ALTRA INDUSTRIAL MOTION

High Precision Planetary Gearheads

Boston® Gear

An Altra Industrial Motion Company

Boston gearheads provide precise, durable and long-lasting performance

The Boston Gear line of servo gearheads has been designed for direct attachment to popular servomotors. Power is transmitted from the motor to a sun gear which drives three planet gears contained within an internal toothed ring gear. The planet gears are mounted in a carrier with double wall supports. The output shaft automatically rotates as the planet gears and carrier rotate.

Due to the load sharing attributes of multiple tooth contacts, planetary gearboxes provide the highest torque and stiffness for any given envelope. Balanced planetary kinematics at high speeds combined with the associated load sharing make planetary-type gearheads ideal for servo applications. Other significant advantages include:

- True helical technology provides increased tooth to tooth contact ratio by 33% vs spur gearing
  - 12º helix angle produces smooth and quiet operation
- One piece planet carrier and output shaft design reduces backlash
  - Single step machining process
  - Assures 100% concentricity
  - Increases tortional rigidity
- Efficient lubrication for life

Boston Planetary Gearheads are designed for a wide variety of applications

Packaging

Semiconductor

Automotive

Machine Tool

Medical

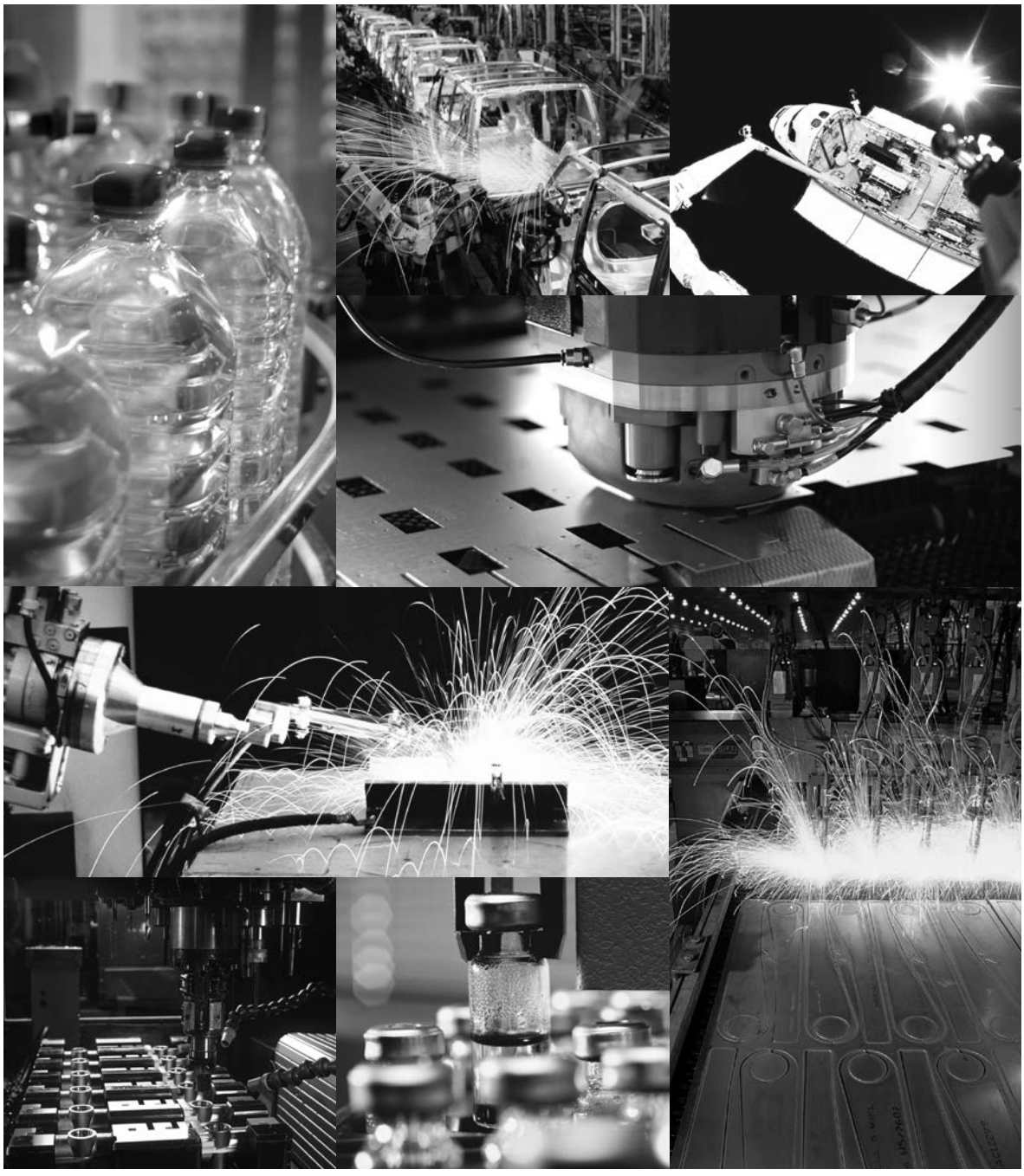
Printing

Paper Converting

Robotics

Assembly

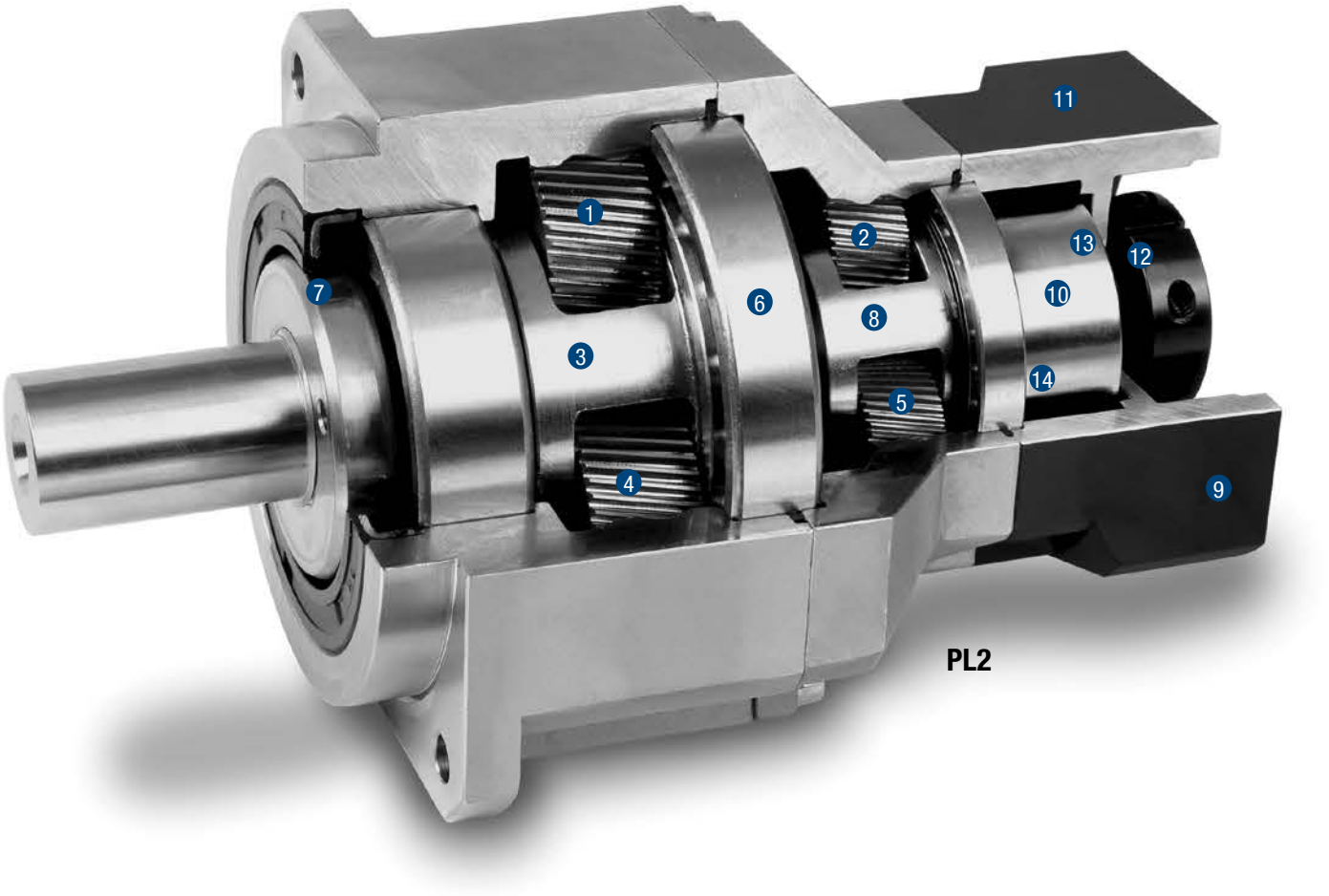
Cut-To-Length



Many applications typically associated with conventional power transmission solutions are beginning to utilize servo control and precision gearheads to meet production requirements. Servo-driven solutions can achieve faster speeds with more precise accuracy while providing greater flexibility and quicker changeover.

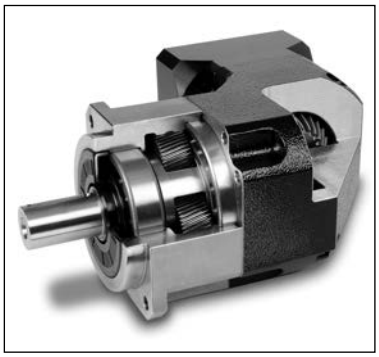
Boston gearheads... the most robust gearheads available.

Superior engineering and design combined with the latest technology have resulted in the creation of a full line of gearheads loaded with enhanced features. Patented planet carrier design, patented input and output sealing designs and special heat and surface treatments are just a few of the unique features that give Boston gearheads a competitive edge.

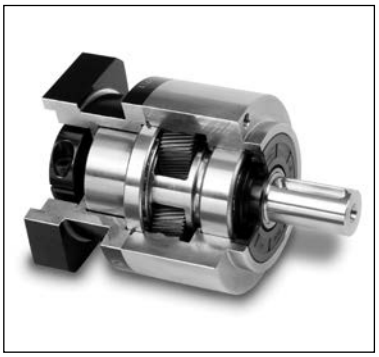


PL2

PR2



PL5



Equipped with **solid uncaged needle roller bearings**, provides maximum contact points to increase stiffness and generates high output torque.

A high setting gear performance is achieved by using **advanced gearing technology**, by **easing off the tooth profile** and **crowning the lead of each tooth**. This optimizes the gear mesh alignment and overlap to achieve maximum tooth surface contact.

Single piece planet carrier with an extended, tapered roller bearing provides maximum radial load capacity (up to 50,000 NM) and increases system reliability and stiffness.

Plasma nitriding heat treatment process maintains the tooth surface hardness at **840Hv** for superior wear-resistance and a core hardness at **30HRc** for toughness.

True Helical Gear Design
Precision helical gearing increases tooth to tooth contact ratio by over 33% versus spur gearing. The helix angle produces smooth and quiet operation with decreased backlash (less than 1 arc-minute and less than or equal to 56dB).

Precision tapered roller bearing support to increase radial and axial loading capacity.

Patented output sealing systems design eliminates friction and heat generation which is accomplished by applying a hi-tech Titanium Carbon Nitride coating to all output contact surfaces. The TiCN coating reaches a hardness of 3000Hv and is ground to Ra 0.2µm finish to ensure sealing.

Patented planet carrier design places the sun gear bearing directly into the planet carrier. This ingenious concept eliminates gear misalignment and gains the highest accuracy on the market. Less than 1 arc-minute backlash!

A special non-electrolysis nickle surface treatment on the output housing and **black anodized** aluminum input adapter are provided for the most extreme environmental conditions to achieve an IP65 Rating.

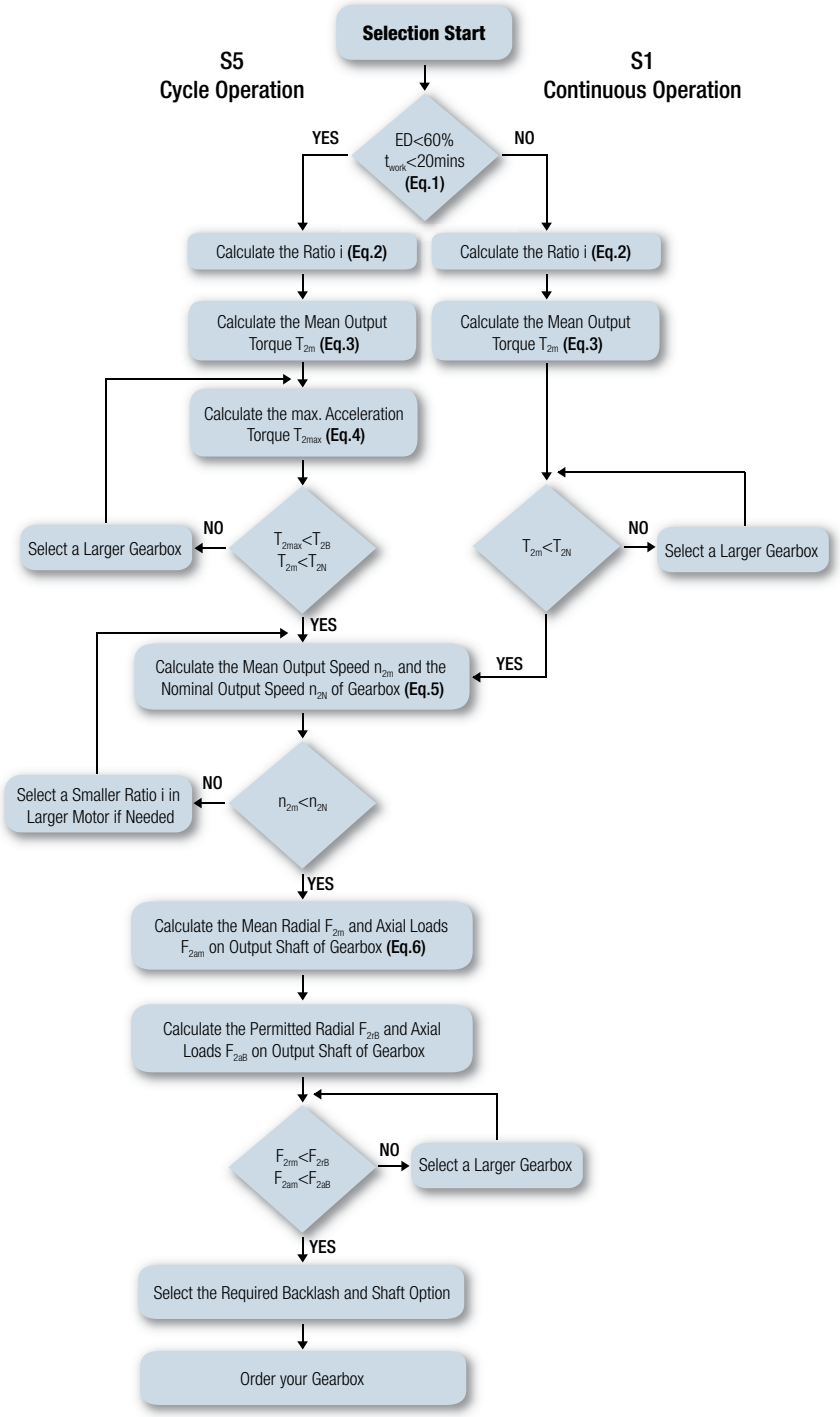
Solid, single-piece sun gear construction obtains precise concentricity with increased strength and rigidity.

The unique **motor adapter** and **bushing module system design** allows for quick and easy mounting of any motor.

Triple split collet with dynamic balanced set collar clamping system provides backlash free power transmission and eliminates slippage. 100% concentricity allows for smooth rotation and higher input speed capability.

Patented input sealing system design eliminates breakaway torque and decreases friction/heat. The TiCN coated bushings (1700 Hv, Ra 0.2µm finish) interface with a proprietory seal which decreases wear and erosion of both sealing surfaces. This new design prevents leakage and has a service life of over 30,000 hours.

Selection of the Optimum Gearbox



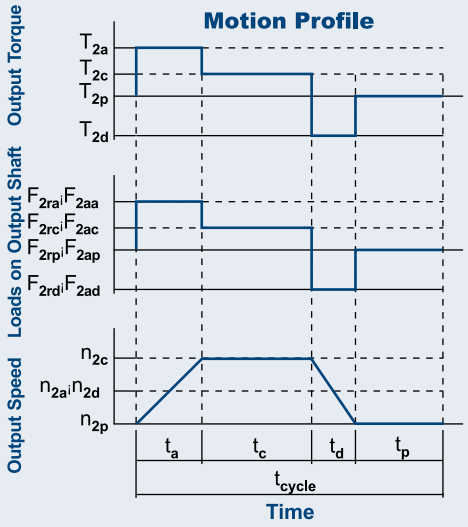
Recommended (for S5 Cycle Operation)
The general design is given for

$$\frac{J}{i^2}< 4 \times J_m^L$$

The optimal design is given for

$$\frac{J}{i^2}\sim J_m^L$$

J Load Inertia
J_m^L Motor Inertia



Eq. 1

$$ED = \frac{t_a + t_c + t_d}{t_{cycle}} \times 100\%,\ t_{work} = t_a + t_c + t_d$$

Index : a. Acceleration, c. Constant,
d. Deceleration, p. Pause

Eq. 2

$$i \cong \frac{n_m}{n_{work}}$$

n_m Output Speed of the Motor

n_{work} Working Speed

Eq. 3

$$T_{2m} = \sqrt[3]{\frac{n_{2a} \times t_a \times T_{2a}^3 + n_{2c} \times t_c \times T_{2c}^3 + n_{2d} \times t_d \times T_{2d}^3}{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}}$$

Eq. 4

$$T_{2max} = T_{mB} \times i \times k_s \times \eta$$

where K_s is

K_s	No. of Cycles / hr
1.0	0 ~ 1,000
1.1	1,000 ~ 1,500
1.3	1,500 ~ 2,000
1.6	2,000 ~ 3,000
1.8	3,000 ~ 5,000

T_{mB} Max. Output Torque of the Motor
η Efficiency of the Gearbox

Eq. 5

$$n_{2a} = n_{2d} = \frac{1}{2} \times n_{2c}$$

$$n_{2m} = \frac{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}{t_a + t_c + t_d}$$

$$n_{2N} = \frac{n_{1N}}{i}$$

Eq. 6

$$F_{2rm} = \sqrt[3]{\frac{n_{2a} \times t_a \times F_{2ra}^3 + n_{2c} \times t_c \times F_{2rc}^3 + n_{2d} \times t_d \times F_{2rd}^3}{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}}$$

$$F_{2am} = \sqrt[3]{\frac{n_{2a} \times t_a \times F_{2aa}^3 + n_{2c} \times t_c \times F_{2ac}^3 + n_{2d} \times t_d \times F_{2ad}^3}{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}}$$

Stainless Steel High Precision Inline Planetary Gearboxes

Dimensional drop-in for
Bayside Stealth
PS Series

Ordering Number System for PL2 Models

Example: PL2060-005-KS-M-0000-00.0

PL	2	060	–	005	–	KS	–	M	–	0000	–	00.0

In-Line/ Right Angle
PL: Precision Gearhead In-Line
PR: Precision Gearhead Right Angle

Series No.
2, 5, 6

Case Size
042, 060, 090, 115, 142, 180, 220

Ratios
Single Reduction:
003, 004, 005, 007, 009, 010
Double Reduction:
015, 020, 025, 030, 035, 040, 045, 050, 070, 090, 100

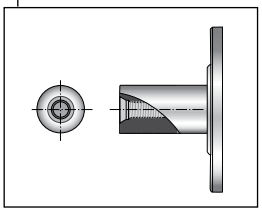
Note: Other ratios are available upon request

Shaft Type
SS: Smooth Shaft
KS: Keyed Shaft

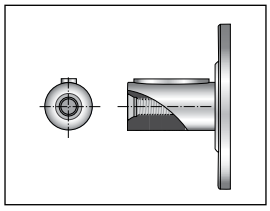
Backlash
S: Standard 5 arcmin
M:: Mid-grade 3 arcmin
P: Premium 1 arcmin

Housing Part No.
Based on servo motor make and model.

