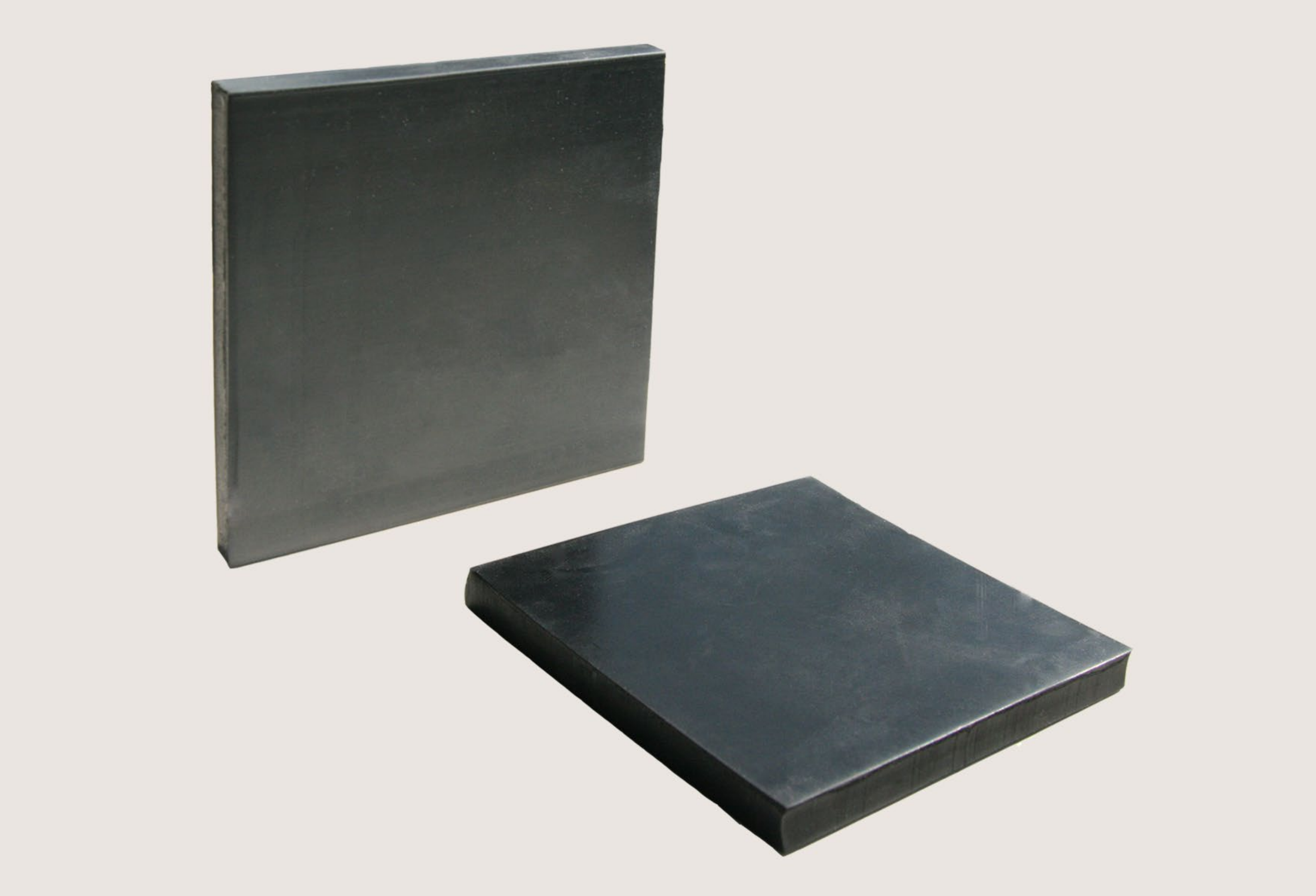
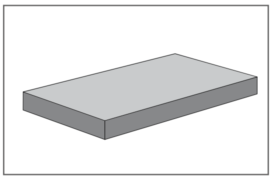
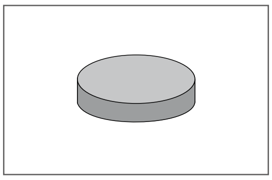
LASTO® – Elastomeric bearings

