mageba cylindrical bearings – for special application and refurbishments

RESTON®CYLINDER bearings

versatile, innovative, economical

mageba

Overview and types

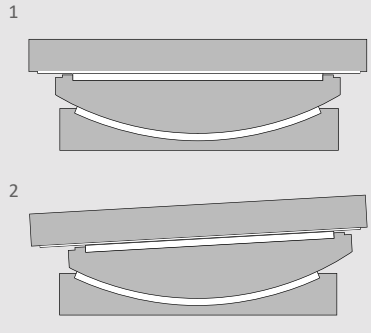
Main application

The key advantages of the cylindrical bearings over the more common pot and spherical bearings is that **practically any ratio of width to length of the core elements** may be defined as required for the specific project situation. This makes it the ideal **state-of-the-art replacement for end-of-life roller bearings and line rocker bearings**.

Principle

The concept of structural bearings, like RESTON®CYLINDER, is to ensure the controlled transfer of loads between a structure's superstructure and its substructure. The bearings link the superstructure above and the substructure below in a specified manner, allowing a defined combination of forces, movements, rotations and moments to be transmitted between superstructure and substructure.

The kinematic response of cylindrical bearings is shown in figures 1 and 2. They accommodate rotations by sliding on a curved surface – similar to the more common RESTON®SPHERICAL bearings. In contrast to spherical bearings, the curved sliding surface is not spherical but cylindrical. Displacements are also accommodated by sliding at a separate interface.

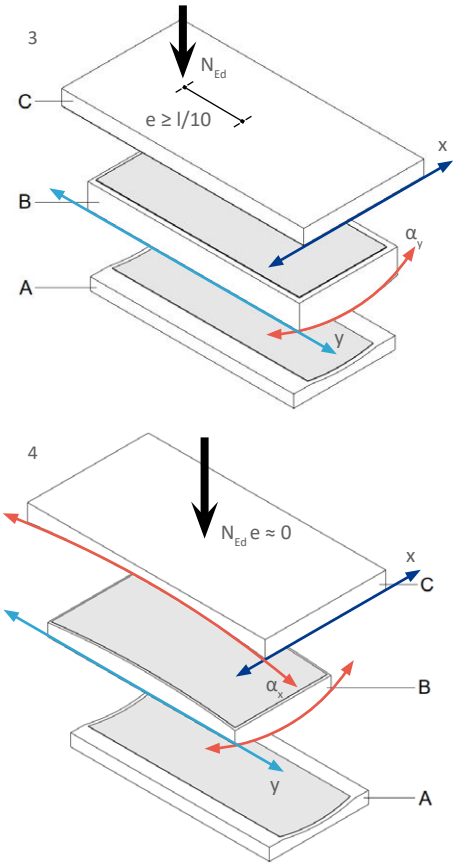


1 Cylindrical bearing, neutral superstructure position
2 Cylindrical bearing, rotated and displaced superstructure

Types

Cylindrical bearings consist of three core elements as shown in figures 3 and 4. The lower concave part (A), supports the calotte (B), which in turn supports the sliding plate (C). The sliding surface below the calotte is cylindrical (the axis of the cylinder being in line with the transverse y-axis) in order to accommodate the (main) rotation about the transverse axis.
The sliding surface above the calotte may be flat (RESTON®CYLINDER MONO) or curved (RESTON®CYLINDER DUPLO), depending on the need to facilitate rotations about the longitudinal (x) axis (see below). Both types can be designed as fixed, free or guided types, depending on their ability to accommodate sliding movements.

RESTON®CYLINDER MONO: With the MONO type, the sliding surface above the calotte is flat and can accommodate displacements in any direction that are not blocked by guides or stoppers. Rotations about the main x-axis cannot be accommodated. For safety reasons, a minimum bending moment equivalent to an eccentricity of one tenth of the sliding pad width (as shown in fig. 3) is always accounted for, however the structural designer should always define the bending moment (eccentricity) for the specific design.



3 RESTON®CYLINDER MONO
4 RESTON®CYLINDER DUPLO

RESTON®CYLINDER DUPLO: The sliding surface above the calotte of the DUPLO type is cylindrical (with the axis of the cylinder in longitudinal direction, as shown in fig. 4), which allows for displacements in the longitudinal direction and also, in contrast to the RESTON®CYLINDER MONO, for rotation about the longitudinal axis. Further, it ensures a centric load introduction without consideration / need for assesement of a load eccentricity. Displacements in the transverse direction are accommodated by the lower sliding surface. In the unusual case that rotations about the vertical axis are not negligibly small, the RESTON®CYLINDER DUPLO SPECIAL bearing foresees a third, flat sliding surface. The degrees of freedom are summarized in table 1.

Type	Action				
	Load	Movement	Rotation		
	MONO and DUPLO		MONO	DUPLO	DUPLO SPECIAL
Fixed	x, y, z	-	α_y	α_y, α_z	α_x, α_y, α_z
Free	z	x, y			
Guided (long.)	y, z	x			
Guided (trans.)	x, z	y			

Table 1: Degrees of freedom of respective types (cartesian coordinate system applies)

Design and quality

ROBO®SLIDE 75 sliding material

Our ROBO®SLIDE 75 is a specially modified ultra-high molecular weight polyethylene. Its performance is superior to standard PTFE in every way: durability, strength, sliding friction and temperature range, as shown in table 2. Dimples filled with silicone grease (see figure 5) ensure that the low sliding friction is maintained over the entire service life. The design characteristics are regulated in our European Technical Assessment ETA-23/0831, issued by the Austrian Institute for Construction Technology (OIB). Thanks to its high durability, the use of ROBO®SLIDE 75 greatly reduces maintenance and replacement costs in comparison with other sliding materials such as PTFE.

