CE

SPHERICAL · BEARINGS · MARKED · SPHERICAL

FIP *INDUSTRIALE*

SFEROPOL® BEARINGS

INTRODUCTION

PRODUCT

Sferopol® are spherical hinges in which the rotations about any horizontal axis are ensured by the sliding of a convex steel element in a monolithic concave element covered with SMF special sliding material.

In addition to vertical compressive loads, **Sferopol**® bearings are capable of transferring forces and/or permit sliding in one or more directions of the horizontal plane depending on the different bearing types.

In the sliding bearings, translational movements are achieved through the mutual sliding of two flat mating surfaces, one of stainless steel and the other of **SMF**.

The **Sferopol**® spherical bearings are entirely manufactured at **FIP Industriale** workshop in Italy.

CE MARKING

This catalogue covers CE marked spherical bearings designed according to FIP ETA 09/0226 standard.

FIP Industriale also designs and manufactures bearings according to other applicable well known and widely used technical specifications such as EN1337 or AASHTO.

CLASSIFICATION

Sferopol® bearings are classified by two letters followed by two or three groups of numbers with the following meanings:

SF V–H	=>	Sferopol® bearing, fixed type
SU V/LM–H	=>	Sferopol® bearing, guided type, longitudinally sliding
SU* V–H/TM	=>	Sferopol® bearing, guided type, transversally sliding
SM V/LM/TM	=>	Sferopol® bearing, free sliding type

where:

V   represents the vertical load capacity in kN/10 at Ultimate Limit State (ULS);

LM   represents the total longitudinal movement in mm;

H   represents the horizontal force in kN/10 at ULS perpendicular to the direction of the movement (if any);

TM   represents the total transverse movement in mm.

For example:

SF 3000-240   Sferopol® bearing, fixed type, with a vertical capacity of 30000 kN able to transfer both longitudinally and transversally horizontal forces of 2400 kN.

SU 400/100-120   Sferopol® bearing, guided type, longitudinally sliding, with a vertical capacity of 4000 kN, that permits longitudinal movements of ± 50 mm and is able to transfer transversally horizontal forces of 1200 kN.

SU* 600-180/50   Sferopol® bearing, guided type, transversally sliding, with a vertical capacity of 6000 kN, able to transfer longitudinally horizontal forces of 1800 kN and that permits transverse movements of ± 25 mm.

SM 1500/550/50   Sferopol® bearing, free sliding type, with a vertical capacity of 15000 kN that permits longitudinal movements of ± 275 mm and transverse movements of ± 25 mm.

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DESCRIPTION

SFEROPOL®
FIXED TYPE

This bearing includes:

• a upper steel element with a concave recess;

• an intermediate convex element;

• a lower steel element with a cylindrical recess which accomodate the intermediate and upper element.

Upside down configuration is also possible.

SFEROPOL®
GUIDED SLIDING TYPE

*Horizontal force up to 10% Maximum vertical load*

This bearing includes:

• a base steel element with a cylindrical recess (pot);

• a convex steel element inserted into the pot;

• an intermediate concave element (piston) inserted into the pot whose upper side has a machined recess to house a dimpled SMF sheet and a centrally arranged key (guide), capable of resisting horizontal forces and determining the sliding direction of the bearing. Two CM1 type composite low friction material strips are bonded to the sides and screwed to the front ends of the guide to assure smooth sliding in the keyway of the upper sliding element covered with stainless steel;

• an upper sliding element, whose underside is covered with a pair of stainless steel sheets, which also cover the sides of the central keyway for the guide.
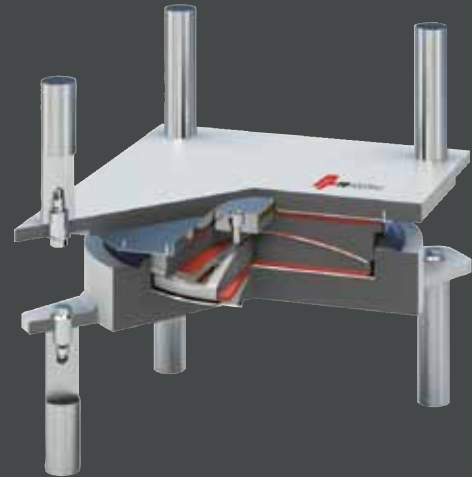
*Horizontal force up to 30% Maximum vertical load*

This bearing includes:

• a base steel element with a concave recess and two confined SMF undimpled strips to the sides to assure smooth sliding in the keyways of the upper sliding element that is covered with stainless steel.

• an intermediate convex steel element whose upper side have a machined recess to house a dimpled SMF sheet.

• an upper sliding element, whose underside is covered with a stainless steel sheets, and two keys (guides) capable of resisting forces perpendicular to them and determining the sliding direction of the bearing.
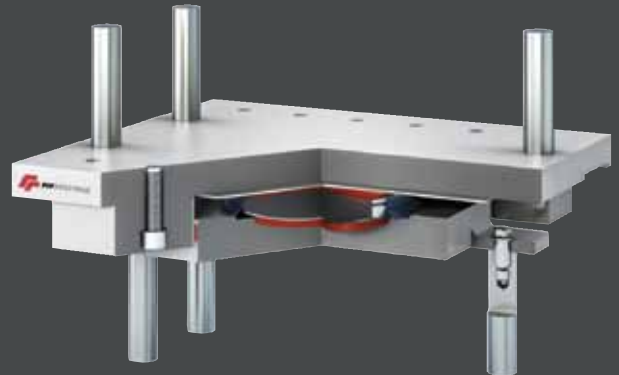
SFEROPOL®
FREE SLIDING TYPE

This bearing includes:

• a lower steel element with a concave recess;

• an intermediate convex element whose upper side have a machined recess to house a dimpled SMF sheet;

• an upper sliding element whose underside is covered with stainless steel sheet.