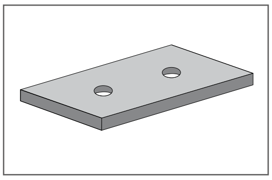


LASTO®BLOCK F

Unreinforced deformation bearings







Applications and key data

Applications

LASTO®BLOCK F is an unreinforced elastomeric deformation bearing which is used to transmit vertical and horizontal loads without constraint forces. It also accommodates longitudinal and transverse displacements and rotations of the structure's bearing surfaces. Thanks to the use of high-quality elastomer mixes, it offers excellent durability and requires no maintenance. It can be used in both civil and structural engineering, and in particular for bridges and buildings.

LASTO®BLOCK F can also be used as a thermal insulation bearing or to reduce the transmission of structure-borne noise under high loads. The elastomers used do not absorb water and can thus act as a barrier to dampness under highly loaded structural elements.

Material properties

LASTO®BLOCK F is available in two varieties (i.e. materials).

For standard applications, LASTO®BLOCK F NR, of natural rubber, is used. For use in exposed conditions and for heightened demands in relation to chemical resistance, LASTO®BLOCK F CR, of chloroprene rubber, is recommended.

Both varieties are very similar with respect to their mechanical properties, and can thus be designed on the same basis.

Permissible loading depends on shape ….

Under vertical pressure, the side walls of an elastomeric bearing bulge outwards (see Figure 2). The extent of this distortion depends on the ratio between side length and thickness. The greater this ratio (i.e. the greater the shape factor S), the stiffer the bearing will be (see Figures 1 and 5).

… and on the connecting structures

The bearing capacity of an elastomeric bearing is strongly dependent on the surfaces of the structural elements above and below. Against polished steel, the low friction that arises results in lower stiffness and thus lower bearing capacity than would arise against concrete. The design graphs and tables thus conservatively show the permissible loading and compression strain against a polished steel surface.

Function

- Transmission of vertical loads and accommodation of horizontal movements and rotations

Permissible pressure

- ≤ 20 N/mm² (at service level)

Shape and dimensions

- Any, up to 1.20 x 1.20m

Bearing type

- Deformation bearing, unreinforced

Materials

Natural rubber	(NR)
Chloroprene rubber	(CR)
Density	approx. 1'250 kg/m³
Hardness	NR: 74 ± 5 IRHD CR: 74 ± 5 IRHD
Thermal conductivity	0.26W/m · K
Ozone resistance	Level 0 No cracks

Performance under permanent loading

Elastomers deform under permanent loading, even without increasing load. This so-called creep deformation continues for somewhat more than 100 days. The deformation that results from creep has already been accounted for in all diagrams (except diagram 1).

Contents

Cover picture:

Product: LASTO®BLOCK F elastomeric bearing

Bearing design

Design approaches

A – Simplified procedure

Conditions for use

- Rectangular bearing without holes
- Only subjected to vertical loading

Step 1 - Decide on preferred dimensions and calculate the average pressure

Step 2 - Check the permissible pressure from Table 1

Step 3 - Check the edge clearance according to Figure 2

B – Procedure for all other cases (Formulae: see pages 4 und 5):

Comments

- Vertical bearing deformation should not exceed the maximum permissible compression strain $\varepsilon_z \leq 30\%$
- Rotation or shear deformation of the bearing may arise
- Other bearing shapes or bearings with holes may be designed using this procedure

Step 1 – Establish the bearing loading and the movements it must allow from the structural design calculations (see Figure 3):

- maximum vertical load F_z
- Rotations α_a and α_b
- Horizontal movement (by deformation) $v_{x,y}$

Step 2 – Choose bearing dimensions (side lengths, holes)

Step 3 – Calculate the shape factor S (see Figure 4)

- Determine the footprint area A (not including the area of any holes)
- Calculate the total area of unloaded side surfaces, A_s
- Calculate the shape factor, $S = A / A_s$
- Note the limitations on page 4

