER	36	40	59	350	450	50
40-550-50 SILVER	36	40	61	450	550	50
40-650-50 SILVER	36	40	65	550	650	50
40-750-50 SILVER	36	40	69	650	750	50
40-850-50 SILVER	36	40	71	750	850	50
40-350-60 SILVER	36	40	55	230	350	60
40-450-60 SILVER	36	40	58	450	450	60
40-550-60 SILVER	36	40	59	430	550	60
40-650-60 SILVER	36	40	62	530	650	60
40-750-60 SILVER	36	40	66	630	750	60
40-900-60 SILVER	36	40	70	780	900	60
40-650-75	36	40	63	500	650	75
40-750-75 SILVER	36	40	66	600	750	75
40-900-75 SILVER	36	40	71	750	900	75
40-1100-75 SILVER	36	40	78	950	1100	75
40-1300-75 SILVER	36	40	84	1150	1300	75
40-1500-75 SILVER	36	40	90	na	1500	75
40-1000-100 SILVER	36	40	68	800	1000	100
40-1200-100 SILVER	36	40	71	1000	1200	100
40-1300-100	36	40	75	1100	1300	100
40-1400-100	36	40	76	1200	1400	100
40-1500-100 SILVER	36	40	78	1300	1500	100
40-1600-100	36	40	81	1400	1600	100

Standard sizes, other sizes on request. All dimension in mm.

DURASPRING	SD*	ID	AD	Lh	Lv	BB
40-1800-100 SILVER	36	40	82	1600	1800	100
40-1800-120	36	40	82	1560	1800	120
40-2000-120	36	40	86	1760	2000	120
40-2200-120	36	40	90	na	2200	120
45-150-30 SILVER	41	45	56	90	150	30
45-250-30 SILVER	41	45	61	190	250	30
45-350-30 SILVER	41	45	65	290	350	30
45-400-30 SILVER	41	45	66	340	400	30
45-350-40	41	45	65	290	350	40
45-400-40	41	45	68	340	400	40
45-450-40 SILVER	41	45	69	390	450	40
45-450-50 SILVER	41	45	66	350	450	50
45-550-50 SILVER	41	45	68	450	550	50
45-650-50 SILVER	41	45	75	550	650	50
45-350-60	41	45	63	230	350	60
45-450-60 SILVER	41	45	65	330	450	60
45-550-60	41	45	65	430	550	60
45-650-60	41	45	69	530	650	60
45-700-60 SILVER	41	45	70	630	700	60
45-650-75 SILVER	41	45	67	500	650	75
45-750-75 SILVER	41	45	76	600	750	75
45-900-75 SILVER	41	45	78	750	900	75
45-1100-75 SILVER	41	45	84	950	1100	75
45-1200-75	41	45	86	1150	1200	75
45-1300-75	41	45	89	na	1300	75
45-1000-100	41	45	71	800	1000	100
45-1200-100	41	45	75	1000	1200	100
45-1300-100	41	45	79	1100	1300	100
45-1400-100	41	45	81	1200	1400	100
45-1500-100	41	45	83	1300	1500	100

Legend

SD	Maximum outside diameter of the part to be covered *value is reduced by 6 mm when using flanges
ID	Inside diameter of spiral spring (±1 mm)
AD	Outside diameter of spiral spring (±2 mm)
Lh	Maximum extension length for horizontal installation position
Lv	Maximum extension length for vertical installation position
BB	Band width, corresponds to L_{min}
SILVER	sizes also in **DURASPRING Silver available**
na	not available

DURASPRING Spiral Springs

DURASPRING	SD*	ID	AD	Lh	Lv	BB
45-1600-100	41	45	87	1400	1600	100
45-1800-100	41	45	87	na	1800	100
45-1800-120	41	45	87	1560	1800	120
45-2000-120	41	45	91	1760	2000	120
45-2200-120 SILVER	41	45	100	na	2200	120
50-150-30 SILVER	46	50	63	90	150	30
50-250-30 SILVER	46	50	68	190	250	30
50-350-30 SILVER	46	50	73	290	350	30
50-250-50 SILVER	46	50	62	150	250	50
50-350-50 SILVER	46	50	66	250	350	50
50-450-50 SILVER	46	50	70	350	450	50
50-550-50 SILVER	46	50	73	450	550	50
50-650-50 SILVER	46	50	76	550	650	50
50-350-60 SILVER	46	50	66	230	350	60
50-450-60	46	50	65	330	450	60
50-550-60 SILVER	46	50	68	430	550	60
50-600-60 SILVER	46	50	72	480	600	60
50-650-60 SILVER	46	50	73	530	650	60
50-750-60 SILVER	46	50	80	630	750	60
50-900-60 SILVER	46	50	81	780	900	60
50-750-75 SILVER	46	50	78	600	750	75
50-900-75 SILVER	46	50	84	750	900	75
50-1100-75	46	50	90	950	1100	75
50-1200-75	46	50	94	1050	1200	75
50-1100-100 SILVER	46	50	77	900	1100	100
50-1300-100 SILVER	46	50	80	1100	1300	100
50-1500-100 SILVER	46	50	88	1300	1500	100
50-1600-100	46	50	89	1400	1600	100
50-1700-100	46	50	91	na	1700	100
50-1800-100 SILVER	46	50	94	na	1800	100
50-1700-120	46	50	91	1460	1700	120
50-1900-120 SILVER	46	50	96	1660	1900	120
50-2100-120 SILVER	46	50	100	1860	2100	120
50-2300-120	46	50	105	na	2300	120
50-2500-120	46	50	115	na	2500	120
50-2800-120	46	50	118	na	2800	120
50-2500-150	46	50	116	2200	2500	150
50-2800-150	46	50	118	2500	2800	150
50-3000-150	46	50	123	2500	3000	150
50-3000-180	46	50	123	2640	3000	180
50-3250-180	46	50	128	na	3250	180

DURASPRING	SD*	ID	AD	Lh	Lv	BB
50-3250-200	46	50	128	2850	3250	200
50-3500-200	46	50	134	na	3500	200
55-150-30 SILVER	51	55	67	90	150	30
55-250-30 SILVER	51	55	73	190	250	30
55-300-40	51	55	71	220	300	40
55-450-40 SILVER	51	55	76	370	450	40
55-250-50 SILVER	51	55	66	150	250	50
55-350-50 SILVER	51	55	71	250	350	50
55-450-50 SILVER	51	55	74	350	450	50
55-550-50 SILVER	51	55	78	450	550	50
55-650-50	51	55	80	450	650	50
55-550-60 SILVER	51	55	75	430	550	60
55-650-60 SILVER	51	55	79	530	650	60
55-750-60 SILVER	51	55	83	630	750	60
55-800-60	51	55	86	680	800	60
55-900-60 SILVER	51	55	89	780	900	60
55-1000-60 SILVER	51	55	92	na	1000	60
55-600-75 SILVER	51	55	80	450	600	75
55-750-75 SILVER	51	55	83	600	750	75
55-900-75 SILVER	51	55	89	750	900	75
55-1100-75 SILVER	51	55	94	950	1100	75
55-1100-100 SILVER	51	55	85	900	1100	100
55-1300-100	51	55	89	1100	1300	100
55-1500-100	51	55	94	1300	1500	100
55-1800-100 SILVER	51	55	102	1600	1800	100
55-1300-120	51	55	92	1060	1300	120
55-1500-120	51	55	94	1260	1500	120
55-1700-120	51	55	96	1460	1700	120
55-1900-120	51	55	100	1660	1900	120
55-2100-120	51	55	105	1860	2100	120
55-2300-120 SILVER	51	55	110	2060	2300	120
55-2500-120	51	55	116	2200	2500	120
55-2800-120	51	55	123	2500	2800	120
55-2500-150	51	55	118	2200	2500	150
55-2800-150	51	55	121	2500	2800	150
55-3000-150	51	55	126	na	3000	150
55-3500-150	51	55	130	2500	3500	150
55-2800-180	51	55	114	2500	2800	180
55-3000-180	51	55	126	2640	3000	180
55-3250-180	51	55	130	2500	3250	180
55-3500-200	51	55	137	na	3500	180

Standard sizes, other sizes on request. All dimension in mm.

Order and request forms available at: www.hema-schutz.de

DURASPRING Spiral Springs

DURASPRING	SD*	ID	AD	Lh	Lv	BB
60-150-30 SILVER	56	60	73	90	150	30
60-250-30 SILVER	56	60	78	190	250	30
60-250-50 SILVER	56	60	73	150	250	50
60-350-50 SILVER	56	60	78	250	350	50
60-450-50 SILVER	56	60	82	350	450	50
60-550-50	56	60	85	450	550	50
60-450-60 SILVER	56	60	78	430	450	60
60-550-60 SILVER	56	60	81	430	550	60
60-650-60 SILVER	56	60	85	530	650	60
60-750-60 SILVER	56	60	89	630	750	60
60-800-60 SILVER	56	60	96	680	800	60
60-900-60 SILVER	56	60	98	na	900	60
60-750-75 SILVER	56	60	89	600	750	75
60-900-75 SILVER	56	60	95	750	900	75
60-1100-75 SILVER	56	60	102	950	1100	75
60-1300-75	56	60	104	1150	1300	75
60-900-100	56	60	85	700	900	100
60-1100-100 SILVER	56	60	90	900	1100	100
60-1300-100 SILVER	56	60	94	1100	1300	100
60-1500-100 SILVER	56	60	100	1300	1500	100
60-1800-100 SILVER	56	60	109	1600	1800	100
60-1700-120	56	60	101	1460	1700	120
60-1900-120 SILVER	56	60	104	1660	1900	120
60-2100-120 SILVER	56	60	108	1860	2100	120
60-2300-120	56	60	114	2060	2300	120
60-2500-120 SILVER	56	60	118	2300	2500	120
60-2800-120	56	60	126	2500	2800	120
60-2500-150 SILVER	56	60	118	2300	2500	150
60-2800-150	56	60	123	2500	2800	150
60-3000-150	56	60	128	na	3000	150
60-3500-150	56	60	138	na	3500	150
60-3000-180	56	60	126	2640	3000	180
60-3250-180	56	60	132	na	3250	180
60-3250-200	56	60	132	2850	3250	200
60-3500-200	56	60	139	na	3500	200
65-100-30	61	65	76	90	100	30
65-150-30 SILVER	61	65	78	90	150	30
65-250-30 SILVER	61	65	85	190	250	30
65-250-50 SILVER	61	65	76	150	250	50
65-350-50 SILVER	61	65	84	250	350	50
65-450-50 SILVER	61	65	88	350	450	50

Standard sizes, other sizes on request. All dimension in mm.