3
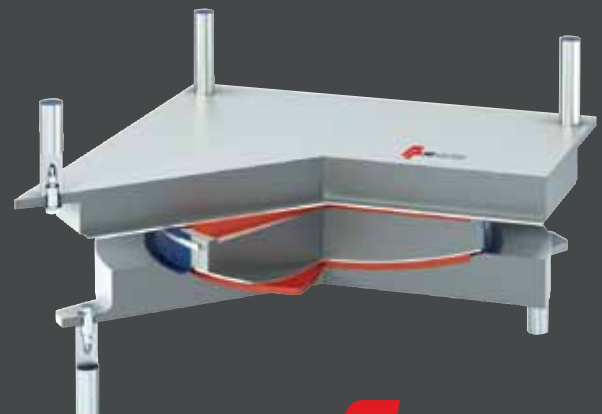
ANCHORING SYSTEMS

According to EN 1337-1 §5.2 the mechanical anchoring becomes compulsory in case of dynamically stressed structures, where extreme load fluctuations can occur, e.g. railway bridges and earthquakes. In this particular case the horizontal force shall not be resisted by friction.

Whenever a mechanical anchoring is required in order to transfer the horizontal forces, the different types of upper and lower anchoring systems indicated below represent the most commonly adopted configurations.
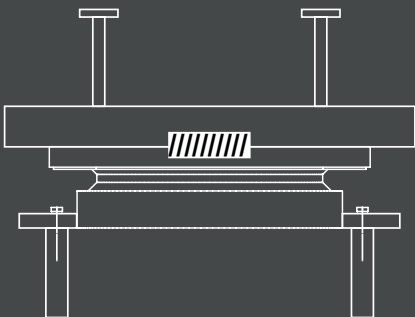
STEEL STRUCTURE

1. Shear pin in counterplate
2. Bolts connected to the structure or to the counterplate

PRECAST CONCRETE STRUCTURE

1. Shear pin in counterplate
2. Bolts connected to the counterplate
3. Bolts and dowels (with pre-formed pockets in the structure)

CAST *IN-SITU* STRUCTURE

1. Shear pin in counterplate
2. Bolts connected to the counterplate
3. Bolts and dowels
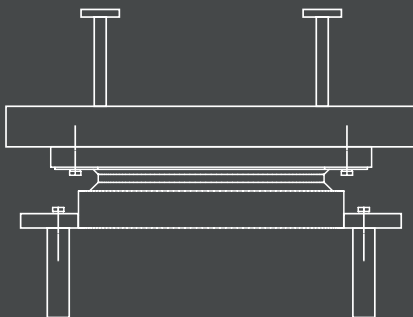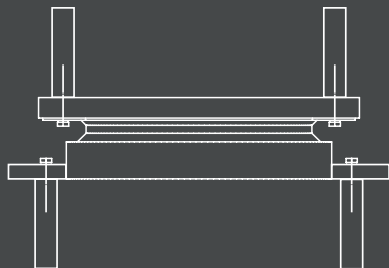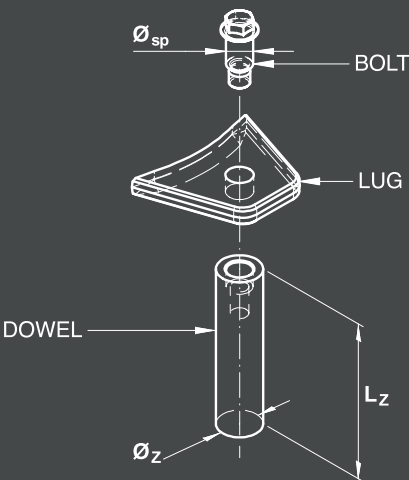

| 1. Shear pin in counterplate | 2. Bolts connected to the counterplate | 3. Bolts and dowels |

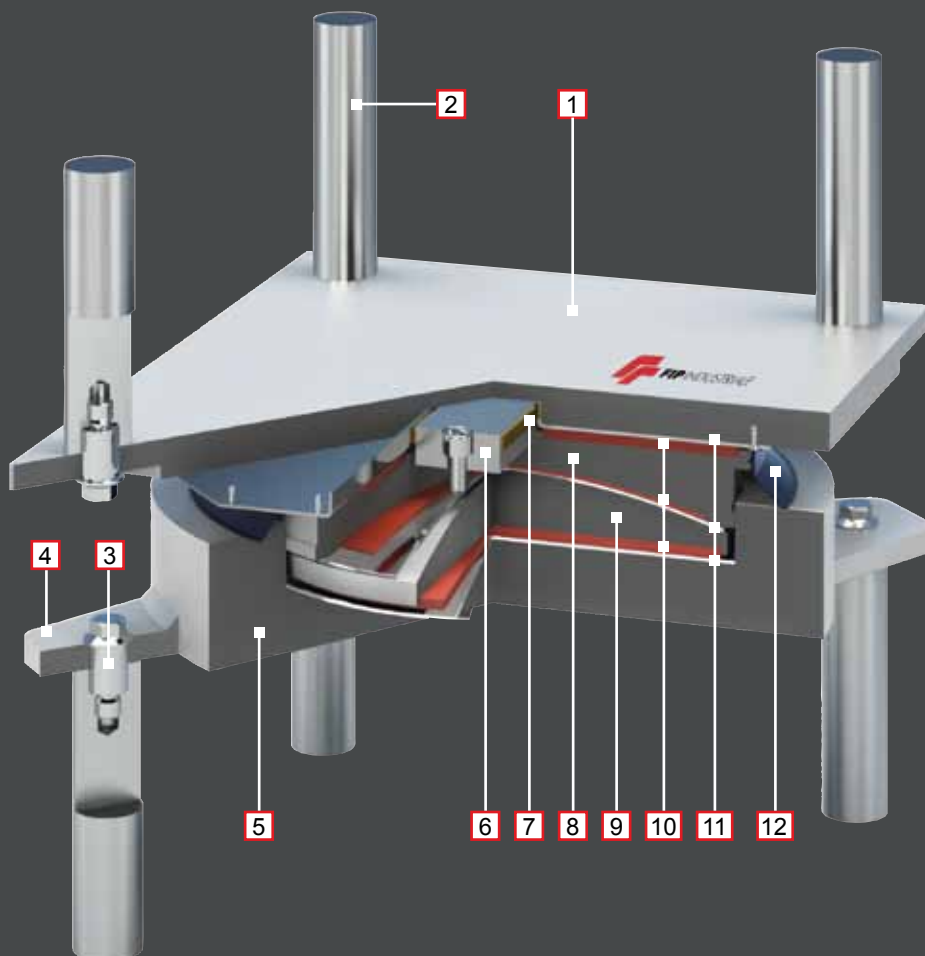| DOWEL TYPE	$\varnothing_{sp}$ (mm)	$\varnothing_Z$ (mm)	L_Z (mm)
1	14	25	100
2	20	35	140
3	30	55	220
4	54	100	400

