



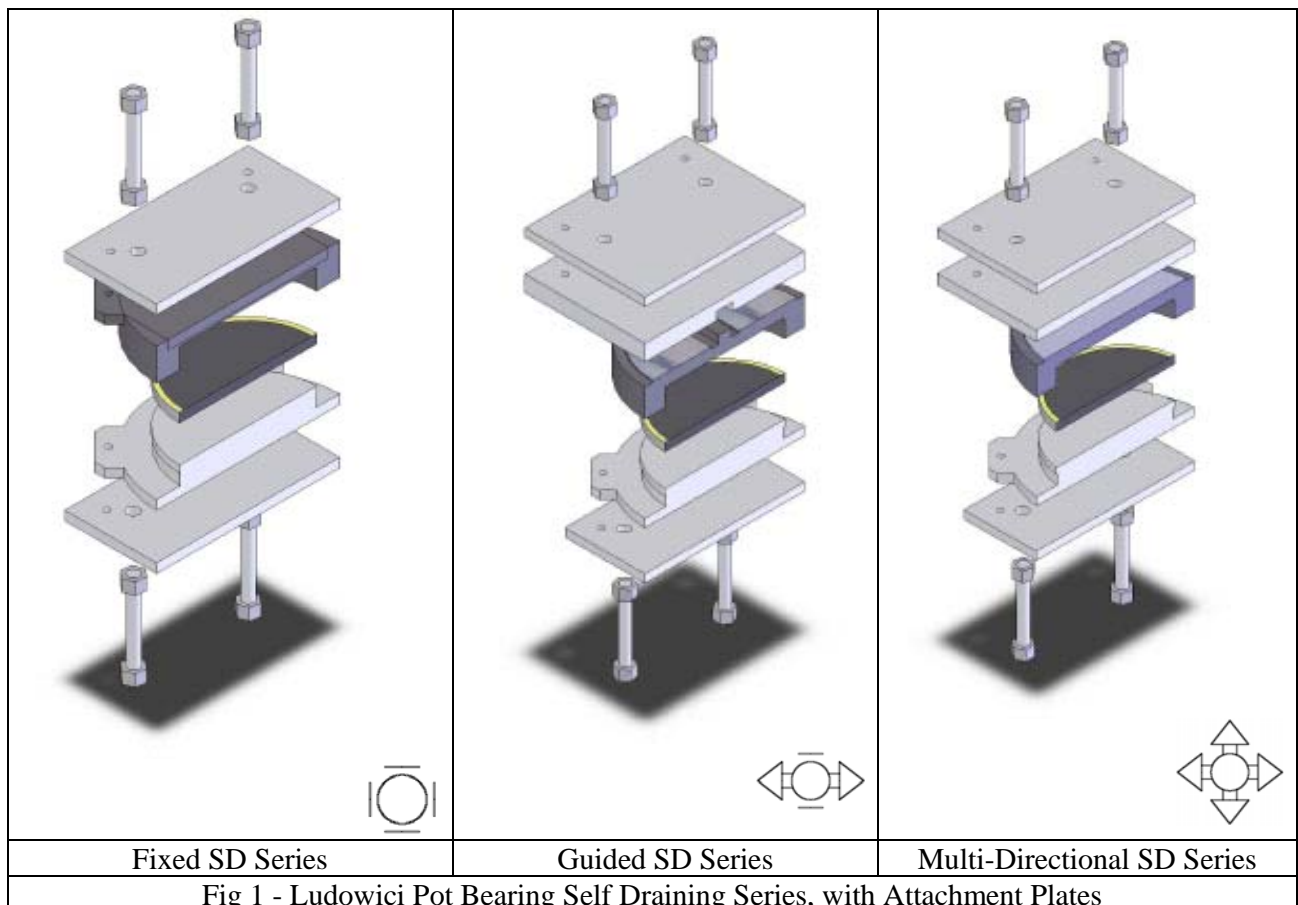
LUDOWICI POT BEARINGS, Self Draining Series (LPB^ / SD~)

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Internet: <http://www.ludowicirubber.com/engineered.html,sku=EP>

Email: engproducts@ludowici.com.au

Ludowici Pot Bearings (LPB[^]) meet latest Australian and International standards (AS5100.4 and prEN1337 in particular), taking their title from the characteristic elastomeric pad confined in a steel cylinder or “pot”, including multiple internal seals. They are designed for Ultimate Limit State (ULS) loads, where previously (eg in the ‘92/96 Austroads Bridge Design Code, referred to as ABDC, and BS5400) they were designed to Serviceability Limit State (SLS) loads.

This catalogue, to our knowledge, gives the most comprehensive design assistance worldwide concerning typical pot bearing dimensions and attachment details using these codes. It should be read in conjunction with Ref 1. Bridge designers should find this catalogue and paper uniquely helpful. Furthermore, Ludowici use industry best practice in their design and manufacture, together with ISO 9001-2000 Certification, and NATA Registered Testing

ULS vs SLS Codes. The following rough conversions apply for other limit states and international codes. Note that AASHTO LRFD is more conservative than AS5100.4, whereas ABDC and BS5400 are slightly less so:-

- the AS5100 designs are based on 50MPa pressure on the elastomer at ULS, (eg 320 diam means 4000kN ULS) (or very approximately, an SLS capacity of 4000 x 0.67, hence 2670kN SLS).
- AASHTO uses 25MPa at SLS, hence the capacity is roughly converted using a factor of 0.5, (eg 2000kN SLS).
- ‘92 ABDC and/or BS5400 SLS use 40MPa at SLS, hence a rough conversion factor of 0.8, (eg 3200kN SLS).

Ludowici’s Self Draining (SD~) series is a design relatively unique to Australia - with the pot above the piston – which allows any trapped moisture to freely drain from the pot (refer to Fig 2a for details). This makes them ideal for flood- and dust-prone conditions. It also makes the requirement for an external seal optional, although it is recognised that many specifications require this seal irrespective of whether the cylinder retains water or not. Technically it is acceptable (and common) to ‘reverse’ them, (Fig 2b), with piston above suitably waterproofed cylinder. In these cases there is no option but to provide a waterproof external seal. We refer to these as our **European (SE~) series**, (covered elsewhere in Ludowici literature). Most fixed bearings supplied around the world are based on the SD design (cylinder over piston), in recognition of this ‘safer’ long-term performance.

Rotations. Ludowici Pot bearings are multi-rotational (generally about any horizontal axis – although a small “self-alignment” rotation about the vertical axis is also acceptable).

Standard Rotations (horizontal axis) for catalogue bearings are $\alpha_{*max} = 0.025\text{rads}$ **Ultimate Limit State.**

Movements. Depending on the translational degrees of freedom designed into them, bearings can be “Fixed”, “Guided” or “Multi-directional” (with respect to movement). “G” and “M” bearings include a slide plate (stainless steel over PTFE), and “G” bearings include a guide (hence Uni-directional). All are very stiff in compression.

Standard movements are $\pm s = \pm 50\text{mm}$ **in the principal ‘S’ direction,**
and, where applicable, i.e. for “M” bearings, $\pm t = \pm 20\text{mm}$ **in the transverse ‘T’ direction.**