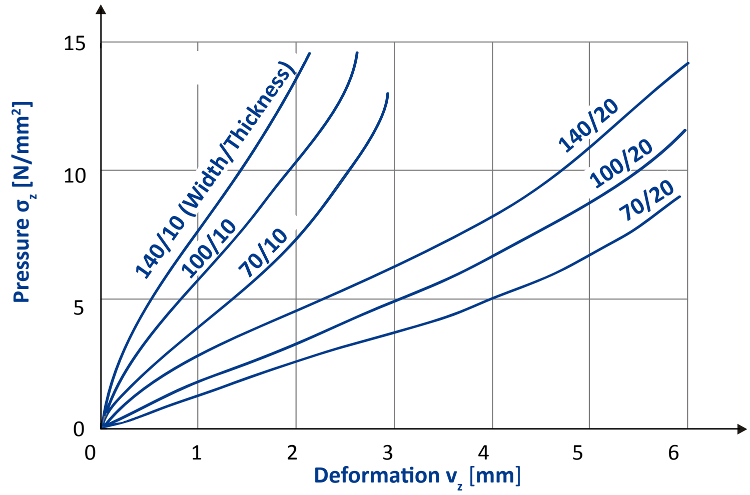
Step 4 – Calculate vertical deformation

- Pressure $\sigma_z = F_z / A$
- Vertical deformation $v_z = \varepsilon_z \cdot t$

  (ε_z from Figure 5)

  $10\% \leq \varepsilon_z \leq 30\%$, see *[7]*
- Check that the deformation will be allowed by the adjacent structural elements (that an adequate gap remains)

1



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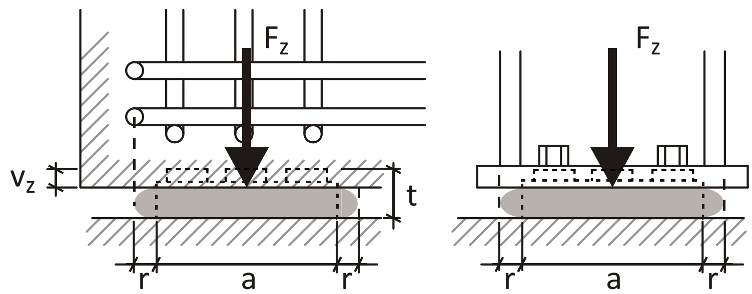


r = 0.5 t + 0.05 a

1 Deformation-Pressure graph based on tests with side lengths (a) of 70, 100 und 140 mm and thicknesses (t) of 10 and 20 mm, against polished steel plates (without consideration of creeping)

2 Schematic illustration of bearing deformation; bulging outwards of the bearing's sides must remain within the reinforced area / base plate of the connecting structure

Step 5 – Check rotation

- Remaining thickness $t_{rest} = (1 - \varepsilon_z)\, t$
- Check the rotation condition according to *[9]* and *[10]*
- Check whether adjacent structural elements collide as a result of rotations and vertical deformations

Step 6 – Check resistance to sliding

- Calculate the coefficient of friction according to *[11]*
- Check the horizontal deformation $v_{x,y}$ according to *[13]*

Note

In the case of structures which may experience significant redistribution of loading as a result of small bearing deformations, mageba's specialists should be consulted.

Design concepts

Basic concepts

Shape factor

The impact of bearing geometry is considered by the shape factor, S. This is defined as the ratio between the area of the loaded surface and the sum of the areas of the freely deformable sides. Side surfaces which cannot deform freely due to adjacent structural elements (e.g. the side of a bolt hole with little clearance to the bolt) are not considered.

Collision of structural elements

The bearing design ensures that the deformed bearing retains adequate thickness t_{rest} to prevent a collision between structural elements. The minimum remaining thickness allowed is 70 % of the nominal thickness, t.

Horizontal deformation and rotation

The design also ensures that the bearing will not slide as a result of horizontal deformation, v_x, and that in the case of rotation, α, of the supported structure, only a limited gap will open up between it and the bearing.