DURASPRING	SD*	ID	AD	Lh	Lv	BB
65-550-50 SILVER	61	65	92	450	550	50
65-500-60 SILVER	61	65	86	380	500	60
65-550-60 SILVER	61	65	88	430	550	60
65-650-60 SILVER	61	65	93	530	650	60
65-700-60 SILVER	61	65	94	580	700	60
65-750-60 SILVER	61	65	95	630	750	60
65-800-60 SILVER	61	65	98	680	800	60
65-900-60	61	65	103	780	900	60
65-750-75 SILVER	61	65	93	600	750	75
65-800-75 SILVER	61	65	96	650	800	75
65-900-75 SILVER	61	65	99	750	900	75
65-1100-75 SILVER	61	65	107	900	1100	75
65-1300-75	61	65	111	1100	1300	75
65-1500-75 SILVER	61	65	115	na	1500	75
65-1000-100 SILVER	61	65	91	800	1000	100
65-1100-100 SILVER	61	65	95	900	1100	100
65-1300-100 SILVER	61	65	99	1100	1300	100
65-1500-100 SILVER	61	65	108	1300	1500	100
65-1700-100 SILVER	61	65	113	na	1700	100
65-1800-100 SILVER	61	65	119	1600	1800	100
65-1500-120 SILVER	61	65	100	1260	1500	120
65-1700-120	61	65	106	1460	1700	120
65-1900-120 SILVER	61	65	109	1660	1900	120
65-2100-120 SILVER	61	65	113	1860	2100	120
65-2300-120	61	65	118	2060	2300	120
65-2500-120 SILVER	61	65	128	2300	2500	120
65-2800-120 SILVER	61	65	134	2500	2800	120
65-2400-150 SILVER	61	65	120	2100	2400	150
65-2800-150	61	65	132	2500	2800	150
65-3000-150	61	65	142	2500	3000	150

Legend

SD	Maximum outside diameter of the part to be covered *value is reduced by 6 mm when using flanges
ID	Inside diameter of spiral spring (±1 mm)
AD	Outside diameter of spiral spring (±2 mm)
Lh	Maximum extension length for horizontal installation position
Lv	Maximum extension length for vertical installation position
BB	Band width, corresponds to L_{min}
SILVER	sizes also in **DURASPRING Silver available**
na	not available

All dimensions in mm if not marked otherwise. Errors and omissions excepted.

DURASPRING Spiral Springs

DURASPRING	SD*	ID	AD	Lh	Lv	BB
65-3000-180	61	65	136	2640	3000	180
65-3250-180	61	65	145	na	3250	180
65-3250-200	61	65	138	2850	3250	200
65-3500-200	61	65	148	na	3500	200
70-150-30 SILVER	66	70	85	90	150	30
70-250-30 SILVER	66	70	93	190	250	30
70-350-30	66	70	99	290	350	30
70-250-50 SILVER	66	70	85	150	250	50
70-350-50 SILVER	66	70	89	250	350	50
70-450-50 SILVER	66	70	94	350	450	50
70-550-50 SILVER	66	70	97	450	550	50
70-650-50	66	70	100	na	650	50
70-550-60 SILVER	66	70	94	430	550	60
70-650-60 SILVER	66	70	97	530	650	60
70-750-60 SILVER	66	70	102	630	750	60
70-900-60	66	70	113	800	900	60
70-500-75 SILVER	66	70	91	350	500	75
70-600-75	66	70	94	450	600	75
70-700-75	66	70	98	550	700	75
70-750-75 SILVER	66	70	98	550	700	75
70-800-75 SILVER	66	70	102	650	800	75
70-900-75 SILVER	66	70	104	750	900	75
70-1100-75 SILVER	66	70	113	900	1100	75
70-700-100 SILVER	66	70	88	700	700	100
70-900-100 SILVER	66	70	98	900	900	100
70-1100-100 SILVER	66	70	102	900	1100	100
70-1300-100 SILVER	66	70	106	1100	1300	100
70-1500-100 SILVER	66	70	115	1300	1500	100
70-1800-100 SILVER	66	70	124	1700	1800	100
70-1500-120 SILVER	66	70	110	1260	1500	120
70-1800-120 SILVER	66	70	118	1560	1800	120
70-2000-120 SILVER	66	70	125	1760	2000	120
70-2200-120	66	70	129	1960	2200	120
70-2400-120	66	70	136	2200	2400	120
70-2600-120	66	70	143	na	2600	120
70-3000-120	66	70	147	na	3000	120
70-2000-150	66	70	129	1700	2000	150
70-2400-150	66	70	135	2100	2400	150
70-2800-150	66	70	139	na	2800	150
70-3000-150	66	70	149	na	3000	150
70-2800-180	66	70	138	2440	2800	180

DURASPRING	SD*	ID	AD	Lh	Lv	BB
70-3000-180	66	70	141	na	3000	180
70-3250-180	66	70	152	2500	3250	180
70-3250-200	66	70	144	2500	3250	200
70-3500-200	66	70	155	2500	3500	200
75-150-30 SILVER	71	75	92	90	150	30
75-250-30 SILVER	71	75	98	190	250	30
75-250-50 SILVER	71	75	89	150	250	50
75-350-50 SILVER	71	75	94	250	350	50
75-450-50 SILVER	71	75	101	350	450	50
75-500-50 SILVER	71	75	105	400	500	50
75-550-60 SILVER	71	75	100	430	550	60
75-650-60 SILVER	71	75	103	530	650	60
75-750-60 SILVER	71	75	109	630	750	60
75-650-75 SILVER	71	75	99	500	650	75
75-750-75 SILVER	71	75	104	600	750	75
75-900-75 SILVER	71	75	111	750	900	75
75-1000-75 SILVER	71	75	114	850	1000	75
75-1100-75 SILVER	71	75	118	950	1100	75
75-900-100 SILVER	71	75	102	na	900	100
75-1100-100 SILVER	71	75	108	900	1100	100
75-1200-100 SILVER	71	75	112	1000	1200	100
75-1300-100 SILVER	71	75	112	1100	1300	100
75-1500-100 SILVER	71	75	120	1300	1500	100
75-1700-100 SILVER	71	75	126	1500	1700	100
75-1800-100	71	75	128	1600	1800	100
75-2000-100	71	75	133	1700	2000	100
75-2200-100	71	75	136	1900	2200	100
75-1500-120 SILVER	71	75	115	1260	1500	120
75-1800-120	71	75	122	1560	1800	120
75-2000-120 SILVER	71	75	127	1760	2000	120
75-2200-120 SILVER	71	75	132	1900	2200	120
75-2400-120	71	75	137	na	2400	120
75-2600-120	71	75	142	2200	2600	120
75-2800-120	71	75	147	na	2800	120
75-2000-150	71	75	135	1700	2000	150
75-2400-150	71	75	140	2100	2400	150
75-2600-150	71	75	144	2300	2600	150
75-2800-150 SILVER	71	75	145	2500	2800	150
75-3000-150	71	75	152	na	3000	150
75-2800-180	71	75	143	2440	2800	180
75-3000-180	71	75	148	na	3000	180

Standard sizes, other sizes on request. All dimension in mm.

Order and request forms available at: www.hema-schutz.de

DURASPRING Spiral Springs

DURASPRING	SD*	ID	AD	Lh	Lv	BB
75-3250-180	71	75	156	2500	3250	180
75-3250-200	71	75	148	2850	3250	200
75-3500-200	71	75	158	na	3500	200
80-150-30 SILVER	76	80	98	90	150	30
80-250-30 SILVER	76	80	106	190	250	30
80-250-50 SILVER	76	80	96	150	250	50
80-450-50 SILVER	76	80	111	350	450	50
80-550-50 SILVER	76	80	114	450	550	50
80-450-60	76	80	102	330	450	60
80-550-60	76	80	105	430	550	60
80-650-60 SILVER	76	80	110	530	650	60
80-750-60	76	80	115	630	750	60
80-550-75 SILVER	76	80	99	400	550	75
80-600-75	76	80	102	450	600	75
80-650-75	76	80	105	500	650	75
80-750-75 SILVER	76	80	108	600	750	75
80-900-75	76	80	119	750	900	75
80-1000-75 SILVER	76	80	123	850	1000	75
80-1200-75 SILVER	76	80	128	1000	1200	75
80-900-100 SILVER	76	80	119	900	900	100
80-1100-100	76	80	115	900	1100	100
80-1300-100 SILVER	76	80	120	1100	1300	100
80-1500-100	76	80	126	1300	1500	100
80-1800-100	76	80	134	1600	1800	100
80-1300-120	76	80	115	1060	1300	120
80-1500-120	76	80	121	1260	1500	120
80-1800-120	76	80	128	1560	1800	120
80-2000-120 SILVER	76	80	133	1700	2000	120
80-2200-120	76	80	137	1700	2200	120
80-2400-120	76	80	142	na	2400	120
80-2800-120	76	80	145	na	2800	120
80-2000-150	76	80	139	1700	2000	150
80-2200-150	76	80	142	1900	2200	150
80-2400-150	76	80	146	2100	2400	150
80-2600-150	76	80	148	2300	2600	150
80-2800-150 SILVER	76	80	152	na	2800	150
80-3000-150	76	80	157	na	3000	150
80-2800-180	76	80	148	2440	2800	180
80-3000-180 SILVER	76	80	154	na	3000	180
80-3250-180	76	80	157	na	3250	180
80-3000-200	76	80	154	2600	3000	200

Standard sizes, other sizes on request. All dimension in mm.