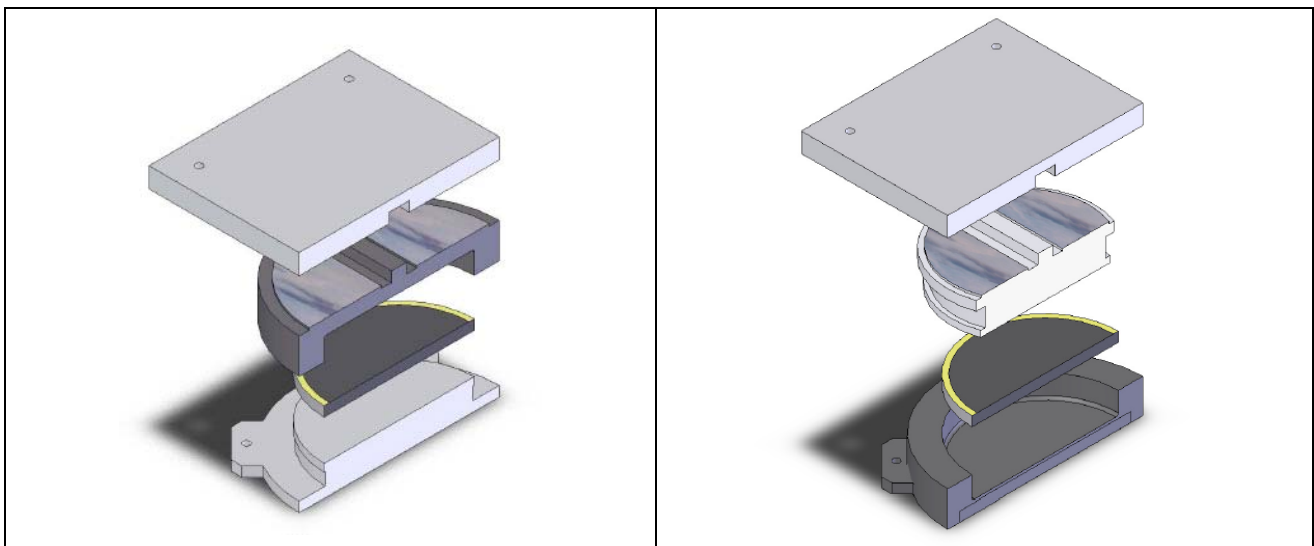
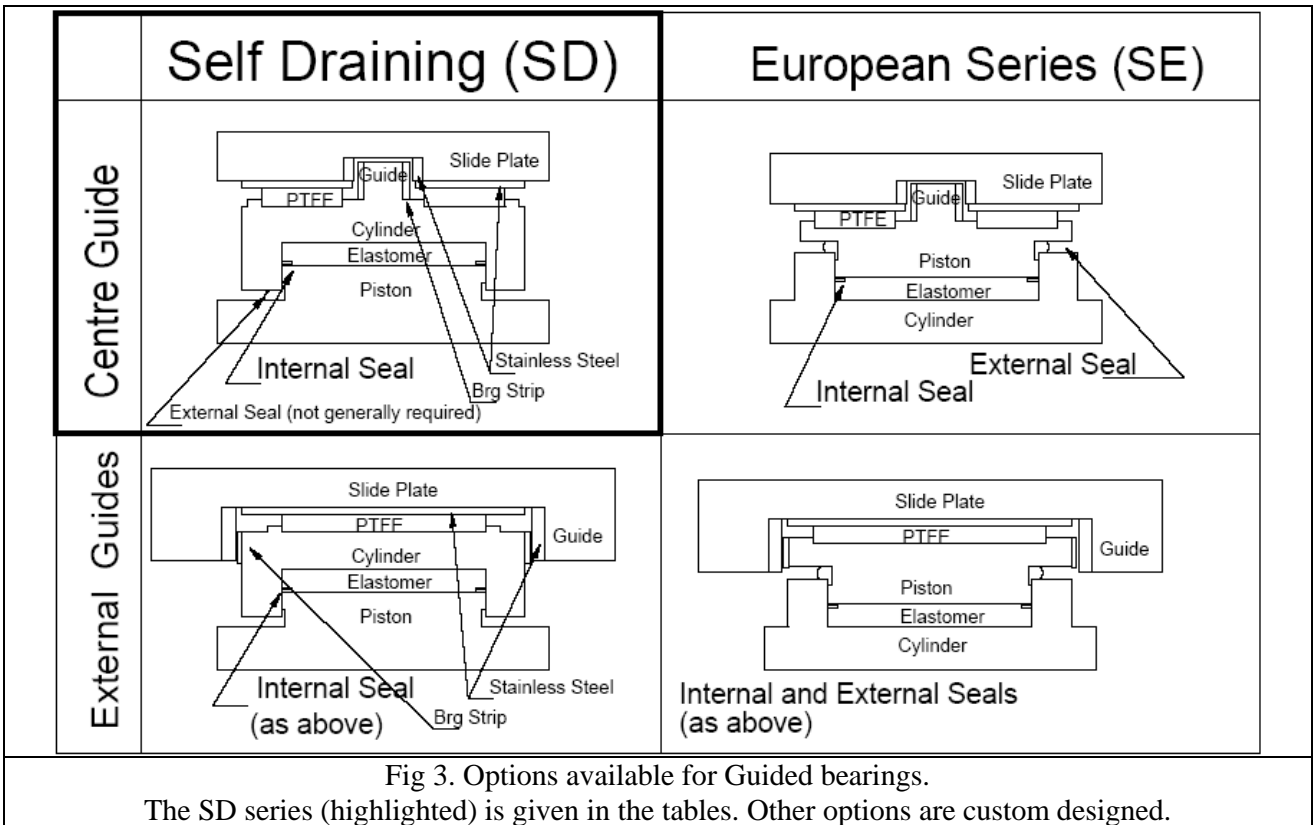


Fig 2a Ludowici Self Draining SD Series and Fig 2b “Reversed” (external seal not shown in both cases)
Note the vulnerability of the right hand design to water retention unless suitably sealed



Compression Loads. Pot bearings can accommodate large compression loads (referred to as N^*_{max}).

Standard compression loads range $N^*_{max} =$ **from 400kN ULS to 25000kN ULS**

There are usually rounded to the nearest 100kN, as given in the tables.

Shear Loads. Pot bearings (types ‘F’ and ‘G’) can also accommodate large ULS shear loads (referred to as H^*_{max} , since they are usually horizontal). The ratio of H^*_{max} to N^*_{max} varies with the size of the bearing and the “Shear Load Series” – see Fig 4.

Standard shear loads range $H^*_{max} =$ **from 20% to 30% of N^*_{max} for small brgs, & from 5% to 10% of N^*_{max} for large brgs.**

Internal guides are standard (where required), although external guides are also available, Fig 3.

Two “Shear Load Series” of standard bearings are available, Series A can accommodate high shear loads, and Series B moderate shear loads.

Other options are of course available. For custom designed bearings (Series X) please contact our Design Office.

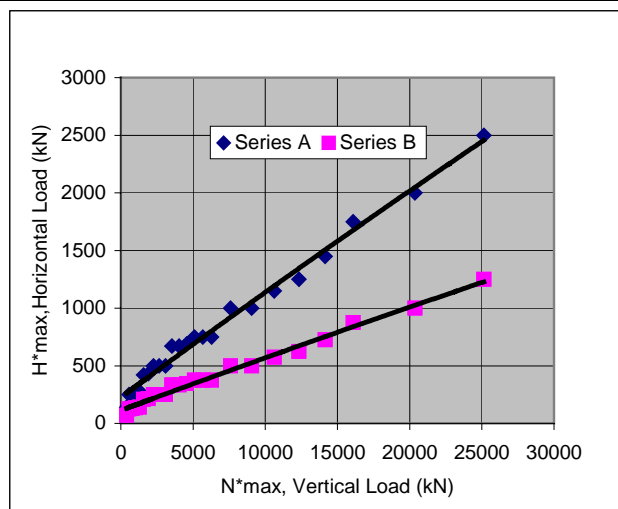


Figure 4 – Shear Load Series A versus Series B

Proof Testing

Concerning acceptance criteria during Proof Testing, designs to AS5100.4 differ from other codes in one important aspect. Representative bearings must be designed to be capable of testing to ULS loads without damage to any part of the bearing. (Many international codes, eg BS5400, permit some damage, provided that the bearing structurally “took the load”).

Contact Pressure

The contact pressure with the sub- and superstructure (whether mortar or steel) is assumed to be 30MPa ULS in the following tables. This is calculated at the interface (i.e. bearing or attachment plate with mortar etc). The distribution area is calculated using a distribution angle of 60 degrees to the vertical through steel from the potpad or PTFE as applicable.

Notation

Notation and Abbreviations include the following:-

- SLS = Serviceability limit state
- ULS = Ultimate limit state (factored)
- SD = Self Draining Pot Bearings
- SE = ‘European’ Design Pot Bearings
- N*max = max compressive load on a bearing, ULS (referred to as ‘V’ in ABDC and BS5400)
- H*max = max shear load on a bearing, ULS (referred to as ‘V’ throughout EN1337 and elsewhere in AS5100. Due to this potential confusion, ‘V’ is not used in AS5100.4 or in this catalogue).
- α^* = rotation on a bearing, ULS
- α^* DL and α^* LL = rotation due to DL (dead load, permanent) and LL (live load, reversible).
- a.S = earthquake factors

For friction at PTFE sliding surfaces due to one bearing (effect on the structure):-

- N_{PE} = the SLS permanent load
- σ = pressure on the PTFE
- μ = friction factor at NPE = $0.8 / (10 + \sigma)$ for temp $> -5^{\circ}\text{C}$, = approx 3% for most dead loads (lubricated)
- H^*_{fr} = the friction at the PTFE slideface = $LF \cdot \mu \cdot NPE$

Compression loads for anchorage design, and testing:-

- N_{min} = the minimum concurrent load normal to the bearing anchorage interface, SLS - particularly for anchorage design of LE brgs, or possibly SLS uplift for pot brgs.
- N^*_{min} (or N^*_{min} coex) = the factored ULS value of N_{min} , usually coexistent with H^* , particularly for anchorage design of pots (and for the testing thereof). Note that N^*_{min} would usually be less than N_{min} .

Note, should N^*_{min} become tensile (uplift, negative compression), all load cases involving uplift must be carefully specified.

Compression load for “best economy” design and testing:-

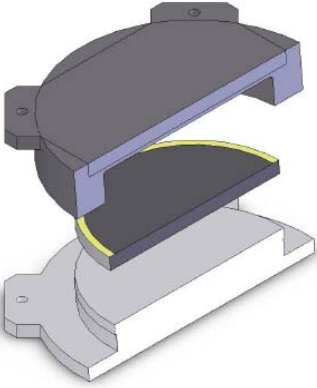
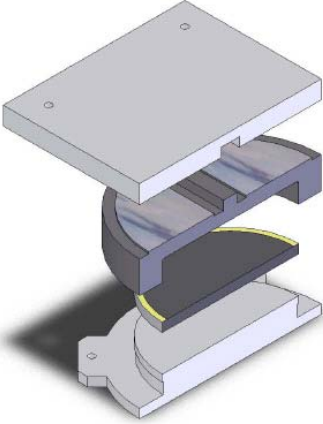
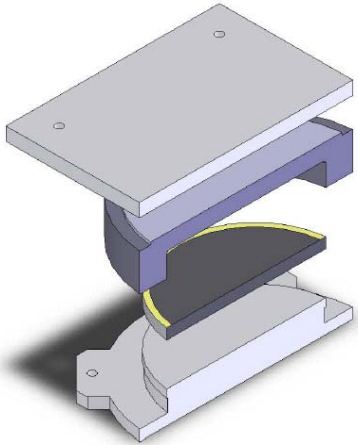
N^*_{max} coex = the maximum concurrent load, ULS (particularly for “best economy” design and/or testing of pots).
 N^*_{max} coex is possibly less than N^*_{max} , but if not given, must be assumed to be N^*_{max} .

References

1. “Design, Specification, Manufacture and Testing of Laminated Elastomeric and Pot Bearings to AS5100.4” Davidson, Sarmiento, Robinson, Willams, 2004. - Please contact our Design Office for a copy.