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BEARING COMPONENTS

ELEMENTS

1 backing plate (sliding element)

2 anchor dowel

3 anchor bolt

4 lug

5 bottom element

6 guide

7 CM1 composite material

8 intermediate element (piston)

9 spherical lens

10 SFM sliding surface

11 stainless steel mating surface

12 external dust seal

MATERIALS

The materials used are in accordance with European Technical Approval ETA 09/0226. In particular, the structural parts are made of steel grade S355 (Designation No. 1.0045) according to EN 10025-2.

Stainless steel grade X5CrNiMo 17-12-2 (Designation No. 1.4401) according to EN 10088-2 with a minimum thickness of 2.5 mm is used for the sliding surfaces.

The mating low friction material consists of **SMF** sheets (ultra high molecular weight polyethylene).

The protrusion from the recess and the total thickness of the **SMF** sheet, are in compliance with ETA 09/0226. The minimum thickness of the **SMF** sheets is fixed in 8 mm.

The low friction material for lateral guides consists of CM1 according to EN 1337-2 or undimpled **SMF** strips, depending on bearings horizontal loads capacity.

ACCESSORIES

Each bearing is provided with an identification label showing its main technical information (i.e. type of bearing, maximum vertical and horizontal design loads, maximum design displacements, year of manufacture and any other information that may be required).

Other accessories are the graduated scale and the movement pointer for the measuring of the offset of the upper element of the bearings.

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| N° COMMESSA ORDER NUMBER | | SISTEMA QUALITÀ ISO 9001 / EN 3834 | |
| N° SERIALE SERIAL NUMBER | | CERTIFICATO ICIM N. 0057/0941 | CE 0672 |

ANNO YEAR

TIPO TYPE

CARICO VERTICALE MAX VERTICAL LOAD kN ULS

CARICO LATERALE MAX LATERAL LOAD kN ULS

SCORRIMENTO TOTALE MAX DISPLACEMENT mm

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SPECIAL FIP SLIDING MATERIAL TYPE SMF

The **SMF** is a special sliding material made of Ultra High Molecular Weight Polyethylene (UHMWPE), with increased bearing capacity and reduced abrasion resistance in comparison with PTFE, developed by **FIP Industriale** for the use in civil and structural constructions. Peculiar of the **SMF** is the high resistance to wear which significantly improves the lifetime of the bearings and of the structure.

SMF high compressive strength (f_k=180 MPa), double of standard PTFE material, allows for the design of smaller bearings reducing their costs and necessary space for their installation within the structure.

SMF CHARACTERISTICS

The admissible contact pressures of FIP **SMF** sliding material in comparison with those of common PTFE are summarized in the following:

		SMF	PTFE
		MPa	MPa
Main sliding surface: **Dead and variable loads**	Compressive strength	180.00	90.00
	Admissible pressure at ULS	128.57	64.29
Main sliding surface: **Dead load**	Admissible pressure	~60.00	~30.00
Guides: **Variable loads**	Compressive strength	180.00	90.00
	Admissible pressure at ULS	128.57	64.29
Guides: **Dead loads, loads from temperature, creep and shrinkage**	Compressive strength	60.00	30.00
	Admissible pressure at ULS	42.86	21.42

The above values refer to bearing working temperatures between -50°C and +35°C. The results of the tests carried out on the SMF show that the values of friction coefficient are within the range of the EN 1337 requirements, both at low temperatures and low pressures.

It has also been demonstrated that the SMF is suitable for applications up to -50°C where a friction coefficient of less than 3% has been recorded. The coefficients of friction as a function of the contact pressure (at low temperatures till -35°C) for FIP SMF can be calculated as follows (PTFE - values in brackets):

$$0,08 \geq \mu = \frac{1,6}{15+p} \geq 0,02 \qquad \left(0,08 \geq \mu = \frac{1,2}{10+p} \geq 0,03\right)$$

As evidenced in the graph near, the friction coefficients at the working pressures results to be much lower by using the SMF material in lieu of the PTFE.

As main consequence of the above, the structures which implement bearings with the SMF will be definitely subjected to lower horizontal reactions during their service life.

FRICTION COEFFICIENT SMF vs PTFE

TEST PERFORMED ON SMF

Comprehensive static and sliding friction tests have been carried out by the independent material testing laboratory of the University of Stuttgart (MPA) in accordance with the test program for heavy duty sliding materials.

After long term friction sliding tests, for a total of 50000 m, carried out at different temperatures (i.e. +40°C,+21°C,0°C,-10°C,-20°C, -35°C and -50°C) with an average contact pressure of 60 MPa and a constant sliding speed of 15 mm/s, the SMF sliding disc showed no particular sign of wear.

Comparing with the requirement of EN 1337-2 for standard PTFE of resisting a sliding path of 10000 m at the average contact pressure of 30 MPa, the SMF has demonstrated to resist more than 5 times the traditional PTFE, with more than positive repercussions on the service life of the devices.