DURASPRING	SD*	ID	AD	Lh	Lv	BB
80-3250-200 SILVER	76	80	160	na	3250	200
80-3500-200	76	80	163	2500	3500	200
85-150-30	81	85	103	90	150	30
85-250-30	81	85	111	190	250	30
85-250-50	81	85	105	150	250	50
85-350-50	81	85	109	250	350	50
85-450-50	81	85	116	350	450	50
85-550-50	81	85	119	450	550	50
85-650-60	81	85	115	530	650	60
85-550-75	81	85	108	400	550	75
85-900-75	81	85	125	750	900	75
85-1500-100	81	85	127	1300	1500	100
85-1500-120	81	85	126	1260	1500	120
85-2000-120	81	85	138	1700	2000	120
85-2400-150 SILVER	81	85	151	2100	2400	150
85-3500-200	81	85	168	na	3500	200
90-150-30 SILVER	86	90	110	90	150	30
90-250-30	86	90	116	190	250	30
90-150-50	86	90	112	50	150	50
90-250-50 SILVER	86	90	116	150	250	50
90-350-50 SILVER	86	90	121	250	350	50
90-450-50 SILVER	86	90	125	350	450	50
90-350-60 SILVER	86	90	112	230	350	60
90-450-60 SILVER	86	90	114	330	450	60
90-450-75	86	90	115	300	450	75
90-550-75 SILVER	86	90	119	400	550	75
90-650-75 SILVER	86	90	124	500	650	75
90-750-75	86	90	128	600	750	75
90-900-75	86	90	133	750	900	75
90-750-100	86	90	115	550	750	100

Legend

SD	Maximum outside diameter of the part to be covered *value is reduced by 6 mm when using flanges
ID	Inside diameter of spiral spring (±1 mm)
AD	Outside diameter of spiral spring (±2 mm)
Lh	Maximum extension length for horizontal installation position
Lv	Maximum extension length for vertical installation position
BB	Band width, corresponds to L_{min}
SILVER	sizes also in **DURASPRING Silver available**
na	not available

DURASPRING Spiral Springs

DURASPRING	SD*	ID	AD	Lh	Lv	BB
90-900-100 SILVER	86	90	120	700	900	100
90-1100-100 SILVER	86	90	126	900	1100	100
90-1300-100 SILVER	86	90	132	1100	1300	100
90-1500-100 SILVER	86	90	144	1300	1500	100
90-1300-120 SILVER	86	90	126	1060	1300	120
90-1500-120 SILVER	86	90	131	1260	1500	120
90-1800-120	86	90	138	1600	1800	120
90-2000-120	86	90	148	na	2000	120
90-1800-150	86	90	144	1500	1800	150
90-2000-150 SILVER	86	90	149	1700	2000	150
90-2300-150	86	90	154	na	2300	150
90-2600-150	86	90	159	na	2600	150
90-2800-150	86	90	160	na	2800	150
90-3000-150	86	90	166	na	3000	150
90-2600-180	86	90	152	2240	2600	180
90-2800-180	86	90	158	na	2800	180
90-3000-180	86	90	164	na	3000	180
90-2600-200 SILVER	86	90	153	2400	2600	200
90-3000-200	86	90	162	2500	3000	200
90-3250-200	86	90	166	2500	3250	200
90-3500-200	86	90	170	na	3500	200
90-3700-200	86	90	173	2500	3700	200
90-4000-200	86	90	182	na	4000	200
90-4200-200 SILVER	86	90	185	na	4200	200
90-4500-200	86	90	194	na	4500	200
100-250-60 SILVER	96	100	121	130	250	60
100-350-60 SILVER	96	100	126	230	350	60
100-350-75 SILVER	96	100	119	200	350	75
100-450-75	96	100	124	300	450	75
100-600-75 SILVER	96	100	129	450	600	75
100-800-75 SILVER	96	100	138	650	800	75
100-800-100 SILVER	96	100	126	600	800	100
100-1000-100 SILVER	96	100	132	800	1000	100
100-1200-100	96	100	137	1000	1200	100
100-1500-100	96	100	146	1300	1500	100
100-1100-120 SILVER	96	100	129	860	1100	120
100-1300-120 SILVER	96	100	136	1060	1300	120
100-1500-120	96	100	144	na	1500	120
100-1800-120 SILVER	96	100	148	na	1800	120
100-1500-150	96	100	147	1200	1500	150
100-1800-150	96	100	151	1500	1800	150

DURASPRING	SD*	ID	AD	Lh	Lv	BB
100-2000-150 SILVER	96	100	157	1700	2000	150
100-2500-150	96	100	164	na	2500	150
100-3000-150	96	100	188	na	3000	150
100-2500-180	96	100	162	2140	2500	180
100-2800-180	96	100	168	na	2800	180
100-2800-200	96	100	165	na	2800	200
100-3000-200	96	100	170	na	3000	200
110-250-50 SILVER	106	110	130	na	250	50
110-250-60 SILVER	106	110	130	130	250	60
110-350-60 SILVER	106	110	135	230	350	60
110-450-60 SILVER	106	110	139	330	450	60
110-350-75 SILVER	106	110	130	200	350	75
110-450-75	106	110	134	300	450	75
110-600-75 SILVER	106	110	140	450	600	75
110-800-75 SILVER	106	110	154	650	800	75
110-650-100 SILVER	106	110	129	450	650	100
110-750-100 SILVER	106	110	134	560	750	100
110-900-100 SILVER	106	110	139	700	900	100
110-1100-120	106	110	139	860	1100	120
110-1300-120 SILVER	106	110	145	1060	1300	120
110-1500-120 SILVER	106	110	155	1260	1500	120
110-1500-150	106	110	155	1200	1500	150
110-1800-150	106	110	157	1500	1800	150
110-2000-150	106	110	160	1700	2000	150
110-2200-180	106	110	165	1840	2200	180
110-2400-180 SILVER	106	110	170	na	2400	180
110-2400-200	106	110	162	2000	2400	200
110-2800-200	106	110	172	2500	2800	200
110-3000-200	106	110	176	na	3000	200
110-3500-200	106	110	189	na	3500	200
120-250-50	116	120	141	na	250	50
120-350-50 SILVER	116	120	143	na	350	50
120-250-60 SILVER	116	120	141	130	250	60
120-350-60 SILVER	116	120	145	230	350	60
120-450-60 SILVER	116	120	150	330	450	60
120-350-75	116	120	140	200	350	75
120-450-75 SILVER	116	120	145	300	450	75
120-600-75	116	120	153	450	600	75
120-650-100 SILVER	116	120	142	450	650	100
120-750-100 SILVER	116	120	147	550	750	100
120-900-100 SILVER	116	120	150	700	900	100

Standard sizes, other sizes on request. All dimension in mm.

Order and request forms available at: www.hema-schutz.de

DURASPRING Spiral Springs

DURASPRING	SD*	ID	AD	Lh	Lv	BB
120-900-120 SILVER	116	120	148	660	900	120
120-1100-120 SILVER	116	120	153	860	1100	120
120-1300-120	116	120	158	1100	1300	120
120-1500-120 SILVER	116	120	162	1300	1500	120
120-1300-150 SILVER	116	120	156	1000	1300	150
120-1500-150	116	120	163	1200	1500	150
120-1800-150	116	120	167	1500	1800	150
120-2000-150	116	120	177	1600	2000	150
120-1600-180	116	120	158	1240	1600	180
120-1800-180	116	120	161	1440	1800	180
120-2000-180 SILVER	116	120	169	1640	2000	180
120-2200-180	116	120	174	na	2200	180
120-2200-200 SILVER	116	120	165	1800	2200	200
120-2400-200	116	120	170	2100	2400	200
120-2600-200	116	120	174	na	2600	200
130-170-50	126	130	150	na	170	50
130-250-60 SILVER	126	130	145	210	250	60
130-350-60	126	130	155	na	350	60
130-450-60	126	130	156	410	450	60
130-250-75 SILVER	126	130	145	220	250	75
130-350-75	126	130	150	310	350	75
130-450-75	126	130	156	410	450	75
130-650-100	126	130	157	600	650	100
130-800-100	126	130	164	na	800	100
130-600-120	126	130	158	360	600	120
130-800-120 SILVER	126	130	161	560	800	120
130-1000-120 SILVER	126	130	164	760	1000	120
130-1100-120	126	130	163	na	1100	120
130-900-150	126	130	163	500	900	150
130-1300-150	126	130	170	1000	1300	150
130-1500-150	126	130	174	1200	1500	150
130-1800-150	126	130	185	na	1800	150
130-1650-180	126	130	170	1650	1650	180
130-2000-200	126	130	180	2000	2000	200
140-250-75	136	140	158	150	250	75
140-350-75	136	140	162	250	350	75
140-450-75	136	140	165	350	450	75
140-600-75	136	140	175	na	600	75
140-350-100	136	140	153	250	350	100
140-450-100	136	140	162	350	450	100
140-600-100	136	140	172	500	600	100

Standard sizes, other sizes on request. All dimension in mm.

DURASPRING	SD*	ID	AD	Lh	Lv	BB
140-700-120	136	140	170	460	700	120
140-1000-120	136	140	192	na	1000	120
140-1000-150	136	140	180	700	1000	150
140-1300-150	136	140	187	1000	1300	150
140-1500-150 SILVER	136	140	190	na	1500	150
140-1900-200	136	140	185	1500	1900	200
140-2000-200	136	140	193	1600	2000	200
140-2400-200	136	140	204	na	2400	200
150-350-60	146	150	172	300	350	60
150-450-75	146	150	188	na	450	75
150-500-75	146	150	190	na	500	75
150-600-75	146	150	194	na	600	75
150-750-150	146	150	180	na	750	150
150-1100-150	146	150	187	na	1100	150
150-1300-150	146	150	197	na	1300	150
160-250-60	156	160	178	na	250	60
160-250-75	156	160	180	na	250	75
160-450-75	156	160	189	na	450	75
160-450-100	156	160	182	350	450	100
160-650-120	156	160	191	550	650	120
160-750-120	156	160	193	600	750	120
160-800-150	156	160	197	na	800	150
160-950-150	156	160	200	na	950	150
160-1000-150	156	160	202	na	1000	150
160-1200-150 SILVER	156	160	204	na	1200	150
160-1200-200	156	160	193	na	1200	200
160-1300-200	156	160	200	na	1300	200
160-1400-200	156	160	212	na	1400	200
160-2000-200	156	160	222	na	2000	200