Standard Ludowici Pot Bearings, Self Draining Series, LPB[^] / SD~.

The following tables give full design details for the following five (5) series of bearings, where ‘[^]’ implies degrees of freedom, (F, G or M); and ‘~’ implies shear load series (A or B).

		
Fixed (SD) Fixed, Series A = LPBF-SDA Fixed, Series B = LPBF-SDB	Guided (SD) Guided, Series A = LPBG-SDA Guided, Series B = LPBG-SDB	Multi-Directional (SD) Multi-directional, Series B (only) = LPBM-SDB. (see note in 3. below).
Figure 5 Standard types of Ludowici Pot bearings (Self Draining)		

The nomenclature is an abbreviation for the type, maximum compression load and movement capacity. The following are examples of standard Catalogue sizes given in the tables:-

- LPBF / 4000u / SDA
 LPBF-Ludowici Pot Bearing Fixed
 4000u-N* max, maximum compression load (ULS), (kN),
 SDA-Self Draining Series A
- LPBG / 4000u #50 / SDB
 LPBG-Ludowici Pot Bearing Guided
 4000u-N* max, maximum compression load (ULS), (kN),
 #50-movt capacity ±50mm (or 100mm total), ULS (s direction).
 SDB-Self Draining Series B
- LPBM / 4000u #50#20 / SDB
 LPBM-Ludowici Pot Bearing Multi-directional
 4000u-N* max, maximum compression load (ULS), (kN),
 #50 #20 - movement capacities ±50mm and +/-20mm ULS (s and t directions)
 SDB-Self Draining Series B

Note. Series B are particularly convenient for Precast Girder Designers. Multidirectional bearings have the same bolts and bolt centres as the equivalent SDB guided bearings, LPBG / 3080u #50 / SDB. Hence these bearings are interchangeable (except for height) making for standard precast girder cast in plates. Furthermore, the dimensions of such plates, both top and bottom are fully detailed in the following tables. As indicated in Fig 5 above, standard Multi-directional bearings are only available in Series B.

Should a non-standard bearing be required, eg LPBG / 4000u #200 / SDX, where SDX = Custom designed, then please contact our Design Office. Note that long movement guided slide plates require top bolts to be checked as an eccentric bolt group at the limit of movement, and hence they qualify as “Custom designed”. Note that ‘*’ is usually reserved for ultimate loads, and ‘#’ is used as simplification of ‘+/-’.

Custom Designed Bearings

Custom designed bearings can include:-

- Bearings with nonstandard compression or shear loads
- Bearings with large and/or nonstandard movement capacities
- Bearings with nonstandard rotation capacities

- Skew Bearings
- Bearings with uplift
- Fatigue loads

- Launch modified bearings
- Load monitoring bearings
- Seismic designs, eg friction damping slide bearings

- Bottom slide plate designs
- High thrust bearings
- Bearings with dampers affixed

- Bearings with “friction brakes” or “plastic yielding brakes” fitted.
- High temperature bearings
- Stainless Steel bearings, with or without electrical insulation

- Etc.

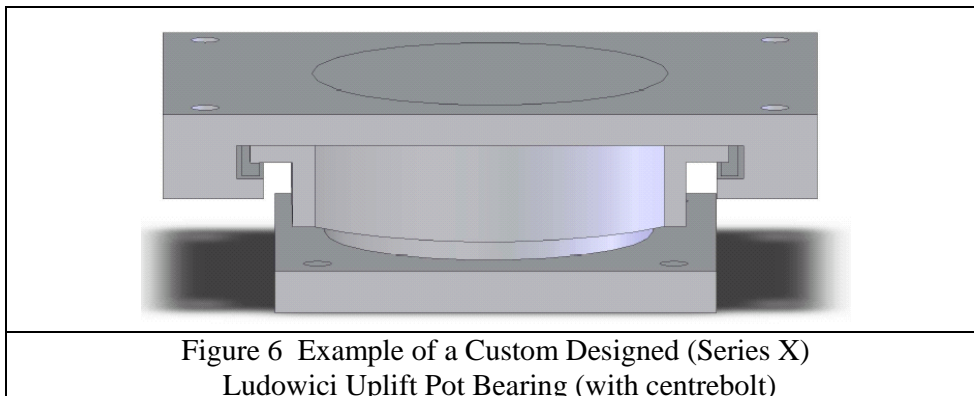
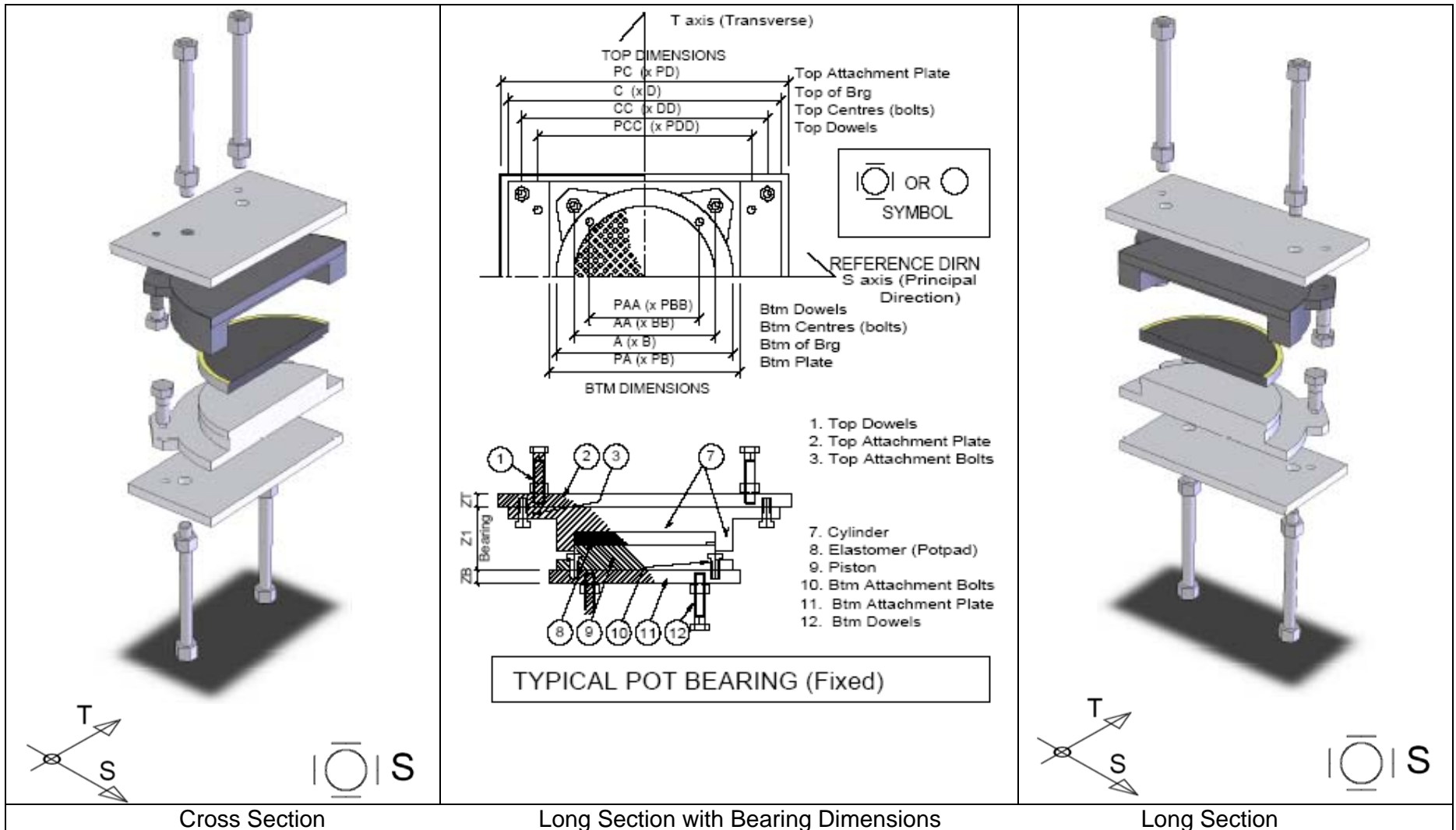



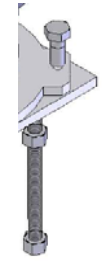
Figure 6 Example of a Custom Designed (Series X)
Ludowici Uplift Pot Bearing (with centrebolt)