Input Shaft Inner Diameter
Based on servo motor make and model.



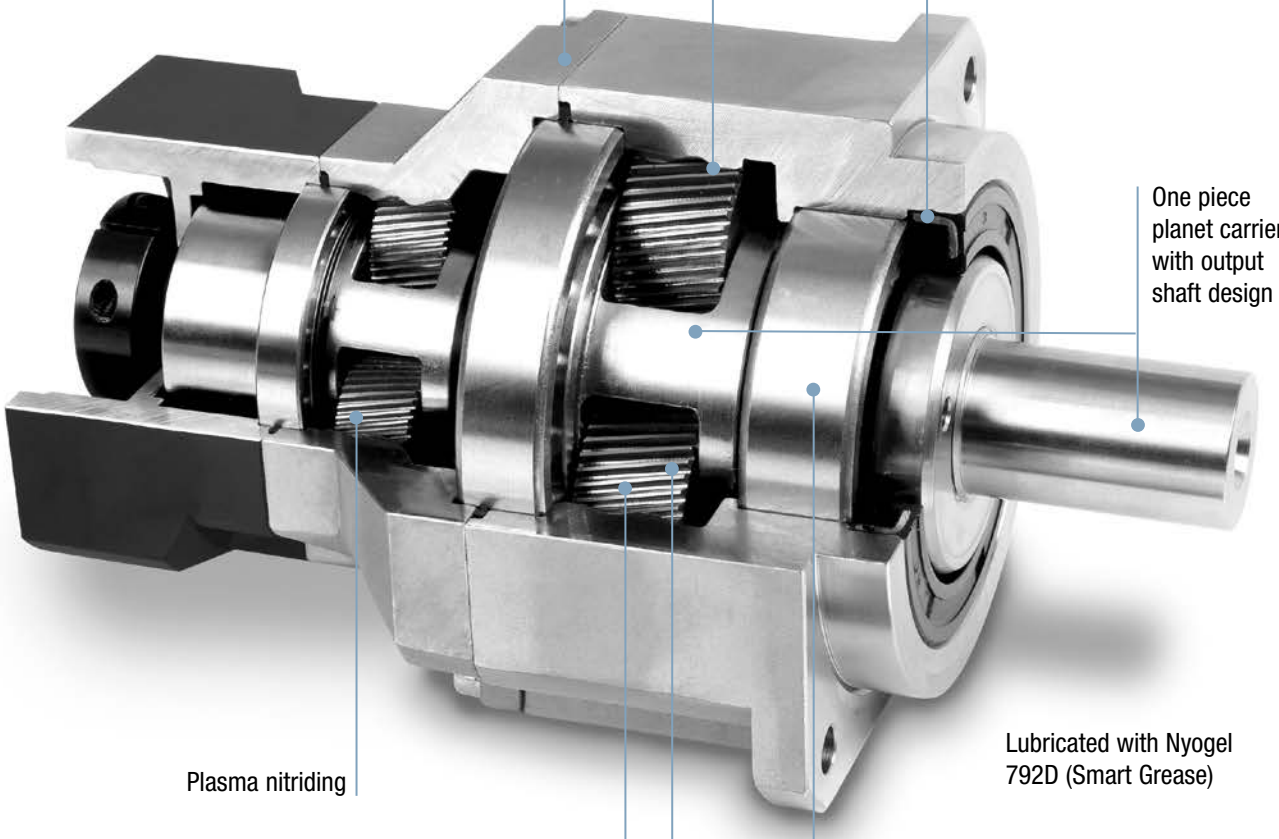
SS Standard output shaft



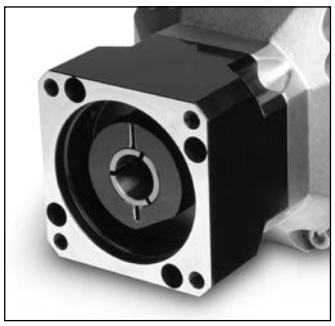
KS Output shaft with key
(Keyway: Standard DIN 6885)

PL2 Series

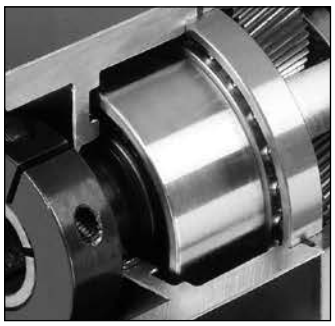
Features



Triple split collet with dynamic balanced set collar clamping sytem.



Unique motor adaptor and bushing module system.



Patented input sealing system design

Specifications

		Stages	Ratio[1]	Model No. PL2042	PL2060	PL2090	PL2115	PL2142	PL2180	PL2220
Nominal Output Torque T_{2N}	Nm	1	**3**	20	55	130	208	342	588	1,140
			4	19	50	140	290	542	1,050	1,700
			5	22	60	160	330	650	1,200	2,000
			7	19	50	140	300	550	1,100	1,800
			9	14	40	100	230	450	900	1,500
			10	14	40	100	230	450	900	1,500
		2	**15**	20	55	130	208	342	588	1,140
			20	19	50	140	290	542	1,050	1,700
			25	22	60	160	330	650	1,200	2,000
			30	20	55	150	310	600	1,100	1,900
			35	19	50	140	300	550	1,100	1,800
			40	17	45	120	260	500	1,000	1,600
			45	14	40	100	230	450	900	1,500
			50	22	60	160	330	650	1,200	2,000
			70	19	50	140	300	550	1,100	1,800
			90	14	40	100	230	450	900	1,500
			100	14	40	100	230	450	900	1,500
Max. Output Torque T_{2B}	Nm	1,2	**3~100**	3 times of Nominal Output Torque						
Nominal Input Speed n_{1N}	rpm	1,2	**3~100**	5,000	5,000	4,000	4,000	3,000	3,000	2,000
Max. Input Speed n_{1B}	rpm	1,2	**3~100**	10,000	10,000	8,000	8,000	6,000	6,000	4,000
Premium Backlash P	arcmin	1	**3~10**	–	–	≤1	≤1	≤1	≤1	≤1
		2	**15~100**	–	–	–	≤3	≤3	≤3	≤3
Mid-grade Backlash M	arcmin	1	**3~10**	≤3	≤3	≤3	≤3	≤3	≤3	≤3
		2	**15~100**	≤5	≤5	≤5	≤5	≤5	≤5	≤5
Standard Backlash S	arcmin	1	**3~10**	≤5	≤5	≤5	≤5	≤5	≤5	≤5
		2	**15~100**	≤7	≤7	≤7	≤7	≤7	≤7	≤7
Torsional Rigidity	Nm/arcmin	1,2	**3~100**	3	7	14	25	50	145	225
Max. Radial Load F_{21B}[2]	N	1,2	**3~100**	780	1,530	3,250	6,700	9,400	14,500	50,000
Max. Axial Load F_{2aB}[2]	N	1,2	**3~100**	390	765	1,625	3,350	4,700	7,250	25,000
Service Life	hr	1,2	**3~100**	20,000*						
Efficiency n	%	1	**3~10**	≥97%						
		2	**15~10**	≥94%						
Weight	kg	1	**3~10**	0.5	1.3	3.7	7.8	14.5	29	48
		2	**15~100**	0.8	1.5	4.1	9	17.5	33	60
Operating Temp	°C	1,2	**3~100**	-10°C ~ + 90°C						
Lubrication		1,2	**3~100**	synthetic gear grease (NYOGEL 792D)						
Degree of Gearbox Protection		1,2	**3~100**	IP65						
Mounting Position		1,2	**3~100**	all directions						
Noise Level (n,= 3000 rpm)	dB	1,2	**3~100**	≤56	≤58	≤60	≤63	≤65	≤67	≤70

Gearbox Inertia

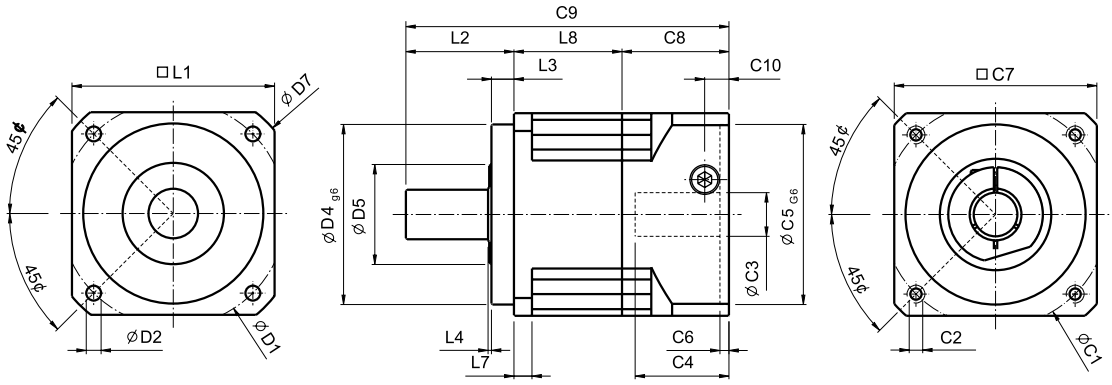
		Stages	Ratio	Model No. PL2042	PL2060	PL2090	PL2115	PL2142	PL2180	PL2220
Mass Moments of Inertia J_1	kg • cm²	1	**3**	0.05	0.24	1.04	5.05	14.61	46.76	118.39
			4	0.04	0.18	0.71	3.67	10.57	33.53	81.87
			5	0.04	0.17	0.64	3.34	9.66	30.31	73.00
			7	0.03	0.15	0.52	2.85	8.24	25.57	59.89
			9	0.03	0.14	0.48	2.66	7.65	23.63	54.51
			10	0.03	0.14	0.47	2.62	7.54	23.23	53.40
		2	**15**	0.04	0.04	0.22	0.70	3.50	10.19	31.69
			20	0.04	0.04	0.21	0.66	3.39	9.84	30.66
			25	0.04	0.04	0.21	0.66	3.37	9.76	30.43
			30	0.04	0.04	0.21	0.65	3.34	9.66	30.15
			35	0.04	0.04	0.21	0.64	3.32	9.62	30.02
			40	0.04	0.04	0.21	0.64	3.31	9.58	29.92
			45	0.04	0.04	0.20	0.64	3.30	9.56	29.85
			50	0.03	0.03	0.15	0.52	2.63	7.56	23.26
			70	0.03	0.03	0.15	0.52	2.61	7.53	23.16
			90	0.03	0.03	0.15	0.52	2.61	7.51	23.11
			100	0.03	0.03	0.15	0.52	2.61	7.51	23.11

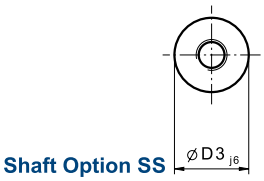
1. Ratio ($i=N_{in}/N_{out}$)
2. F_{2B} F_{2aB} applied to the output shaft center @ 100 rpm

*S1 service life 10,000 hrs

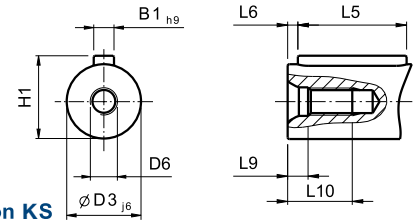
PL2 Series

Dimensions (1-stage, Ratio i = 3-10)





Shaft Option SS



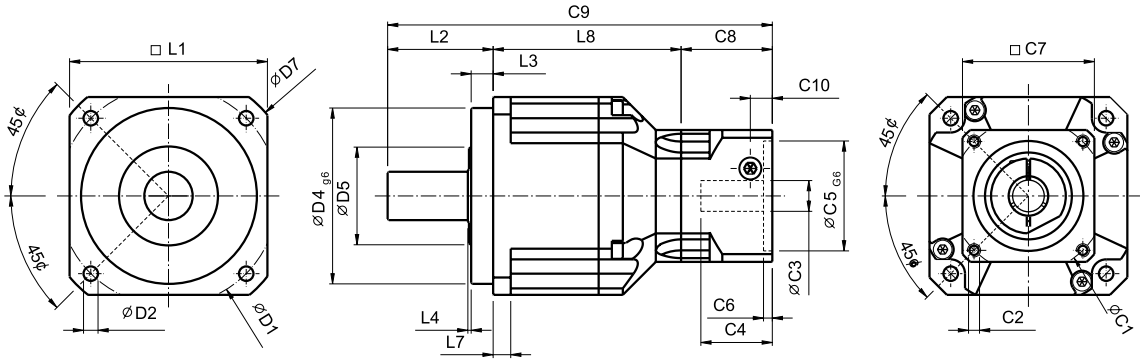
Shaft Option KS

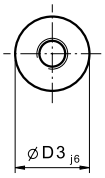
Note: Dimensions shown in mm

Dimension	PL2042	PL2060	PL2090	PL2115	PL2142	PL2180	PL2220
D1	50	70	100	130	165	215	250
D2	3.4	5.5	6.6	9	11	13	17
D3 j6	13	16	22	32	40	55	75
D4 g6	35	50	80	110	130	160	180
D5	22	30	45	60	75	95	115
D6	M4 x 0.7P	M5 x 0.8P	M8 x 1.25P	M12 x 1.75P	M16 x 2P	M20 x 2.5P	M20 x 2.5P
D7	56	80	116	152	185	240	292
L1	42	60	90	115	142	180	220
L2	26	37	48	65	97	105	138
L3	5.5	7	10	12	15	20	30
L4	1	1.5	1.5	2	3	3	3
L5	16	25	32	40	63	70	90
L6	2	2	3	5	5	6	7
L7	4	6	8	10	12	15	20
L8	31	35	48	61	71.5	84.5	93
L9	3.2	4	6	9.5	12	15	15
L10	10	12.5	19	28	36	42	42
C1[3]	46	70	100	130	165	215	235
C2[3]	M4 x 0.7P	M5 x 0.8P	M6 x 1P	M8 x 1.25P	M10 x 1.5P	M12 x 1.75P	M12 x 1.75P
C3[3]	≤11	*≤14 / ≤16	*≤19 / ≤24	≤32	≤38	≤48	≤55
C4[3]	25	30	40	50	60	82	82
C5[3] G6	30	50	80	110	130	180	200
C6[3]	3.5	4	4	5	6	6	6
C7[3]	42	60	90	115	142	190	220
C8[3]	29.5	41.5	48	61	71	96	100
C9[3]	86.5	113.5	144	187	239.5	285.5	331
C10[3]	8.75	10	11.25	13.5	16	18.25	20
B1 h9	5	5	6	10	12	16	20
H1	15	18	24.5	35	43	59	79.5

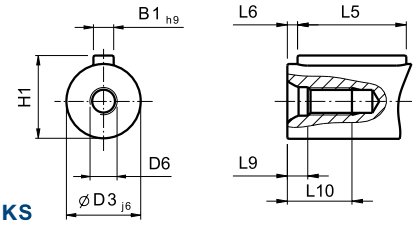
3. C1~C10 are motor specific dimensions (metric std shown).
* PL2060 ratio 5,10 provides C3 ≤ 16 option. * PL2090 ratio 3~10 provides C3 = 24 option.

