



Seismic devices

Infrastructure | Buildings | Industrial structures

# mageba seismic protection devices – for reliable preservation of structures



## **LASTO® LRB Lead Rubber Bearing**

proven, safe, versatile



**mageba**



# Product Features

## Principle

mageba LASTO®LRB lead rubber bearings work on the principle of base isolation and limit the energy transferred from the ground to the structure in the event of an earthquake. The rubber and steel laminated bearing is designed to support the weight of the structure and to provide post-yield elasticity. The rubber provides the isolation and re-centering of the bearing after a seismic event. The lead core deforms plastically under shear deformations, while dissipating energy through heat.

## Properties

LASTO®LRB lead rubber bearings consist of alternate layers of elastomeric material and vulcanized reinforcement steel plates with a central lead core. They provide a high level of damping of up to 30 % due to the high absorption capacity of the lead core.

The reinforcement steel plates are fully embedded in the elastomeric material and sealed, and are therefore protected against corrosion. The devices are manufactured with the rubber vulcanized to the top and bottom connection plates. The bearings can also be supplied with additional anchor plates, allowing easier removal of the device for maintenance purposes.

## Application

LASTO®LRB devices are made from natural rubber (NR) providing a high resistance against mechanical wear.

Lead rubber bearings find wide applications in structures. This is due to their simplicity and the combined isolation and energy dissipation functions in a single compact unit. In terms of seismic protection, this is a crucial aspect to minimizing the seismic energy transfer to the superstructure and to limit the horizontal displacements of the device.

Under normal conditions, LASTO®LRB lead rubber bearings act as regular elastomeric bearings. Therefore, in case of structures with limited space for bearings and seismic protection means all these functions can be combined in a single device.

Lead rubber bearings are one of the most widely used means of seismic isolation in structures and have proven effective in numerous earthquakes worldwide. The system has been researched over the past several decades and offers the structural engineer a straight-forward simulation of device response due to simple bi-linear modeling.

## Seismic Isolation

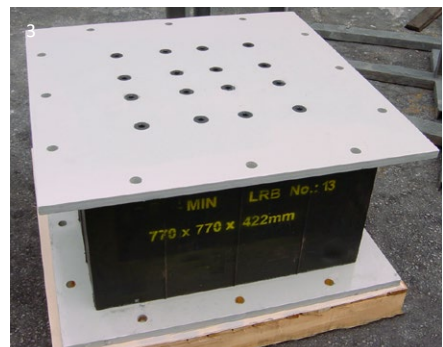
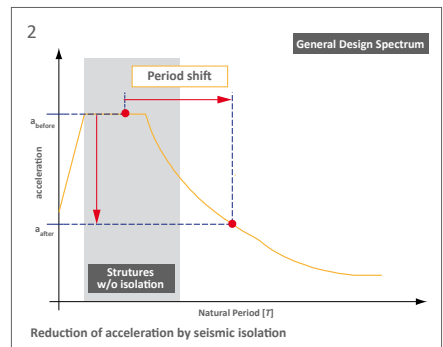
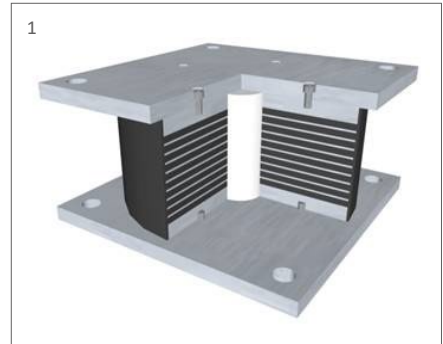
Seismic isolation is the decoupling of structures from ground motions induced by earthquakes motions which could cause damage to the structures. To achieve such decoupling, different seismic devices – known as isolators – are strategically installed in specific locations of structures, allowing them to perform properly during an earthquake.

Seismic isolators provide sufficient flexibility to the structure, so that the natural period of the structure differentiates as much as possible from the natural period of the earthquake. This prevents the occurrence of resonance, which could lead to severe damage or even collapse of a structure.

An effective seismic isolation system shall provide the following main functions:

- Performance under all service loads, vertical and horizontal; shall be as effective as conventional structural bearings
- Provide enough horizontal flexibility in order to reach the target natural period for the isolated structure
- Re-centering capabilities after the occurrence of a severe earthquake so that no residual displacements can disrupt the serviceability of the structure
- Provide an adequate level of energy dissipation in order to control the displacements that could otherwise damage other structural members

- 1 Schematic view of a LASTO®LRB device
- 2 Principle of seismic isolation – reduction of acceleration by means of period shifting
- 3 LASTO®LRB device ready for installation
- 4 Viaduct de Chillon, Switzerland, retrofitted with LASTO®LRB bearings



# Properties & Benefits

## Materials

The following materials are used for the production of mageba LASTO®LRB lead rubber bearings:

- Reinforcing plates, the top and bottom plates are made from rolled carbon steel conforming to ASTM A709 Grade 36 and 50
- Natural rubber, type NR, as per ASTM D4014
- Lead with a minimum purity of 99.9 %

## Anchoring System

LASTO®LRB devices are equipped with anchor plates to facilitate the connection to the lower and upper concrete structures. Alternatively, the bearings can be prepared for connection to steel structures.

## Corrosion Protection

mageba proposes corrosion protection systems based on hot dip galvanizing ASTM A-123 / AASTHO M111, or any applicable painting systems approved by the responsible Department of Transportation (D.O.T.). Corrosion protection systems according to other standards can be provided upon request.