Applicability

This design procedure applies within the following limitations:

a) Dimensions

Shape factor: $0.5 < S < 5$ [5]

Smaller side lengths b:

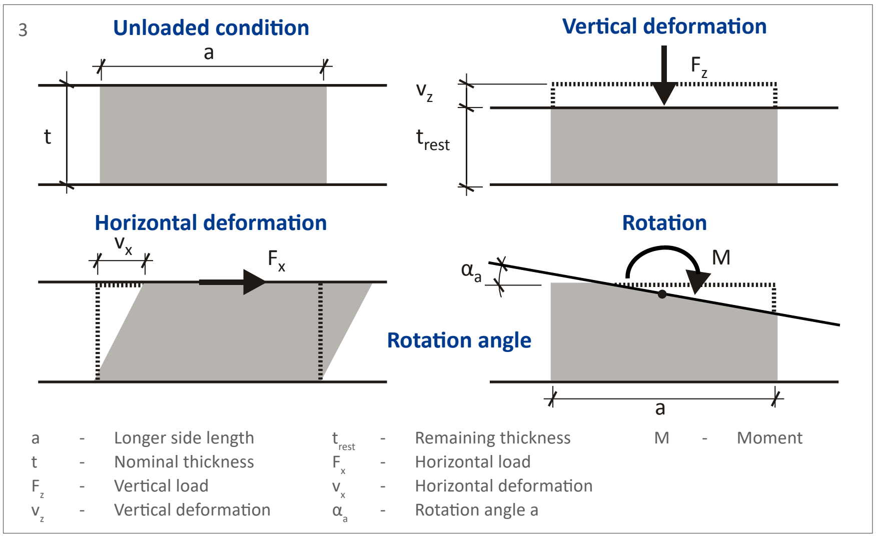
$4 < b/t < 25$ or $4 < D/t < 25$ [6]

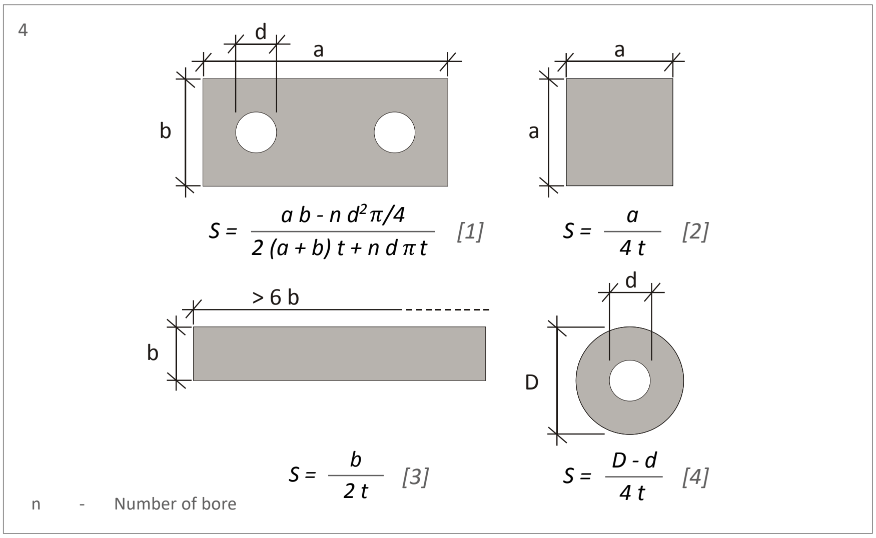
Side lengths of half the lower limit are permissible, as long as the supported structural element cannot move horizontally.

b) Deformations

Remaining thickness $0.9 \cdot t \geq t_{rest} \geq 0.7 \cdot t$ [7]

Horizontal deformation $v_x \leq 0.7\ t$ [8]





Limitation of rotations

Rotations are to be limited as follows, depending on vertical deformation and thus the remaining thickness t_{rest}:

$$t - t_{rest} - \frac{(a \cdot \alpha_a + b \cdot \alpha_b)}{3} \geq 0 \qquad [9]$$

$$\alpha_a < 0.9 \cdot \frac{t}{a} \text{ and } < 10\ \% \qquad [10]$$

where t = nominal thickness, t_{rest} = remaining thickness as shown in Figure 3, a and b are the side lengths, and α_a and α_b are the angles of rotation about the sides with lengths b and a.