Dimensions (2-stage, Ratio i = 15-100)





Shaft Option SS



Shaft Option KS

Note: Dimensions shown in mm

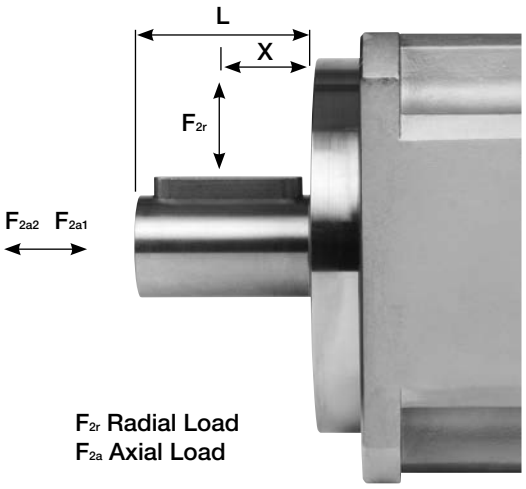
Dimension	PL2042	PL2060	PL2090	PL2115	PL2142	PL2180	PL2220
D1	50	70	100	130	165	215	250
D2	3.4	5.5	6.6	9	11	13	17
D3 [j6]	13	16	22	32	40	55	75
D4 [g6]	35	50	80	110	130	160	180
D5	22	30	45	60	75	95	115
D6	M4 x 0.7P	M5 x 0.8P	M8 x 1.25P	M12 x 1.75P	M16 x 2P	M20 x 2.5P	M20 x 2.5P
D7	56	80	116	152	185	240	292
L1	42	60	90	115	142	180	220
L2	26	37	48	65	97	105	138
L3	5.5	7	10	12	15	20	30
L4	1	1.5	1.5	2	3	3	3
L5	16	25	32	40	63	70	90
L6	2	2	3	5	5	6	7
L7	4	6	8	10	12	15	20
L8	58.5	72	85.5	113	135	161.5	178.5
L9	3.2	4	6	9.5	12	15	15
L10	10	12.5	19	28	36	42	42
C1[4]	46	46	70	100	130	165	215
C2[4]	M4 x 0.7P	M4 x 0.7P	M5 x 0.8P	M6 x 1P	M8 x 1.25P	M10 x 1.5P	M12 x 1.75P
C3[4]	≤11	*≤11 / ≤12	*≤14/≤16	*≤19 / ≤24	≤32	≤38	≤48
C4[4]	25	25	30	40	50	60	82
C5[4 G6]	30	30	50	80	110	130	180
C6[4]	3.5	3.5	4	4	5	6	6
C7[4]	42	42	60	90	115	142	190
C8[4]	29.5	29.5	41.5	48	61	71	96
C9[4]	114	138.5	175	226	293	337.5	412.5
C10[4]	8.75	8.75	10	11.25	13.5	16	18.25
B1 [h9]	5	5	6	10	12	16	20
H1	15	18	24.5	35	43	59	79.5

4. C1~C10 are motor specific dimensions (metric std shown).
* PL2060 ratio 15-50 provides C3 ≤ 12 option. * PL2090 ratio 15-50 provides C3 ≤ 16 option. * PL2115 ratio 15-100 provides C3 = 24 option.

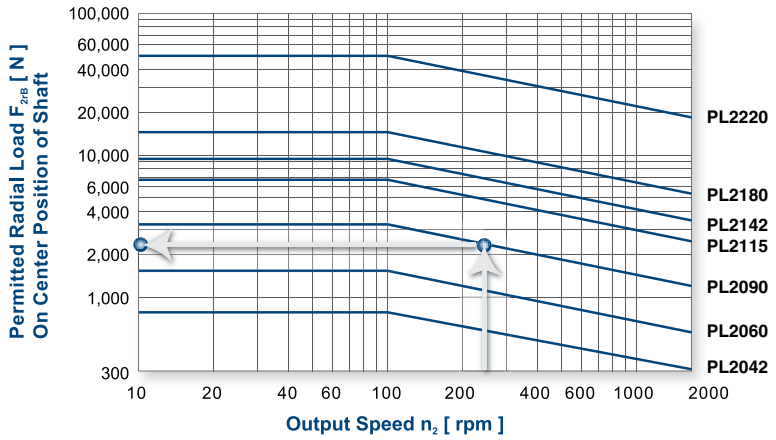
PL2 Series

Radial and axial loads allowed on the output shaft

The permitted radial and axial loads on the output shaft of the gearbox is dependent upon the design of the gearbox supporting bearings. The Boston Gear PL2 Series uses an oversized, straddle mount, ball bearing design, which can take heavy loads from both axes.



F_{2r} Radial Load
F_{2a} Axial Load



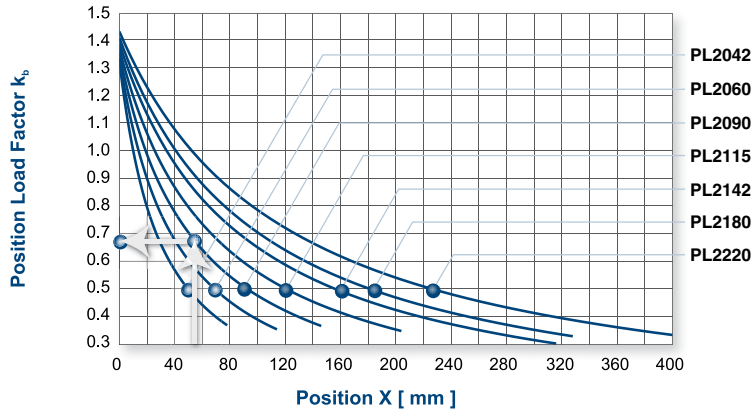
If the radial force F_{2r} **is** exerted on the center of the output shaft, then X=0.5 x L.

Under these conditions the permitted radial load can be determined from the graph on the left.

The permitted axial load can then be calculated by using the following formulas:

F_{2a1B} = 0.2 x F_{2rB} (axial force towards the gearhead)

F_{2a2B} = 0.1 x F_{2rB} (axial force away from the gearhead)



If the radial force F_{2r} **is not** exerted on the center of the output shaft then X is the distance measured from the output seal.

The position load factor K_b can then be determined by the graph to the left.

Under these conditions the radial and axial loads can be calculated by using the following formulas:

Radial Load:

$F'_{2rB}=K_b \times F_{2rB}$

Axial Load:

$F'_{2a1B}=0.2 \times F'_{2rB}$

$F'_{2a2B}=0.1 \times F'_{2rB}$

* Continuous running reduces service life by 50%.

Stainless Steel High Precision Right Angle Planetary Gearboxes

Dimensional drop-in for
Bayside Stealth
RS Right Angle
Series

Ordering Number System for PR2 Models

Example: PR2060-005-SS-M-0000-00.0

PR 2 060 – 005 – SS – M – 0000 – 00.0

In-Line/ Right Angle
PL: Precision Gearhead In-Line
PR: Precision Gearhead Right Angle

Series No.
2, 5, 6

Case Size
042, 060, 090, 115, 142, 180, 220

Ratios
Single Reduction:
003, 004, 005, 007, 009, 010, 014, 020
Double Reduction:
025, 030, 035, 040, 045, 050, 060, 070, 080, 090, 100, 140, 180, 200

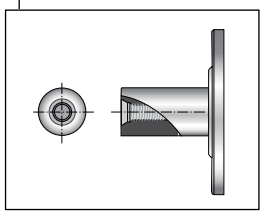
Note: Other ratios are available upon request

Shaft Type
SS: Smooth Shaft
KS: Keyed Shaft

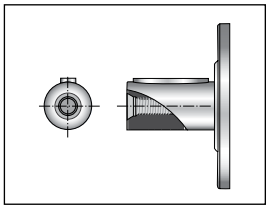
Backlash
S: Standard 5 arcmin
M:: Mid-grade 3 arcmin
P: Premium 1 arcmin

Housing Part No.
Based on servo motor make and model.

Input Shaft Inner Diameter
Based on servo motor make and model.



S1 Standard output shaft

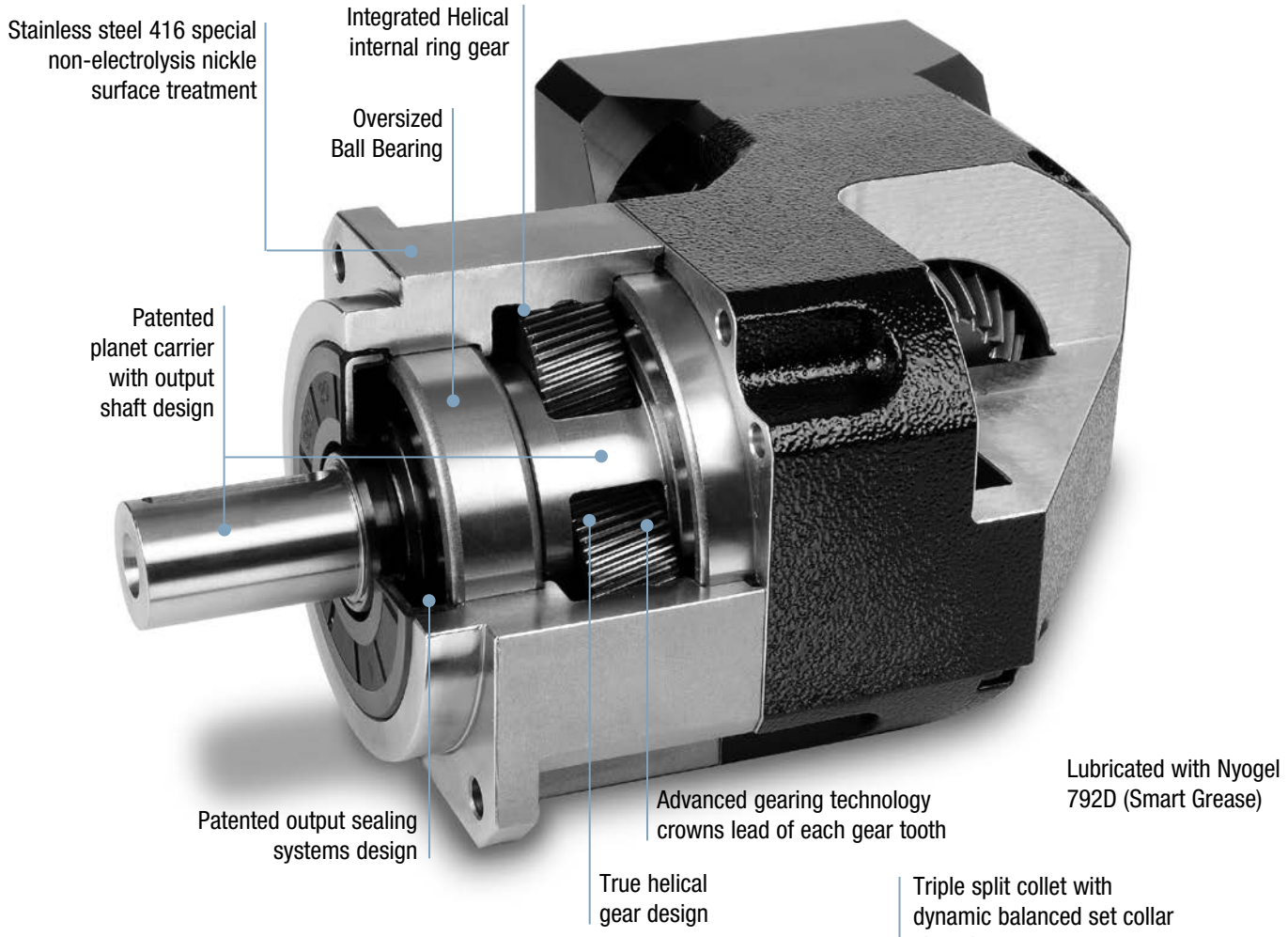


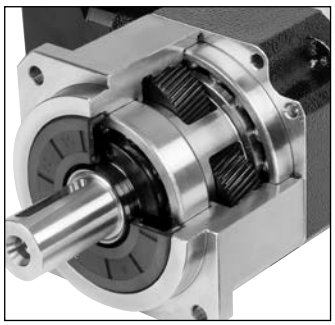
KS Output shaft with key
(Keyway: Standard DIN 6885)

PR2 Series

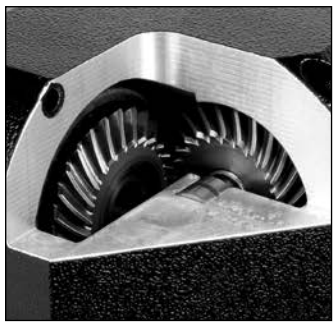
Features

- Higher output torque rating by using spiral bevel gear design. 30% more than straight bevel gear.
- Allows input speeds up to 8 times than with straight bevel gearing.
- Improved load sharing through precision tooth design and longer service life.
- Ground gears verified with sophisticated software, ensures smooth, quiet operation with reduced backlash (≤2 arcmin).
- High tensile low weight single piece aluminum alloy housing for highest stiffness.
- Maintenance free lifetime lubrication.
- Patented sealing design for high speed and continuous running.
- High efficiency up to 95%. Low noise level down to 61dB.
- Most ratios available from 3~200.

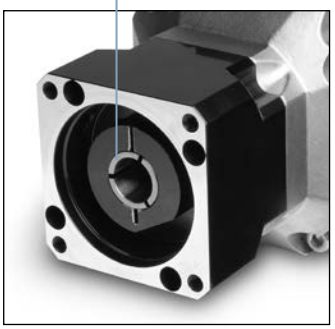




Plasma nitriding



Spiral Bevel gear design



Unique motor adaptor and bushing module system.

Specifications

		Stages	Ratio[1]	Model No. PR2042	PR2060	PR2090	PR2115	PR2142	PR2180	PR2220
Nominal Output Torque T_{2N}	Nm	1	**3**	9	36	90	195	342	588	1,140
			4	12	48	120	195	520	1,040	1,680
			5	15	60	150	260	650	1,200	2,000
			7	19	50	140	310	550	1,100	1,800
			9	14	40	100	260	450	900	1,500
			10	14	40	100	230	450	900	1,500
			14	-	42	140	300	550	1,100	1,800
			20	-	40	100	230	450	900	1,500
		2	**25**	15	60	150	325	650	1,200	2,000
			30	20	55	150	310	600	1,100	1,900
			35	19	50	140	300	550	1,100	1,800
			40	17	45	120	260	500	1,000	1,600
			45	14	40	100	230	450	900	1.500
			50	14	60	100	230	650	1,200	2,000
			70	19	50	140	300	550	1,100	1,800
			90	14	40	100	230	450	900	1,500
			100	14	40	100	230	450	900	1,500
			140	-	-	140	300	550	1,100	1,800
			180	-	-	100	230	450	900	1,500
			200	-	-	100	230	450	900	1,500
Max. Output Torque T_{2B}	Nm	1,2	**3~200**	3 times of Nominal Output Torque						
Nominal Input Speed n_{1N}	rpm	1,2	**3~200**	5,000	5,000	4,000	4,000	3,000	3,000	2,000
Max. Input Speed n_{1B}	rpm	1,2	**3~200**	10,000	10,000	8,000	8,000	6,000	6,000	4,000
Premium Backlash P	arcmin	1	**3~20**	-	-	≤2	≤2	≤2	≤2	≤2
		2	**25~200**	-	-	≤4	≤4	≤4	≤4	≤4
Mid-grade Backlash M	arcmin	1	**3~20**	≤4	≤4	≤4	≤4	≤4	≤4	≤4
		2	**25~200**	≤7	≤7	≤7	≤7	≤7	≤7	≤7
Standard Backlash S	arcmin	1	**3~20**	≤6	≤6	≤6	≤6	≤6	≤6	≤6
		2	**25~200**	≤9	≤9	≤9	≤9	≤9	≤9	≤9
Torsional Rigidity	Nm/arcmin	1,2	**3~200**	3	7	14	25	50	145	225
Max. Radial Load F_{2rB}	N	1,2	**3~200**	780	1,530	3,250	6,700	9,400	14,500	50,000
Max. Axial Load F_{2aB}	N	1,2	**3~200**	390	765	1,625	3,350	4,700	7,250	25,000
Service Life	hr	1,2	**3~200**	20,000*						
Efficiency h	%	1	**3~20**	≥95%						
		2	**25~200**	≥92%						
Weight	kg	1	**3~20**	0.9	2.1	6.4	13	24.5	51	83
		2	**25~200**	1.2	1.5	7.8	14.2	27.5	54	95
Operating Temp	C	1,2	**3~200**	-10°C~+90°C						
Lubrication		1,2	**3~200**	synthetic gear grease (NYOGEL 792D)						
Degree of Gearbox Protection		1,2	**3~200**	IP65						
Mounting Position		1,2	**3~200**	all directions						
Noise Level (n_1= 3000 rpm)	dB	1,2	**3~200**	≤61	≤63	≤65	≤68	≤70	≤72	≤74

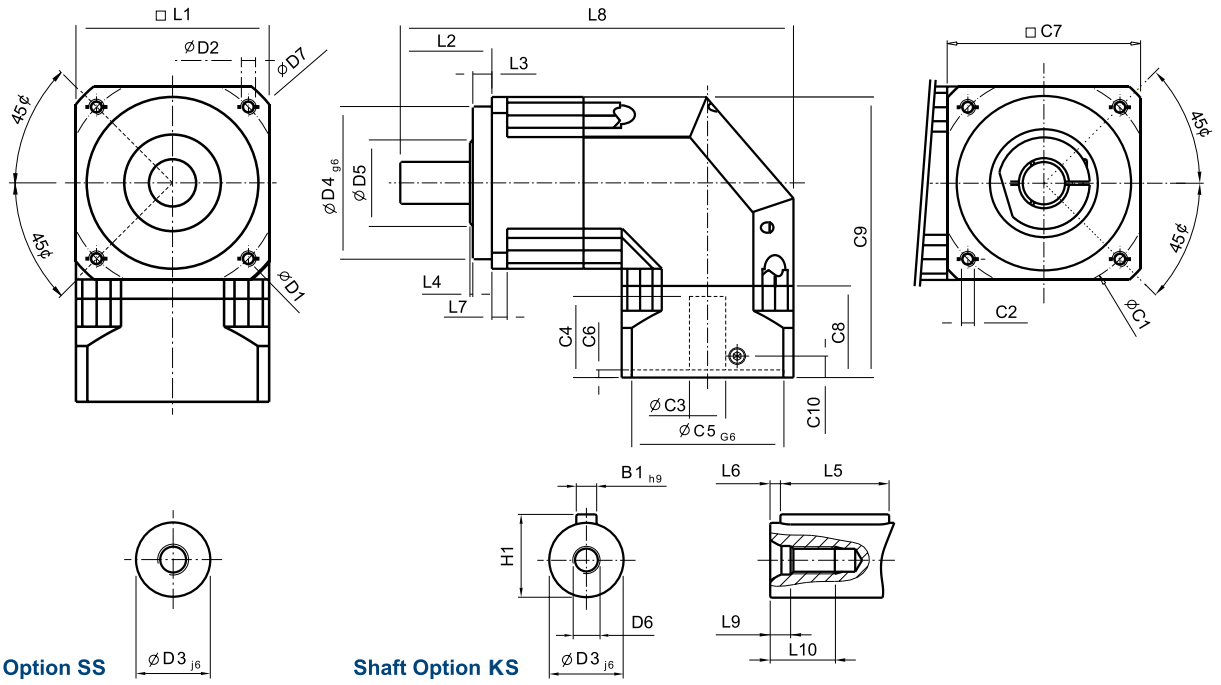
Gearbox Inertia

		Stages	Ratio	Model No. PR2042	PR2060	PR2090	PR2115	PR2142	PR2180	PR2220
Mass Moments of Inertia J1	kg • cm2	1	**3~10**	0.09	0.35	2.25	6.84	23.4	68.9	135.4
			14	-	0.07	1.87	6.25	21.8	65.6	119.8
			20	-	0.07	1.87	6.25	21.8	65.6	119.8
		2	**25~100**	0.09	0.09	0.35	2.25	6.84	23.4	66.9
			140~200	-	-	0.31	1.87	6.25	21.8	65.6