1.0 Ludowici Pot Bearings - Self Draining (LPB^ SD~)

1.1 Fixed - Series A (LPBF-SDA)

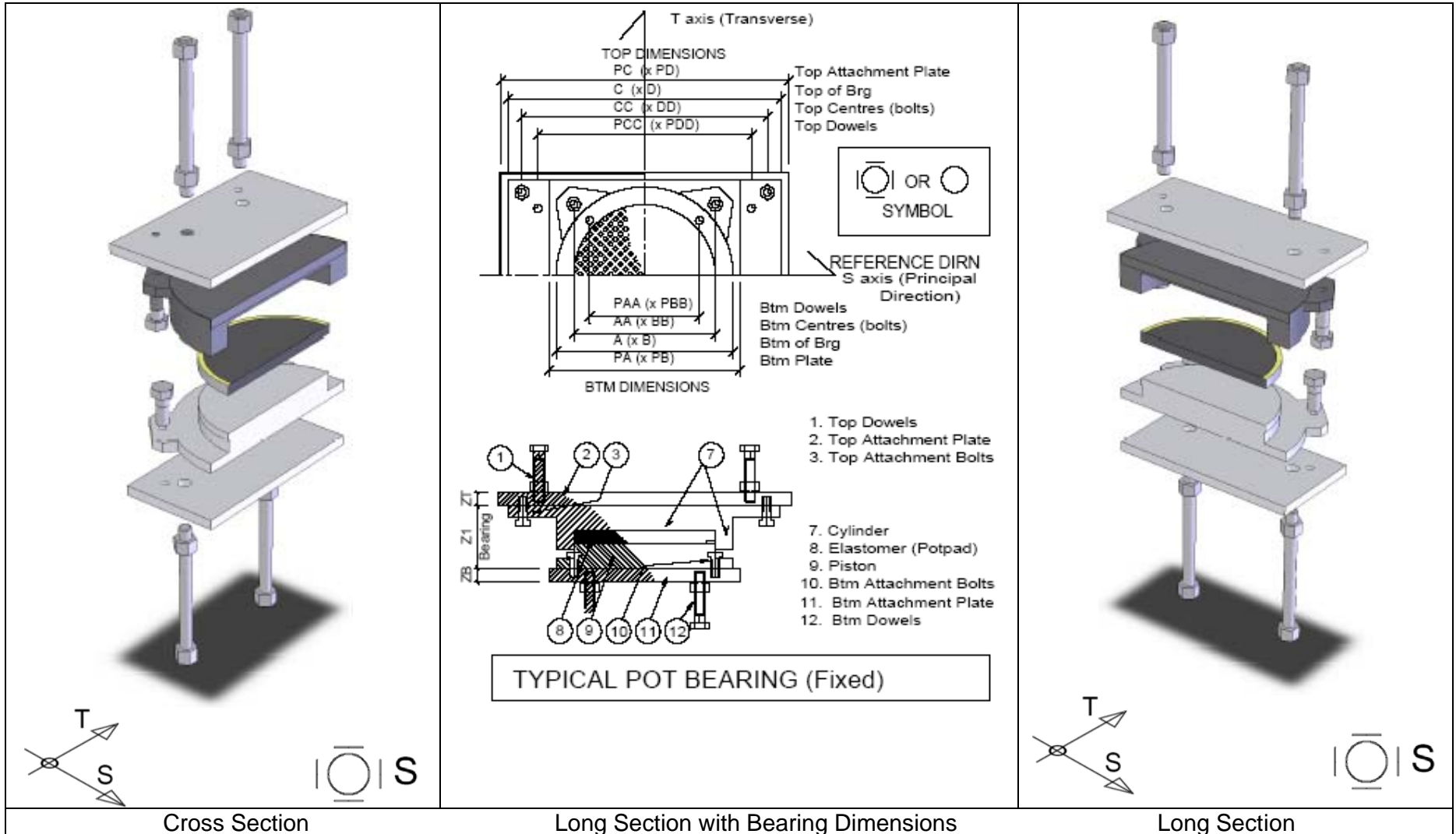


1.1	Ludowici Pot Fixed Bearing Ultimate Series SDA LPBF/.../SDA	Loads		Rotation ULS α^*_{max}	Bearing Attachment Bolts	Bottom of Bearing O/All & Bolt Ctrs		Top of Bearing O/All & Bolt Ctrs		Brg Ht Z1	Attachment Plates		
		N* _{max} (kN)	N* _{min} , coex (kN)			H* _{max} (kN)	Btm Brg A (B)	Bolt Ctrs AA (BB)	Top Brg Cx D		Bolt Ctrs CCxDD	Btm Attt PL PA x PB x Zb	Top Attt PL PC x PD x Zt
1	LPBF/ 400u /SDA	400	80	135	0.025	4/M16Gr8.8	150 dia	130sq	280 x 180	230 x 100	71	180sq x 20	280 x 180 x 20
2	LPBF/ 550u /SDA	550	110	150	0.025	4/M16Gr8.8	170 dia	150sq	280 x 200	230 x 120	81	200sq x 20	280 x 200 x 20
3	LPBF/ 750u /SDA	750	150	160	0.025	4/M16Gr8.8	190 dia	160sq	300 x 210	250 x 140	82	210sq x 20	300 x 210 x 20
4	LPBF/ 1000u /SDA	1000	200	220	0.025	4/M16Gr8.8	210 dia	170sq	320 x 220	270 x 160	83	220sq x 25	320 x 220 x 25
5	LPBF/ 1250u /SDA	1250	250	260	0.025	4/M20Gr8.8	240 dia	200sq	350 x 260	290 x 180	84	260sq x 25	350 x 260 x 25
6	LPBF/ 1600u /SDA	1600	310	320	0.025	4/M20Gr8.8	260 dia	220sq	370 x 280	310 x 200	86	280sq x 25	370 x 280 x 25
7	LPBF/ 1900u /SDA	1900	380	430	0.025	4/M24Gr8.8	280 dia	240sq	410 x 310	330 x 210	87	310sq x 25	410 x 310 x 25
8	LPBF/ 2300u /SDA	2300	750	500	0.025	4/M24Gr8.8	300 dia	250sq	430 x 430	350 x 230	91	320sq x 28	430 x 320 x 28
9	LPBF/ 2700u /SDA	2700	770	500	0.025	4/M30Gr8.8	330 dia	270sq	470 x 360	380 x 240	92	360sq x 28	470 x 360 x 28
10	LPBF/ 3100u /SDA	3100	770	500	0.025	4/M30Gr8.8	350 dia	290sq	470 x 380	380 x 260	93	380sq x 28	470 x 380 x 28
11	LPBF/ 3500u /SDA	3500	770	670	0.025	4/M30Gr8.8	370 dia	300sq	490 x 390	400 x 280	95	390sq x 36	490 x 390 x 36
12	LPBF/ 4000u /SDA	4000	800	670	0.025	4/M30Gr8.8	400 dia	320sq	520 x 410	430 x 310	96	410sq x 36	520 x 410 x 36
13	LPBF/ 4500u /SDA	4500	910	690	0.025	4/M30Gr8.8	420 dia	340sq	540 x 430	450 x 330	101	430sq x 36	540 x 430 x 36
14	LPBF/ 5100u /SDA	5100	1280	750	0.025	4/M30Gr8.8	440 dia	350sq	560 x 440	470 x 350	111	440sq x 36	560 x 440 x 36
15	LPBF/ 5700u /SDA	5700	1250	750	0.025	4/M30Gr8.8	470 dia	370sq	570 x 470	480 x 380	115	470sq x 36	570 x 470 x 36
16	LPBF/ 6300u /SDA	6300	1250	750	0.025	4/M30Gr8.8	490 dia	390sq	590 x 490	500 x 400	115	490sq x 36	590 x 490 x 36
17	LPBF/ 7600u /SDA	7600	2660	1000	0.025	4/M36Gr8.8	540 dia	430sq	660 x 540	550 x 430	133	540sq x 36	660 x 540 x 36
18	LPBF/ 9000u /SDA	9000	2670	1000	0.025	4/M36Gr8.8	580 dia	460sq	680 x 580	570 x 470	131	580sq x 45	680 x 580 x 45
19	LPBF/ 10600u /SDA	10600	2120	1150	0.025	4/M36Gr8.8	630 dia	500sq	730 x 630	620 x 520	150	630sq x 45	730 x 630 x 45
20	LPBF/ 12300u /SDA	12300	2460	1250	0.025	4/M36Gr8.8	680 dia	530sq	780 x 680	670 x 570	149	680sq x 45	780 x 680 x 45
21	LPBF/ 14100u /SDA	14100	3550	1450	0.025	4/M36Gr8.8	730 dia	570sq	830 x 730	720 x 620	178	730sq x 45	830 x 730 x 45
22	LPBF/ 16100u /SDA	16100	3220	1750	0.025	4/M36Gr8.8	770 dia	600sq	870 x 770	760 x 660	175	770sq x 50	870 x 770 x 50
23	LPBF/ 20400u /SDA	20400	4500	2000	0.025	4/M36Gr8.8	870 dia	670sq	970 x 870	860 x 760	193	870sq x 50	970 x 870 x 50
24	LPBF/ 25100u /SDA	25100	7500	2500	0.025	4/M36Gr8.8	960 dia	730sq	1060 x 960	950 x 850	210	960sq x 50	1060 x 960 x 50


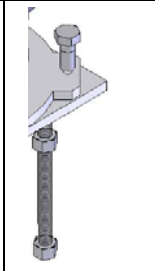
Attachment Bolt Size Qb1	Standard Cast-In Bolts			PAA=AA-2J Bottom Cast-In Bolt Centres PBB=BB-2J Bottom Cast-In Bolt Centres PCC=CC-2J Top Cast-In Bolt Centres PDD=DD-2J Top Cast-In Bolt Centres	 Bottom Cast-In Detail for Sockets (Top similar)	 Bottom Cast-In Detail with Attachment plate, (Top similar).
	Qb2	J	L			
M12 Gr8.8	M12Gr8.8	25	100			
M16 Gr8.8	M16Gr8.8	30	130			
M20 Gr8.8	M20Gr8.8	35	160			
M24 Gr8.8	M24Gr8.8	45	180			
M30 Gr8.8	M30Gr8.8	55	220			
M36 Gr8.8	M36Gr8.8	65	250			

Disclaimer. These Table may only be used for preliminary design and sizing, not for final design or design verification