## Main Dimensions

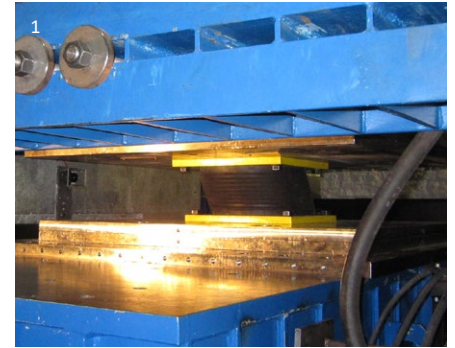
The table below summarizes the main dimensions for one given seismic design displacement. Values for other sets of input parameters can be provided upon request.

## Benefits

- Significant dissipation of energy during earthquakes leading to an optimized structure size and reduced structure cost
- Combined transfer of service and seismic loads leading to minimal space requirement for the devices
- Effective solution for a wide range of types of structures
- Effective solution for the retrofitting or upgrading of existing structures
- Re-centering capabilities of bearings after a seismic event allows the serviceability of the structure to be maintained
- Well researched technology with several decades of track record for many applications worldwide

## Inspection and Maintenance

LASTO®LRB lead rubber bearings are maintenance free. The condition and position of the bearings should be inspected at regular intervals. Upon request, mageba specialists can carry out such inspections and summarize the results in a detailed report.



- Testing of LASTO®LRB bearings
- Manufacturing of LASTO®LRB bearings

LASTO®LRB – d <sub>bd</sub> = 15.75 inches / 400 mm																				
D (in)	D (mm)	t <sub>e</sub> (in)	t <sub>e</sub> (mm)	H <sub>B</sub> (in)	H <sub>B</sub> (mm)	N <sub>Sd</sub> (kips)	N <sub>Sd</sub> (kN)	N <sub>Ed</sub> (kips)	N <sub>Ed</sub> (kN)	F <sub>1</sub> (kips)	F <sub>1</sub> (kN)	F <sub>2</sub> (kips)	F <sub>2</sub> (kN)	K <sub>r</sub> (kips/in)	K <sub>r</sub> (kN/mm)	K <sub>eff</sub> (kips/in)	K <sub>eff</sub> (kN/mm)	K <sub>v</sub> (kips/in)	K <sub>v</sub> (kN/mm)	ξ (%)
19.7	500	6.3	160	12.8	326	809	3,600	281	1,250	71	315	170	755	6.28	1.1	10.79	1.89	4,648	814	29
23.6	600	6.9	176	13.8	350	1,338	5,950	483	2,150	94	420	223	990	8.28	1.45	14.22	2.49	7,686	1,346	28
27.6	700	7.6	192	14.7	374	1,967	8,750	776	3,450	116	515	277	1,230	10.28	1.8	17.64	3.09	11,368	1,991	28
31.5	800	8.2	208	15.7	398	2,462	10,950	1,147	5,100	139	620	337	1,500	12.39	2.17	21.30	3.73	15,560	2,725	26
35.4	900	8.5	216	16.1	410	3,653	16,250	1,517	6,750	155	690	393	1,750	15.13	2.65	25.01	4.38	20,887	3,658	26
39.4	1,000	8.8	224	16.6	422	4,215	18,750	2,271	10,100	171	760	456	2,030	18.04	3.16	28.95	5.07	26,797	4,693	25

**Important Note:** This table is intended only as a preliminary reference for the design of the isolator. Final design and technical details will be fully defined once all the parameters of the project are considered in the final design.

## Legend

$d_{bd}$	Design seismic displacement	$F_1$	Yield force
$D$	Rubber block diameter	$F_2$	Maximum horizontal force (at dbd)
$t_e$	Total rubber height	$K_r$	Horizontal stiffness
$H_B$	Total isolator's height	$K_{eff}$	Effective stiffness
$N_{Sd}$	Maximum vertical service load	$K_v$	Vertical stiffness
$N_{Ed}$	Maximum vertical seismic load	$\xi$	Damping ratio





## Seismic devices

# Quality & Support

### Quality

For five decades, mageba bearings have proven their worth in thousands of structures under the most demanding conditions. In addition to the product properties, the extensive experience of mageba's well-qualified manufacturing and installation staff also contributes to the high quality and durability of the products.

mageba has a process-orientated quality system. In addition, its quality is regularly inspected by independent testing institutes. mageba factories are AISC certified for Major Bridges (CPT, STD, SPE) and also maintain AWS certifications for D1.1 and D1.5.

### Certification

mageba LASTO®LRB lead rubber bearings are designed and manufactured in accordance with "AASHTO Guide Specification for Seismic Isolation Design".

Alternatively, LASTO®LRB lead rubber bearings can be also designed and manufactured in accordance with European Standard EN 15129 and with EN 1337. Bearings are then marked with the CE mark of conformity, which confirms that they satisfy all requirements of this standard, without exception.

All necessary type testing performed on LASTO®LRB devices are carried out at an independent testing facility and fully supervised by a certified body.

### Testing

If required by the client, full-scale factory production control testing can be carried out. mageba performs the tests in-house as well as with independent 3<sup>rd</sup> party test institutes. Commonly performed tests are based on AASHTO "Guide Specifications for Seismic Isolation Design" or European Standard EN 15129:2009. For special projects, customized testing can also be performed if requested by the client.

### Customer Support

Our product specialists will be glad to advise you in selection of the optimal solution for your project, and to provide you with a quotation.

On our website, [mageba-group.com](https://www.mageba-group.com), you can find further product information, including reference lists and tender documentation.

### Reference Projects for mageba Seismic Devices



Awaza Bridge (TM)



Flendruz (CH)



Langenargen (DE)



Ramstore Bridge (KZ)



Agin Bridge (TR)



Vasco da Gama Bridge (PT)

### mageba Seismic Devices



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