Legend

SD	Maximum outside diameter of the part to be covered *value is reduced by 6 mm when using flanges
ID	Inside diameter of spiral spring (±1 mm)
AD	Outside diameter of spiral spring (±2 mm)
Lh	Maximum extension length for horizontal installation position
Lv	Maximum extension length for vertical installation position
BB	Band width, corresponds to L_{min}
SILVER	sizes also in **DURASPRING Silver available**
na	not available

BAUKASTENRPINZIP

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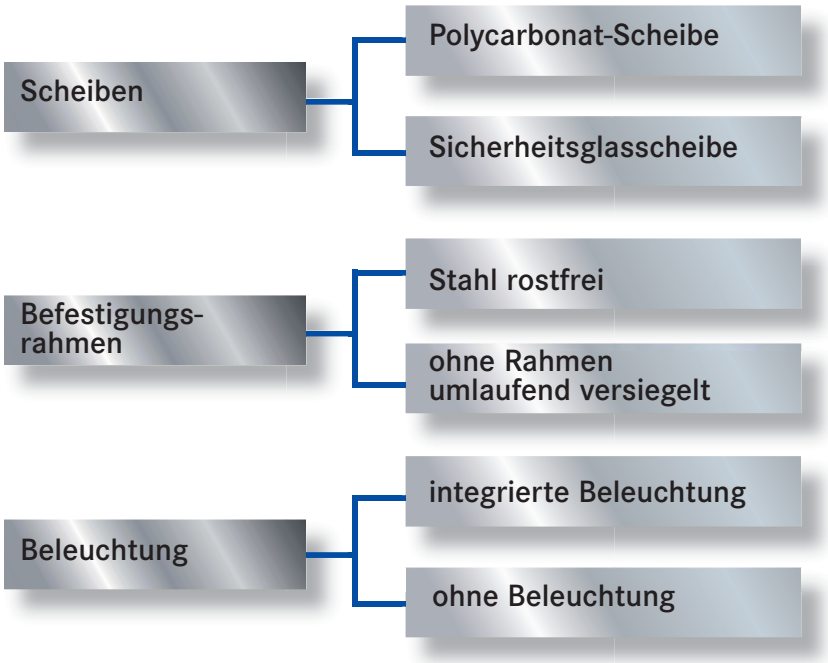
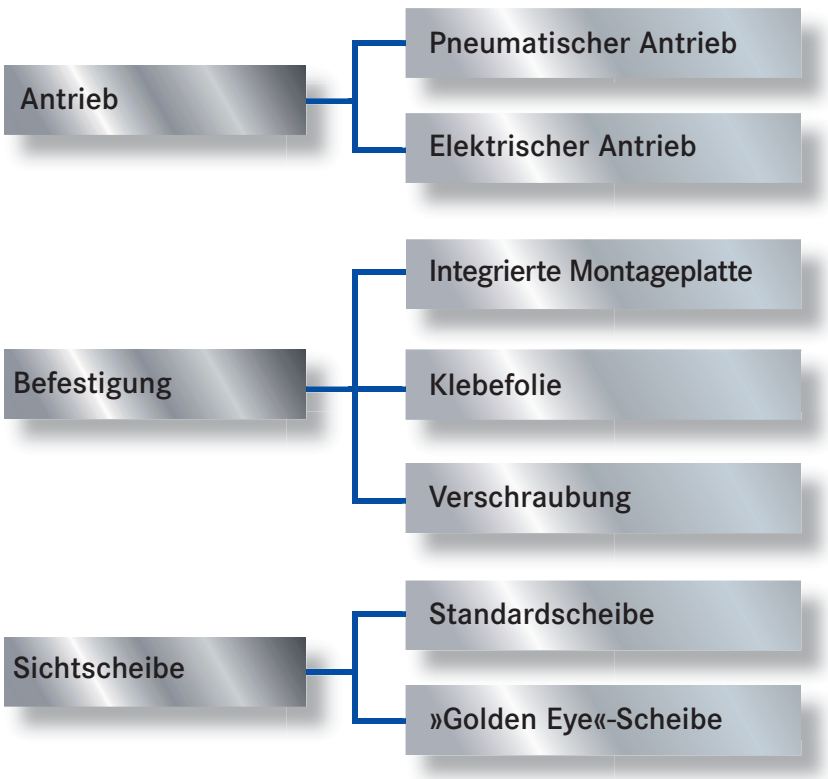


VISIPORT® DREHFENSTER



Maschinensicherheitsscheiben

Sicherheitsscheiben sind fangende Schutzeinrichtungen an Werkzeugmaschinen. Sie verhindern das Herausschleudern von Werkzeugen, Werkstücken und Bruchstücken aus dem Arbeitsraum der Maschine und schützen so Personen vor Verletzungen durch wegfliegende Teile.
Sichtscheiben an Werkzeugmaschinen, idealerweise in Kombination mit Drehfenstersystemen, sollen dem Bediener Einblick in die Maschine gewähren und so den Fertigungsprozess transparent machen.
Sind die Sichtscheiben im Flugbereich weggeschleuderter Teile angeordnet, müssen sie auch eine ausreichende Rückhaltefähigkeit aufweisen.

Als Material für Sicherheitsfenster eignet sich nach den gegenwärtigen Versuchen und Erkenntnissen Polycarbonat durch das Energieaufnahmevermögen am besten.

Anwendung	Schutz vor
Drehen	■ Gebrochene Spannbacken ■ Werkzeuge ■ gelöste Werkstücke
Fräsen	■ Heiße Späne ■ abgebrochene Werkzeugteile ■ gelöste Werkstücke
Schleifen	■ Bruchstücke berstender Schleifscheiben

Einsatzbereiche Maschinensicherheitsscheiben

Die Rückhaltefähigkeit einer 8 mm dicken PC-Scheibe entspricht in etwa einem 3 mm dicken St 12.03 Stahlblech.
Polycarbonat ist jedoch kratzempfindlich und wird durch die auf die Oberfläche prallenden heißen Späne und Funken beschädigt wird. Zudem ist Polycarbonat nur wenig beständig gegenüber der Einwirkung von Kühlschmiermittelstoffen, Fetten und Ölen, die zu einer Versprödung des Polycarbonats führen können. Hierdurch kann die Rückhaltefähigkeit innerhalb weniger Jahre deutlich abnehmen.
Durch äußere mechanische Einwirkungen beschädigte, z. B. Risse oder tiefe Kratzer aufweisende, oder aber durch chemische Einwirkungen blind gewordene Sichtscheiben müssen ausgetauscht werden, da ihre Schutzfunktion nicht mehr in vollem Umfang gewährleistet ist.
Die Rückhaltefähigkeit von Sicherheitsscheiben hängt nicht nur von der Stärke des verwendeten Polycarbonat-Materials ab, sondern auch von der Blechkonstruktion, in die sie eingebaut werden. Hierfür eignen sich am besten Klemm- und Klebeverbindungen sowie Rahmenlösungen. Um beim Aufprall von Teilen das Durchstoßen der Scheibe durch den Rahmen der Schutzeinrichtung zu verhindern, müssen die Verbindungen mit einer ausreichenden Überdeckung ausgeführt sein.

Maschinensicherheitsscheibe mit VA-Rahmen und montiertem VISIPORT® mit »Golden Eye«-Scheibe

Maschinensicherheitsscheiben von HEMA sind durch ihre Kapselung und Versiegelung gegen äußere Einflussfaktoren dauerhaft und wirksam geschützt. HEMA Maschinensicherheitsscheiben und Drehfenstersysteme wurden entsprechend der Normen für spanende Werkzeugmaschinen, DIN EN 23125 für Drehmaschinen, DIN EN 13128 für Schleifmaschinen sowie DIN EN 12417 für Bearbeitungszentren, konzipiert.

Maschinensicherheitsscheibe Standardausführung

Alle Angaben in mm, wenn nicht anderweitig gekennzeichnet. Änderung und Irrtum vorbehalten.

AUFPRALLPRÜFUNG

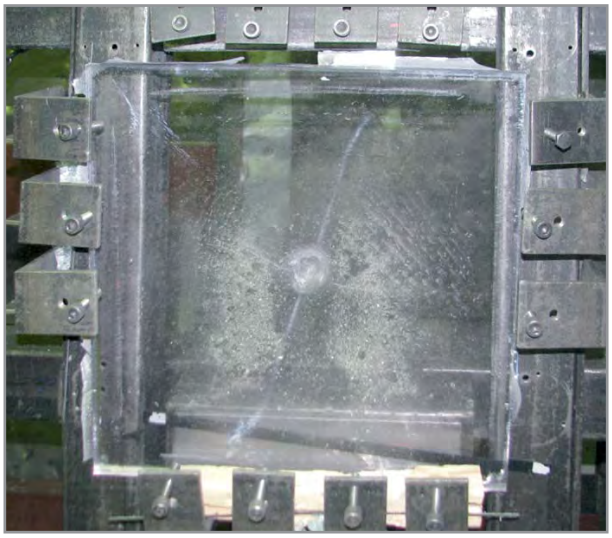
Maschinenschutzscheiben werden als fangende Schutzeinrichtungen eingestuft. Zur Überprüfung der Rüchhaltefähigkeit der Polycarbonatscheiben von HEMA wurden verschiedene Scheibenstärken und Aufbauvarianten - mit und ohne integrierte Visiportmontageplatte - am IWF der TU Berlin getestet.

Einspannbedingungen

Für den Beschusstest nach DIN EN 23125, Widerstandsklasse C3, wurden beispielsweise Scheiben mit 10 mm Einscheibensicherheitsglas und 15 mm Polycarbonat in Ausführungen mit und ohne Trägerrahmen für Visiport geprüft.

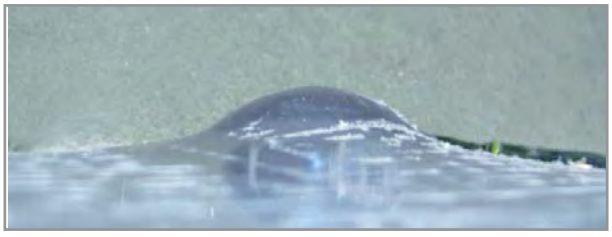
Prüfablauf

Die Polycarbonatscheiben in den Beschussrahmen eingespannt und mit einem Projektil von 2,5 kg beschossen.
Die Projektilgeschwindigkeit wird über den Arbeitsdruck der Anlage eingestellt. Die Messung der Geschwindigkeit erfolgt mit Hilfe einer doppelten Laser-Lichtschranke.