3 Types of bearing deformation

4 Shape factor S, depending on footprint area and thickness t; the side surfaces of bolt holes with little clearance to the bolt must not be considered. The area of bolt holes which account for less than < 10% of the total footprint area can be ignored.

Design concepts

Check of sliding resistance

The horizontal movement of the supported structural element must be limited in order to prevent sliding and displacement of the bearing.

The coefficient of friction μ is calculated as follows:

$$\mu = 0.1 + \frac{1.5\, K_f \cdot N/mm^2}{\sigma_z} \qquad [11]$$

with $K_f = 0.6$ for concrete and $K_f = 0.2$ for all other surfaces.

The horizontal restoring force F_x and the check of sliding resistance results from:

$$F_x = \frac{v_{x,y}}{t_{rest}}\, G \cdot A < \mu \cdot \sigma_z \cdot A \qquad [12]$$

where $v_{x,y}$ is the total horizontal deformation (vector addition), A is the footprint area and the shear modulus G = 2.2 N/mm². The permissible horizontal deformation is thus:

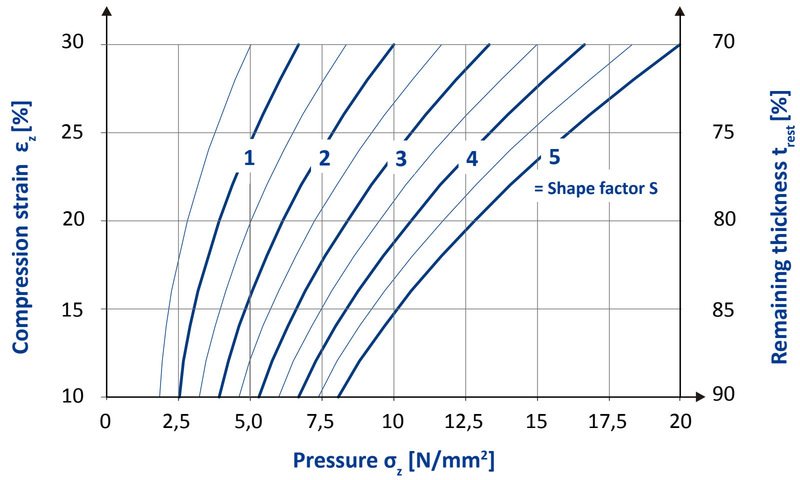
$$v_{x,y} < \frac{\mu \cdot \sigma_z \cdot t_{rest}}{G} \text{ and } v_{x,y} < 0.7 \cdot t \qquad [13]$$

(lower value applies)

The maximum possible shear strain ε_x can be taken from Table 2. The maximum allowable deformation is given by:

$$V_{x,y} \leq \varepsilon_{x,y} \cdot t \qquad [14]$$

5



5 Dependence of remaining thickness (as % of the nominal thickness, t) on pressure and shape factor

Examples

A – Simplified procedure

Vertical load F_z = 160 kN

Selected bearing geometry:

$a \cdot b \cdot t = 140\ mm \cdot 100\ mm \cdot 10\ mm$

$$\sigma_z = \frac{F_z}{A} = \frac{160\ kN}{140\ mm \cdot 100\ mm} = 11.4\ N/mm^2$$

Interpolating from Table 1:

$\sigma_{zul} = 13.0\ N/mm^2 > \sigma_z \rightarrow$ *ok!*

Ensure adequate edge cover (load bearing area)!