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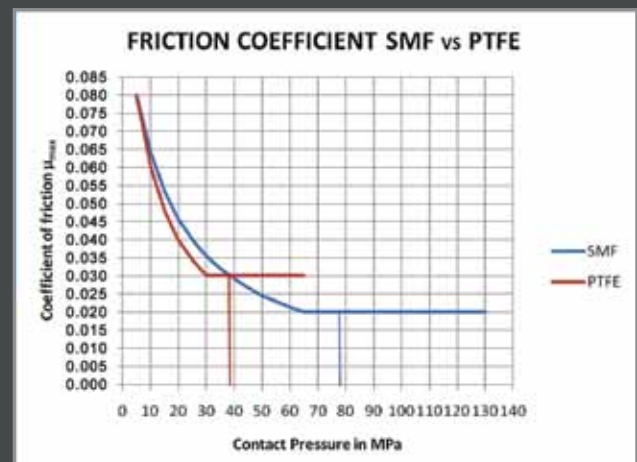
INDICATIONS

CORROSION PROTECTION

The corrosion protection system of the exposed steel surfaces comprises:

- Sandblasting SA 2.5-3
- Cycloaliphatic Epoxy Polyamide Finish mdft 210 µm

The corrosion protection follows the indications given in EN 1337-9. The bearings are finished with a light grey (RAL 7035) unless otherwise requested. The bearing devices are supplied with an external dust seal and a dust scraper for the sliding surfaces.

PRE-SETTING

The sliding plate of the sliding bearings can be pre-set in the workshop to cater for special construction requirements. The pre-setting values must be defined and communicated to **FIP Industriale** before the production process starts.

HANDLING

The bearings are delivered assembled with the different elements kept together by a pair of yellow brackets. The yellow brackets must not be removed before the device is installed and in any case not before the Engineer deems fit.

Pallets must be used to move the packaged bearings. They shall be properly harnessed and lifted using suitable mechanical equipment (crane, forklift). To handle the individual bearing use eyebolts to be screwed into the threaded holes on the upper side of the bearing. Dismounting the bearing device on site is not permitted for any reason.

STORAGE

The bearing devices are delivered assembled and ready for installation. If they are not installed immediately, the Customer is responsible for ensuring that they are properly stored in order to prevent mechanical damages and harmful effects of dust, dirt, humidity, heat, pollutants, and other.

INSTALLATION

The bearing devices are supplied with drawings and installation instructions. Customers and Engineers should feel free to contact **FIP Industriale**'s Technical Department for information on the most appropriate installation procedure based on the type of structure and its construction phases.

• **Saint Petersburg, Russia - Sofijskaja Street Extension**

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DESIGN CRITERIA

The bearings of this catalogue and as listed in the tables, have been designed considering the following:

LOADS

The bearings have been designed considering the vertical loads at ULS and the following relations:

• Vertical loads of reference at ULS

• Maximum vertical load at Service Limit State (SLS) = Maximum Vertical load at Ultimate Limit State (ULS) / 1.4

• Minimum vertical load = 0.3 x Vertical load at SLS

• Vertical dead load (i.e. permanent load) = 0.6 x Vertical load at SLS

SLIDING MOVEMENTS

The European Standard EN 1337-1 requires that the total design movement as increased by 40 mm and establishes a total minimum movement of 100 mm in the main sliding direction.

Therefore, the sliding bearings in the tables below provide the following minimum movements:

SU: longitudinally= 100 mm (± 50 mm)   transversally = 0

SU*:   longitudinally = 0   transversally = 100 mm (± 50 mm)

SM: longitudinally= 100 mm (± 50 mm)   transversally = 50 mm (± 25 mm)

ROTATIONS

The **SMF** spherical bearings provide for the following rotations:

Total maximum rotation = ±0.010 rad.

In addition to the above according to EN 1337-1 bearings can accommodate occasionally an extra rotation of ±0.005 rad. This rotation should not be considered in bearings verifications.

ANCHORING SYSTEMS

Upper anchoring system: Bolts and dowels.
Lower anchoring system: Bolts and dowels.

The anchoring system is calculated without considering friction.

Free sliding bearings can be supplied with no mechanical anchoring (friction only), if requested by the designer.

Note: the choice of anchoring systems other than the assumed ones, might require a change in the bearing dimensions.

SUPER AND SUB STRUCTURE

Bearings maximum average contact pressure on the concrete at SLS < 30 MPa
Bearings maximum design eccentric pressure on the concrete at ULS < 50 MPa

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Allowable concrete contact pressure on upper and lower concrete may be calculated according to EN 1992 §6.7 as follows:

$$\sigma_{Rdu} = f_{Cd} \cdot \sqrt{A_{C1}/A_{C0}} \leq 3,0 \cdot f_{Cd} \qquad f_{Cd} = \frac{\alpha_{cc} \cdot f_{ck}}{\gamma_c}$$

Where:

A_{c0} =   circular area of concrete loaded by the bearing or by the lower/upper counterplate

A_{c1} = A_{c0} distribution into the upper/lower concrete

α_{cc} =   is a coefficient taking into account long-term effects on the compressive strength and unfavorable effects resulting from the way the load is applied = 1.

γ_c =   safety coefficient of the concrete.

f_{ck} =   cylindrical characteristic strength of the concrete.

No wedged elements for the recovering of the longitudinal or transverse slopes of the deck are included.

BEARINGS SELECTION

In order to easily select the most appropriate bearings for a correct restraint system for the different types of structures, you can refer to the following tables covering the «standard» fixed, longitudinally guided sliding, transversally guided sliding, and free sliding **Sferopol®** bearings.

To cover the greatest number of cases, the two bearing types that transmit horizontal forces have further been divided into Normal and High, which differ for the lower or higher horizontal forces resisted up to 10% or 30% of vertical load, respectively.