Eingespannte Polycarbonatscheibe nach Beschuss

Vers. Nr.	Prüf-objekt	Projektil-geschwindig-keit v [m/s]	Projektil-energie E [Nm]	Ergebnis, Bemerkungen
1	4e	80	8000	Bestanden
2	4b	80	8000	Bestanden
3	4c	80	8000	Bestanden
4	4f	80	8000	Bestanden



Ideale Auswölbung der Polycarbonatscheibe nach Beschuss

Quelle: IWF

Panoramaansicht des Prüflabors am IWF der TU Berlin. Im Vordergrund Beschleunigungsrohr mit Projektil (vergrößert).

Maschinensicherheitsscheiben

Material / Klassifizierung	A1	A2	A3	B1	B2	B3	C1	C2	C3
Projektilmasse in kg	0,625	0,625	0,625	1,25	1,25	1,25	2,50	2,50	2,50
Kin. Energie in Joule	320	781	2000	1562	2480	4000	3124	4960	8000
PC 6 mm	■			■					
PC 8 mm	■	■		■	■		■		
PC 10 mm	■	■	■	■	■		■	■	
PC 12 mm	■	■	■	■	■	■	■	■	
PC 15 mm	■	■	■	■	■	■	■	■	■
PC 19 mm laminiert	■	■	■	■	■	■	■	■	■

Beschussklassen nach EN DIN 23125 an Normprüffenstern in der Größe 500 x 500 mm
■ Mögliche Kombinationen (ohne Gewähr)

Einflussgrößen bei der Berechnung der Schutzklassen und Polycarbonatscheibendicke für Drehmaschinen nach DIN EN 23125

Kreisbahndurchmesser	größter Außendurchmesser des Spannbackenfutters bei der Maschine, das zum Einsatz kommt
Umdrehungsfrequenz der Spindel	maximale Drehzahl der Drehmaschine laut Hersteller
Spannbackenmasse	Gewicht einer Spannbacke (Klassen nach Normentwurf)

Spannzeug Ø (mm)	Umfangs-geschwindig-keit v (m/s)	Projektilmaße D x a (mm x mm)	Projektil-masse m (kg)	Aufprallge-schwindigkeit v (m/s), bis zu	Aufprall-energie (Nm), bis zu	Widerstands-klasse*	Mindest-dicke PC (mm)
bis 130	25	30 x 19	0,625	32	320	A1	6
	40			50	781	A2	6
	63			80	2.000	A3	8
130 bis 250	40	40 x 25	1,250	50	1.562	B1	6
	50			63	2.480	B2	8
	63			80	4.000	B3	12
über 250	40	50 x 30	2,500	50	3.124	C1	8
	50			63	4.960	C2	10
	63			80	8.000	C3	15

*A1 bis C3 = Normklassen nach DIN EN 23125; PK 1 bis 5 = Prüfklassen nach VDW

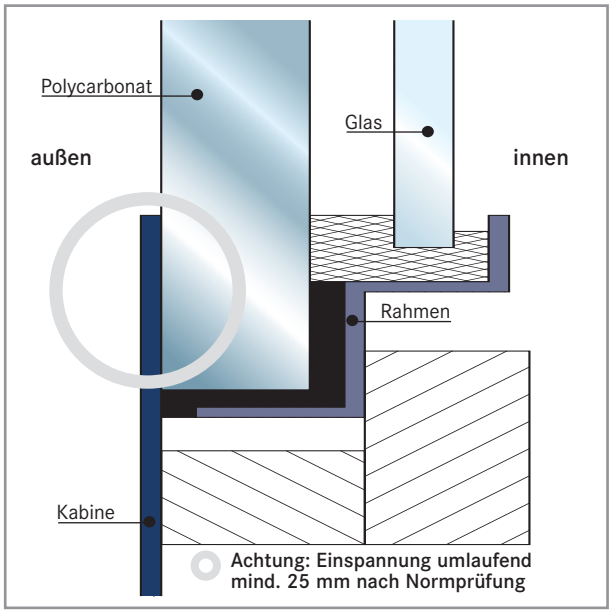
MASCHINENSICHERHEITSSCHEIBEN

Einflussgrößen bei Berechnung der Schutzklassen und PC Stärken für Fräsmaschinen nach DIN EN 12147

Kreisbahndurchmesser	größter Außendurchmesser der Werkzeugeinheit bei der Maschine, das zum Einsatz kommt
Umdrehungsfrequenz der Spindel	maximale Spindel-Drehzahl laut Hersteller
Werkzeugmasse	Gewicht der Werkzeugeinheit (lt Normentwurf nur für 100 g definiert)

Erforderliche Daten zur Emitllung von Aufprallenergie und Aufprallgeschwindigkeit

Projektil-Masse m (kg) m (kg)	Aufprallgeschwindigkeit vt (m/s), bis zu	Aufprallenergie (Nm), bis zu	Mindestdicke Polycarbonat (mm)
0,100	85	361	4
0,100	100	500	6
0,100	120	720	8
0,100	145	1.063	10
0,100	150	1.125	12
0,100	170	1.445	15
0,100	>170	>1.445	19



Schnittbild Maschinensicherheitsscheibe mit Metallrahmen

Ungeschützte Polycarbonatscheiben

Polycarbonatscheiben (PC) ohne Schutz können bereits nach wenigen Monaten im Einsatz teilweise oder vollständig ihre Sicherheitsrückhaltefunktion verlieren. Untersuchungen am BIA haben dies bewiesen. In systematische Testreihen wurde festgestellt, dass mit Kühlmittelstoffen benetzte Polycarbonat-Scheiben nach neunmonatiger Benetzung eine um bis zu 60% geringere Rückhaltekraft aufwiesen.

Maschinensicherheitsscheiben aus Polycarbonat sind dann als ungeschützt einzustufen, wenn sie nicht vollständig durch eine zusätzliche Glas- und PC-Beschichtung gekapselt und versiegelt sind. Diese Kapselung und Versiegelung können aber nur Spezialbetriebe sicherstellen.
Dennoch ist zu beobachten, dass vorwiegend Hersteller von Fräs-/Bohr-Bearbeitungsmaschinen mit geringeren Schutzklassenanforderungen und Scheibenstärken unter 6 mm Polycarbonat ihre Scheiben direkt beim Großhersteller des Flachmaterials kaufen. Diese Scheibenstärken entsprechen dann der Maschinenkonfiguration, sind aber »ungeschützt«, d.h. nicht gekapselt und versiegelt. Hilfsweise wird dann oft die doppelte PC-Stärke des Materials als zusätzliche Sicherheit eingebaut.
Polycarbonat-Maschinenscheiben sollten aber gegen chemische Einwirkungen geschützt werden, um langfristig ihre Sicherheitsfunktion zu gewährleisten

Die Sicherheitsvorschriften sowie die Haftungs- und Produktrisiken für Hersteller von Werkzeugmaschinen werden weiter verschärft. Der Austausch von »ungeschützten« Polycarbonat-Scheiben wird bereits nach zwei Jahren vom VDMA aufgrund der in den letzten Jahren nachgewiesenen Sicherheitsrisiken bei Maschinensicherheitsscheiben.
Die Sicherheitsfenster entsprechen den geltenden VDMA-Empfehlungen und gewährleisten eine Rückhaltsicherung von A1 bis C3.

Maschinensicherheitsscheiben

Import von Bearbeitungszentren aus außereuropäischen Drittländern können Sicherheitsrisiken darstellen, da oft die geforderten gesetzlichen Auflagen nicht erfüllt werden. Durch Nachrüstung dieser preisgünstigen Maschinen auf die notwendigen europäischen Sicherheitsstandards kann ein sicherer Betrieb ermöglicht werden.

Empfehlung für Scheibentausch

Angelehnt an die Empfehlungen der deutschen Berufsgenossenschaft BIA, dem Werkzeugmaschinenverband VDW und dem IWF der TU Berlin, Fachgebiet Werkzeugmaschinen und Fertigungtechnik, sollten Polycarbonatscheiben nach fünf Jahren ausgewechselt werden.
Bei Kauf von neuen oder gebrauchten Werkzeug-maschinen müssen die Käufer ausdrücklich auf das Alterungsproblem des Polycarbonates hingewiesen werden, z. B. in der Betriebsanleitung. Zudem wird empfohlen, das Einbaudatum der Polycarbonat-Scheibe auf der Scheibe zu kennzeichnen.
Beim Austausch und bei der Pflege der Sichtscheiben müssen die Einbau-, Montage- und Pflegehinweise des Herstellers unbedingt beachtet werden. In den folgenden Fällen ist ein sofortiger Austausch dringend zu empfehlen:

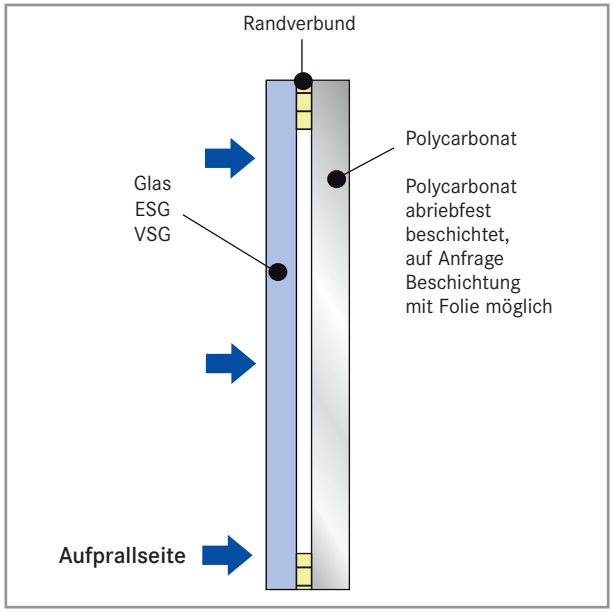
- Plastische Verformungen (Beulung) durch Aufprall, Risse in der Scheibe
- Beschädigung der Randabdichtung
- Bei eingedrungenem Kühlschmierstoff im Verbundaufbau
- Bei zerstörter oder beschädigter Schutzscheibe (auch kratzfeste Splitterschutzfolie) auf der Arbeitsraum- oder Maschinenseite