1.2 Fixed – Series B (LPBF-SDB)

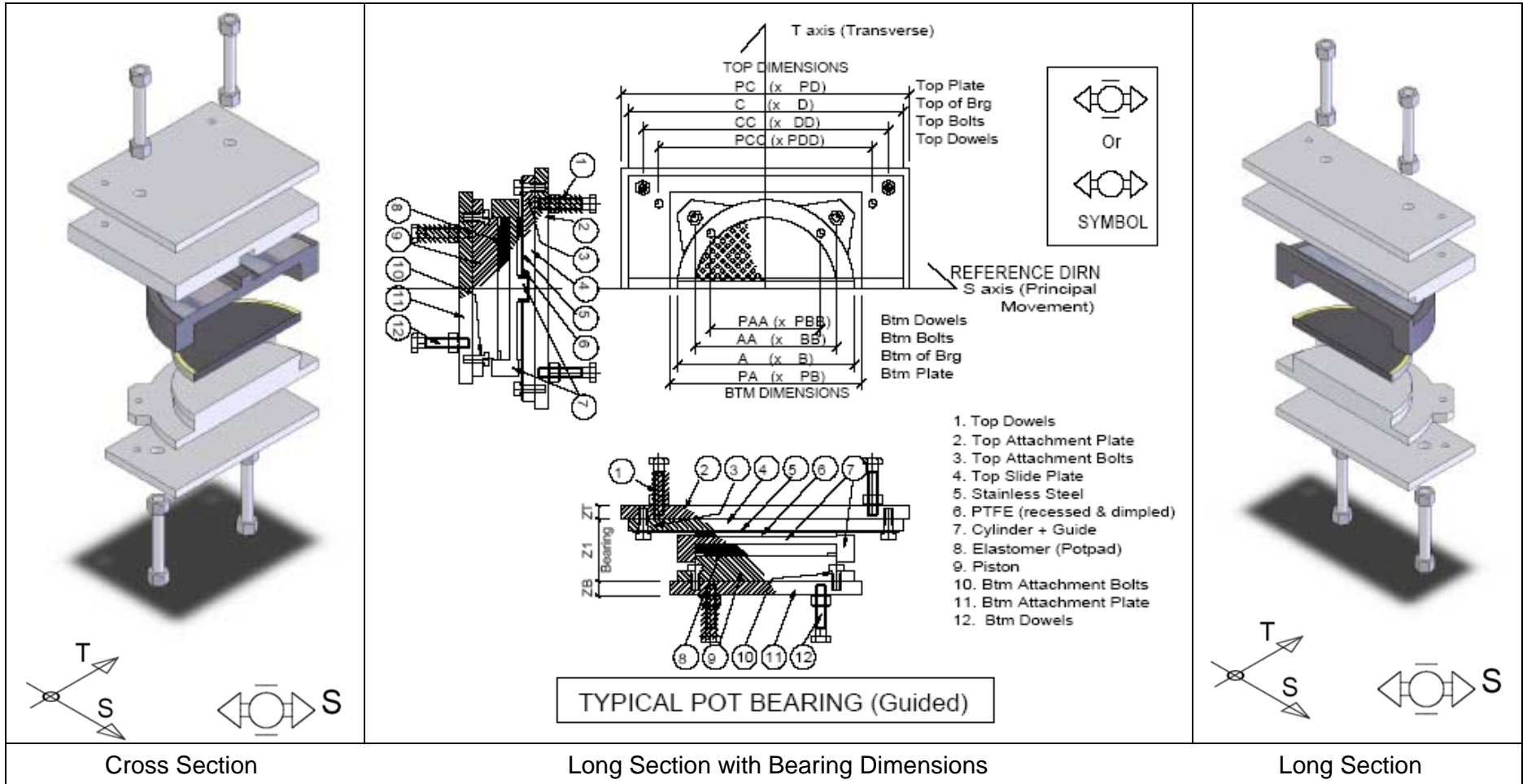


1.2	Ludowici Pot Fixed Bearing Ultimate Series SDB LPBF/.... /SDB	Loads			Rotation ULS α^*_{max} (rads)	Bearing Attachment Bolts	Bottom of Bearing O/All & Bolt Ctrs		Top of Bearing O/All & Bolt Ctrs		Brg Ht Z1	Attachment Plates	
		N^*_{max} (kN)	N^*_{min} , coex (kN)	H^*_{max} (kN)			Btm Brg A (B)	Bolt Ctrs AA (BB)	Top Brg C x D	Bolt Ctrs CC x DD		Btm Attt PL PA x PB x Zb	Top Attt PL PC x PD x Zt
1	LPBF/ 400u /SDB	400	80	70	0.025	4/M12Gr8.8	150 dia	130sq	280 x 170	240 x 110	63	170sq x 16	280 x 170 x 16
2	LPBF/ 550u /SDB	550	110	125	0.025	4/M12Gr8.8	180 dia	150sq	290 x 190	250 x 140	74	190sq x 16	250 x 190 x 16
3	LPBF/ 750u /SDB	750	150	130	0.025	4/M16Gr8.8	210 dia	170sq	320 x 220	270 x 160	74	220sq x 20	320 x 220 x 20
4	LPBF/ 1000u /SDB	1000	200	135	0.025	4/M16Gr8.8	230 dia	190sq	340 x 240	290 x 180	74	240sq x 20	340 x 240 x 20
5	LPBF/ 1250u /SDB	1250	250	140	0.025	4/M16Gr8.8	250 dia	200sq	360 x 250	310 x 200	78	250sq x 20	360 x 250 x 20
6	LPBF/ 1600u /SDB	1600	310	210	0.025	4/M16Gr8.8	270 dia	220sq	380 x 270	330 x 220	82	270sq x 20	380 x 270 x 20
7	LPBF/ 1900u /SDB	1900	380	215	0.025	4/M16Gr8.8	290 dia	230sq	400 x 290	350 x 240	91	290sq x 20	400 x 290 x 20
8	LPBF/ 2300u /SDB	2300	750	250	0.025	4/M16Gr8.8	310 dia	250sq	420 x 310	370 x 260	91	310sq x 20	420 x 310 x 20
9	LPBF/ 2700u /SDB	2700	770	250	0.025	4/M20Gr8.8	330 dia	260sq	440 x 330	390 x 280	95	330sq x 20	440 x 330 x 20
10	LPBF/ 3100u /SDB	3100	770	250	0.025	4/M20Gr8.8	360 dia	290sq	460 x 360	400 x 300	95	360sq x 25	460 x 360 x 25
11	LPBF/ 3500u /SDB	3500	770	335	0.025	4/M20Gr8.8	380 dia	300sq	480 x 380	420 x 320	99	380sq x 25	480 x 380 x 25
12	LPBF/ 4000u /SDB	4000	800	335	0.025	4/M20Gr8.8	400 dia	310sq	500 x 400	440 x 340	98	400sq x 25	500 x 500 x 25
13	LPBF/ 4500u /SDB	4500	910	345	0.025	4/M20Gr8.8	430 dia	340sq	530 x 430	470 x 370	108	430sq x 25	530 x 430 x 25
14	LPBF/ 5100u /SDB	5100	1280	375	0.025	4/M20Gr8.8	450 dia	350sq	550 x 450	490 x 390	117	450sq x 25	550 x 450 x 25
15	LPBF/ 5700u /SDB	5700	1250	375	0.025	4/M20Gr8.8	470 dia	360sq	570 x 470	510 x 410	116	470sq x 25	570 x 470 x 25
16	LPBF/ 6300u /SDB	6300	1250	375	0.025	4/M24Gr8.8	490 dia	380sq	590 x 490	530 x 430	126	490sq x 25	590 x 490 x 25
17	LPBF/ 7600u /SDB	7600	2660	500	0.025	4/M24Gr8.8	540 dia	420sq	640 x 540	570 x 470	134	540sq x 28	640 x 540 x 28
18	LPBF/ 9000u /SDB	9000	2670	500	0.025	4/M24Gr8.8	590 dia	450sq	690 x 590	620 x 520	143	590sq x 28	690 x 590 x 28
19	LPBF/ 10600u /SDB	10600	2120	575	0.025	4/M24Gr8.8	640 dia	490sq	740 x 640	670 x 570	152	640sq x 28	740 x 640 x 28
20	LPBF/ 12300u /SDB	12300	2460	625	0.025	4/M24Gr8.8	680 dia	520sq	780 x 680	710 x 610	161	680sq x 28	780 x 680 x 28
21	LPBF/ 14100u /SDB	14100	3550	725	0.025	4/M24Gr8.8	730 dia	550sq	830 x 730	760 x 660	179	730sq x 28	830 x 730 x 28
22	LPBF/ 16100u /SDB	16100	3220	875	0.025	4/M24Gr8.8	770 dia	580sq	870 x 770	800 x 700	178	770sq x 28	870 x 770 x 28
23	LPBF/ 20400u /SDB	20400	4500	1000	0.025	4/M24Gr8.8	870 dia	650sq	970 x 870	900 x 800	196	870sq x 28	970 x 870 x 28
24	LPBF/ 25100u /SDB	25100	7500	1250	0.025	4/M24Gr8.8	960 dia	720sq	1060 x 960	990 x 890	213	960sq x 28	1060 x 960 x 28


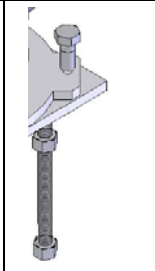
Attachment Bolt Size Qb1	Standard Cast-In Bolts			PAA=AA-2J Bottom Cast-In Bolt Centres PBB=BB-2J Bottom Cast-In Bolt Centres PCC=CC-2J Top Cast-In Bolt Centres PDD=DD-2J Top Cast-In Bolt Centres		Bottom Cast-In Detail for Sockets (Top similar)		Bottom Cast-In Detail with Attachment plate, (Top similar).
	Qb2	J	L					
M12 Gr8.8	M12Gr8.8	25	100					
M16 Gr8.8	M16Gr8.8	30	130					
M20 Gr8.8	M20Gr8.8	35	160					
M24 Gr8.8	M24Gr8.8	45	180					
M30 Gr8.8	M30Gr8.8	55	220					
M36 Gr8.8	M36Gr8.8	65	250					

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1.3 Guided Series A (LPBG-SDA)