$r = 0.5 \cdot t + 0.05 \cdot a = 0.5 \cdot 10\, mm + 0.05 \cdot 140\, mm$

$r = 12\ mm \rightarrow$ *allow approx. 15 mm*

B – Procedure for all other cases

Vertical load	F_z = 160 kN
Horizontal deformations	v_x = 3 mm
	v_y = 4 mm
Rotation	α_a = 5 %, α_b = 0
Central hole	d = 15 mm
Connecting surface	

$$S = \frac{a \cdot b - n \cdot d^2 \cdot \pi/4}{2 \cdot (a + b) \cdot t + n \cdot d \cdot \pi \cdot t}$$

$$= \frac{140 \cdot 100 - 1 \cdot 15^2 \cdot \pi/4}{2\,(140 + 100) \cdot 10 + 1 \cdot 15 \cdot \pi \cdot 10} = 2.62$$

Check of limitation of shape factor:

$0.5 < S < 5 \rightarrow$ *ok*

Calculation of vertical deformation:

$$\sigma_z = \frac{F_z}{a \cdot b - d^2 \cdot \pi/4} =$$

$$\frac{160\ kN}{140\ mm \cdot 100\ mm - (15\ mm)^2 \cdot \pi/4} = 11.6\ N/mm^2$$

ε_z = 30% (from Figure 5)

$t_{rest} = (1 \cdot \varepsilon_z) \cdot t = (1 - 0.3)\ 10\ mm = 7\ mm$

Check of rotation:

$$t - t_{rest} - \frac{a \cdot \alpha_a + b \cdot \alpha_b}{3} = 10\, mm - 7\, mm - \frac{140\, mm \cdot 5\%}{3}$$

$= 0.67 \geq 0 \rightarrow$ *ok!*

$$\alpha_a < 0.9 \cdot \frac{t}{a} = 0.9 \cdot \frac{10\, mm}{140\, mm}$$

$= 6.4\% < 10\% \rightarrow$ *ok!*

Check of resistance to sliding:

$$\mu = 0.1 + \frac{1.5 \cdot K_f\, N/mm^2}{\sigma_z} = 0.1 + \frac{1.5 \cdot 0.6\, N/mm^2}{11.6\, N/mm^2}$$

$= 0.18$

$$v_{xy} = \sqrt{(3\ mm)^2 + (4\ mm)^2} = 5\ mm < 0.7 \cdot t$$

$= 7mm \rightarrow$ *ok!*

$$\frac{v_{xy}}{t_{rest}} \cdot G \cdot A \leq \mu \cdot \sigma_z \cdot A$$

$$\frac{5mm}{7mm} \cdot 2.2\ N/mm^2 \leq 0.18 \cdot 11.6\ N/mm^2$$

$1.57\ N/mm^2 \leq 2.09\ N/mm^2 \rightarrow$ *ok!*

Design tables

Table 1: Maximum permissible pressure σ_z [N/mm²]

Thicknesses [mm]					Side length a [mm]														
				8	16	20	24	32	40	48	60	72	84	100	120	140	168	200	240
				10	20	25	30	40	50	60	75	90	105	125	150	175	210	250	300
				15	30	37.5	45	60	75	90	112.5	135	157.5	187.5	225	262.5	315	375	450
	8	**10**	**15**	**20**	40	50	60	80	100	120	150	180	210	250	300	350	420	500	600
	16	20	30	40	5.0	5.2	5.4	5.6	5.8	5.9	6.0	6.1	6.2	6.2	6.3	6.4	6.4	6.5	6.5
	20	25	37.5	50	5.2	5.5	5.6	5.9	6.1	6.3	6.5	6.6	6.7	6.8	6.9	7	7.1	7.2	7.2
	24	30	45	60	5.4	5.6	5.9	6.2	6.5	6.7	6.9	7.1	7.3	7.4	7.5	7.6	7.7	7.8	7.9
	32	40	60	80	5.6	5.9	6.2	6.7	7.1	7.4	7.7	8.0	8.2	8.4	8.6	8.8	9.0	9.1	9.2
	40	50	75	100	5.8	6.1	6.5	7.1	7.5	7.9	8.4	8.7	9.0	9.3	9.6	9.8	10.1	10.3	10.5
	48	60	90	120	5.9	6.3	6.7	7.4	7.9	8.4	8.9	9.4	9.7	10.1	10.5	10.8	11.1	11.4	11.7
Side length b	60	75	112.5	150	6.0	6.5	6.9	7.7	8.4	8.9	9.6	10.2	10.6	11.2	11.7	12.1	12.6	13	13.3
[mm]	72	90	135	180	6.1	6.6	7.1	8	8.7	9.4	10.2	10.9	11.4	12.1	12.7	13.2	13.8	14.4	14.9
	84	105	157.5	210	6.2	6.7	7.3	8.2	9.0	9.7	10.6	11.4	12.1	12.9	13.6	14.3	15	15.7	16.3
	100	125	187.5	250	6.2	6.8	7.4	8.4	9.3	10.1	11.2	12.1	12.9	13.8	14.7	15.5	16.4	17.2	18
	120	150	225	300	6.3	6.9	7.5	8.6	9.6	10.5	11.7	12.7	13.6	14.7	15.8	16.8	17.9	18.9	20
	140	175	262.5	350	6.4	7	7.6	8.8	9.8	10.8	12.1	13.2	14.3	15.5	16.8	17.9	19.2	20	20
	168	210	315	420	6.4	7.1	7.7	9.0	10.1	11.1	12.6	13.8	15	16.4	17.9	19.2	20	20	20
	200	250	375	500	6.5	7.2	7.8	9.1	10.3	11.4	13	14.4	15.7	17.2	18.9	20	20	20	20
	240	300	450	600	6.5	7.2	7.9	9.2	10.5	11.7	13.3	14.9	16.3	18	20	20	20	20	20