Should different conditions be required, **FIP Industriale** shall be provided at least with the following data in order to prepare an adequate technical proposal:

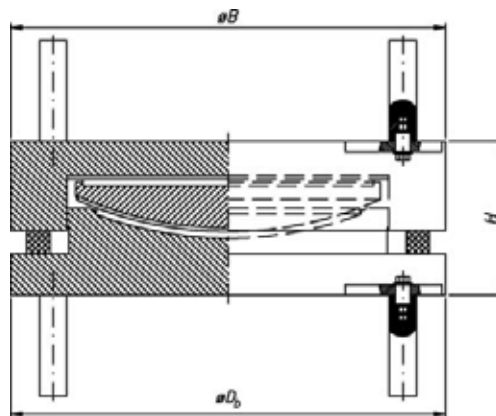|	
$N_{sd\ ULS}$	maximum axial force (vertical load) at ULS
N_{conc}	axial force (vertical load) concurrent with the maximum horizontal force
N_{perm}	permanent axial force (vertical load)
$V_{x,\ ULS}$	maximum longitudinal horizontal force
$V_{y,\ ULS}$	maximum transverse horizontal force
V_{conc}	horizontal force concurrent with Nsd ULS
α_{max}	maximum rotation
υ_x	maximum longitudinal movement in the worst Limit State condition (SU and SM bearings)
υ_y	maximum transverse movement in the worst Limit State condition (SU* and SM bearings)
P_x	longitudinal slope to be compensated for by the bearing (if any)
P_y	transverse slope to be compensated for by the bearing (if any)
	type of deck (steel, cast *in situ* concrete, precast concrete), for anchoring purposes
	type of upper anchoring system
	type of lower anchoring system

Please clarify whether the maximum horizontal force at ULS has to be considered seismic.

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TABLES SFEROPOL® FIXED TYPE

Bearings of fixed type series SF, horizontal load **up to 10% vertical load**.

SF
NORMAL

mark	N_{SLS}	N_{ULS}	V_{ULS}	base øD$_b$	upper øB	height H	weight
	(kN)	(kN)	(kN)	(mm)	(mm)	(mm)	(kg)
SF 100-10	714	1000	100	210	210	87	19
SF 200-20	1429	2000	200	280	280	101	41
SF 300-30	2143	3000	300	330	330	105	60
SF 400-40	2857	4000	400	380	380	113	86
SF 500-50	3571	5000	500	420	420	132	126
SF 600-60	4286	6000	600	460	460	140	163
SF 700-70	5000	7000	700	500	500	144	197
SF 800-80	5714	8000	800	530	530	149	230
SF 900-90	6429	9000	900	560	560	158	274
SF 1000-100	7143	10000	1000	605	605	166	339
SF 1500-150	10714	15000	1500	730	730	186	554
SF 2000-200	14286	20000	2000	830	830	215	838
SF 2500-250	17857	25000	2500	930	930	232	1142
SF 3000-300	21429	30000	3000	1020	1020	260	1551
SF 3500-350	25000	35000	3500	1090	1090	268	1826
SF 4000-400	28571	40000	4000	1170	1170	295	2324
SF 4500-450	32143	45000	4500	1250	1250	303	2725
SF 5000-500	35714	50000	5000	1310	1310	332	3274
SF 6000-600	42857	60000	6000	1400	1400	338	3823
SF 7000-700	50000	70000	7000	1520	1520	375	5027
SF 8000-800	57143	80000	8000	1630	1630	394	6093
SF 9000-900	64286	90000	9000	1740	1740	411	7239
SF 10000-1000	71429	100000	10000	1840	1840	438	8628

Typical drawing with upper and lower dowel anchorage

$N_{sd\ ULS}$	maximum axial force (vertical load) at ULS
N_{conc}	axial force (vertical load) concurrent with the maximum horizontal force
N_{perm}	permanent axial force (vertical load)
$V_{x,\ ULS}$	maximum longitudinal horizontal force
$V_{y,\ ULS}$	maximum transverse horizontal force
V_{conc}	horizontal force concurrent with Nsd ULS
α_{max}	maximum rotation
υ_x	maximum longitudinal movement in the worst Limit State condition (SU and SM bearings)
υ_y	maximum transverse movement in the worst Limit State condition (SU* and SM bearings)
P_x	longitudinal slope to be compensated for by the bearing (if any)
P_y	transverse slope to be compensated for by the bearing (if any)

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Bearings of fixed type series SF, horizontal load **up to 30% vertical load**.

SF
HIGH

mark	N_{SLS}	N_{ULS}	V_{ULS}	base øD$_b$	upper øB	height H	weight
	(kN)	(kN)	(kN)	(mm)	(mm)	(mm)	(kg)
SF 100-30	714	1000	300	230	230	98	27
SF 200-60	1429	2000	600	300	300	123	60
SF 300-90	2143	3000	900	360	360	133	94
SF 400-120	2857	4000	1200	410	410	142	131
SF 500-150	3571	5000	1500	450	450	145	162
SF 600-180	4286	6000	1800	490	490	162	217
SF 700-210	5000	7000	2100	540	540	172	281
SF 800-240	5714	8000	2400	570	570	175	320
SF 900-270	6429	9000	2700	600	600	184	373
SF 1000-300	7143	10000	3000	650	650	191	455
SF 1500-450	10714	15000	4500	800	800	235	865
SF 2000-600	14286	20000	6000	950	950	260	1344
SF 2500-660	17857	25000	6600	1030	1030	269	1642
SF 3000-720	21429	30000	7200	1120	1120	288	2070
SF 3500-780	25000	35000	7800	1170	1170	315	2492
SF 4000-860	28571	40000	8600	1280	1280	323	3046
SF 4500-900	32143	45000	9000	1320	1320	353	3565
SF 5000-1000	35714	50000	10000	1410	1410	361	4144
SF 6000-1200	42857	60000	12000	1540	1540	386	5300
SF 7000-1400	50000	70000	14000	1670	1670	421	6814
SF 8000-1600	57143	80000	16000	1850	1850	429	8553
SF 9000-1700	64286	90000	17000	1930	1930	448	9690
SF 10000-1800	71429	100000	18000	2000	2000	477	11139