1. Ratio ($i=N_{in}/N_{out}$)
2. F_{2rB} F_{2aB} applied to the output shaft center @ 100 rpm

*S1 service life 10,000 hrs

Dimensions (1-stage, Ratio i = 3-20)



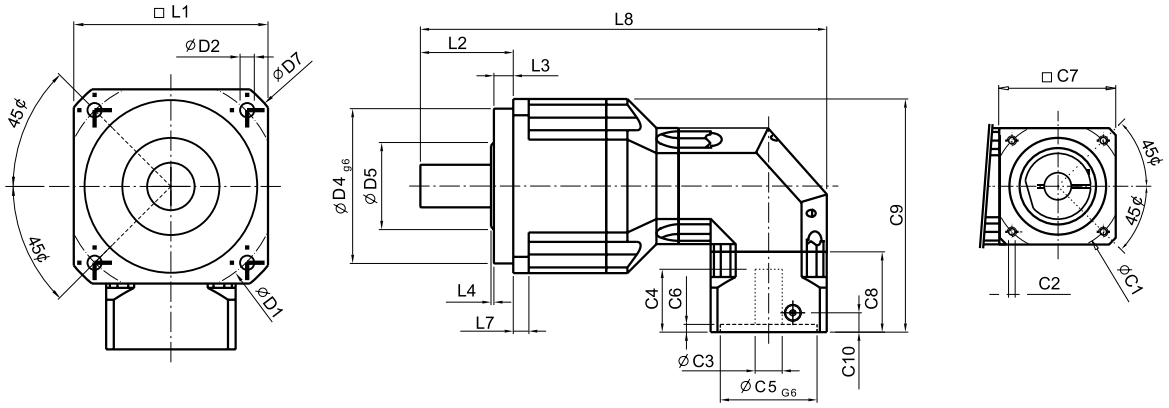
Shaft Option SS **Shaft Option KS**

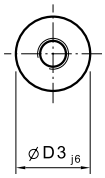
Note: Dimensions shown in mm

Dimension	PR2042	PR2060	PR2090	PR2115	PR2142	PR2180	PR2220
D1	50	70	100	130	165	215	250
D2	3.4	5.5	6.6	9	11	13	17
D3 j6	13	16	22	32	40	55	75
D4 g6	35	50	80	110	130	160	180
D5	22	30	45	60	75	95	115
D6	M4 x 0.7P	M5 x 0.8P	M8 x 1.25P	M12 x 1.75P	M16 x 2P	M20 x 2.5P	M20 x 2.5P
D7	56	80	116	152	185	240	292
L1	42	60	90	115	142	180	220
L2	26	37	48	65	97	105	138
L3	5.5	7	10	12	15	20	30
L4	1	1.5	1.5	2	3	3	3
L5	16	25	32	40	63	70	90
L6	2	2	3	5	5	6	7
L7	4	6	8	10	12	15	20
L8	111.5	145	203	259	333	394	484
L9	3.2	4	6	9.5	12	15	15
L10	10	12.5	19	28	36	42	42
C1[3]	46	70	100	130	165	215	235
C2[3]	M4 x 0.7P	M5 x 0.8P	M6 x 1P	M8 x 1.25P	M10 x 1.5P	M12 x 1.75P	M12 x 1.75P
C3[3]	≤11	≤14/≤16	*≤19/≤24	≤32	≤38	≤48	≤55
C4[3]	25	30	40	50	60	82	82
C5[3] G6	30	50	80	110	130	180	200
C6[3]	3.5	4	4	5	6	6	6
C7[3]	42	60	90	115	142	190	220
C8[3]	29.5	41.5	48	61	71	96	100
C9[3]	90.5	108	153	192	236	301	345
C10[3]	8.75	10	11.25	13.5	16	18.25	20
B1 h9	5	5	6	10	12	16	20
H1	15	18	24.5	35	43	59	79.5

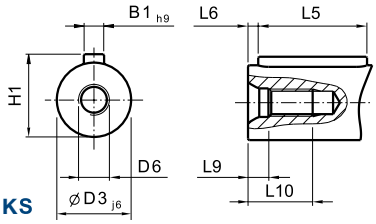
3. C1~C10 are motor specific dimensions (metric std shown).
* PR2090 C3 option = 24 option.

Dimensions (2-stage, Ratio i = 25-200)





Shaft Option SS



Shaft Option KS

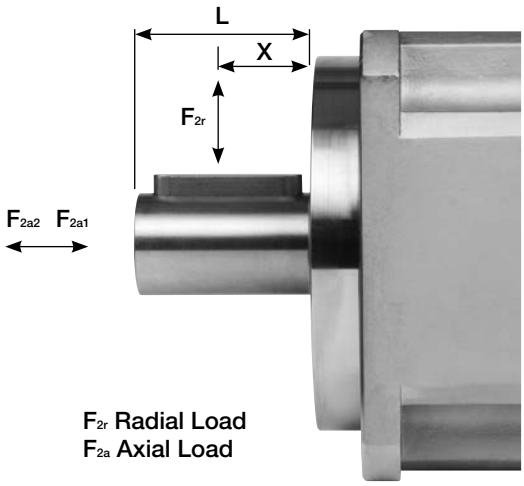
Note: Dimensions shown in mm

Dimension	PR2042	PR2060	PR2090	PR2115	PR2142	PR2180	PR2220
D1	50	70	100	130	165	215	250
D2	3.4	5.5	6.6	9	11	13	17
D3 j6	13	16	22	32	40	55	75
D4 g6	35	50	80	110	130	160	180
D5	22	30	45	60	75	95	115
D6	M4 x 0.7P	M5 x 0.8P	M8 x 1.25P	M12 x 1.75P	M16 x 2P	M20 x 2.5P	M20 x 2.5P
D7	56	80	116	152	185	240	292
L1	42	60	90	115	142	180	220
L2	26	37	48	65	97	105	138
L3	5.5	7	10	12	15	20	30
L4	1	1.5	1.5	2	3	3	3
L5	16	25	32	40	63	70	90
L6	2	2	3	5	5	6	7
L7	4	6	8	10	12	15	20
L8	139	163.5	206.5	285	365	431	521
L9	3.2	4	6	9.5	12	15	15
L10	10	12.5	19	28	36	42	42
C1[4]	46	70	70	100	130	165	215
C2[4]	M4 x 0.7P	M4 x 0.7P	M5 x 0.8P	M6 x 1P	M8 x 1.25P	M10 x 1. 5P	M12 x 1.75P
C3[4]	≤11	*≤11/≤12	*≤14/≤16	*≤19 / ≤24	≤32	≤38	≤48
C4[4]	25	25	30	40	50	60	82
C5[4] G6	30	30	50	80	110	130	180
C6[4]	3.5	3.5	4	4	5	6	6
C7[4]	42	42	60	90	115	142	190
C8[4]	29.5	29.5	41.5	48	61	71	96
C9[4]	90.5	99.5	123	165.5	205.5	255	321
C10[4]	8.75	8.75	10	11.25	13.5	16	18.25
B1 h9	5	5	6	10	12	16	20
H1	15	18	24.5	35	43	59	79.5

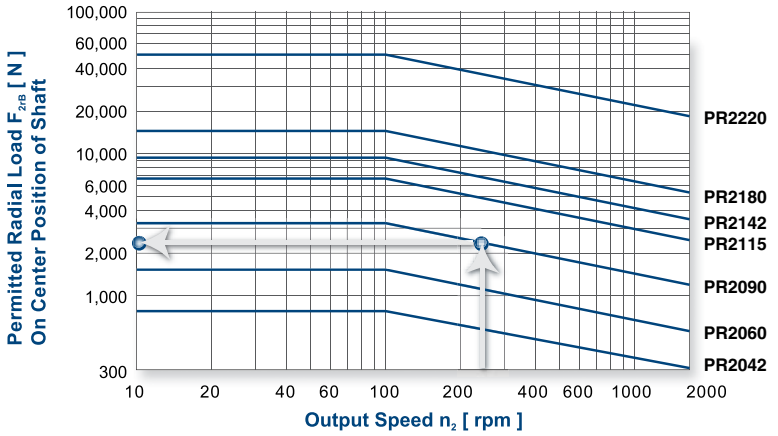
4. C1~C10 are motor specific dimensions (metric std shown).
* PR2115 C3 option = 24 option.

Radial and axial loads allowed on the output shaft

The permitted radial and axial loads on the output shaft of the gearbox is dependent upon the design of the gearbox supporting bearings. The Boston Gear PR2 series uses an oversized, straddle mount, ball bearing design, which can take heavy loads from both axes.



F_{2r} Radial Load
F_{2a} Axial Load



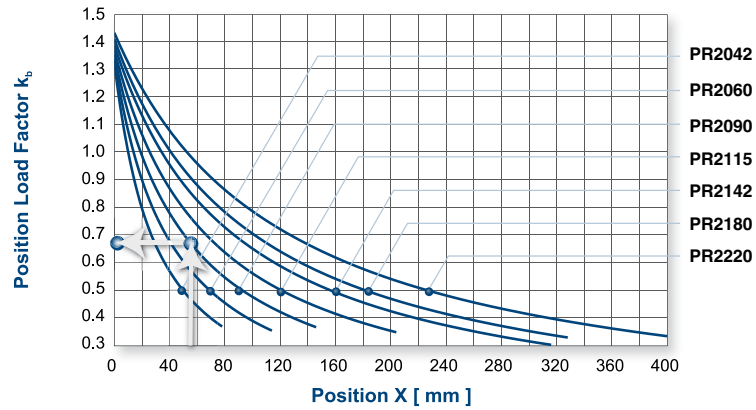
If the radial force F_{2r} **is** exerted on the center of the output shaft, then X=0.5 x L.

Under these conditions the permitted radial load can be determined from the graph on the left.

The permitted axial load can then be calculated by using the following formulas:

$F_{2a1B} = 0.2 \times F_{2rB}$ (axial force towards the gearhead)

$F_{2a2B} = 0.1 \times F_{2rB}$ (axial force away from the gearhead)



If the radial force F_{2r} **is not** exerted on the center of the output shaft, then X is the distance measured from the output seal.

The position load factor K_b can then be determined by the graph to the left.

Under these conditions the radial and axial loads can be calculated by using the following formulas:

Radial Load:

$F'_{2rB}=K_b \times F_{2rB}$

Axial Load:

$F'_{2a1B}=0.2 \times F'_{2rB}$

$F'_{2a2B}=0.1 \times F'_{2rB}$

* Continuous running reduces service life by 50%.

Stainless Steel High Precision Inline Planetary Gearboxes

Dimensional drop-in for Alpha SP, Alpha SP+, Stober Servofit P and Micron UltraTrue Series

Ordering Number System for PL6 Models

Example: PL6180-009-KS-P-0000-00.0

PL	6	180	–	009	–	KS	–	P	–	0000	–	00.0

In-Line/ Right Angle
PL: Precision Gearhead In-Line
PR: Precision Gearhead Right Angle

Series No.
2, 5, 6

Case Size
042, 060, 075, 100, 140, 180, 220

Ratios
Single Reduction:
003, 004, 005, 007, 009, 010
Double Reduction:
015, 020, 025, 030, 035, 040, 045
050, 070, 090, 100

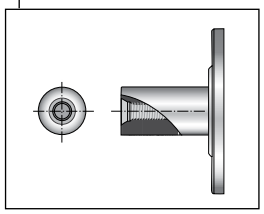
Note: Other ratios are available upon request

Shaft Type
SS: Smooth Shaft
KS: Keyed Shaft

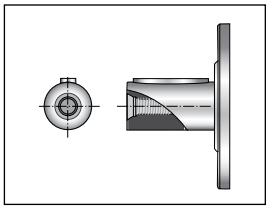
Backlash
S: Standard 5 arcmin
M:: Mid-grade 3 arcmin
P: Premium 1 arcmin

Housing Part No.
Based on servo motor make and model.

Input Shaft Inner Diameter
Based on servo motor make and model.



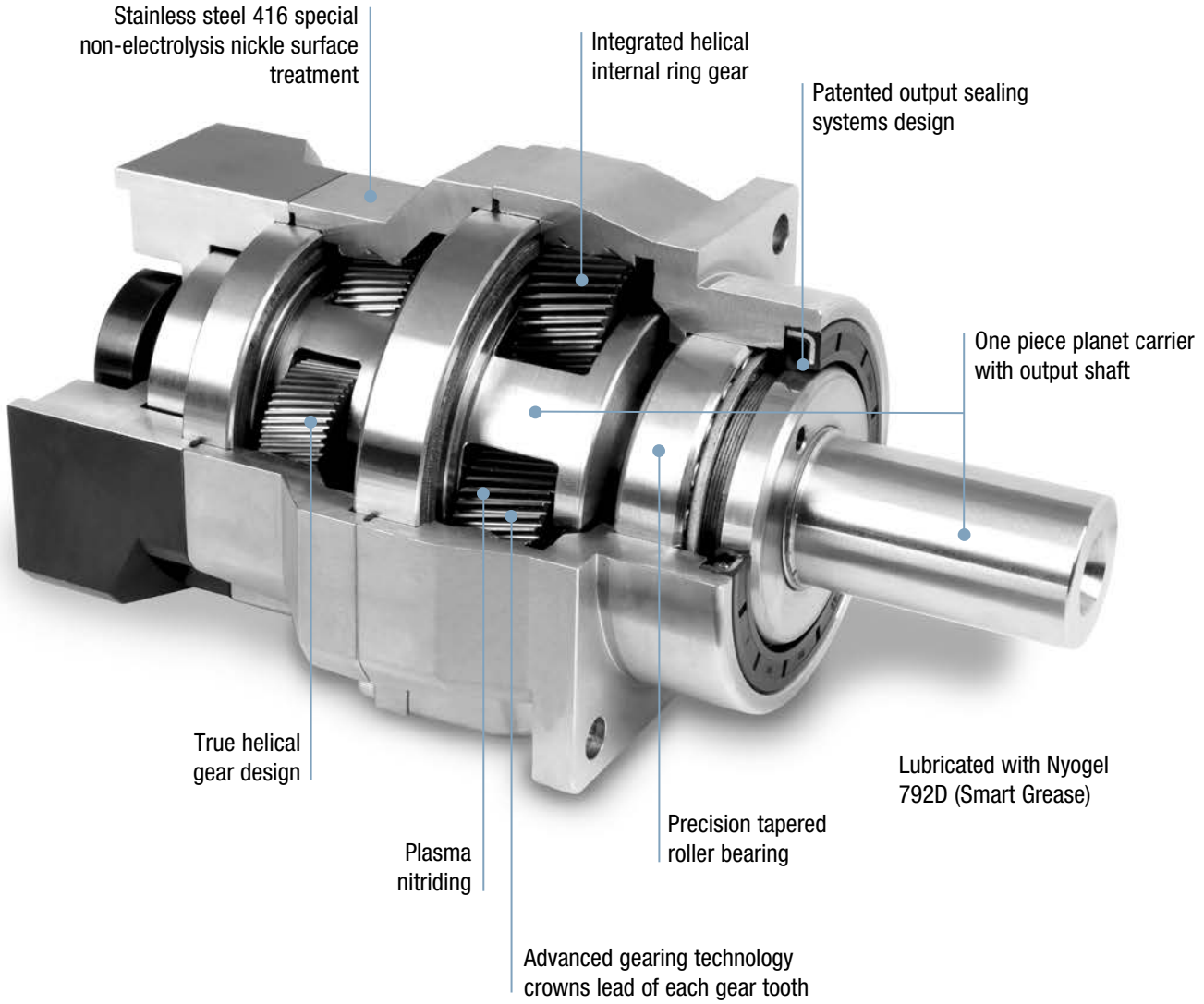
SS Standard output shaft

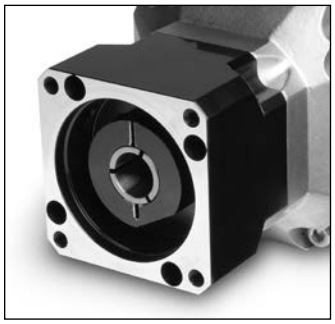


KS Output shaft with key
(Keyway: Standard DIN 6885)

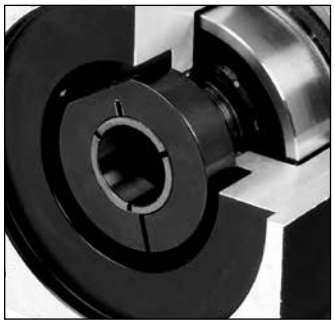
PL6 Series

Features

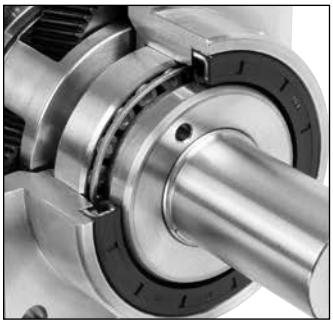




Unique motor adaptor and bushing module system.



Triple split collet with dynamic balanced set collar clamping sytem.