Maximum permissible pressure in N/mm² for a minimum remaining thickness of 70 % of the nominal thickness, depending on side lengths a, b and thickness t. For example, a bearing of dimensions 80 x 200 x 10 mm³ will be compressed to a thickness of 7 mm under a pressure of 12.9 N/mm².

— Values for Example A on Page 5

Table 2: Maximum permissible shear strain $\varepsilon_{x,y} = \frac{v_{x,y}}{t}$ [mm]

Thicknesses [mm]					Side length a [mm]														
				8	16	20	24	32	40	48	60	72	84	100	120	140	168	200	240
				10	20	25	30	40	50	60	75	90	105	125	150	175	210	250	300
				15	30	37.5	45	60	75	90	112.5	135	157.5	187.5	225	262.5	315	375	450
	8	**10**	**15**	**20**	40	50	60	80	100	120	150	180	210	250	300	350	420	500	600
	16	20	30	40	0.45	0.46	0.46	0.47	0.47	0.48	0.48	0.48	0.49	0.49	0.49	0.49	0.49	0.49	0.5
	20	25	37.5	50	0.46	0.46	0.47	0.48	0.48	0.49	0.5	0.5	0.5	0.51	0.51	0.51	0.51	0.52	0.52
	24	30	45	60	0.46	0.47	0.48	0.49	0.5	0.5	0.51	0.52	0.52	0.52	0.53	0.53	0.54	0.54	0.54
	32	40	60	80	0.47	0.48	0.49	0.5	0.51	0.52	0.53	0.54	0.55	0.56	0.56	0.57	0.57	0.58	0.58
	40	50	75	100	0.47	0.48	0.5	0.51	0.53	0.54	0.56	0.57	0.58	0.59	0.6	0.6	0.61	0.62	0.62
	48	60	90	120	0.48	0.49	0.5	0.52	0.54	0.56	0.57	0.59	0.6	0.61	0.62	0.63	0.64	0.65	0.66
Side length b	60	75	112.5	150	0.48	0.5	0.51	0.53	0.56	0.57	0.6	0.61	0.63	0.65	0.66	0.68	0.69	0.7	0.7
[mm]	72	90	135	180	0.48	0.5	0.52	0.54	0.57	0.59	0.61	0.64	0.65	0.67	0.7	0.7	0.7	0.7	0.7
	84	105	157.5	210	0.49	0.5	0.52	0.55	0.58	0.6	0.63	0.65	0.68	0.7	0.7	0.7	0.7	0.7	0.7
	100	125	187.5	250	0.49	0.51	0.52	0.56	0.59	0.61	0.65	0.67	0.7	0.7	0.7	0.7	0.7	0.7	0.7
	120	150	225	300	0.49	0.51	0.53	0.56	0.6	0.62	0.66	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
	140	175	262.5	350	0.49	0.51	0.53	0.57	0.6	0.63	0.68	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
	168	210	315	420	0.49	0.51	0.54	0.57	0.61	0.64	0.69	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
	200	250	375	500	0.49	0.52	0.54	0.58	0.62	0.65	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
	240	300	450	600	0.5	0.52	0.54	0.58	0.62	0.66	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7