Further information about the sliding material can be found in the ROBO®SLIDE 75 brochure.

Mating surface

ROBO®SLIDE 75 is paired with premium quality stainless steel sheets (grades 1.4401/4 +2B acc. to EN 10088-4.

It is mirror finished to a roughness not higher than $R_z \leq 1$ µm acc. to ISO 4287.

All stainless steel sheets are welded to the backing plates along the full circumference for best durability and corrosion resistance.

	ROBO®SLIDE 75 acc. to ETA-23/0831	PTFE acc. to EN 1337-2
Char. strength [MPa]	180 at 35 °C	90 at 30 °C
Tested accumulated sliding path [km]	75	10
Expectable lifetime [years]	75[a]	10 – 25[b]
Min/Max temperature	-50 °C / +80 °C	-35 °C / +48 °C
Sliding friction	2.3 – 2.8 %[c]	2.0 – 3.0 %[c]
PFAS free	Yes	No

Table 2: Comparison of ROBO®SLIDE 75 and PTFE

[a] acc. EAD 050004-00-0301 for 75 km accum. sliding path

[b] acc. to EN 1990. 10 km accum. sliding path acc. EN 1337-2

[c] main surface, at 50% utilization

Backing plates

Steel backing plates, supporting the sliding sheets and stainless steel sheets, are typically of grade S355 acc. to EN 10025-2 or grade 50 acc. to ASTM A709. Together with our steel suppliers we can supply any special steel type at your request.

Anchoring

Typical connections to steel structures include prestressed high-strength bolts of grade 10.9 / A490 and welds.

Typical connections to concrete structures include shear studs welded to anchor plates (best practice for exchange works) and high-performance anchor dowels, designed acc. to EN 1992-4.

Special solutions

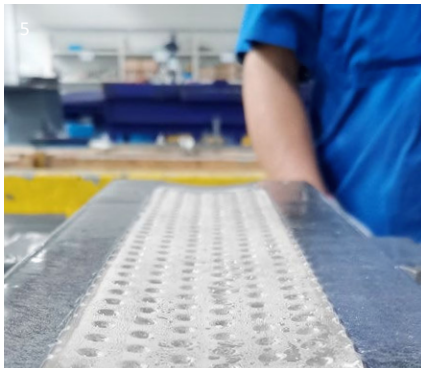
For special requirements, RESTON® CYLINDER bearings can be designed with the following special features:

- **Tension/Compression Bearings:** Our RESTON®CYLINDER bearings can be an excellent choice for transferring not only compressive but also tensile forces (depending on rotational requirements); see figure 8.
- **RESTON®PENDULUM Curved Surface Sliders (seismic isolation):** In order to meet special requirements (space restrictions; curvature), our pendulum-type bearings (see figure 9) can also be designed with cylindrical sliding surfaces.

Quality control

The quality and durability of mageba bearings is ensured not only by their well-proven product properties, but also by the extensive experience of our personnel.

mageba operates a process-oriented quality system that is certified in accordance with ISO 9001. All factories are certified for steel construction acc. to EN 1090 and welding works acc. to ISO 3834-2.



5 Concave part of a RESTON®CYLINDER DUPLO bearing

6 Sliding plate being placed on calotte of a DUPLO-type bearing

7 Installed RESTON®CYLINDER DUPLO bearing

Constancy of performance of our construction products in compliance with EU regulation 305/2011 is attested by MPA Stuttgart's structural bearing division, through their

- regular third party surveillance of our production facilities
- independent certification (level 3.2 as per EN 10204) of material and sliding characteristics of each batch of ROBO®SLIDE 75

Installation and design input

Installation

- RESTON®CYLINDER bearings must be handled with proper care during unloading and installation. Sliding surfaces, movement indicators and corrosion protection are particularly sensitive to damage and must be protected accordingly.
- Presetting values should be defined prior to fabrication in order to be considered in the factory. Adjustments of pre-setting on site must be done by trained staff only.
- The bearings are clearly marked for correct positioning in the structure.
- Rainfall protection with good ventilation is mandatory even for short-term storage on site.
- In preparation for the installation, threaded rods may be embedded in the concrete. Then the bearings can be easily levelled using cap nuts (topped with soft paddings against force concentration).
- After the anchorage is effective, the transport fixations are removed and the bearing's service starts.

See mageba's installation manual for more details.

Design input

Quotations are provided on the basis of the types and numbers of bearing required. If desired, mageba will gladly design and price the required bearings based on the following input:

- ULS or SLS actions (forces, rotations, movements)
- Permissible pressure on structure (without other input, mageba assumes 50 N/mm^2)
- Structural member material
- Bearing steel grade (if any special requirement)

The following (additional) data should be available for a detailed design:

- ULS, SLS, and permanent actions
- Permissible length, width and height
- Preferred type (possibly shape) of connection member
- Operating temperature range
- Corrosion Protection requirements

Support

Our specialists will gladly support you in selecting the optimal solution for your project.
Please also visit **www.mageba-group.com** for further product information and local contact details.

8 RESTON®CYLINDER UPLIFT allows the transfer of tensile or compressive forces
9 RESTON®CYLINDER PENDULUM for 3rd Bosphorus Bridge in Turkey

Project references – RESTON®CYLINDRICAL bearings


SBB Schänzli (CH)


3rd Bosphorus Bridge (TR)


"Y-Bridge" (DE)


Bhairab Rail Bridge (BD)


Br. No. 20, USBRL (IN)


Bhagirathi Rail Bridge (IN)

mageba structural bearings


Elastomeric bearings


Spherical bearings


Pot bearings


Lifting/measuring bearing

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