Precision tapered roller bearing support for increased radial and axial loading capacity

Specifications

		Stages	Ratio[1]	Model No. PL6042	PL6060	PL6075	PL6100	PL6140	PL6180	PL6220
Nominal Output Torque T_{2N}	Nm	1	3	20	55	130	208	342	588	1,140
			4	19	50	140	290	542	1,050	1,700
			5	22	60	160	330	650	1,200	2,000
			7	19	50	140	300	550	1,100	1,800
			9	14	40	100	230	450	900	1,500
			10	14	40	100	230	450	900	1,500
		2	15	20	55	130	208	342	588	1,140
			20	19	50	140	290	542	1050	1,700
			25	22	60	160	330	650	1,200	2,000
			30	20	55	150	310	600	1,100	1,900
			35	19	50	140	300	550	1,100	1,800
			40	17	45	120	260	500	1,000	1,600
			45	14	40	100	230	450	900	1.500
			50	22	60	160	330	650	1,200	2,000
			70	19	50	140	300	550	1,100	1,800
			90	14	40	100	230	450	900	1,500
			100	14	40	100	230	450	900	1,500
Max. Output Torque T_{2B}	Nm	1,2	3~100	3 times of Nominal Output Torque						
Nominal Input Speed n_{1N}	rpm	1,2	3~100	5,000	5,000	4,000	4,000	3,000	3,000	2,000
Max. Input Speed n_{1B}	rpm	1,2	3~100	10,000	10,000	8,000	8,000	6,000	6,000	4,000
Premium Backlash P	arcmin	1	3~10	-	-	≤1	≤1	≤1	≤1	≤1
		2	15~100	-	-	-	≤3	≤3	≤3	≤3
Mid-grade Backlash M	arcmin	1	3~10	≤3	≤3	≤3	≤3	≤3	≤3	≤3
		2	15~100	≤5	≤5	≤5	≤5	≤5	≤5	≤5
Standard Backlash S	arcmin	1	3~10	≤5	≤5	≤5	≤5	≤5	≤5	≤5
		2	15~100	≤7	≤7	≤7	≤7	≤7	≤7	≤7
Torsional Rigidity	Nm/arcmin	1,2	3~100	3	7	14	25	50	145	225
Max. Radial Load F_{2rB}	N	1,2	3~100	610	1,400	4,100	9,200	14,000	18,000	49,000
Max. Axial Load F_{2aB}	N	1,2	3~100	302	605	3,700	5,800	11,400	19,500	13,200
Service Life	hr	1,2	3~100	30,000*						
Efficiency h	%	1	3~10	≥97%						
		2	15~100	≥94%						
Weight	kg	1	3~10	0.6	1.3	3.7	6.9	13.7	28	48
		2	15~100	0.8	1.5	4.1	8.1	16.6	33	59
Operating Temp	°C	1,2	3~100	-10°C~+90°C						
Lubrication		1,2	3~100	synthetic gear grease (NYOGEL 792D)						
Degree of Gearbox Protection		1,2	3~100	IP65						
Mounting Position		1,2	3~100	all directions						
Noise Level (n1= 3000 rpm)	dB	1,2	3~100	≤56	≤58	≤60	≤63	≤65	≤67	≤70

Gearbox Inertia

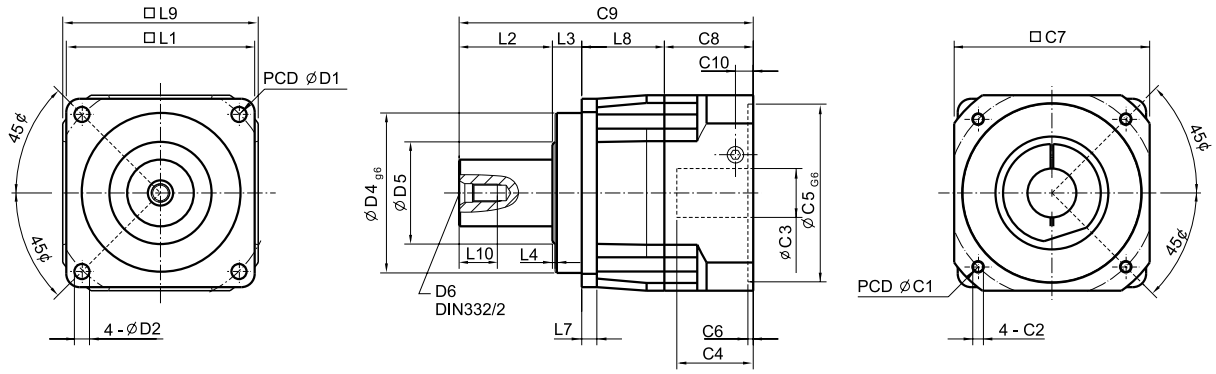
		Stages	Ratio	Model No. PL6042	PL6060	PL6075	PL6100	PL6140	PL6180	PL6220
Mass Moments of Inertia J_1	kg • cm²	1	3	0.05	0.24	1.04	4.94	14.35	46.39	117.96
			4	0.04	0.18	0.70	3.56	10.29	33.02	87.79
			5	0.04	0.16	0.63	3.24	9.43	29.95	72.06
			7	0.03	0.14	0.51	2.77	8.00	25.19	58.48
			9	0.03	0.13	0.46	2.58	7.42	23.26	53.13
			10	0.03	0.13	0.45	2.54	7.31	22.87	52.05
		2	15	0.04	0.04	0.18	0.68	3.39	9.89	31.16
			20	0.04	0.04	0.17	0.65	3.28	9.57	30.22
			25	0.04	0.04	0.17	0.64	3.27	9.51	30.03
			30	0.04	0.04	0.17	0.63	3.24	9.43	29.78
			35	0.04	0.04	0.17	0.63	3.23	9.39	29.67
			40	0.04	0.04	0.16	0.62	3.22	9.35	29.57
			45	0.04	0.04	0.16	0.62	3.21	9.33	29.51
			50	0.03	0.03	0.13	0.45	2.54	7.33	22.89
			70	0.03	0.03	0.13	0.45	2.53	7.30	22.80
			90	0.03	0.03	0.13	0.45	2.53	7.29	22.76
			100	0.03	0.03	0.13	0.45	2.53	7.29	22.76

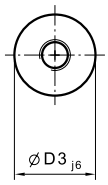
1. Ratio ($i=N_{in}/N_{out}$)
*S1 service life 15,000 hrs

2. F_{2rB} F_{2aB} applied to the output shaft center @ 100 rpm

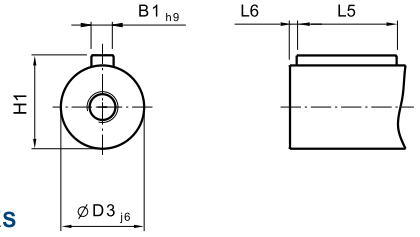
PL6 Series

Dimensions (1-stage, Ratio i = 3-10)





Shaft Option SS



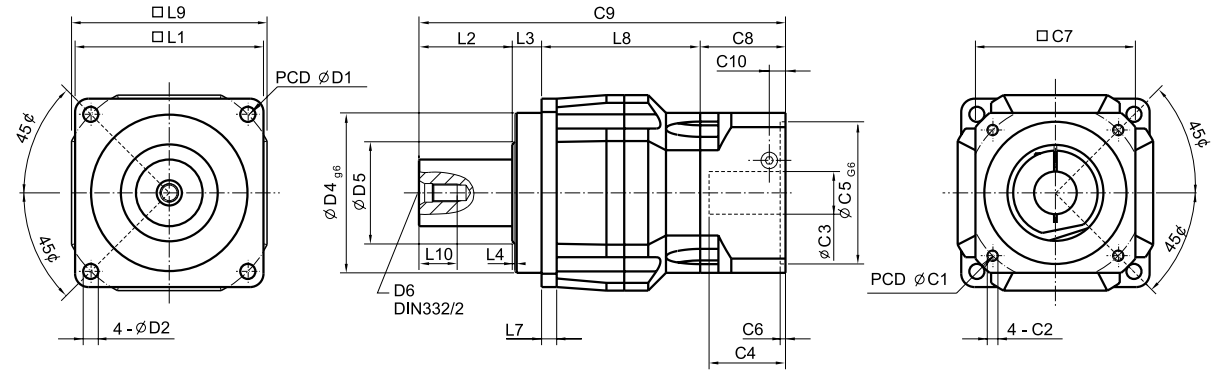
Shaft Option KS

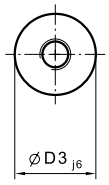
Note: Dimensions shown in mm

Dimension	PL6042	PL6060	PL6075	PL6100	PL6140	PL6180	PL6220
D1	50	68	85	120	165	215	250
D2	3.4	5.5	6.8	9	11	13	17
D3 $_{j6}$	13	16	22	32	40	55	75
D4 $_{g6}$	35	60	70	90	130	160	180
D5	22	30	45	60	75	95	115
D6	M4 x 0.7P	M5 x 0.8P	M8 x 1.25P	M12 x 1.75P	M16 x 2P	M20 x 2.5P	M20 x 2.5P
L1	42	62	76	105	142	180	220
L2	19.5	28.5	36	58	82	82	105
L3	6.5	20	20	30	30	30	33
L4	1	1.5	2	2	3	3	3
L5	16	25	32	40	63	70	90
L6	2	2	3	5	5	6	7
L7	4	6	7	10	12	15	20
L8	31	23.5	56	48.5	62	80.5	93
L9	42	60	90	115	142	180	220
L10	10	12.5	19	28	36	42	42
C1[3]	46	70	100	130	165	215	235
C2[3]	M4 x 0.7P	M5 x 0.8P	M6 x 1P	M8 x 1.25P	M10 x 1.5P	M12 x 1. 75P	M12 x 1.75P
C3[3]	≤11	≤16	*≤19/≤24	≤32	≤38	≤48	≤55
C4[3]	25	30	40	50	60	82	82
C5[3] $_{G6}$	30	50	80	110	130	180	200
C6[3]	3.5	4	4	5	6	6	6
C7[3]	42	60	90	115	142	190	220
C8[3]	29.5	41.5	48	61	71	96	100
C9[3]	86.5	113.5	160	197.5	245	288.5	331
C10[3]	8.75	10	11.25	13.5	16	18.25	20
B1 $_{h9}$	5	5	6	10	12	16	20
H1	15	18	24.5	35	43	59	79.5

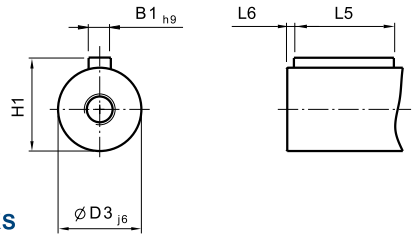
3. C1~C10 are motor specific dimensions (metric std shown).
* PL6075 ratio 3~10 provides C3 = 24 option.

Dimensions (2-stage, Ratio i = 15-100)





Shaft Option SS



Shaft Option KS

Note: Dimensions shown in mm

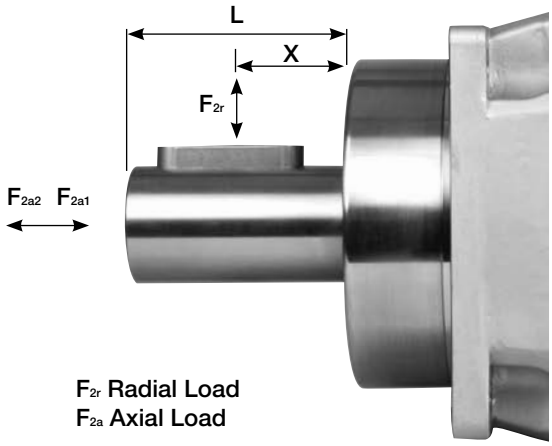
Dimension	PL6042	PL6060	PL6075	PL6100	PL6140	PL6180	PL6220
D1	50	68	85	120	165	215	250
D2	3.4	5.5	6.8	9	11	13	17
D3 $_{j6}$	13	16	22	32	40	55	75
D4 $_{g6}$	35	60	70	90	130	160	180
D5	22	30	45	60	75	95	115
D6	M4 x 0.7P	M5 x 0.8P	M8 x 1.25P	M12 x 1.75P	M16 x 2P	M20 x 2.5P	M20 x 2.5P
L1	42	62	76	105	142	180	220
L2	19.5	28.5	36	58	82	82	105
L3	6.5	20	20	30	30	30	33
L4	1	1.5	2	2	3	3	3
L5	16	25	32	40	63	70	90
L6	2	2	3	5	5	6	7
L7	4	6	7	10	12	15	20
L8	58.5	60.5	93.5	100.5	125.5	157.5	178.5
L9	42	60	90	115	142	180	220
L10	10	12.5	19	28	36	42	42
C1[4]	46	46	70	100	130	165	215
C2[4]	M4 x 0.7P	M4 x 0.7P	M5 x 0.8P	M6 x 1P	M8 x 1.25P	M10 x 1. 5P	M12 x 1.75P
C3[4]	≤11	*≤11/≤12	*≤14/≤16	*≤19 / ≤24	≤32	≤38	≤48
C4[4]	25	25	30	40	50	60	82
C5[4] $_{G6}$	30	30	50	80	110	130	180
C6[4]	3.5	3.5	4	4	5	6	6
C7[4]	42	42	60	90	115	142	190
C8[4]	29.5	29.5	41.5	48	61	71	96
C9[4]	114	138.5	191	236.5	298.5	340.5	412.5
C10[4]	8.75	8.75	10	11.25	13.5	16	18.25
B1 $_{h9}$	5	5	6	10	12	16	20
H1	15	18	24.5	35	43	59	79.5

4. C1~C10 are motor specific dimensions (metric std shown).

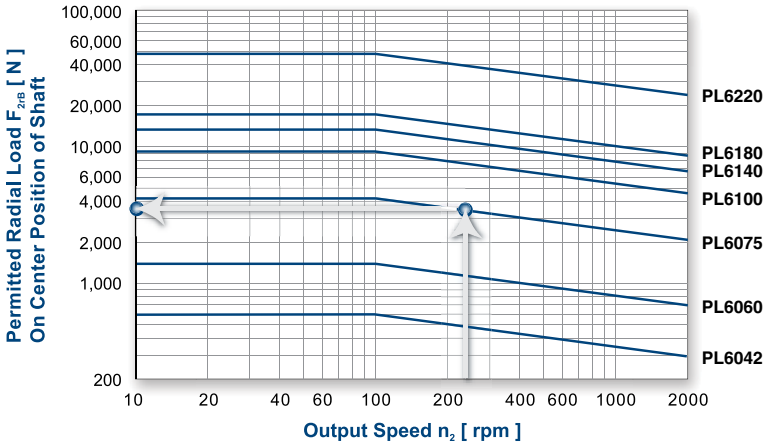
* PL6060 ratio 15-50 provides C3 ≤ 12 option. * PL6075 ratio 15-50 provides C3 ≤ 16 option *PL6100 ratio 15~100 provides C3 = 24 option.

Radial and axial loads allowed on the output shaft

The permitted radial and axial loads on the output shaft of the gearbox is dependent upon the design of the gearbox supporting bearings. The oversized, tapered roller bearing, straddle mount design for the PL6 Series accomodates high radial and axial loads with extended life. This design enables a 50% more load capacity than a standard angular contact bearing design.



F_{2r} Radial Load
F_{2a} Axial Load



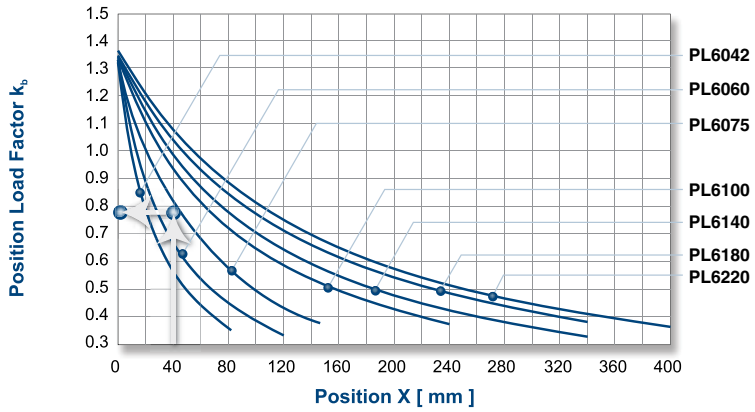
If the radial force F_{2r} **is** exerted on the center of the output shaft, then X=0.5 x L.

Under these conditions the permitted radial load can be determined from the graph on the left.

The permitted axial load can then be calculated by using the following formulas:

$F_{2a1B} = 0.2 \times F_{2rB}$ (axial force towards the gearhead)

$F_{2a2B} = 0.1 \times F_{2rB}$ (axial force away from the gearhead)



If the radial force F_{2r} **is not** exerted on the center of the output shaft, then X is the distance measured from the output seal.

The position load factor K_b can then be determined by the graph to the left.

Under these conditions the radial and axial loads can be calculated by using the following formulas:

Radial Load:

$F'_{2rB}=K_b \times F_{2rB}$

Axial Load:

$F'_{2a1B}=0.2 \times F'_{2rB}$

$F'_{2a2B}=0.1 \times F'_{2rB}$

* Continuous running reduces service life by 50%.

Stainless Steel High Precision Right Angle Planetary Gearboxes

Dimensional drop-in for Alpha SPK, Stober Servofit PKS and Micron UltraTrue 90 Right Angle Series

Ordering Number System for PR6 Models

Example: PR6220-045-SS-P-0000-00.0

PR **6** **220** – **040** – **SS** – **P** – **0000** – **00.0**

In-Line/ Right Angle
PL: Precision Gearhead In-Line
PR: Precision Gearhead Right Angle

Series No.
2, 5, 6

Case Size
042, 060, 075, 100, 142, 180, 220

Ratios
Single Reduction:
003, 004, 005, 007, 009, 010, 014, 020
Double Reduction:
025, 030, 035, 040, 050, 060, 070, 080, 090, 100, 140, 180, 200

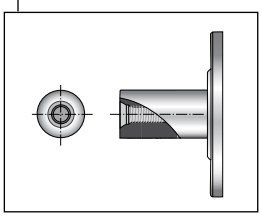
Note: Other ratios are available upon request

Shaft Type
SS: Smooth Shaft
KS: Keyed Shaft

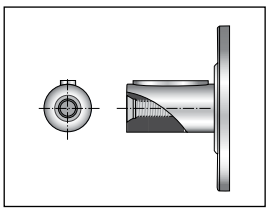
Backlash
S: Standard 5 arcmin
M:: Mid-grade 3 arcmin
P: Premium 1 arcmin

Housing Part No.
Based on servo motor make and model.

Input Shaft Inner Diameter
Based on servo motor make and model.