Typical drawing with upper and lower dowel anchorage

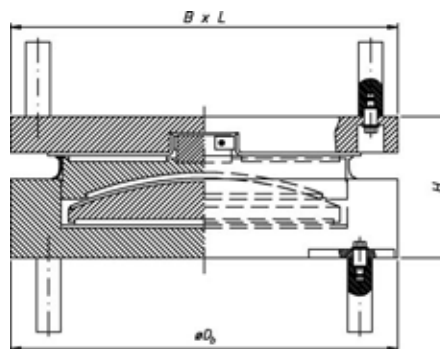|	
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N_{perm}	permanent axial force (vertical load)
$V_{x,\ ULS}$	maximum longitudinal horizontal force
$V_{y,\ ULS}$	maximum transverse horizontal force
V_{conc}	horizontal force concurrent with Nsd ULS
α_{max}	maximum rotation
υ_x	maximum longitudinal movement in the worst Limit State condition (SU andSM bearings)
υ_y	maximum transverse movement in the worst Limit State condition (SU* and SM bearings)
P_x	longitudinal slope to be compensated for by the bearing (if any)
P_y	transverse slope to be compensated for by the bearing (if any)

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Bearings of unidirectional sliding type series SU, horizontal load **up to 10% Maximum vertical load**.

SU
NORMAL

N_{SLS}	N_{ULS}	V_{ULS}	mark	base	upper B x L					height	weight	Δw/±50 mm
					/100 ± 50 mm	/200 ± 100 mm	/300 ± 150 mm	/400 ± 200 mm	/500 ± 250 mm	H		
				$øD_b$								
(kN)	(kN)	(kN)		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(kg)	(kg)
714	1000	100	SU 100/xxx-10	210	240x370	240x470	240x570	240x670	240x770	120	40	5
1429	2000	200	SU 200/xxx-20	280	290x410	290x510	290x610	290x710	290x810	135	67	6
2143	3000	300	SU 300/xxx-30	330	330x480	330x580	330x680	330x780	330x880	144	96	7
2857	4000	400	SU 400/xxx-40	380	380x520	380x620	380x720	380x820	380x920	147	127	8
3571	5000	500	SU 500/xxx-50	420	430x550	430x650	430x750	430x850	430x950	165	177	11
4286	6000	600	SU 600/xxx-60	460	460x590	460x690	460x790	460x890	460x990	169	211	12
5000	7000	700	SU 700/xxx-70	500	500x630	500x730	500x830	500x930	500x1030	182	273	15
5714	8000	800	SU 800/xxx-80	530	510x660	510x760	510x860	510x960	510x1060	183	303	15
6429	9000	900	SU 900/xxx-90	560	560x710	560x810	560x910	560x1010	560x1110	191	365	19
7143	10000	1000	SU 1000/xxx-100	605	605x730	605x830	605x930	605x1030	605x1130	198	427	20
10714	15000	1500	SU 1500/xxx-150	730	770x880	770x980	770x1080	770x1180	770x1280	229	734	29
14286	20000	2000	SU 2000/xxx-200	830	860x980	860x1080	860x1180	860x1280	860x1380	256	1060	38
17857	25000	2500	SU 2500/xxx-250	930	930x1040	930x1140	930x1240	930x1340	930x1440	266	1338	42
21429	30000	3000	SU 3000/xxx-300	1020	990x1110	990x1210	990x1310	990x1410	990x1510	303	1793	53
25000	35000	3500	SU 3500/xxx-350	1090	1090x1210	1090x1310	1090x1410	1090x1510	1090x1610	309	2139	58
28571	40000	4000	SU 4000/xxx-400	1170	1170x1290	1170x1390	1170x1490	1170x1590	1170x1690	337	2686	71
32143	45000	4500	SU 4500/xxx-450	1250	1250x1370	1250x1470	1250x1570	1250x1670	1250x1770	344	3138	76
35714	50000	5000	SU 5000/xxx-500	1310	1350x1470	1350x1570	1350x1670	1350x1770	1350x1870	383	3887	92
42857	60000	6000	SU 6000/xxx-600	1400	1400x1520	1400x1620	1400x1720	1400x1820	1400x1920	400	4616	107
50000	70000	7000	SU 7000/xxx-700	1520	1520x1640	1520x1740	1520x1840	1520x1940	1520x2040	426	5871	128
57143	80000	8000	SU 8000/xxx-800	1630	1630x1750	1630x1850	1630x1950	1630x2050	1630x2150	445	7044	150
64286	90000	9000	SU 9000/xxx-900	1740	1740x1860	1740x1960	1740x2060	1740x2160	1740x2260	483	8706	173
71429	100000	10000	SU 10000/xxx-1000	1840	1840x1960	1840x2060	1840x2160	1840x2260	1840x2360	500	10160	198

dimensions = trasv x long (with reference to the longitudinal axis of the structure)

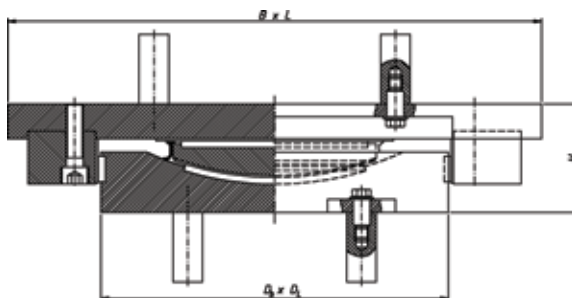*Typical drawing with upper and lower dowel anchorage*

$N_{sd\ ULS}$	maximum axial force (vertical load) at ULS
N_{conc}	axial force (vertical load) concurrent with the maximum horizontal force
N_{perm}	permanent axial force (vertical load)
$V_{x,\ ULS}$	maximum longitudinal horizontal force
$V_{y,\ ULS}$	maximum transverse horizontal force
V_{conc}	horizontal force concurrent with Nsd ULS
α_{max}	maximum rotation
υ_x	maximum longitudinal movement in the worst Limit State condition (SU and SM bearings)
υ_y	maximum transverse movement in the worst Limit State condition (SU* and SM bearings)
P_x	longitudinal slope to be compensated for by the bearing (if any)
P_y	transverse slope to be compensated for by the bearing (if any)

FIP INDUSTRIALE

Bearings of unidirectional sliding type series SU, horizontal load **up to 30% Maximum vertical load**.