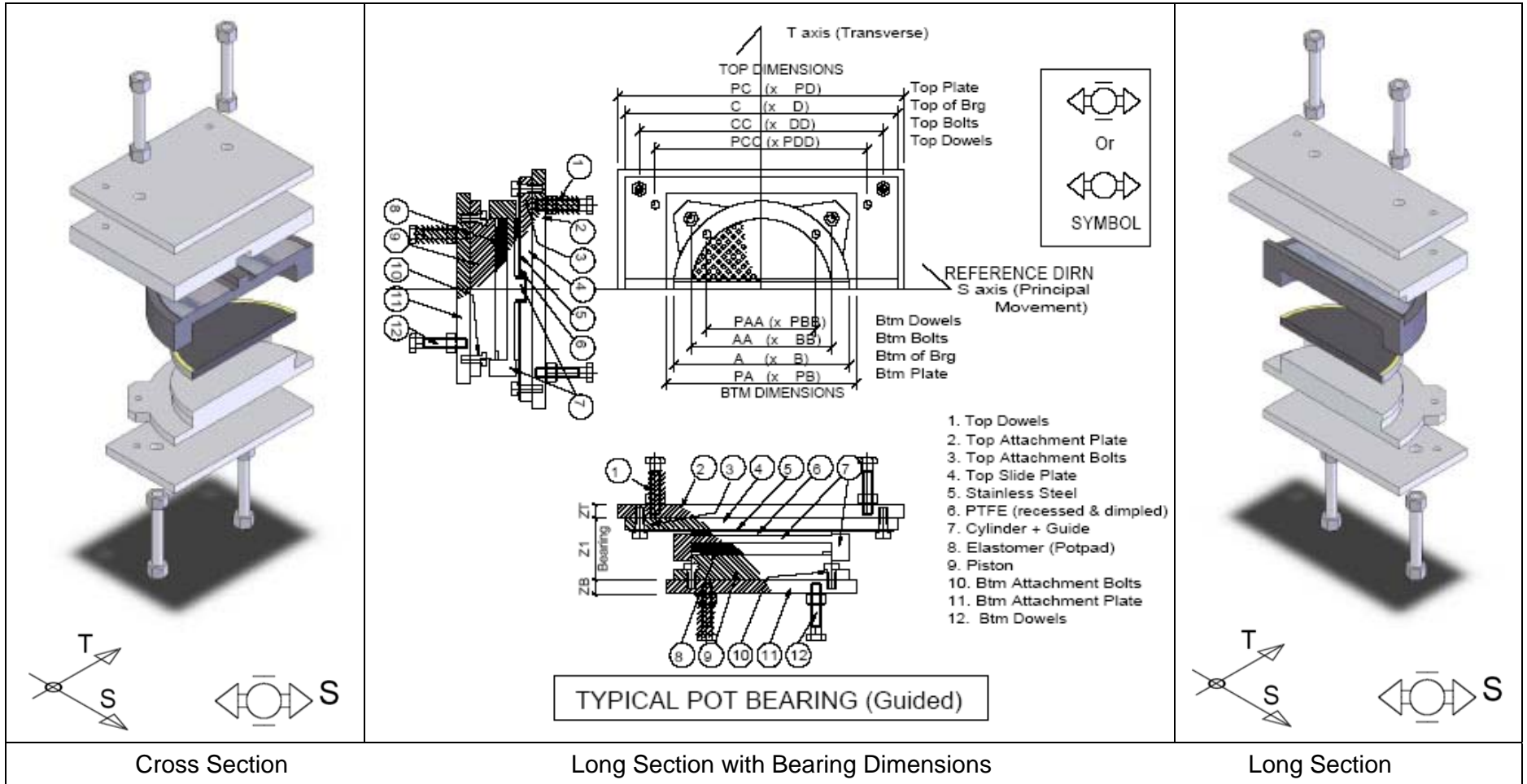


1.3	Ludowici Pot Guided Bearing Ultimate Series SDA LPBG/..../SDA	Loads			Rotation		Bottom of Bearing O/All & Bolt Ctrs		Top of Bearing O/All & Bolt Ctrs		Brg Ht Z1	Attachment Plates	
		N* _{max} (kN)	N* _{min} , coex (kN)	H* _{max} (kN)	α* _{max} (rads)	Bearing Attachment Bolts	Btm Brg A (B)	Bolt Ctrs AA (BB)	Top SL PL C x D	Bolt Ctrs CCxDD		Btm Attt PL PA x PB x Zb	Top Attt PL PC x PD x Zt
1	LPBG/ 400u #50 /SDA	400	80	135	0.025	4/M16Gr8.8	150 dia	130sq	280 x 180	230 x 130	110	180sq x 20	280 x 180 x 20
2	LPBG/ 550u #50 /SDA	550	110	150	0.025	4/M16Gr8.8	170 dia	150sq	280 x 200	230 x 150	115	200sq x 20	280 x 200 x 20
3	LPBG/ 750u #50 /SDA	750	150	160	0.025	4/M16Gr8.8	190 dia	160sq	300 x 210	250 x 160	116	210sq x 20	300 x 210 x 20
4	LPBG/ 1000u #50 /SDA	1000	200	220	0.025	4/M16Gr8.8	210 dia	170sq	320 x 220	270 x 170	117	220sq x 25	320 x 220 x 25
5	LPBG/ 1250u #50 /SDA	1250	250	260	0.025	4/M20Gr8.8	240 dia	200sq	350 x 260	290 x 200	118	260sq x 25	350 x 260 x 25
6	LPBG/ 1600u #50 /SDA	1600	310	320	0.025	4/M20Gr8.8	260 dia	220sq	370 x 280	310 x 220	130	280sq x 25	370 x 280 x 25
7	LPBG/ 1900u #50 /SDA	1900	380	430	0.025	4/M24Gr8.8	280 dia	240sq	410 x 310	330 x 230	131	310sq x 25	410 x 310 x 25
8	LPBG/ 2300u #50 /SDA	2300	750	500	0.025	4/M24Gr8.8	300 dia	250sq	430 x 320	350 x 240	130	320sq x 28	430 x 320 x 28
9	LPBG/ 2700u #50 /SDA	2700	770	500	0.025	4/M30Gr8.8	330 dia	270sq	470 x 360	380 x 270	131	360sq x 28	470 x 360 x 28
10	LPBG/ 3100u #50 /SDA	3100	770	500	0.025	4/M30Gr8.8	350 dia	290sq	470 x 380	380 x 290	132	380sq x 28	470 x 380 x 28
11	LPBG/ 3500u #50 /SDA	3500	770	670	0.025	4/M30Gr8.8	370 dia	300sq	490 x 390	400 x 300	149	390sq x 36	460 x 370 x 36
12	LPBG/ 4000u #50 /SDA	4000	800	670	0.025	4/M30Gr8.8	400 dia	320sq	520 x 410	430 x 320	150	410sq x 36	520 x 410 x 36
13	LPBG/ 4500u #50 /SDA	4500	910	690	0.025	4/M30Gr8.8	420 dia	340sq	540 x 430	450 x 340	160	430sq x 36	540 x 430 x 36
14	LPBG/ 5100u #50 /SDA	5100	1280	750	0.025	4/M30Gr8.8	440 dia	350sq	560 x 440	470 x 350	160	440sq x 36	560 x 440 x 36
15	LPBG/ 5700u #50 /SDA	5700	1250	750	0.025	4/M30Gr8.8	470 dia	370sq	570 x 470	480 x 380	159	470sq x 36	570 x 470 x 36
16	LPBG/ 6300u #50 /SDA	6300	1250	750	0.025	4/M30Gr8.8	490 dia	390sq	590 x 490	500 x 400	159	490sq x 36	590 x 490 x 36
17	LPBG/ 7600u #50 /SDA	7600	2660	1000	0.025	4/M36Gr8.8	540 dia	430sq	660 x 540	550 x 430	177	540sq x 36	660 x 540 x 36
18	LPBG/ 9000u #50 /SDA	9000	2670	1000	0.025	4/M36Gr8.8	580 dia	460sq	680 x 580	570 x 470	186	580sq x 45	680 x 580 x 45
19	LPBG/ 10600u #50 /SDA	10600	2120	1150	0.025	4/M36Gr8.8	630 dia	500sq	730 x 630	620 x 520	194	630sq x 45	730 x 630 x 45
20	LPBG/ 12300u #50 /SDA	12300	2460	1250	0.025	4/M36Gr8.8	680 dia	530sq	780 x 680	670 x 570	203	680sq x 45	780 x 680 x 45
21	LPBG/ 14100u #50 /SDA	14100	3550	1450	0.025	4/M36Gr8.8	730 dia	570sq	830 x 730	720 x 620	212	730sq x 45	830 x 730 x 45
22	LPBG/ 16100u #50 /SDA	16100	3220	1750	0.025	4/M36Gr8.8	770 dia	600sq	870 x 770	760 x 660	230	770sq x 50	870 x 770 x 50
23	LPBG/ 20400u #50 /SDA	20400	4500	2000	0.025	4/M36Gr8.8	870 dia	670sq	970 x 870	860 x 760	247	870sq x 50	970 x 870 x 50
24	LPBG/ 25100u #50 /SDA	25100	7500	2500	0.025	4/M36Gr8.8	960 dia	730sq	1060 x 960	950 x 860	264	960sq x 50	1060 x 960x 50