Maximum permissible shear strain, $\varepsilon_{x,y} = v_{x,y}/t$, of a bearing against concrete, depending on geometry, if the bearing is vertically loaded to its full capacity. For example, a bearing of dimensions 80 x 200 x 10 mm³ can allow horizontal deformation of v_x = 0.70 t = 7.0 mm, if the bearing is loaded with full permissible vertical load.

Product range and installation guidelines

Product range

Material	Thickness [mm]	Designation	Slab dimensions [mm x mm]	Delivery form
Natural rubber (NR)	5	LASTO-BLOCK F 05 NR	1200 x 1200	Full slabs or cut to size according to clients' wishes
	8	LASTO-BLOCK F 08 NR		
	10	LASTO-BLOCK F 10 NR		
	15	LASTO-BLOCK F 15 NR		
	20	LASTO-BLOCK F 20 NR		
	25	LASTO-BLOCK F 25 NR		
	30	LASTO-BLOCK F 30 NR		
Chloroprene rubber (CR)	5	LASTO-BLOCK F 05 CR		
	8	LASTO-BLOCK F 08 CR		
	10	LASTO-BLOCK F 10 CR		
	15	LASTO-BLOCK F 15 CR		
	20	LASTO-BLOCK F 20 CR		
	25	LASTO-BLOCK F 25 CR		
	30	LASTO-BLOCK F 30 CR		

Thicknesses of up to 20 mm are available from stock, other thicknesses on request

Installation guidelines

LASTO®BLOCK F bearings are generally laid on a smooth flat surface without ridges, burrs or large recesses. When laid on concrete or a mortar bed, it must be ensured that the surface has adequate strength. It must also be ensured that the bearing surfaces are clean and grease-free.

Tender texts

Tender texts for bearings of natural rubber (NR)

Supply and installation of high-capacity, unreinforced deformation bearings of natural rubber (NR)

Product: LASTO®BLOCK F
The permissible loading depends on the bearing geometry and is limited to max. 20 N/mm².

Proven remaining bearing thickness under a permanent load of duration 100 days to be min. 70% of nominal thickness.

Required displacement capacity $v_{x,y}$ = ...mm

Required rotation capacity α = ... ‰

Bearing thickness: ... mm

Dimensions (L x W) : ... mm x ... mm

Including creation of a flat load-bearing surface.

Units: Pieces.

Supplier:

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Solistrasse 68
8180 Bulach
Switzerland
Tel.: +41-44-872 40 50
Fax: +41-44-872 41 29
Email: buildings.ch@mageba-group.com
www.mageba-group.com

Tender texts for bearings of chloroprene rubber (CR)

Supply and installation of high-capacity, unreinforced deformation bearings of chloroprene rubber (CR)

Product: LASTO®BLOCK F
The permissible loading depends on the bearing geometry and is limited to max. 20 N/mm².

Proven remaining bearing thickness under a permanent load of duration 100 days to be min. 70% of nominal thickness.

Required displacement capacity $v_{x,y}$ = ...mm

Required rotation capacity α = ... ‰

Bearing thickness: ... mm

Dimensions (L x W) : ... mm x ... mm

Including creation of a flat load-bearing surface.

Units: Pieces.

Supplier:

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Project references


Amiens, FR


Municipal library of Stuttgart, DE


Convention Center, HK


Shopping Centre, CH


Hurghada Airport, EG


Stade de Suisse, CH

Product groups (building construction)


Bearings


Vibration isolation


Expansion joints


Special products

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