SU
HIGH

N_{SLS}	N_{ULS}	V_{ULS}	mark	base	upper B x L					height	weight	Δw/ ±50 mm
				D_b x D_L	/100 ± 50 mm	/200 ± 100 mm	/300 ± 150 mm	/400 ± 200 mm	/500 ± 250 mm	H		
(kN)	(kN)	(kN)		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(kg)	(kg)
714	1000	300	SU 100/xxx-30	220x270	390x480	390x580	390x680	390x780	390x880	95	89	15
1429	2000	600	SU 200/xxx-60	270x320	470x550	470x650	470x750	470x850	470x950	116	153	22
2143	3000	900	SU 300/xxx-90	330x380	560x670	560x770	560x870	560x970	560x1070	132	257	31
2857	4000	1200	SU 400/xxx-120	380x430	620x750	620x850	620x950	620x1050	620x1150	135	325	34
3571	5000	1500	SU 500/xxx-150	410x460	700x780	700x880	700x980	700x1080	700x1180	142	407	40
4286	6000	1800	SU 600/xxx-180	450x500	770x815	770x915	770x1015	770x1115	770x1215	151	512	49
5000	7000	2100	SU 700/xxx-210	490x550	830x870	830x970	830x1070	830x1170	830x1270	154	602	53
5714	8000	2400	SU 800/xxx-240	520x580	850x940	850x1040	850x1140	850x1240	850x1340	168	721	58
6429	9000	2700	SU 900/xxx-270	550x610	900x970	900x1070	900x1170	900x1270	900x1370	177	820	61
7143	10000	3000	SU 1000/xxx-300	580x640	940x1000	940x1100	940x1200	940x1300	940x1400	176	889	64
10714	15000	4500	SU 1500/xxx-450	710x770	1160x1170	1160x1270	1160x1370	1160x1470	1160x1570	218	1555	91
14286	20000	6000	SU 2000/xxx-600	820x900	1290x1320	1290x1420	1290x1520	1290x1620	1290x1720	236	2194	113
17857	25000	6600	SU 2500/xxx-660	940x1040	1420x1470	1420x1570	1420x1670	1420x1770	1420x1870	236	2725	120
21429	30000	7200	SU 3000/xxx-720	1000x1100	1510x1500	1510x1600	1510x1700	1510x1800	1510x1900	257	3296	142
25000	35000	7800	SU 3500/xxx-780	1080x1180	1630x1620	1630x1720	1630x1820	1630x1920	1630x2020	273	4025	158
28571	40000	8600	SU 4000/xxx-860	1160x1260	1750x1700	1750x1800	1750x1900	1750x2000	1750x2100	289	4839	180
32143	45000	9000	SU 4500/xxx-900	1230x1330	1790x1750	1790x1850	1790x1950	1790x2050	1790x2150	304	5422	186
35714	50000	10000	SU 5000/xxx-1000	1300x1400	1910x1850	1910x1950	1910x2050	1910x2150	1910x2250	314	6373	215
42857	60000	12000	SU 6000/xxx-1200	1400x1550	2040x1950	2040x2050	2040x2150	2040x2250	2040x2350	322	7671	248
50000	70000	14000	SU 7000/xxx-1400	1500x1650	2230x2050	2230x2150	2230x2250	2230x2350	2230x2450	345	9512	297
57143	80000	16000	SU 8000/xxx-1600	1650x1800	2380x2200	2380x2300	2380x2400	2380x2500	2380x2600	349	11353	331
64286	90000	17000	SU 9000/xxx-1700	1800x1950	2530x2360	2530x2460	2530x2560	2530x2660	2530x2760	363	13517	367
71429	100000	18000	SU 10000/xxx-1800	2000x2150	2770x2550	2770x2650	2770x2750	2770x2850	2770x2950	378	16782	410

dimensions = trasv x long (with reference to the longitudinal axis of the structure)

Typical drawing with upper and lower dowel anchorage

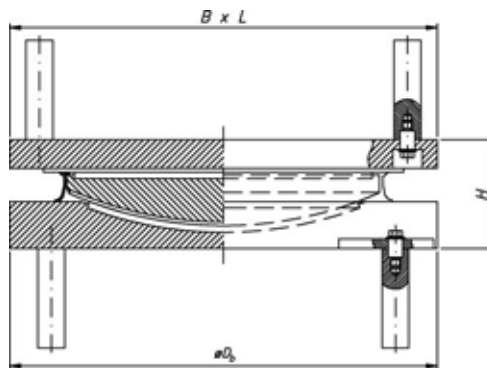|	
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N_{conc}	axial force (vertical load) concurrent with the maximum horizontal force
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$V_{x,\ ULS}$	maximum longitudinal horizontal force
$V_{y,\ ULS}$	maximum transverse horizontal force
V_{conc}	horizontal force concurrent with Nsd ULS
α_{max}	maximum rotation
υ_x	maximum longitudinal movement in the worst Limit State condition (SU and SM bearings)
υ_y	maximum transverse movement in the worst Limit State condition (SU* and SM bearings)
P_x	longitudinal slope to be compensated for by the bearing (if any)
P_y	transverse slope to be compensated for by the bearing (if any)

FIP INDUSTRIALE

Bearings of free sliding type series SM.