SS Standard output shaft

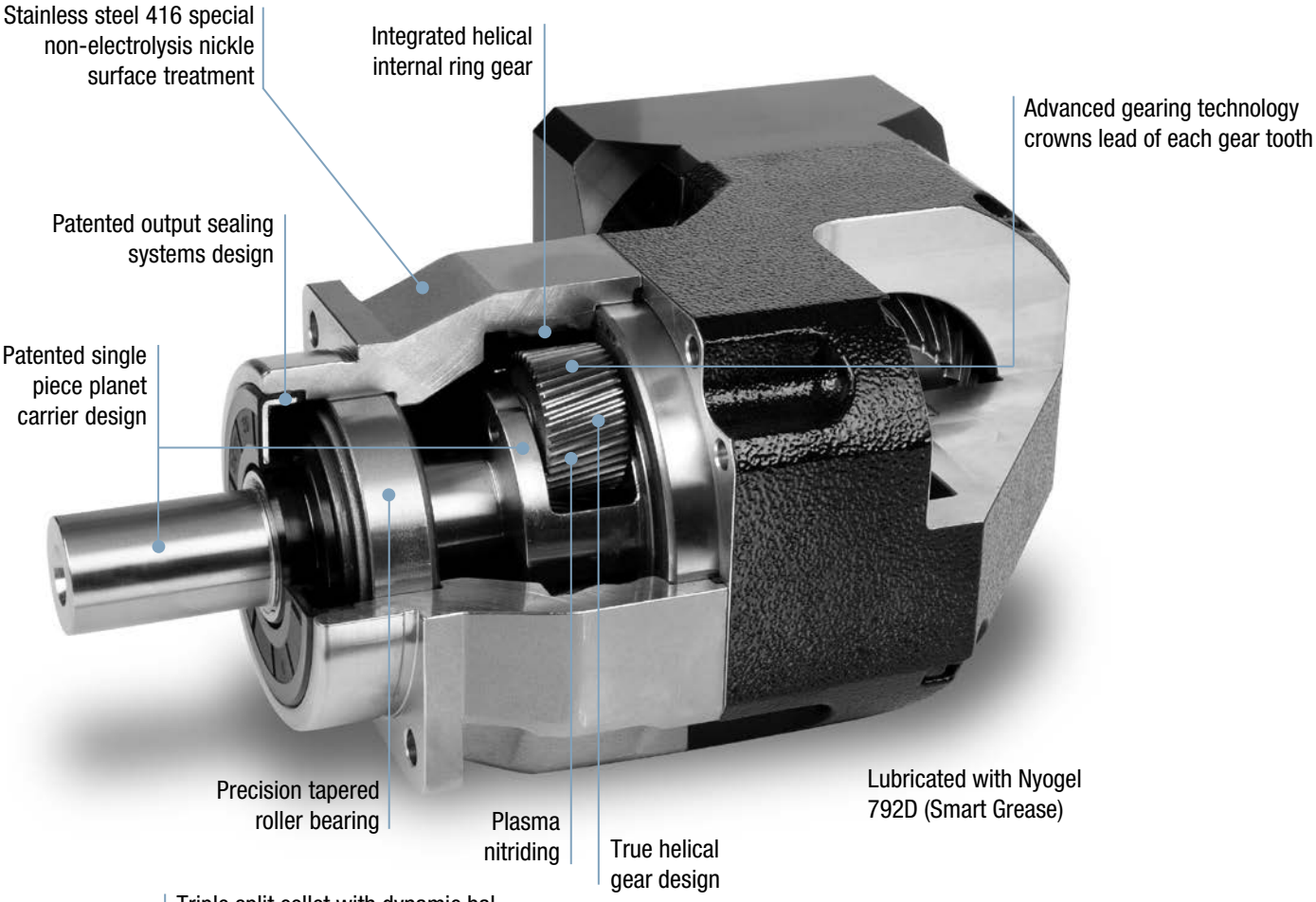


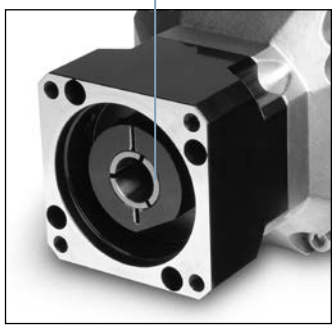
KS Output shaft with key
(Keyway: Standard DIN 6885)

PR6 Series

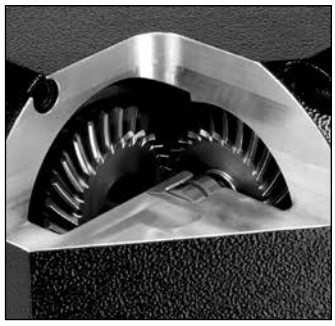
Features

- Higher output torque rating by using spiral bevel gear design. 30% more than straight bevel gear.
- Allows input speeds up to 8 times than with straight bevel gearing.
- Improved load sharing through precision tooth design and longer service life.
- Ground gears verified with sophisticated software, ensures smooth, quiet operation with reduced backlash (≤2 arcmin).
- High tensile low weight single piece aluminum alloy housing for highest stiffness.
- Maintenance free lifetime lubrication.
- Patented sealing design for high speed and continuous running.
- High efficiency up to 95%. Low noise level down to 61dB.
- Most ratios available from 3~200.





Unique motor adaptor and bushing module system



Spiral Bevel gear design

Precision tapered roller bearing support for increased radial and axial loading capacity

Specifications

		Stages	Ratio[1]	Model No. PR6042	PR6060	PR6075	PR6100	PR6140	PR6180	PR6220
Nominal Output Torque T_{2N}	Nm	1	**3**	9	36	90	195	342	588	1,140
			4	12	48	120	260	520	1,040	1,680
			5	15	60	150	325	650	1,200	2,000
			7	19	50	140	300	550	1,100	1,800
			9	14	40	100	230	450	900	1,500
			10	14	40	100	230	450	900	1,500
			14	-	42	140	300	550	1,100	1,800
			20	-	40	100	230	450	900	1,500
		2	**25**	15	60	150	325	650	1,200	2,000
			30	20	55	150	310	600	1,100	1,900
			35	19	50	140	300	550	1,100	1,800
			40	17	45	120	260	500	1,000	1,600
			45	14	40	100	230	450	900	1,500
			50	14	60	100	230	650	1,200	2,000
			70	19	50	140	300	550	1,100	1,800
			90	14	40	100	230	450	900	1,500
			100	14	40	100	230	450	900	1,500
			140	-	-	140	300	550	1,100	1,800
			180	-	-	100	230	450	900	1,500
			200	-	-	100	230	450	900	1,500
Max. Output Torque T_{2B}	Nm	1,2	**3~200**	3 times of Nominal Output Torque						
Nominal Input Speed n_{1N}	rpm	1,2	**3~200**	5,000	5,000	4,000	4,000	3,000	3,000	2,000
Max. Input Speed n_{1B}	rpm	1,2	**3~200**	10,000	10,000	8,000	8,000	6,000	6,000	4,000
Premium Backlash P	arcmin	1	**3~20**	-	-	≤2	≤2	≤2	≤2	≤2
		2	**25~200**	-	-	≤4	≤4	≤4	≤4	≤4
Mid-grade Backlash M	arcmin	1	**3~20**	≤4	≤4	≤4	≤4	≤4	≤4	≤4
		2	**25~200**	≤7	≤7	≤7	≤7	≤7	≤7	≤7
Standard Backlash S	arcmin	1	**3~20**	≤6	≤6	≤6	≤6	≤6	≤6	≤6
		2	**25~200**	≤9	≤9	≤9	≤9	≤9	≤9	≤9
Torsional Rigidity	Nm/arcmin	1,2	**3~200**	3	7	14	25	50	145	225
Max. Radial Load F 2rB2	N	1,2	**3~200**	610	1,400	4,100	9,200	14,000	18,000	49,000
Max. Axial Load F 2aB2	N	1,2	**3~200**	302	605	3,700	5,800	11,400	19,500	13,200
Service Life	hr	1,2	**3~200**	30,000*						
Efficiency h	%	1	**3~20**	≥95%						
		2	**25~200**	≥92%						
Weight	kg	1	**3~20**	0.9	2.1	6.4	13.9	23.7	50	83
		2	**25~200**	1.2	1.5	7.8	15.1	26.7	54	94
Operating Temp	°C	1,2	**3~200**	-10°C~+90°C						
Lubrication		1,2	**3~200**	synthetic gear grease (NYOGEL 792D)						
Degree of Gearbox Protection		1,2	**3~200**	IP65						
Mounting Position		1,2	**3~200**	all directions						
Noise Level (n1= 3000 rpm)	dB	1,2	**3~200**	≤61	≤63	≤65	≤68	≤70	≤72	≤74

Gearbox Inertia

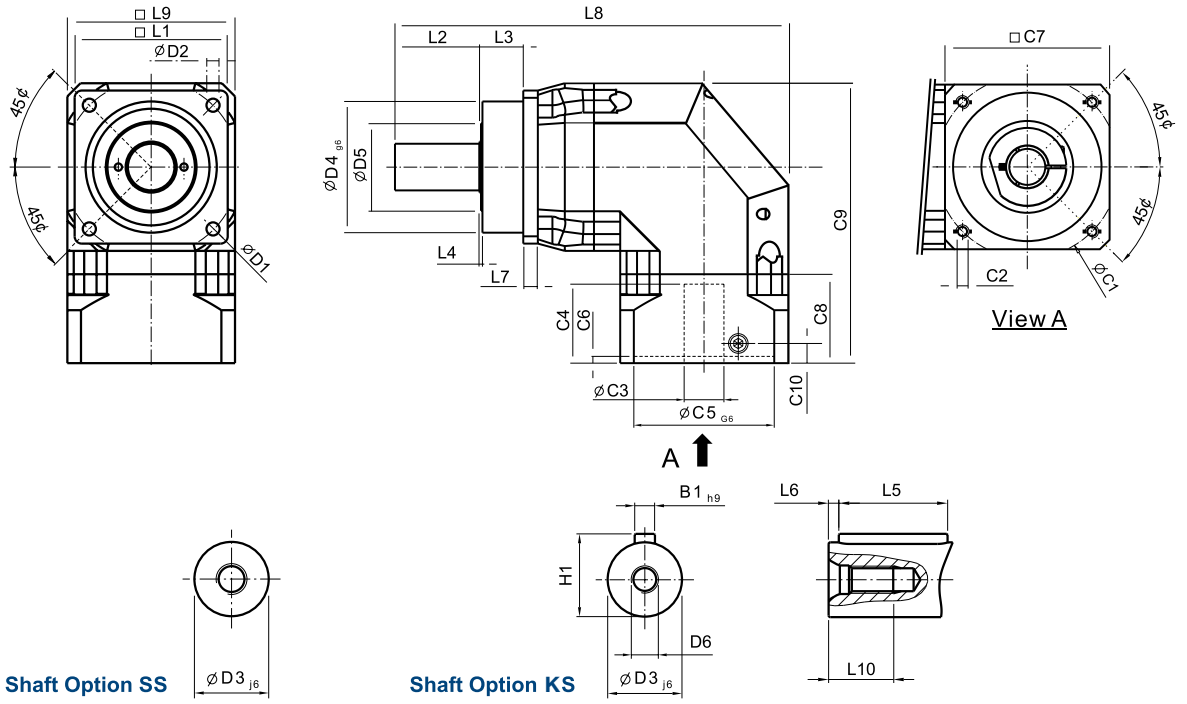
		Stages	Ratio	Model No. PR6042	PR6060	PR6075	PR6100	PR6140	PR6180	PR6220
Mass Moments of Inertia J1	kg • cm^2	1	**3~10**	0.09	0.35	2.25	6.84	23.4	68.9	135.4
			14	-	0.07	1.87	6.25	21.8	65.6	119.8
			20	-	0.07	1.87	6.25	21.8	65.6	119.8
		2	**25~100**	0.09	0.09	0.35	2.25	6.84	23.4	66.9
			140~200	-	-	0.31	1.87	6.25	21.8	65.6

1. Ratio ($i=N_{in}/N_{out}$)

2. F_{2R} F_{2A} applied to the output shaft center @ 100 rpm

*S1 service life 15,000 hrs

Dimensions (1-stage, Ratio i = 3-20)



Shaft Option SS

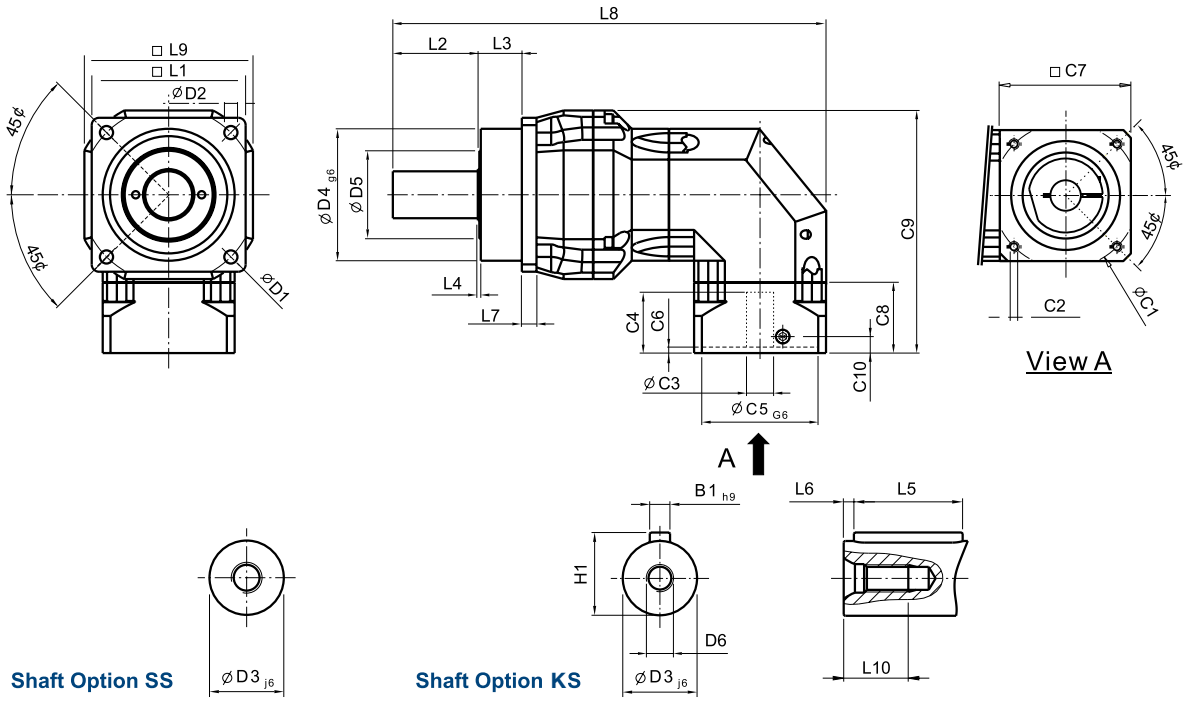
Shaft Option KS

Note: Dimensions shown in mm

Dimension	PR6042	PR6060	PR6075	PR6100	PR6140	PR6180	PR6220
D1	50	68	85	120	165	215	250
D2	3.4	5.5	6.8	9	11	13	17
D3 $_{j6}$	13	16	22	32	40	55	75
D4 $_{g6}$	35	60	70	90	130	160	180
D5	22	30	45	60	75	95	115
D6	M4 x 0.7P	M5 x 0.8P	M8 x 1.25P	M12 x 1.75P	M16 x 2P	M20 x 2.5P	M20 x 2.5P
L1	42	62	76	105	142	180	220
L2	19.5	28.5	36	58	82	82	105
L3	6.5	20	20	30	30	30	33
L4	1	1.5	2	2	3	3	3
L5	16	25	32	40	63	70	90
L6	2	2	3	5	5	6	7
L7	4	6	7	10	12	15	20
L8	111.5	145	219	269.5	338.5	397	484
L9	42	60	90	115	142	180	220
L10	10	12.5	19	28	36	42	42
C1[3]	46	70	100	130	165	215	235
C2[3]	M4 x 0.7P	M5 x 0.8P	M6 x 1P	M8 x 1.25P	M10 x 1.25P	M12 x 1.75P	M12 x 1.75P
C3[3]	≤11	≤16	*≤19/≤24	≤32	≤38	≤48	≤55
C4[3]	25	30	40	50	60	82	82
C5[3] $_{G6}$	30	50	80	110	130	180	200
C6[3]	3.5	4	4	5	6	6	6
C7[3]	42	60	90	115	142	190	220
C8[3]	29.5	41.5	48	61	71	96	100
C9[3]	90.5	108	153	192	236	301	345
C10[3]	8.75	10	11.25	13.5	16	18.25	20
B1 $_{h9}$	5	5	6	10	12	16	20
H1	15	18	24.5	35	43	59	79.5

3. C1~C10 are motor specific dimensions (metric std shown).
* PR6075 C3 option = 24 option.

Dimensions (2-stage, Ratio i = 25-200)



Shaft Option SS

Shaft Option KS

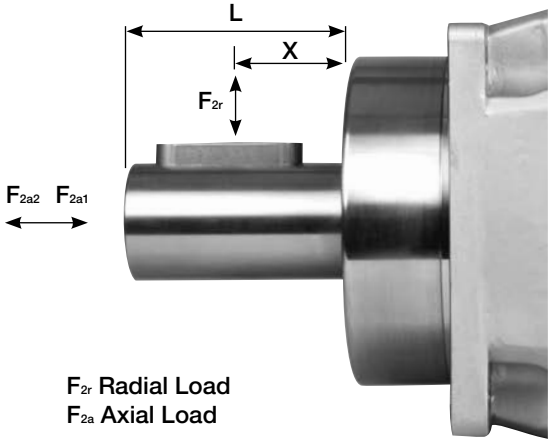
Note: Dimensions shown in mm

Dimension	PR6042	PR6060	PR6075	PR6100	PR6140	PR6180	PR6220
D1	50	68	85	120	165	215	250
D2	3.4	5.5	6.8	9	11	13	17
D3 $_{j6}$	13	16	22	32	40	55	75
D4 $_{g6}$	35	60	70	90	130	160	180
D5	22	30	45	60	75	95	115
D6	M4 x 0.7P	M5 x 0.8P	M8 x 1.25P	M12 x 1.75P	M16 x 2P	M20 x 2.5P	M20 x 2.5P
L1	42	62	76	105	142	180	220
L2	19.5	28.5	36	58	82	82	105
L3	6.5	20	20	30	30	30	33
L4	1	1.5	2	2	3	3	3
L5	16	25	32	40	63	70	90
L6	2	2	3	5	5	6	7
L7	4	6	7	10	12	15	20
L8	139	63.5	222.5	295.5	370.5	434	521
L9	42	60	90	115	142	180	220
L10	10	12.5	19	28	36	42	42
C1[4]	46	46	70	100	130	165	215
C2[4]	M4 x 0.7P	M4 x 0.7P	M5 x 0.8P	M6 x 1P	M8 x 1.25P	M10 x 1.5P	M12 x 1.75P
C3[4]	≤11	*≤11/≤12	*≤14/≤16	*≤19/≤24	≤32	≤38	≤48
C4[4]	25	25	30	40	50	60	82
C5[4] $_{G6}$	30	30	50	80	110	130	180
C6[4]	3.5	3.5	4	4	5	6	6
C7[4]	42	42	60	90	115	142	190
C8[4]	29.5	29.5	41.5	48	61	71	96
C9[4]	90.5	99.5	123	165.5	205.5	255	321
C10[4]	8.75	8.75	10	11.25	13.5	16	18.25
B1 $_{h9}$	5	5	6	10	12	16	20
H1	15	18	24.5	35	43	59	79.5

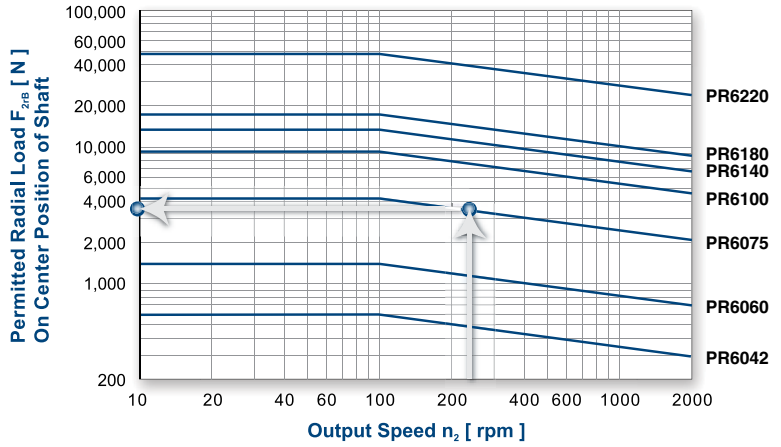
4. C1~C10 are motor specific dimensions (metric std shown).
* PR6075 C3 option ≤ 16. * PR6100 C3 option = 24 option.