HEMA Sicherheitsscheiben

- Ausschließliche Verwendung von geprüften Qualitätsscheiben aus Polycarbonat mit einer leistungsfähigen Oberflächenbeschichtung als Schutz gegen Chemiekalien, Abrieb und Verkratzung, optional mit Folie
- Einsatz PC-Scheiben namhafter Hersteller
- PC-Scheiben in allen marktgängigen Stärken lieferbar Grundmaterial sind PC-Platten von 5 bis 15 mm Stärke
- Schutz der PC-Scheiben auf der Maschineninnenraumseite zusätzlich mit Einscheiben- oder Verbundscheibensicherheitsglas
- Der Scheibenaufbau kann entsprechend der Anforderung und Einsatzbereich individuell aus Polycarbonat mit abriebfester Beschichtung und Glas angelegt werden.
- Einsatz von Verbundglasscheiben, bei Beschädigung weisen diese durch ihre sehr geringe Zersplitterung ein geringeres Verletzungsrisiko und weniger Reinigungs- und Standzeiten in der Maschinenkabine auf.
- Scheibenkanten sind diffusionsdicht und kühlmittelresistent versiegelt, auf Wunsch zusätzlich mit Rahmen aus rostfreien Stahl montagefertig lieferbar.
- Die Scheiben und Komponenten werden nach DIN EN 23125, Beschussklassen A1 bis C3 im Beschussinstitut IWF Berlin auf ihr Rückhaltevermögen getestet und entsprechen den Maschinenschutzforderungen EN/TC143/WG3.
- Auf die gekapselte und versiegelte Sicherheitsscheibe kann eine mindestens fünfjährige Rückhaltegarantie gegeben werden (gemäß den Garantiebestimmungen).
- Die Integration von modernen Drehfensterlösungen wie VISIPORT® ist ohne Sicherheitsrisiko und zusätzlichem Montageaufwand möglich.

Aufbau von Maschinensicherheitsscheiben

Für vielen Anwendungsbereiche bietet sich die bewährte Konstruktionsausführung »HEMA WINDOW« an.
Die Sicherheitsscheiben können optional mit rostfreiem Stahlrahmen, auch mit Stufungen und Schutzfolien ausgeführt werden. Auch die Ausstattung mit integrierter LED-Beleuchtung ist möglich (sh. Seite 74).



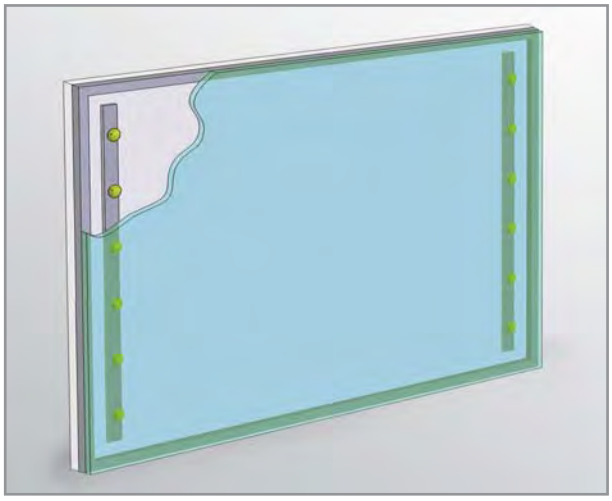
Aufbau Maschinensicherheitsscheibe »HEMA WINDOW«

Nach Berechnung der Beschussklassen und unter Berücksichtigung der individuellen Platzverhältnisse werden die Polycarbonatstärke und der Fensteraufbau definiert. Das HEMA Chargennummern-System garantiert eine nachverfolgbare Qualität und die bequeme Nachbestellung beim Scheibentausch.

Kennzeichnung der Scheiben

MASCHINENSICHERHEITSSCHEIBE MIT INTEGRIERTER BELEUCHTUNG

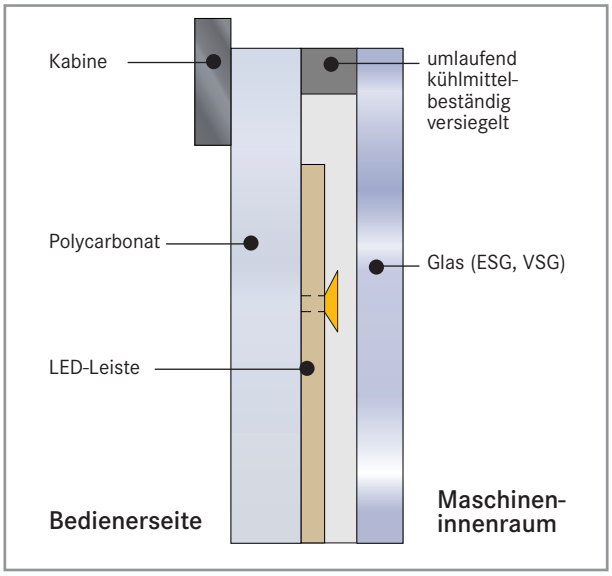
Maschinensicherheitsscheiben ermöglichen die Kontrolle der Arbeitsvorgänge im Innenraum der Werkzeugmaschine, eine zusätzliche Beleuchtung ist fast immer erforderlich.
Abhängig vom zur Verfügung stehenden Bauraum und der Position der Beleuchtung bilden sich an dieser häufig Ansammlungen von Verschmutzungen, wie z. B. Spänenestern.



Maschinensicherheitsscheibe mit integrierter Beleuchtung

Eine optimale Lösung vereint die Sicht in den Innenraum mit der passenden Beleuchtung - die Antwort hierauf sind die Sicherheitsscheiben HEMA Window mit Beleuchtung - die Integration von LED-Technik in einen Maschinensicherheitsscheibenverbund, zwei bewährte Systeme in einem kompakten System. Die variabel zu platzierende LED-Leisten in der Maschinensicherheitsscheibe ermöglichen eine sehr flexible Ausleuchtung des Maschineninnenraums, die Bildung von Spänenestern an verbauten Maschinenleuchten im Maschineninnenraum gehört durch dieses System der Vergangenheit an. Durch die bewährte, umlaufende kühlmittelbeständige Abdichtung der Maschinensicherheitsscheibe sind die LEDs vor Verschmutzungen und Feuchtigkeit geschützt.

Maschinensicherheitsscheibe mit LED-Beleuchtung



Aufbau der Sicherheitsscheibe mit integrierter Beleuchtung

Vorteile HEMA Windows mit integrierter Beleuchtung:

- Kompakte Systemlösung
- Flexible Ausleuchtung des Maschineninnenraums
- Bewährte LED Technologie
- Vermeidung von Spänenestern
- Betriebsspannung 24V
- Nachträgliche Ausstattung von Maschinen im Retrofit

Ausführungsmöglichkeiten

Betriebsspannung	24VDC
Nennstromaufnahme	270mA, 540mA, 800mA, 1100mA, 2160mA
Leistung	6W / 12W / 18W / 24W / 48W
Abstrahlwinkel	ca. 120°
Lichttemperatur	5700K
Anschluss	M12

Ein durchdachtes Einschubsystem ermöglicht den Erhalt der LED-Beleuchtungsleisten bei beschädigter Maschinensicherheitsscheibe.
Die »SECRET« LED-Beleuchtungssleisten sind auch **separat für andere Anwendungen erhältlich**, gern berät Sie unser Serviceteam.

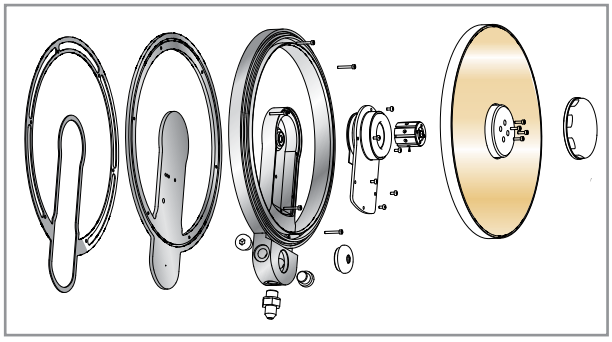
HEMA »SECRET« LED-Beleuchtungsleisten

VISIPORT® Drehfenster

VISIPORT® Drehfenster sind für alle Arten von CNC-Hochgeschwindigkeitsfräs- und Drehmaschinen sowie Bearbeitungszentren geeignet. Der Einbau kann in der OEM-Erstausrüstung als auch problemlos im nachträglichen Einbau erfolgen.
Die Arbeitsergonomie und Produktivität wird durch die großzügige Sicht auf den tatsächlichen Bearbeitungsvorgang in der Maschine ohne Sichtbeeinträchtigung durch Kühlmittel oder Späne erheblich verbessert.

VISIPORT® 220.C2

Das leichte Gewicht, die einfache Montage und die aufgrund modularer Bauweise optimale Wartung reduzieren die Kosten für Montage und Wartung. Zusätzliche elektronische Sicherheitsfeatures vervollständigen den perfekten Eindruck.



Schematischer Aufbau des VISIPORT®

Auch sind Komplettlösungen - Maschinenscheiben mit bereits eingebautem VISIPORT® Drehfenster verfügbar, hier entsteht kein zusätzlicher Montageaufwand.
Die Systeme können so vorkonfiguriert werden, dass sie lediglich noch eingebaut und angeschlossen werden müssen.
Alle Systeme erfüllen die jeweils notwendigen Sicherheitsanforderungen.

Vorteile der Visiport-Drehfenster

Die VISIPORT® Drehfenster stehen für eine aktive Sicherheitsvorsorge, sie gewährleisten dem Maschinenbediener einen direkten Blick auf die Vorgänge in der Maschine.
Das Gefahrenpotential für schwere Umfälle durch Umgehen der Sicherheitsschaltung der Maschine wird somit reduziert.

Direkter Blick auf Bearbeitungsvorgang in der Maschine

Dieses ist besonders hinsichtlich Produkthaftung und Sicherheitsvorschriften zu beachten.