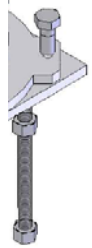
Attachment Bolt Size	Standard Cast-In Bolts				PAA=AA-2J Bottom Cast-In Bolt Centres PBB=BB-2J Bottom Cast-In Bolt Centres PCC=CC-2J Top Cast-In Bolt Centres PDD=DD-2J Top Cast-In Bolt Centres		Bottom Cast-In Detail for Sockets (Top similar)		Bottom Cast-In Detail with Attachment plate, (Top similar).
	Qb1	Qb2	J	L					
M12 Gr8.8	M12Gr8.8	25	100						
M16 Gr8.8	M16Gr8.8	30	130						
M20 Gr8.8	M20Gr8.8	35	160						
M24 Gr8.8	M24Gr8.8	45	180						
M30 Gr8.8	M30Gr8.8	55	220						
M36 Gr8.8	M36Gr8.8	65	250						

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1.4 Guided Series B (LPBG-SDB)

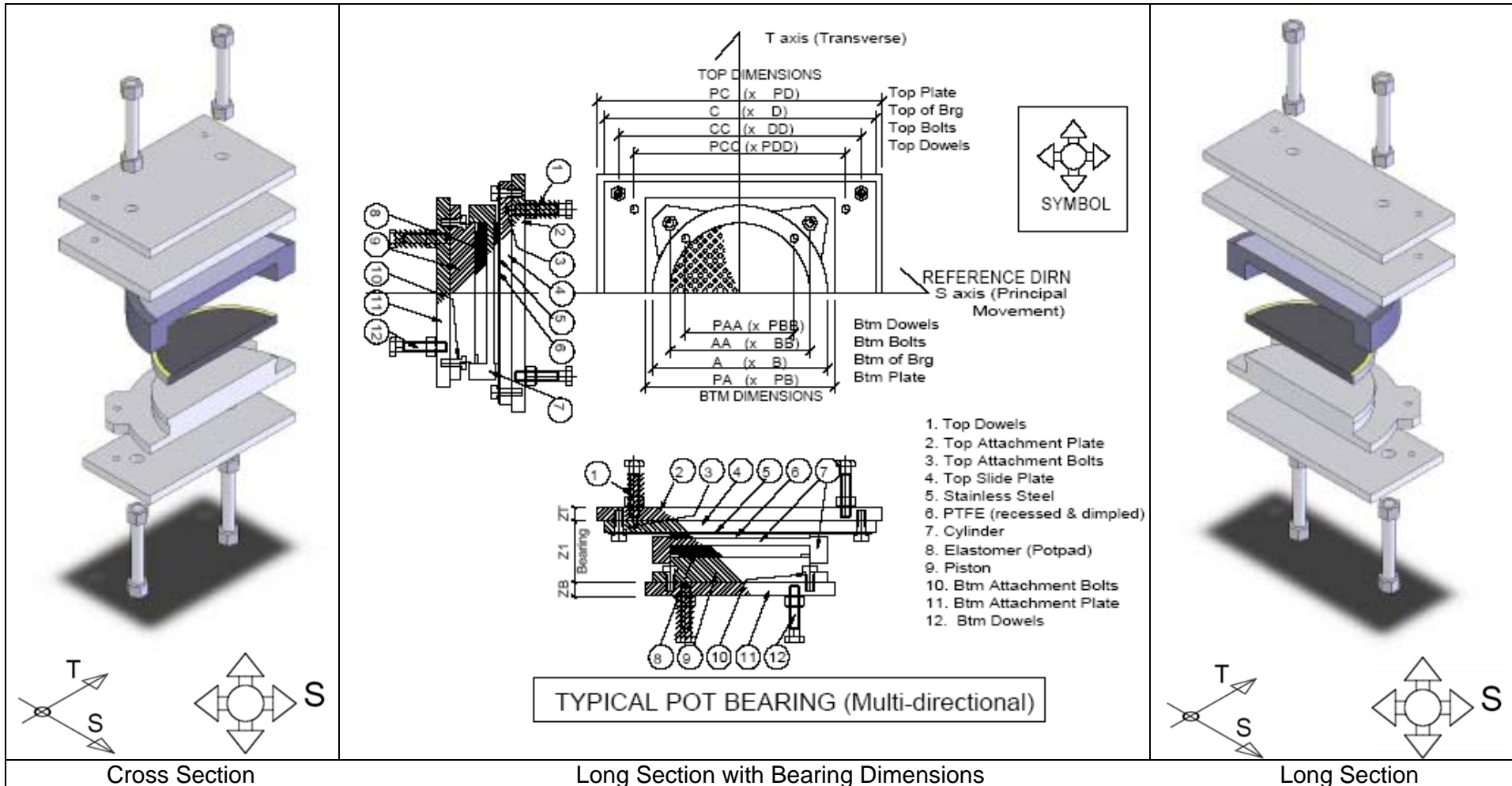


1.4	Ludowici Pot Guided Bearing Ultimate Series SDB LPBG/..../SDB	Loads ULS			Rotation ULS	Bearing Attachment Bolts	Bottom of Bearing O/All & Bolt Ctrs		Top of Bearing O/All & Bolt Ctrs		Brg Ht Z1	Attachment Plates	
		N* _{max}	N* _{min}	H* _{max}	α* _{max}		Btm Brg A (B)	Bolt Ctrs AA (BB)	Top SL PL C x D	Bolt Ctrs CC x DD		Btm Attt PL PA x PB x Zb	Top Attt PL PC x PD x Zt
		(kN)	(kN)	(kN)	(rads)								
1	LPBG/ 400u #50 /SDB	400	80	70	0.025	4/M12Gr8.8	150 dia	130sq	280 x 170	240 x 130	97	170sq x 16	280 x 170 x 16
2	LPBG/ 550u #50 /SDB	550	110	125	0.025	4/M12Gr8.8	180 dia	150sq	290 x 190	250 x 150	113	190sq x 16	290 x 190 x 16
3	LPBG/ 750u #50 /SDB	750	150	130	0.025	4/M16Gr8.8	210 dia	170sq	320 x 220	270 x 170	113	220sq x 20	320 x 220 x 20
4	LPBG/ 1000u #50 /SDB	1000	200	135	0.025	4/M16Gr8.8	230 dia	190sq	340 x 240	290 x 190	113	240sq x 20	340 x 240 x 20
5	LPBG/ 1250u #50 /SDB	1250	250	140	0.025	4/M16Gr8.8	250 dia	200sq	360 x 250	310 x 200	113	250sq x 20	360 x 250 x 20
6	LPBG/ 1600u #50 /SDB	1600	310	210	0.025	4/M16Gr8.8	270 dia	220sq	380 x 270	330 x 220	121	270sq x 20	380 x 270 x 20
7	LPBG/ 1900u #50 /SDB	1900	380	215	0.025	4/M16Gr8.8	290 dia	230sq	420 x 290	370 x 230	125	290sq x 20	420 x 290 x 20
8	LPBG/ 2300u #50 /SDB	2300	750	250	0.025	4/M16Gr8.8	310 dia	250sq	440 x 310	390 x 260	130	310sq x 20	440 x 310 x 20
9	LPBG/ 2700u #50 /SDB	2700	770	250	0.025	4/M20Gr8.8	330 dia	260sq	470 x 330	420 x 280	134	330sq x 20	470 x 330 x 20
10	LPBG/ 3100u #50 /SDB	3100	770	250	0.025	4/M20Gr8.8	360 dia	290sq	480 x 360	420 x 300	134	360sq x 25	480 x 360 x 25
11	LPBG/ 3500u #50 /SDB	3500	770	335	0.025	4/M20Gr8.8	380 dia	300sq	500 x 380	440 x 320	143	380sq x 25	500 x 380 x 25
12	LPBG/ 4000u #50 /SDB	4000	800	335	0.025	4/M20Gr8.8	400 dia	310sq	520 x 400	460 x 340	147	400sq x 25	520 x 400 x 25
13	LPBG/ 4500u #50 /SDB	4500	910	345	0.025	4/M20Gr8.8	430 dia	340sq	550 x 430	490 x 350	152	430sq x 25	550 x 430 x 25
14	LPBG/ 5100u #50 /SDB	5100	1280	375	0.025	4/M20Gr8.8	450 dia	350sq	570 x 450	510 x 390	156	450sq x 25	570 x 450 x 25
15	LPBG/ 5700u #50 /SDB	5700	1250	375	0.025	4/M20Gr8.8	470 dia	360sq	570 x 470	510 x 420	160	470sq x 25	570 x 470 x 25
16	LPBG/ 6300u #50 /SDB	6300	1250	375	0.025	4/M24Gr8.8	490 dia	380sq	590 x 490	530 x 410	165	490sq x 25	590 x 490 x 25
17	LPBG/ 7600u #50 /SDB	7600	2660	500	0.025	4/M24Gr8.8	540 dia	420sq	660 x 540	580 x 460	178	540sq x 28	660 x 540 x 28
18	LPBG/ 9000u #50 /SDB	9000	2670	500	0.025	4/M24Gr8.8	590 dia	450sq	680 x 590	610 x 510	187	590sq x 28	680 x 590 x 28
19	LPBG/ 10600u #50 /SDB	10600	2120	575	0.025	4/M24Gr8.8	640 dia	490sq	730 x 640	660 x 560	191	640sq x 28	730 x 640 x 28
20	LPBG/ 12300u #50 /SDB	12300	2460	625	0.025	4/M24Gr8.8	680 dia	520sq	780 x 680	700 x 600	200	680sq x 28	780 x 680 x 28
21	LPBG/ 14100u #50 /SDB	14100	3550	725	0.025	4/M24Gr8.8	730 dia	550sq	830 x 730	750 x 650	208	730sq x 28	830 x 730 x 28
22	LPBG/ 16100u #50 /SDB	16100	3220	875	0.025	4/M24Gr8.8	770 dia	580sq	870 x 770	790 x 690	222	770sq x 28	870 x 770 x 28
23	LPBG/ 20400u #50 /SDB	20400	4500	1000	0.025	4/M24Gr8.8	870 dia	650sq	970 x 870	890 x 790	245	870sq x 28	970 x 870 x 28
24	LPBG/ 25100u #50 /SDB	25100	7500	1250	0.025	4/M24Gr8.8	960 dia	720sq	1060 x 960	980 x 880	262	960sq x 28	1060 x 960 x 28