Radial and axial loads allowed on the output shaft

The permitted radial and axial loads on the output shaft of the gearbox is dependent upon the design of the gearbox supporting bearings. The oversized, tapered roller bearing, straddle mount design for the PR6 Series accomodates high radial and axial loads with extended life. This design enables a 50% more load capacity than a standard angular contact bearing design.



F_{2r} Radial Load
F_{2a} Axial Load



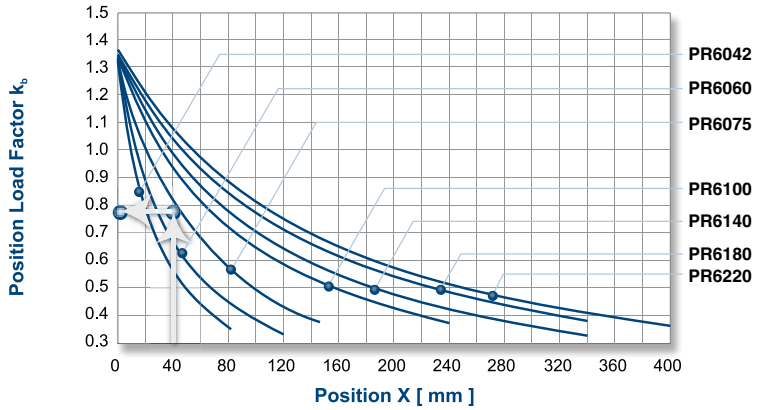
If the radial force F_{2r} **is** exerted on the center of the output shaft, then X=0.5 x L.

Under these conditions the permitted radial load can be determined from the graph on the left.

The permitted axial load can then be calculated by using the following formulas:

$F_{2a1B} = 0.2 \times F_{2rB}$ (axial force towards the gearhead)

$F_{2a2B} = 0.1 \times F_{2rB}$ (axial force away from the gearhead)



If the radial force F_{2r} **is not** exerted on the center of the output shaft then X is the distance measured from the output seal.

The position load factor K_b can then be determined by the graph to the left.

Under these conditions the radial and axial loads can be calculated by using the following formulas:

Radial Load:

$F'_{2rB}=K_b \times F_{2rB}$

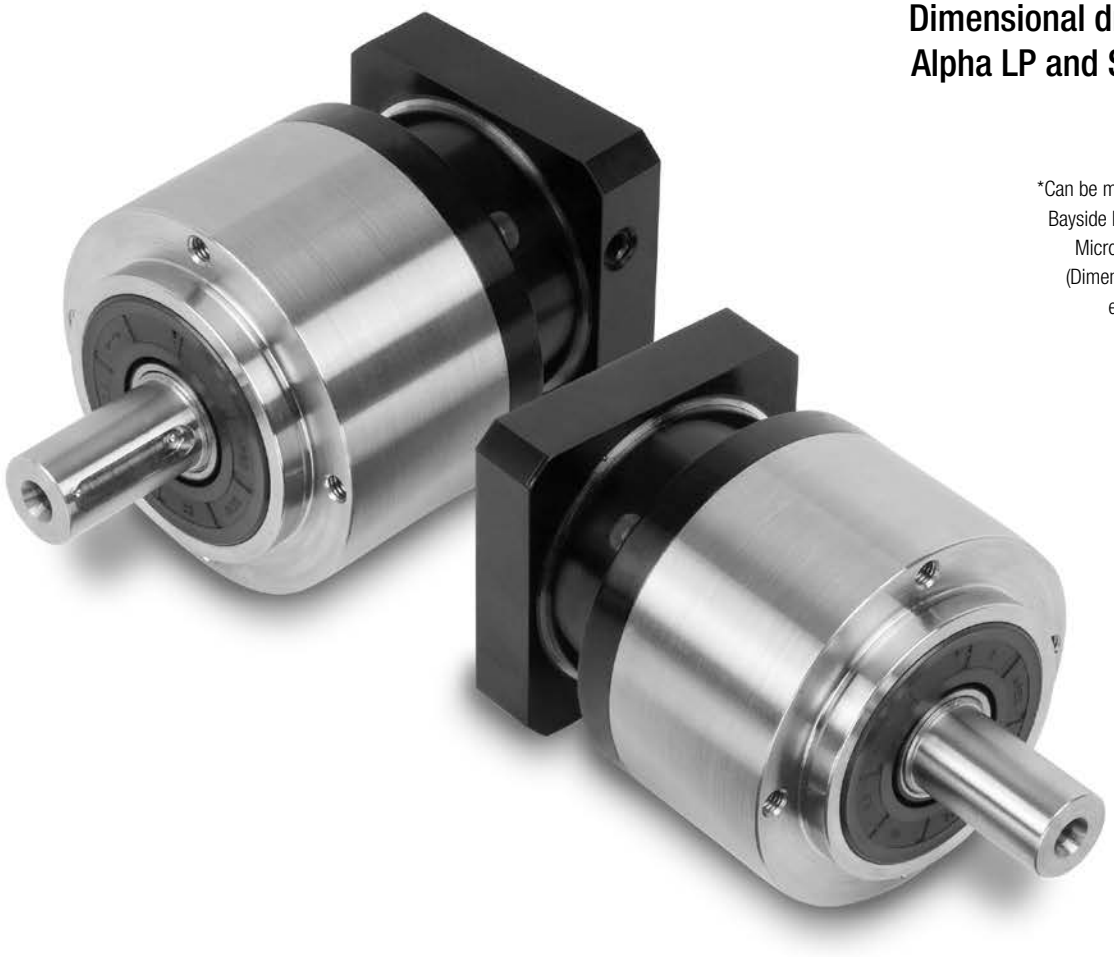
Axial Load:

$F'_{2a1B}=0.2 \times F'_{2rB}$

$F'_{2a2B}=0.1 \times F'_{2rB}$

* Continuous running reduces service life by 50%.

Stainless Steel High Precision Economy Inline Planetary Gearboxes



Dimensional drop-in for Alpha LP and Stober PE Series

*Can be modified to replace Bayside PX and PV Series, Micron NT & DT Series (Dimensions may not be exact in all cases).

Ordering Number System for PL5 Models

Example: PL5120-070-0000-00.0

PL **5** **120** – **070** – **0000** – **00.0**

In-Line
PL: Precision Gearhead In-Line

Series No.
5

Case Size
050, 070, 090, 120, 155, 205, 235

Ratios
Single Reduction:
003, 004, 005, 007, 009, 010
Double Reduction:
015, 020, 025, 030, 035, 040, 045, 050, 070, 090, 100

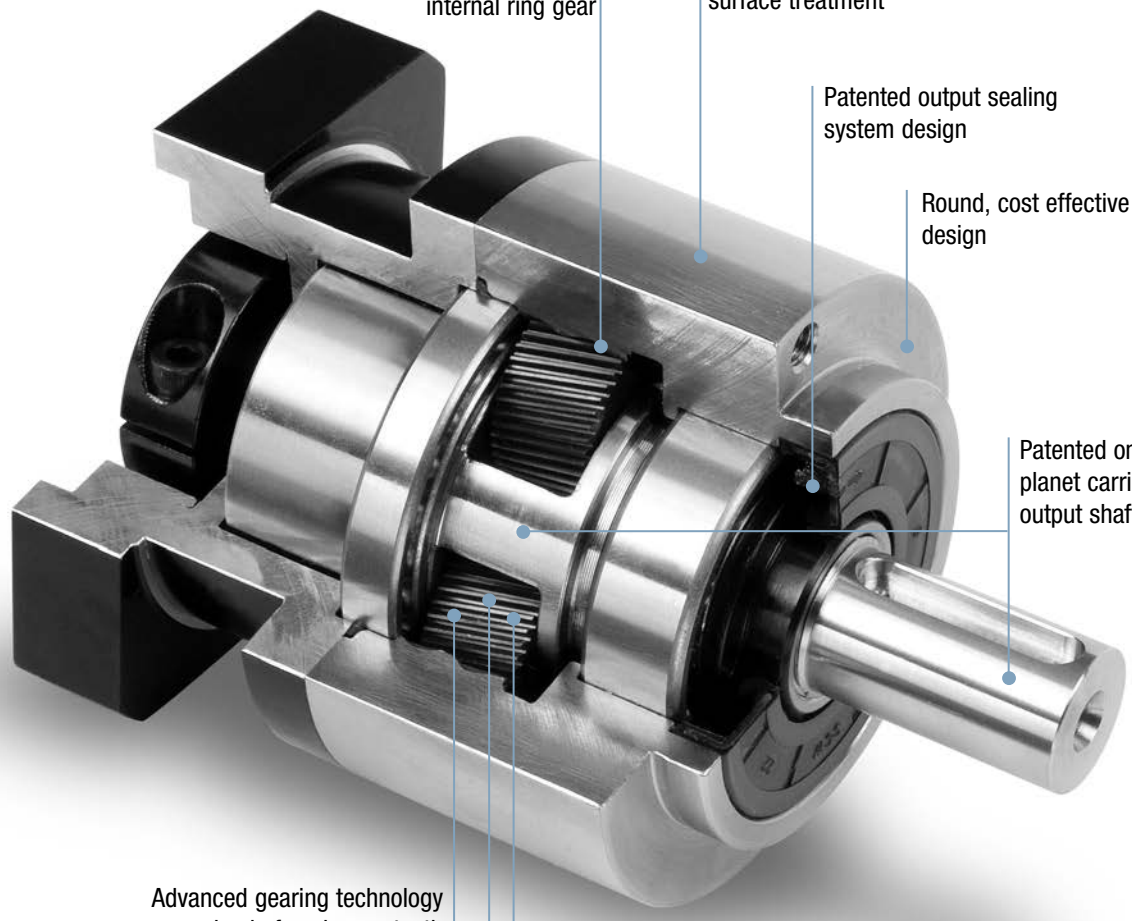
Housing Part No.
Based on servo motor make and model.

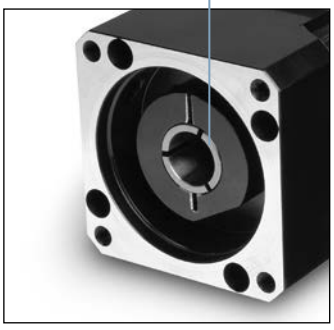
Input Shaft Inner Diameter
Based on servo motor make and model.

Note: Other ratios are available upon request

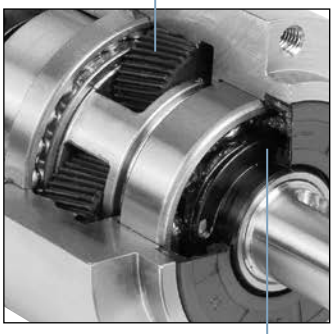
PL5 Series

Features





Unique motor adaptor and bushing module system



Patented output sealing system design

Patented input sealing system design

Specifications

		Stages	Ratio[1]	Model No. PL5050	PL5070	PL5090	PL5120	PL5155	PL5205	PL5235
Nominal Output Torque T_{2N}	Nm	1	**3**	20	55	130	208	342	588	1,140
			4	19	50	140	290	542	1,050	1,700
			5	22	60	160	330	650	1,200	2,000
			7	19	50	140	300	550	1,100	1,800
			9	14	40	100	230	450	900	1,500
			10	14	40	100	230	450	900	1,500
		2	**15**	20	55	130	208	342	588	1,140
			20	19	50	140	290	542	1,050	1,700
			25	22	60	160	330	650	1,200	2,000
			30	20	55	150	310	600	1,100	1,900
			35	19	50	140	300	550	1,100	1,800
			40	17	45	120	260	500	1,000	1,600
			45	14	40	100	230	450	900	1,500
			50	22	60	160	330	650	1,200	2,000
			70	19	50	140	300	550	1,100	1,800
			90	14	40	100	230	450	900	1,500
			100	14	40	100	230	450	900	1,500
Max. Output Torque T_{2B}	Nm	1,2	**3~100**	3 times of Nominal Output Torque						
Nominal Input Speed n_{1N}	rpm	1,2	**3~100**	5,000	5,000	4,000	4,000	3,000	3,000	2,000
Max. Input Speed n_{1B}	rpm	1,2	**3~100**	10,000	10,000	8,000	8,000	6,000	6,000	4,000
Backlash	arcmin	1	**3~10**	≤8	≤8	≤8	≤8	≤8	≤8	≤8
		2	**15~100**	≤12	≤12	≤12	≤12	≤12	≤12	≤12
Torsional Rigidity	Nm/arcmin	1,2	**3~100**	3	7	14	25	50	145	225
Max. Radial Load F_{2rB}[2]	N	1,2	**3~100**	702	1,377	2,985	6,100	8,460	13,050	8,700
Max. Axial Load F_{2aB}[2]	N	1,2	**3~100**	390	765	1,625	2,350	4,700	7,250	4,800
Service Life	hr	1,2	**3~100**	20,000*						
Efficiency h	%	1	**3~10**	≥97%						
		2	**15~100**	≥94%						
Weight	kg	1	**3~10**	0.6	1.4	3.3	6.9	13	31	53
		2	**15~100**	0.9	1.6	4.7	8.7	17	35	66
Operating Temp	°C	1,2	**3~100**	-10°C~+90°C						
Lubrication		1,2	**3~100**	synthetic gear grease (NYOGEL 792D)						
Degree of Gearbox Protection		1,2	**3~100**	IP65						
Mounting Position		1,2	**3~100**	all directions						
Noise Level (n1 = 3000 rpm)	dB	1,2	**3~100**	≤56	≤58	≤60	≤63	≤65	≤67	≤70

Gearbox Inertia

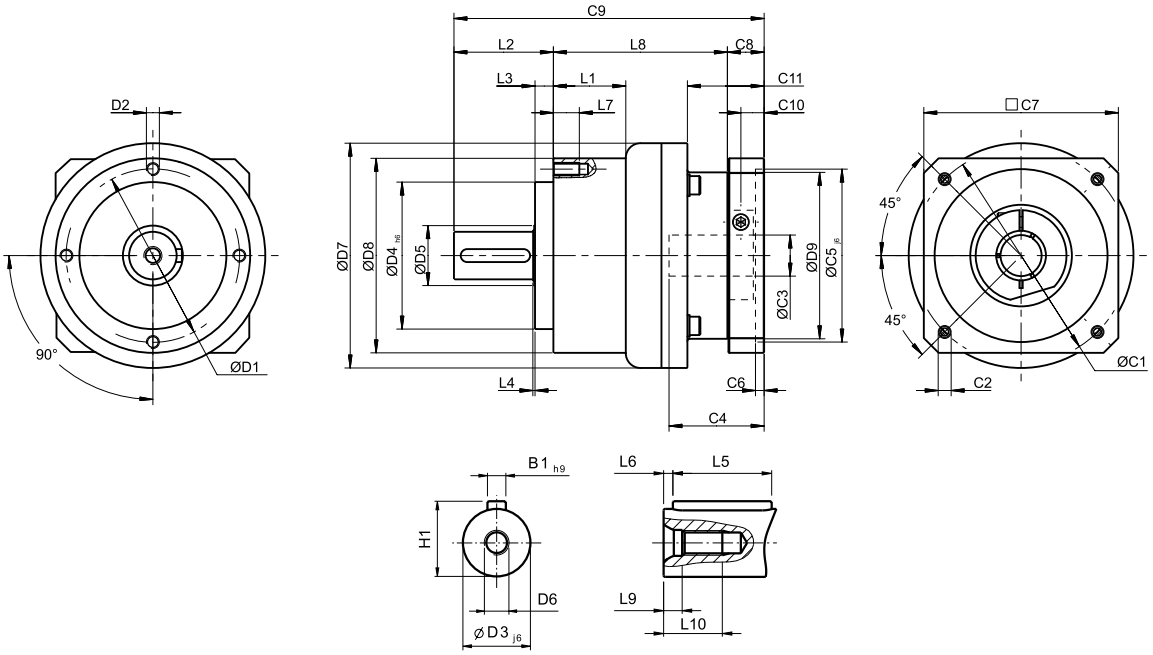
		Stages	Ratio	Model No. PL5050	PL5070	PL5090	PL5120	PL5155	PL5205	PL5235
Mass Moments of Inertia J_1	kg • cm^2	1	**3**	0.03	0.16	0.61	3.25	9.21	28.98	69.61
			4	0.03	0.14	0.48	2.74	7.54	23.67	54.37
			5	0.03	0.13	0.47	2.71	7.42	23.29	53.27
			7	0.03	0.13	0.45	2.62	7.14	22.48	50.97
			9	0.03	0.13	0.44	2.57	7.04	22.53	50.63
			10	0.03	0.13	0.44	2.57	7.03	22.51	50.56
		2	**15**	0.03	0.03	0.13	0.47	2.71	7.42	23.29
			20	0.03	0.03	0.13	0.47	2.71	7.42	23.29
			25	0.03	0.03	0.13	0.47	2.71	7.42	23.29
			30	0.03	0.03	0.13	0.47	2.71	7.42	23.29
			35	0.03	0.03	0.13	0.47	2.71	7.42	23.29
			40	0.03	0.03	0.13	0.47	2.71	7.42	23.29
			45	0.03	0.03	0.13	0.47	2.71	7.42	23.29
			50	0.03	0.03	0.13	0.44	2.57	7.03	22.51
			70	0.03	0.03	0.13	0.44	2.57	7.03	22.51
			90	0.03	0.03	0.13	0.44	2.57	7.03	22.51
			100	0.03	0.03	0.13	0.44	2.57	7.03	22.51