SM

N_{SLS}	N_{ULS}	mark	base	upper B x L					height	weight	Δw/
				/100	/200	/300	/400	/500			±50 mm
			$øD_b$	± 50 mm	± 100 mm	± 150 mm	± 200 mm	± 250 mm	H		
(kN)	(kN)		(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(kg)	(kg)
714	1000	SM 100/xxx/50	260	270x375	270x475	270x575	270x675	270x775	91	37	5
1429	2000	SM 200/xxx/50	310	315x420	315x520	315x620	315x720	315x820	97	54	6
2143	3000	SM 300/xxx/50	345	355x460	355x560	355x660	355x760	355x860	103	71	7
2857	4000	SM 400/xxx/50	380	385x490	385x590	385x690	385x890	385x890	105	89	8
3571	5000	SM 500/xxx/50	410	415x520	415x620	415x720	415x820	415x920	117	118	11
4286	6000	SM 600/xxx/50	440	440x550	440x650	440x750	440x1150	440x950	116	133	11
5000	7000	SM 700/xxx/50	480	480x590	480x690	480x790	480x1290	480x990	129	178	14
5714	8000	SM 800/xxx/50	510	510x620	510x720	510x820	510x920	510x1020	128	199	15
6429	9000	SM 900/xxx/50	550	550x660	550x760	550x860	550x1560	550x1060	136	250	19
7143	10000	SM 1000/xxx/50	580	580x690	580x790	580x890	580x990	580x1090	141	292	22
10714	15000	SM 1500/xxx/50	700	700x810	700x910	700x1010	700x2310	700x1210	169	514	32
14286	20000	SM 2000/xxx/50	810	810x920	810x1020	810x1120	810x1220	810x1320	187	767	40
17857	25000	SM 2500/xxx/50	900	900x1010	900x1110	900x1210	900x3510	900x1410	206	1055	51
21429	30000	SM 3000/xxx/50	980	980x1100	980x1200	980x1300	980x1400	980x1500	213	1306	60
25000	35000	SM 3500/xxx/50	1070	1070x1190	1070x1290	1070x1390	1070x4690	1070x1590	239	1737	74
28571	40000	SM 4000/xxx/50	1140	1140x1260	1140x1360	1140x1460	1140x1560	1140x1660	254	2126	87
32143	45000	SM 4500/xxx/50	1210	1210x1330	1210x1430	1210x1530	1210x5830	1210x1730	259	2417	92
35714	50000	SM 5000/xxx/50	1280	1280x1400	1280x1500	1280x1600	1280x1700	1280x1800	279	2934	108
42857	60000	SM 6000/xxx/50	1390	1390x1520	1390x1620	1390x1720	1390x1820	1390x1920	302	3765	128
50000	70000	SM 7000/xxx/50	1500	1500x1610	1500x1710	1500x1810	1500x1910	1500x2010	325	4690	150
57143	80000	SM 8000/xxx/50	1600	1600x1730	1600x1830	1600x1930	1600x2030	1600x2130	329	5466	160
64286	90000	SM 9000/xxx/50	1700	1700x1820	1700x1920	1700x2020	1700x2120	1700x2220	353	6595	183
71429	100000	SM 10000/xxx/50	1800	1800x1940	1800x2040	1800x2140	1800x2240	1800x2340	378	7942	208

dimensions = trasv x long (with reference to the longitudinal axis of the structure)

Typical drawing with upper and lower dowel anchorage

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FIP *INDUSTRIALE*

SPECIAL SFEROPOL® BEARINGS

To meet particular functional requirements **FIP Industriale** also manufactures **Sferopol®** bearings integrated with special elements and/or specially shaped.

The main types are listed below. For further information see **FIP Industriale**'s website.

ANTI-LIFTING SFEROPOL®

Also known as "negative load" or "double-acting" bearings. These devices are capable of resisting also vertical tension loads, commonly called "uplift forces".

SFEROPOL® LOAD MEASURING BEARINGS

They permit *in situ* measuring of vertical loads acting on the bearings. Depending on the technology used, measurements can be read on the bearing itself or at a remote location at any time during the service life of the bearing.

SFEROPOL® WITH DAMPERS

They combine a free sliding or guided sliding **Sferopol®** bearing and steel hysteretic (SEL, SEP) and/or fluid viscous (SOP, SOTP, SELOP, SELOTP) dampers into a single device.

They are also called "flat surface sliders with dampers".

SFEROPOL® WITH SHOCK TRANSMISSION UNITS

Sliding bearings coupled with shock transmission units (also called lock-up devices). In case of sudden movements, such as seismic shocks, the shock transmission units prevent the relative movement of the bearing elements they connect, and thus temporarily transform the bearings from sliding into fixed in the direction desired.

SFEROPOL® ELASTIC REACTION BEARING

They are fixed or guided sliding bearings, in which an elastomeric ring is placed between the outer circumference of the intermediate element and the pot wall, to reduce the horizontal stiffness of the bearing.

SFEROPOL® FOR INCREMENTALLY LAUNCHED BRIDGES

Their design allows for the sliding of the bridge deck during launching operation by means of a supplementary special stainless steel sheet fixed to the specially shaped upper side of the bearing, which can be removed after completion of launching.

TEMPORARILY FIXED SFEROPOL®

Sliding bearings with additional temporary restraints that permit them to be fixed in a first phase, e.g. during casting or launching of bridge decks, and subsequently become sliding after the removal of these temporary blocks.

TEMPORARILY SLIDING SFEROPOL®

These bearings are initially free sliding, e.g. so as not to oppose displacements generated during the construction phase, and subsequently fixed or guided sliding after the addition of supplementary restraints or guides.

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