Attachment Bolt Size	Standard Cast-In Bolts			PAA=AA-2J Bottom Cast-In Bolt Centres PBB=BB-2J Bottom Cast-In Bolt Centres PCC=CC-2J Top Cast-In Bolt Centres PDD=DD-2J Top Cast-In Bolt Centres	 Bottom Cast-In Detail for Sockets (Top similar)	 Bottom Cast-In Detail with Attachment plate, (Top similar).
	Qb1	Qb2	J L			
M12 Gr8.8	M12Gr8.8	25	100			
M16 Gr8.8	M16Gr8.8	30	130			
M20 Gr8.8	M20Gr8.8	35	160			
M24 Gr8.8	M24Gr8.8	45	180			
M30 Gr8.8	M30Gr8.8	55	220			
M36 Gr8.8	M36Gr8.8	65	250			

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1.5 Multi-directional – Series B (LPBM-SDB)



1.5	Ludowici Pot Multi-Movement Bearing Ultimate Series SDB LPBM/.... /SDB	Loads ULS		Rotation ULS	Bearing Attachment	Bottom of Bearing O/All & Bolt Ctrs		Top of Bearing O/All & Bolt Ctrs		Brg Ht Z1	Attachment Plates	
		N* _{max}	N* _{min} , coex	α^* _{max}	Bolts	Btm Brg A	Bolt Ctrs AA	Top SL PL C x D	Bolt Ctrs CC x DD		Btm Att PL PA x PB x Zb	Top Att PL PC x PD x Zt
		(kN)	(kN)	(rads)		(B)	(BB)					
1	LPBM/ 400u #50 #20 /SDB	400	80	0.025	4/M12Gr8.8	150 dia	130sq	280 x 170	240 x 130	97	170sq x 16	280 x 170 x 16
2	LPBM/ 550u #50 #20 /SDB	550	110	0.025	4/M12Gr8.8	180 dia	150sq	290 x 190	250 x 150	113	190sq x 16	290 x 190 x 16
3	LPBM/ 750u #50 #20 /SDB	750	150	0.025	4/M16Gr8.8	210 dia	170sq	320 x 220	270 x 170	113	220sq x 20	320 x 220 x 20
4	LPBM/ 1000u #50 #20 /SDB	1000	200	0.025	4/M16Gr8.8	230 dia	190sq	340 x 240	290 x 190	113	240sq x 20	340 x 240 x 20
5	LPBM/ 1250u #50 #20 /SDB	1250	250	0.025	4/M16Gr8.8	250 dia	200sq	360 x 250	310 x 200	113	250sq x 20	360 x 250 x 20
6	LPBM/ 1600u #50 #20 /SDB	1600	310	0.025	4/M16Gr8.8	270 dia	220sq	380 x 270	330 x 220	121	270sq x 20	380 x 270 x 20
7	LPBM/ 1900u #50 #20 /SDB	1900	380	0.025	4/M16Gr8.8	290 dia	230sq	420 x 290	370 x 230	125	290sq x 20	420 x 290 x 20
8	LPBM/ 2300u #50 #20 /SDB	2300	750	0.025	4/M16Gr8.8	310 dia	250sq	440 x 310	390 x 260	130	310sq x 20	440 x 310 x 20
9	LPBM/ 2700u #50 #20 /SDB	2700	770	0.025	4/M20Gr8.8	330 dia	260sq	470 x 330	420 x 280	134	330sq x 20	470 x 330 x 20
10	LPBM/ 3100u #50 #20 /SDB	3100	770	0.025	4/M20Gr8.8	360 dia	290sq	480 x 360	420 x 300	134	360sq x 25	480 x 360 x 25
11	LPBM/ 3500u #50 #20 /SDB	3500	770	0.025	4/M20Gr8.8	380 dia	300sq	500 x 380	440 x 320	143	380sq x 25	500 x 380 x 25
12	LPBM/ 4000u #50 #20 /SDB	4000	800	0.025	4/M20Gr8.8	400 dia	310sq	520 x 400	460 x 340	143	400sq x 25	520 x 400 x 25
13	LPBM/ 4500u #50 #20 /SDB	4500	910	0.025	4/M20Gr8.8	430 dia	340sq	550 x 430	490 x 350	152	430sq x 25	550 x 430 x 25
14	LPBM/ 5100u #50 #20 /SDB	5100	1280	0.025	4/M20Gr8.8	450 dia	350sq	570 x 450	510 x 390	156	450sq x 25	570 x 450 x 25
15	LPBM/ 5700u #50 #20 /SDB	5700	1250	0.025	4/M20Gr8.8	470 dia	360sq	570 x 470	510 x 420	160	470sq x 25	570 x 470 x 25
16	LPBM/ 6300u #50 #20 /SDB	6300	1250	0.025	4/M24Gr8.8	490 dia	380sq	590 x 490	530 x 410	165	490sq x 25	590 x 490 x 25
17	LPBM/ 7600u #50 #20 /SDB	7600	2660	0.025	4/M24Gr8.8	540 dia	420sq	660 x 540	580 x 460	178	540sq x 28	660 x 540 x 28
18	LPBM/ 9000u #50 #20 /SDB	9000	2670	0.025	4/M24Gr8.8	590 dia	450sq	680 x 590	610 x 510	187	590sq x 28	680 x 590 x 28
19	LPBM/ 10600u #50 #20 /SDB	10600	2120	0.025	4/M24Gr8.8	640 dia	490sq	730 x 640	660 x 560	191	640sq x 28	730 x 640 x 28
20	LPBM/ 12300u #50 #20 /SDB	12300	2460	0.025	4/M24Gr8.8	680 dia	520sq	780 x 680	700 x 600	200	680sq x 28	780 x 680 x 28
21	LPBM/ 14100u #50 #20 /SDB	14100	3550	0.025	4/M24Gr8.8	730 dia	550sq	830 x 730	750 x 650	208	730sq x 28	830 x 730 x 28
22	LPBM/ 16100u #50 #20 /SDB	16100	3220	0.025	4/M24Gr8.8	770 dia	580sq	870 x 770	790 x 690	222	770sq x 28	870 x 770 x 28
23	LPBM/ 20400u #50 #20 /SDB	20400	4500	0.025	4/M24Gr8.8	870 dia	650sq	970 x 870	890 x 790	245	870sq x 28	970 x 870 x 28
24	LPBM/ 25100u #50 #20 /SDB	25100	7500	0.025	4/M24Gr8.8	960 dia	720sq	1060 x 960	980 x 880	262	960sq x 28	1060 x 960 x 28

Attachment Bolt Size Qb1	Standard Cast-In Bolts			PAA=AA-2J Bottom Cast-In Bolt Centres PBB=BB-2J Bottom Cast-In Bolt Centres PCC=CC-2J Top Cast-In Bolt Centres PDD=DD-2J Top Cast-In Bolt Centres	 Bottom Cast-In Detail for Sockets (Top similar)	 Bottom Cast-In Detail with Attachment plate, (Top similar).
	Qb2	J	L			
M12 Gr8.8	M12Gr8.8	25	100			
M16 Gr8.8	M16Gr8.8	30	130			
M20 Gr8.8	M20Gr8.8	35	160			
M24 Gr8.8	M24Gr8.8	45	180			
M30 Gr8.8	M30Gr8.8	55	220			
M36 Gr8.8	M36Gr8.8	65	250			

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Identifying Mark of bearings		#B12, #B14, and #B16	
Type and Description of bearing		Guided Longitudinal	
Number of Bearings		3	
Load Combinations (In each case, a range of N* values for a set of H*, δ* and α* values.)		(N*max or N*min) + H*coex	(N*max coex or N*min coex)+ H*max
Compressive Load Range For these parameters	N* max (kN)	8000	6000
	N* min (kN)	2000	3000
Horizontal Load (can / cannot coexist)	H*tra (kN)	600	1600, (ship)
	H*lon (kN)	Friction only	Friction only
Displacements+=expansion (can / cannot coexist)	δtra (mm)	+/- 2 limit	+/- 2 limit
	δlongitudinal (mm)	+200, -300	+200, -300
ULS Rotations (can / cannot coexist)	αlon, tilt in long'al dirn	0.010 rads	0.010 rads
	αtra, tilt in transverse dirn	0.005 rads	0.005 rads
Is Frictional Assistance Permitted for Anchorage ?		Yes	Yes
Maximum pressure (60deg distribution) on mortar		30MPa ULS	30MPa ULS

Fig 7. Typical Pot Bearing Performance Schedule, (from Ref 1).

Identifying Mark of bearings			
Type and Description of bearing			
Number of Bearings			
Load Combinations (In each case, a range of N* values for a set of H*, δ* and α* values.)		(N*max or N*min) + H*coex	(N*max coex or N*min coex)+ H*max
Compressive Load Range For these parameters	N* max (kN)		
	N* min (kN)		
Horizontal Load (can / cannot coexist) **	H*tra (kN)		
	H*lon (kN)		
Displacements+=expansion (can / cannot coexist)	δtra (mm)		
	δlongitudinal (mm)		
ULS Rotations, (can / cannot coexist)	αlon, tilt in long'al dirn		
	αtra, tilt in transverse dirn		
Is Frictional Assistance Permitted for Anchorage ?			
Maximum pressure (60deg distribution) on mortar			

Fig 8. Pot Bearing Questionnaire

** = cross off whichever option does not apply