1. Ratio ($i=N_{in}/N_{out}$)
2. F_{2rB} F_{2aB} applied to the output shaft center @ 100 rpm

*S1 service life 10,000 hrs

PL5 Series

Dimensions (1-stage, Ratio i = 3-10)



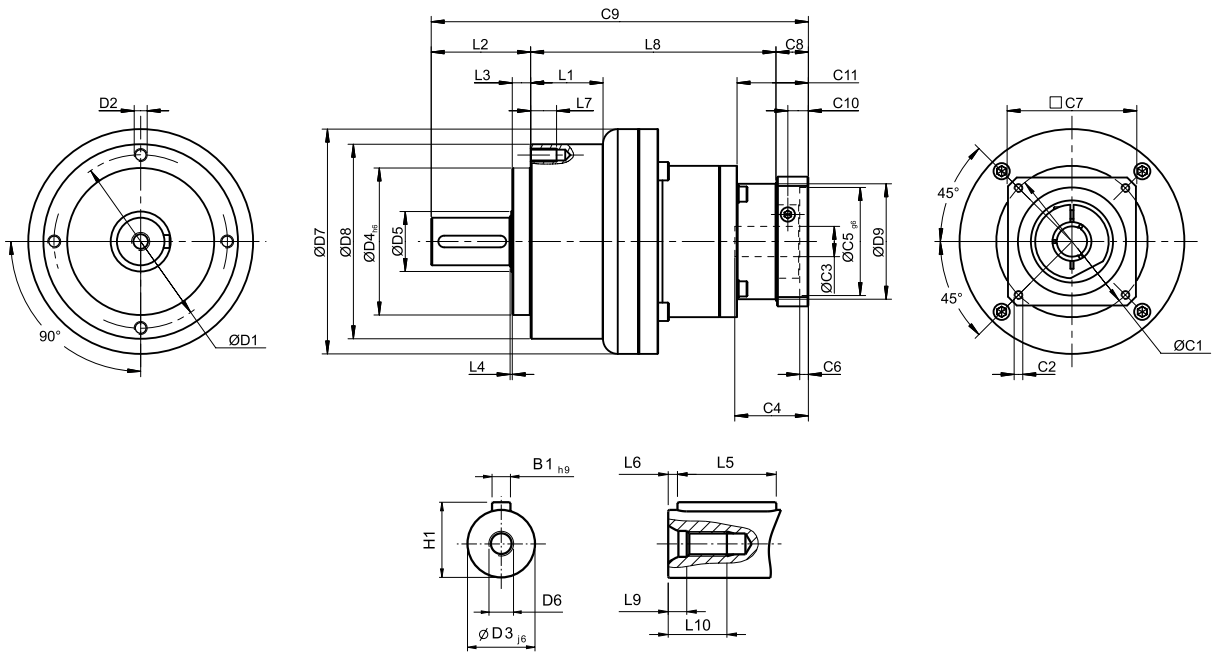
Note: Dimensions shown in mm

Dimension	PL5050	PL5070	PL5090	PL5120	PL5155	PL5205	PL5235
D1	44	62	80	108	140	184	210
D2	M4 x 0.7P	M5 X 0.8P	M6 x 1P	M8 x 1.25P	M10 x 1.5P	M12 x 1.75P	M16 x 2P
D3 j6	12	16	22	32	40	55	75
D4 h6	35	52	68	90	120	160	180
D5	22	22	30	40	75	95	115
D6	M4 x 0.7P	M5 x 0.8P	M8 x 1.25P	M12 x 1.75P	M16 x 2P	M20 x 2.5P	M20 x 2.5P
D7	53	70	104	130	162	205	260
D8	50	70	90	120	155	205	235
D9	45.5	53.4	77	102	125	160	205
L1	34.5	-	33.5	38	50	-	70
L2	24.5	36	46	70	97	100	126
L3	4	6.5	8.5	17.5	15	15	18
L4	1	1	1	1.5	3	3	3
L5	14	25	32	40	63	70	90
L6	2	2	3	5	5	6	7
L7	8	10	12	16	20	22	28
L8	47	62	80.5	97	119.5	159	175.5
L9	3.2	4	6	9.5	12	15	15
L10	10	12.5	19	28	36	42	42
C1[3]	46	70	100	130	165	200	235
C2[3]	M4 x 0.7P	M4 x 0.7P	M6 x 1P	M8 x 1.25P	M10 x 1.5P	M12 x 1.75P	M12 x 1.75P
C3[3]	≤11	*≤14/≤16	≤19/≤24	≤32	≤38	≤48	≤55
C4[3]	30	30	40	50	60	113	116
C5[3] G6	30	50	80	110	130	114.3	200
C6[3]	3.5	4	4	5	6	6	6
C7[3]	48	60	90	115	142	180	220
C8[3]	19.5	15	17	19.5	22.5	57	63
C9[3]	91	113	143.5	186.5	239	316	364.5
C10[3]	13.25	9.5	10.75	13	15.5	48.75	53.5
C11[3]	19.5	33	35.5	46	53.5	107.5	106.5
B1 h9	4	5	6	10	12	16	20
H1	14	18	24.5	35	43	59	79.5

3. C1~C10 are motor specific dimensions (metric std shown).

* PL5070 ratio 5.10 provides C3 ≤ 16 option.

Dimensions (2-stage, Ratio i = 15-100)



Note: Dimensions shown in mm

Dimension	PL5050	PL5070	PL5090	PL5120	PL5155	PL5205	PL5235
D1	44	62	80	108	140	184	210
D2	M4 x 0.7P	M5 X 0.8P	M6 x 1P	M8 x 1.25P	M10 x 1.5P	M12 x 1.75P	M16 x 2P
D3 $_{j6}$	12	16	22	32	40	55	75
D4 $_{h6}$	35	52	68	90	120	160	180
D5	22	22	30	40	75	95	115
D6	M4 x 0.7P	M5 x 0.8P	M8 x 1.25P	M12 x 1.75P	M16 x 2P	M20 x 2.5P	M20 x 2.5P
D7	53	70	104	130	162	205	260
D8	50	70	90	120	155	205	235
D9	45.5	45.5	53.4	77	102	125	160
L1	61.5	-	33.5	38	50	-	70
L2	24.5	36	46	70	97	100	126
L3	4	6.5	8.5	17.5	15	15	18
L4	1	1	1	1.5	3	3	3
L5	14	25	32	40	63	70	90
L6	2	2	3	5	5	6	7
L7	8	10	12	16	20	22	28
L8	74	87.5	113.5	138.5	176	214.5	260
L9	3.2	4	6	9.5	12	15	15
L10	10	12.5	19	28	36	42	42
C1[4]	46	46	70	100	130	165	200
C2[4]	M4 x 0.7P	M4 x 0.7P	M4 x 0.7P	M6 x 1P	M8 x 1.25P	M10 x 1.5P	M12 x 1.75P
C3[4]	≤11	*≤11/≤12	*≤14/≤16	≤19/≤24	≤32	≤38	≤48
C4[4]	30	30	30	40	50	60	113
C5[4] $_{G6}$	30	30	50	80	110	130	114.3
C6[4]	3.5	3.5	4	4	5	6	6
C7[4]	48	48	60	90	115	142	180
C8[4]	19.5	19.5	15	17	19.5	22.5	57
C9[4]	118	143	174.5	225.5	292.5	337	443
C10[4]	13.25	13.25	9.5	10.75	13	15.5	48.75
C11[4]	19.5	19.5	33	35.5	46	53.5	107.5
B1 $_{h9}$	4	5	6	10	12	16	20
H1	14	18	24.5	35	43	59	79.5

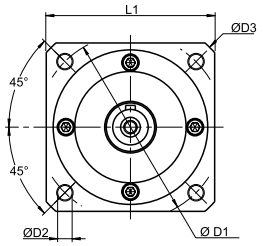
4. C1~C10 are motor specific dimensions (metric std shown).

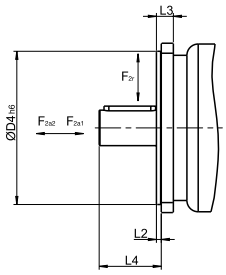
* PL5070 ratio 15~50 provides C3 ≤ 12 option. * PL5090 ration 15~50 provides C3 ≤ 16 option.

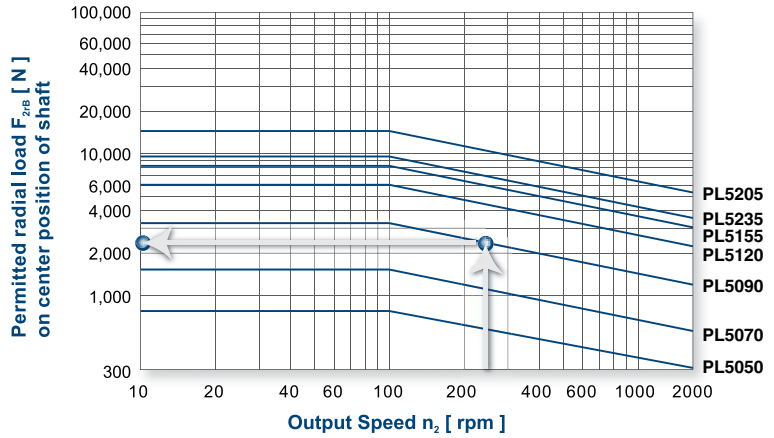
Front Plate Option

Note: Dimensions shown in mm

Dimension	D1	D2	D3	D4[h6]	L1	L2	L3	L4
PL5050-NEMA 23	66.675	6	77	38.15	57.2	2	8	18.5
PL5050-PX60	70	5.6	80.5	50	60	2.5	8.5	18.5
PL5070-Metric	90	6.6	106	50	80	3	11	28
PL5070-NEMA 34	98.425	5.6	115	73.08	86	2.5	8	30.5
PL5070-DT90/PX90	100	6.6	120	80	90	3	8	31
PL5090-IEC 63D5 B5	115	9	140	95	105	3	10.5	38.5
PL5090-NEMA 42	125.73	7	144	55.58	107	4	14.5	35.5
PL5120-NEMA 56	149.225	6.6	170	114.3	127	3	17.5	55.5
PL5155-B5	175	11	196	130	160	5	20	82
PL5205-B5	230	13	277	180	210	5	23	82
PL5235-B5	275	17	317	235	240	5	23	108







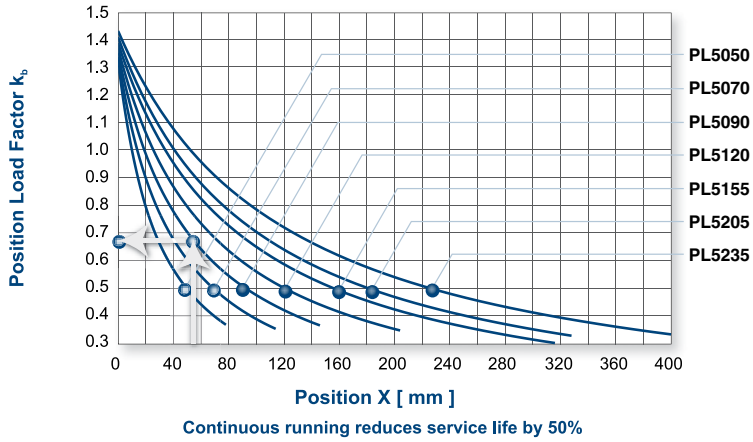
If the radial force F_{2r} **is** exerted on the center of the output shaft, then X=0.5 x L.

Under these conditions the permitted radial load can be determined from the graph on the left.

The permitted axial load can then be calculated by using the following formulas:

$F_{2a1B} = 0.2 \times F_{2rB}$ (axial force towards the gearhead)

$F_{2a2B} = 0.1 \times F_{2rB}$ (axial force away from the gearhead)



* Continuous running reduces service life by 50%.

If the radial force F_{2r} **is not** exerted on the center of the output shaft, then X is the distance measured from the output seal.

The position load factor K_b can then be determined by the graph to the left.

Under these conditions the radial and axial loads can be calculated by using the following formulas:

Radial Load:

$F'_{2rB}=K_b \times F_{2rB}$

Axial Load:

$F'_{2a1B}=0.2 \times F'_{2rB}$

$F'_{2a2B}=0.1 \times F'_{2rB}$

For Motor Mounting

Bolt Size	Width Across Flats (mm)	Strength 8.8 Tightening Torque (Nm)	Strength 8.8 Tightening Torque (In-lbs)	Strength 10.9 Tightening Torque (Nm)	Strength 10.9 Tightening Torque (In-lbs)	Strength 12.9 Tightening Torque (Nm)	Strength 12.9 Tightening Torque (In-lbs)
M3 x 0.5P	2.5	1.3	12	1.8	16	2.1	19
M4 x 0.7P	3	3	27	4.1	37	4.9	44
M5 x 0.8P	4	6.1	55	8.2	73	9.8	87
M6 x 1P	5	11	98	14	124	17	151
M8 x 1.25P	6	25	222	34	302	41	364
M10 x 1.5P	8	49	434	67	594	80	709
M12 x 1.75P	10	85	753	116	1028	139	1232
M14 x 2P	12	137	1214	186	1648	223	1976
M16 x 2P	14	210	1860	286	2534	343	3038

Table 1

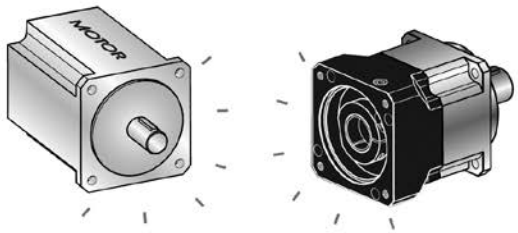
For Set Collar Bolt

Gearbox Size		Motor Shaft Dia. (mm)	Bolt Size (mm)	Width Across Flats (mm)	Tighten Torque (Nm)	Tighten Torque (In-lbs)
PL2042 / PR2042	1 stage	≤11	M3 x 0.5P x 8L	2.5	2.1	19
PL6042 / PR6042	2 stage	≤11	M3 x 0.5P x 8L	2.5	2.1	19
PL2060 / PR2060 PL6060 / PR6060	1 stage	≤14	M4 x 0.7 x 12L	3	4.9	44
	2 stage	≤11	M3 x 0.5P x 8L	2.5	2.1	19
PL2090 / PR2090 PL6075 / PR6075	1 stage	≤19	M5 x 0.8P x 14L	4	9.8	87
	2 stage	≤14	M4 x 0.7P x 12L	3	4.9	44
PL2115 / PR2115 PL6100 / PR6100	1 stage	≤32	M6 x 1P x 16L	5	17	151
	2 stage	≤19	M5 x 0.8P x 14L	4	9.8	87
PL2142 / PR2142 PL6140 / PR6140	1 stage	≤38	M8 x 1.25P x 20L	6	41	364
	2 stage	≤32	M6 x 1P x 16L	5	17	151
PL2180 / PR2180 PL6180 / PR6180	1 stage	≤48	M10 x 1.5P x 25L	8	80	709
	2 stage	≤38	M8 x 1.25P x 20L	6	41	364
PL2220 / PR2220 PL6220 / PR6220	1 stage	≤55	M12 x 1.75P x 30L	10	139	1232
	2 stage	≤48	M10 x 1.5P 25L	8	80	709

Table 2

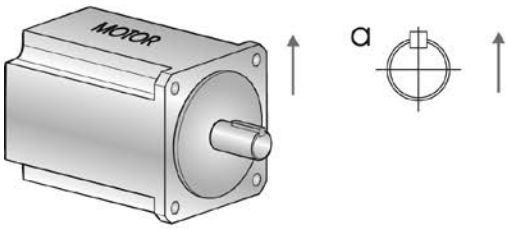
Motor Mounting Instructions

1. Double-check the motor and gearbox size.
Clean the mounting surface.

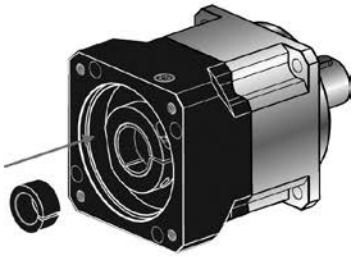


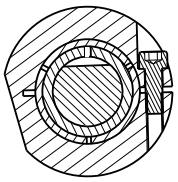
2. Remove the plug on the adapter plate.
Rotate the set collar until the bolt is aligned with the hole.

3. Remove motor key.



4. Check motor shaft size and insert bushing if necessary.

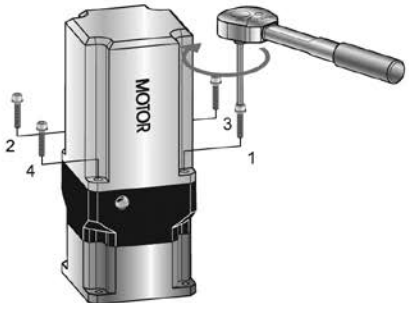




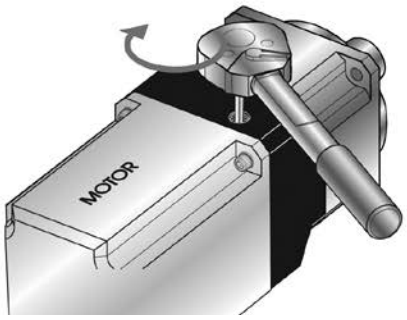
When installing on flatted shafts, be sure to align the collet gap over the flat and the set collar bolt perpendicular to the flat.

5. Attach the motor. Tighten to 5% of the recommended torque shown in Table 2 on page 35.

6. Tighten the mounting bolt (including washer) in 1~4 order with torque wrench to specified torque. (See Table 1 on page 35)



7. Tighten the set collar bolt with torque wrench to specified torque. (See Table 2 on page 35)



8. Tighten back the screw plug.

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