Einbau und Befestigung

Durch den Einbau des Visiport® wird die Maschinenschutzscheibe nicht beschädigt, Bohrungen sind nicht erforderlich. Das Visiport® wird entweder auf der geklebten Montageplatte verschraubt oder direkt auf die Scheibe geklebt. Bei Verwendung der Montageplatte wird ein schneller Austausch der VISIPORT®-Einheit möglich. Das VISIPORT® kann vertikal und bis 30° geneigt zur Vertikalen eingebaut werden.
Der Einbau kann sowohl in die Bedienertür als auch in ein »festes« Fenster erfolgen. Durch die flache Bauweise ist eine Anpassung an unterschiedlichste Tür- und Fenster-Ausführungen problemlos möglich. Bei ausreichend Zwischenraum kann auch eine Befestigung an Schiebetüren erfolgen.
Das VISIPORT® kann auf verschiedene Arten befestigt werden

- Klebebefestigung
- Verschrauben an Sicherheitsscheibe
- Verschraubem an integrierter Montageplatte

Klebebefestigung

Die einfachste Montage des VISIPORT® erfolgt per Hightech-Klebeband (Klebstoffträgermaterial: geschlossener Acrylzellschaum). Dazu wird die Klebefolie auf der Rückseite entfernt und das VISIPORT® an die gewünschte Position der sorgfältig gereinigten Scheibe geklebt. Die normale Austrock-nungszeit beträgt 72 Stunden.
Durch eine Vakuumpumpe (optional lieferbar) oder durch Einbringen von Wärme kann die Trocknungszeit auf ca. ein bis zwei Stunden reduziert werden, hierbei werden ca. 95% der Klebekraft erreicht. Es ist sehr schwierig, von einer vorher ausreichend gereinigten Oberfläche das VISIPORT® von der Klebefläche (Glas- oder PC-Fenster) abzutrennen.
Die Verbindung ist extrem stark und nur mechanisch lösbar, es muss kein Loch in die Scheibe geschnitten werden. Das Ausmessen und Einpassen entfällt, eine schnelle und einfache Inbetriebnahme ist gewährleistet.

VISIPORT® DREHFENSTER

Schraubverbindung

Bei der Direktverschraubung werden sechs Durchgangslöcher in die Polycabonat-Scheibe gebohrt. Die Rückhaltefähigkeit der Scheibe wird hierdurch jedoch geschwächt. Die Abdichtung erfolgt kabinenseitig durch einen im Lieferumfang enthaltenen O-Ring. Das VISIPORT® wird bedienerseitig durch Verschraubung und Klemmflansch befestigt.

Integrierte Montageplatte

Die bereits in die Maschinensicherheitsscheibe integrierte Montagescheibe ist die einfachste Befestigungsmöglichkeit. Das VISIPORT® muss nur noch mittels der beiligenden Schrauben befestigt und angeschlossen werden.

Maschinensicherheitsscheibe mit integrierter Montageplatte

Ent- und Belüftung des VISIPORT®

Das VISIPORT® besitzt ein patentiertes Belüftungssystem. Die erforderliche Luftmenge zur Innenbelüftung wird durch den separat erhältlichen Schlauch gewährleistet. Eine konstante Luftzirkulation ist wichtig, die Entlüftung sollte immer gewährleistet sein. Der Schlauch schützt den Kabelbaum zwischen der VISIPORT®-Einheit und der Anschlussbox.

Antrieb

Beim Antrieb des VISIPORT® kann zwischen dem elektrisch betriebenen VISIPORT® 220.C2 und dem pneumatisch betriebenen DiscAir 180 Turbo gewählt werden.

Kühlmittel

Das VISIPORT® eignet sich am besten für Kühlmittel auf Wasserbasis oder dünnflüssige mineralische Öle, andere Öle auf Anfrage. Für ölhaltige Kühlmittel empfiehlt sich zudem die Verwendung einer »Golden Eye-Spezialscheibe« mit spezieller Beschichtung.

»Golden Eye«-Spezialscheibe

Aluminium- und Magnesiumwerkstücke erzeugen im Zerspanungsvorgang Späne, die sich wie ein Film auf Maschinenscheibe und Drehfenstern niederschlagen und bereits nach kurzer Zeit zur Erblindung der Scheibe führen. Für diese Anwendungsbereiche und für ölhaltige Kühlmittel empfiehlt sich die Ausrüstung des VISIPORTs® mit der »Golden Eye«-Drehscheibe.

Durch die spezielle Beschichtung weist diese Drehscheibe eine goldfarbene Tönung auf. Im umfangreichen Serientest über 18 Monate unter härtesten Bedingungen in der mechanischen Fertigung von Boing in Seattle hat sich diese Beschichtung bewährt.

Die elektrisch angetriebenen Modelle VISIPORT® 180.B5 220.B5 und 220.C2 können problemlos mit dem »GoldenEye« nachgerüstet oder bereits zusammen mit der Haupteinheit bestellt werden. Das DiscAir 180 Turbo ist serienmäßig mit der »Golden Eye«-Drehscheibe ausgerüstet.

Produktqualität

Alle VISIPORT®-Modelle haben eine werkseitige Garantiezeit von zwölf Monaten, ausgeschlossen hiervon sind typische Verschleissteile.

Die Grundbauteile sind aus hochwertigem Aluminium, die Kugellager sind auf Lebensdauer geschmiert und austauschbar. Der flexible Metallschlauch oder das Metallrohrsystem sind temperaturbeständig bis 300°C.

Die Elektronikbauteile wurden speziell für VISIPORT® entwickelt. Alle Bauteile und Komponenten des VISIPORT® werden auf Materialqualität und Lebensdauer geprüft.

Modell	VISIPORT® 220.C2	VISIPORT®DiscAir 180 Turbo
erforderliche Spannung	24V (± 1V), mind. 5A Dauerlast	-
erforderlicher Luftdruck	-	5,3 - 5,8 bar
Nenndrehzahl	2.235 rpm	4000 rpm (bei 5,5 Bar)
Luftverbrauch	-	38 l/min
Schallpegel	-	79 dB (ohne Einhausung, Abstand 3 m)
Außendurchmesser	253 m / 299 mm	201,7 / 236,2 mm
Sichtfeldgröße	215 mm	175 mm
Gewicht	2,1 kg	0,7 kg
Aufbauhöhe	32,5 mm / 43 mm	29,6 mm / 44,9 mm
Stärke der Drehscheibe	3 mm	2 mm
Golden-Eye-Scheibe	optional	Serienausstattung

VISIPORT® 220.C2

VISIPORT® 220.C2

- Maschinenseitig angebrachte Drehscheibe, die durch die hohe Drehgeschwindigkeit (> 2.235 Upm) eine klare Sicht auf den Bearbeitungsvorgang gewährt
- Integrierte, geschützte Steuerungselektronik mit Schutz vor Verpolung der Betriebsspannung und Überspannung, Thermoschutz vor Überhitzung (150°C)
- Antrieb: integrierter bürstenloser Gleichstrommotor, 24 V (± 1V) DC, mindestens 5 A Dauerbelastung der Stromversorgung erforderlich
- CE-Niederspannungsrichtlinien werden erfüllt
- geringes Gewicht, nur ca. 2,1 kg
- integrierter Späneschutz mit speziell gestaltetem Labyrinthsystem
- ausgewuchtete Drehscheibe mit chemisch gehärtetem, 3 mm starkem Glas
- optional mit Plasmabeschichtung »Golden Eye«

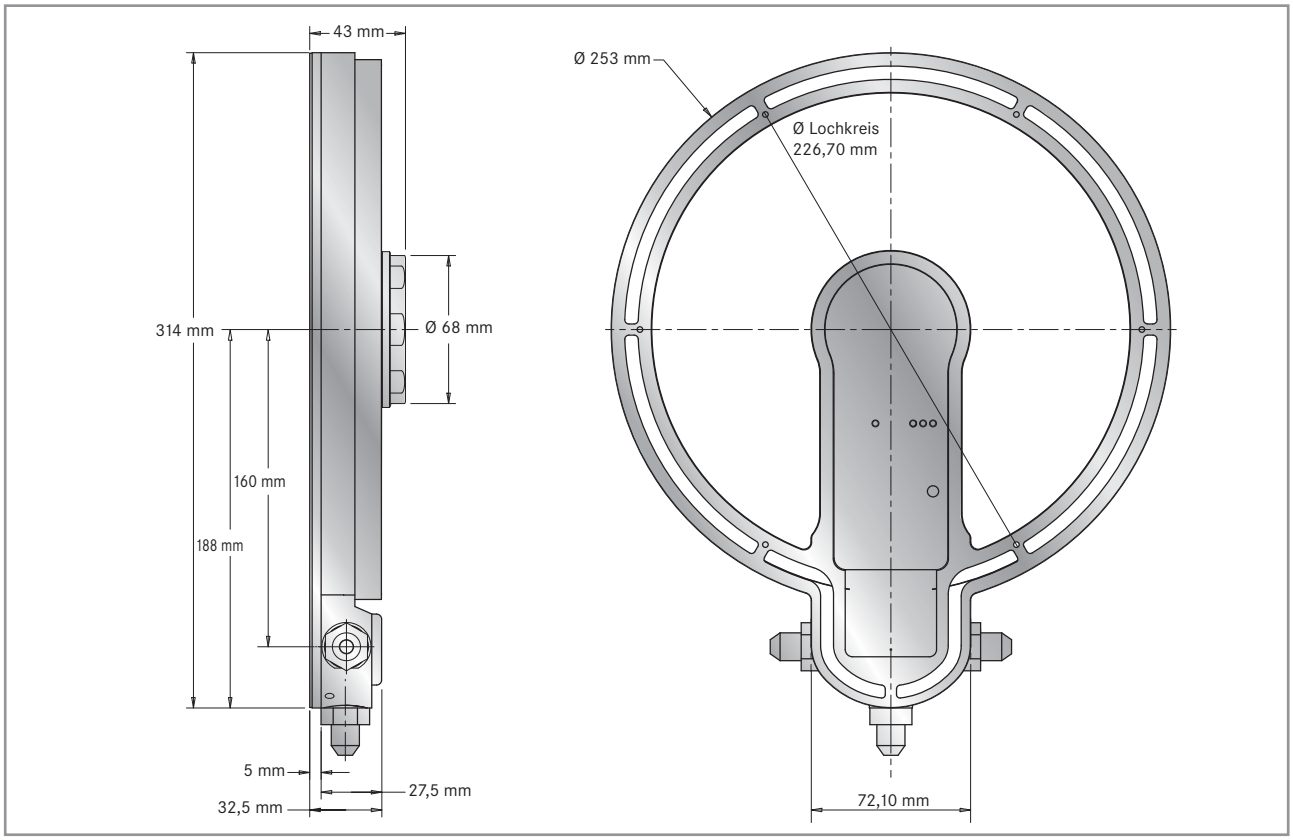
Anschluss

Das VISIPORT® 220.C2 verfügt über drei Anschlussöffnungen an der Gerätebasis:

- Anschlussverschraubung Basis zu FLEX-Metalldrahtschlauch
- FESTO-Schnellanschluss für FESTO-Schläuche 8 x 1,25 mm
- EO-Rohranschluss für Metallrohre mit Ø 8, 10 oder 12 mm
- Rohrverschraubung EH-PG09 zu Kabelschutzschlauch EW-PA-M12/P9

Übersicht Gerätevarianten Modell VISIPORT® 220.C2

FDX	Grundmodell zur Direktverschraubung auf Polycarbonatscheiben
FMX	Grundmodell mit VHB-Klebeband auf Basisgerät
FVX	Grundmodell mit VHB-Klebeband auf separater Montageplatte für den einfachen Austausch
HM	Grundmodell mit separater Steuerbox, VHB-Klebeband auf Basisgerät
HV	Grundmodell mit Steuerbox und VHB-Klebeband auf separater Montageplatte zum einfachen Austausch



Alle Angaben in mm, wenn nicht anderweitig gekennzeichnet. Änderung und Irrtum vorbehalten.

VISIPORT® DiscAir 180 Turbo

VISIPORT® DiscAir 180 Turbo

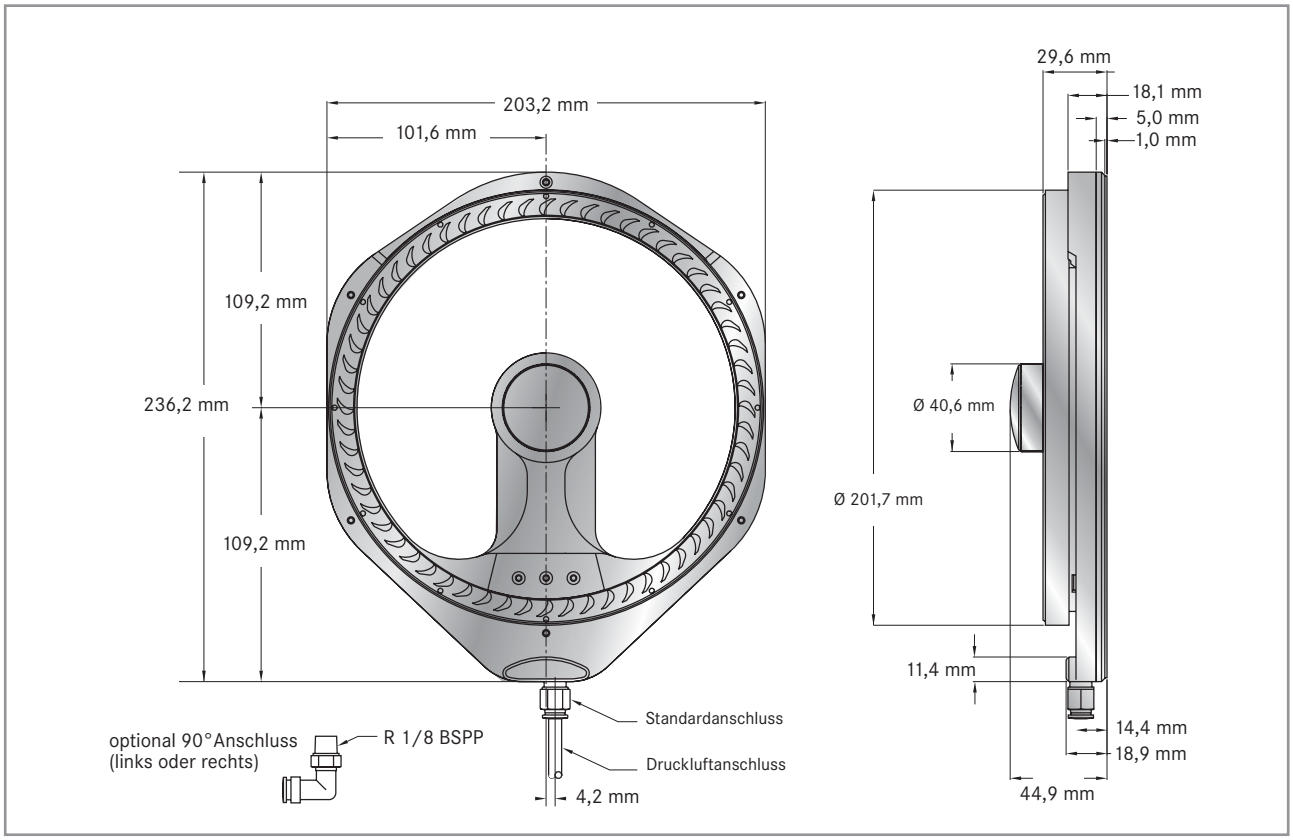
- Maschinenseitig angebrachte Drehscheibe, sie gewährt durch die hohe Drehgeschwindigkeit von über 4000 Umdrehungen pro Minute eine klare Sicht auf den Bearbeitungsvorgang
- Antrieb durch gereinigte Druckluft, kein elektrischer Anschluss erforderlich
- Geeignet für den Einsatz bei intermittierender Kühlmittelbesprühung
- Rotorlagerung mit Präzisionskugellagern
- Ausgewuchtete Drehscheibe mit gehärtetem Glas
- Anschluss Luftschlauch über Steckverbindung
- Patentierter Antriebsring mit hoher Effizienz
- Luftverbrauch 38 l/min

Anschluss

Das DiscAir Modell wird mit Druckluft betrieben, die an fast jeder Maschine bzw. Werkstatt verfügbar ist.
Das DiscAir wird einfach an die Druckluftversorgung angeschlossen und kann sofort und ohne aufwendige Elektroverkabelung in Betrieb genommen werden. Konstruktions- und antriebsbedingt weist das VISIPORT® DiscAir-Modell ein lauteres Betriebsgeräusch auf als das sehr leise elektrische VISIPORT®.
Ein durchdachtes Luftzirkulationssystem sowie ein hochpräziser Herstellungsprozess reduzieren die Geräuschbelastung enorm, die gesetzlichen Richtlinien werden erfüllt.

Bei geschlossener Kabine ist gegenüber den Laufgeräuschen der Maschine kaum ein Unterschied feststellbar.
Der Luftaustritt am DiscAir wirkt gleichzeitig unterstützend als Schutz gegen das Eindringen von Kühlmittel und Spänen

Das VISIPORT® DiscAir Modell zeichnet sich durch sein ausgezeichnetes Preis-/ Leistungsverhältnis aus, ideal als Einstieg in die Drehfenstertechnologie.



Material recommendation

Material	suitable for bellows	suitable for Roller	waterproof	resistant to emulsion (oil)	resistant to chemicals	resistant to sparks, hot chips	self-extenguishing	Colour	Thickness	Width	recommended temperature range	basis of material
ERA 7810	■	■	■	■	□	□	□	black	0.39 mm	1500/2150 mm	-15°C to +100°C	polyester
ERA 7812	■	■	■	■	□	□	□	beige	0.32 mm	1500 mm	-15°C to +100°C	polyester
ERA 7815	■	■	■	■	□	□	□	black	0.23 mm	1500/2150 mm	-15°C to +100°C	polyester
ERA 386	■	■	■	■	□	□	□	grey	0.22 mm	1500 mm	-15°C to +100°C	polyester
PUR 018	■	□	■	□	□	□	□	black	0.21 mm	1230 mm	-40°C to +120°C	polyester
OZ PUR S	■	■	■	■	□	□	□	black	0.40 mm	1500/2150 mm	-30°C to +70°C	polyester
Nylon PU	■	□	■	■	□	□	□	black	0.22 mm	1500 mm	-40°C to +120°C	polyamide
OZ 23	■	□	■	■	□	□	□	black	0.25 mm	1550 mm	-15°C to +70°C	polyester
OZ 35	■	□	■	■	□	□	□	black*	0.40 mm	1550/2150 mm	-15°C to +70°C	polyester
OZ 45	■	□	■	■	□	□	□	black	0.45 mm	1550 mm	-15°C to +70°C	polyester
PUR PTF	■	■	■	■	■	□	□	black	0.33 mm	1500/2150 mm	-15°C to +180°C	polyester
PUR Teflon 027	■	■	■	■	■	□	□	black	0.30 mm	1400 mm	-20°C to +250°C	diverse
PUR Teflon 045	■	■	■	■	■	□	□	black	0.45 mm	1400 mm	-20°C to +250°C	diverse
Preotex 030	■	□	■	□	□	■	■	black	0.35 mm	1500 mm	0°C to +400°C	aramid/kevlar
Preotex 035	■	■	□	□	□	■	■	black	0.40 mm	1500 mm	0°C to +400°C	aramid/kevlar
Preotex 060	■	■	■	□	□	■	■	black	0.60 mm	1500 mm	0°C to +400°C	aramid/kevlar
Preotex SP-PU	■	■	■	■	□	■	■	black	0.37 mm	1500 mm	-30°C to +160°C	diverse
Awning cloth	■	■	■	□	□	□	□	black*	0.60 mm	1500/3000 mm	-10°C to +80°C	polyester
GN 807	■	■	■	■	□	□	□	black/grey	0.60 mm	1450 mm	-40°C to +80°C	polyamide
TPU 07	■	■	■	■	□	□	□	black	0.70 mm	2050 mm	-30°C to +80°C	polyester
TPU 11	□	■	■	■	□	□	□	black	1.10 mm	1600 mm	-30°C to +80°C	polyester
Neoprene 2003	□	■	■	□	□	□	□	black	0.5 mm	1500 mm	-20°C to +70°C	polyester

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■ suitable □ not suitable *available in yellow, blue, grey and white upon request.

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