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PLANETARY GEARBOX
NEW GENERATION P-SERIES
PSII / PEII / PAII / PGII
PSIIR / PEIIR / PAIIR / PGIIR

Planetary Gearbox Series

Features:

Economic
High efficiency
Low noise
Reduced backlash
Optimized Inertia moment
Limited temperature rise
Long service life
Flexible mounting diameters
Minimized size and weight

Your motor's perfect match!!

The brand new APEX PII / PIIR series. The PII / PIIR series is an economic high precision planetary gearbox with excellent performance and quality. Our innovative PII / PIIR series design features minimal size, light weight and high efficiency.

PSII

PEII

PAII

PGII

PSIIR

PEIIR

PAIIR

PGIIR

ORDERING CODE

PEII 090	–	010[1]	–	( )[2]	/	MOTOR
PEIIR 090	–	010[1]	–	( )[2]	/	MOTOR

Motor Type :
Manufacture and Model

Ratio[1]:
1-stage: 3, 4, 5, 7, 9[3],10
2-stage: 15, 16, 20, 25, 30, 35, 40, 50, 70, 81[3], 100

Gear Size:
PSII : PSII A, PSII B, PSII C, PSII D, PSII E
PAII : PAII 042, PAII 060, PAII 090, PAII 115, PAII 142
PEII : PEII 050, PEII 070, PEII 090, PEII 120, PEII 155
PGII : PGII 040, PGII 060, PGII 080, PGII 120, PGII 160

Ordering Example : PEII 090 - 010 / SIEMENS 1FT6 041 - 4AF71
PAII 090 - 010 - S1 / SIEMENS 1FT6 041 - 4AF71

Gear Size:
PSIIR : PSIIR A, PSIIR B, PSIIR C, PSIIR D, PSIIR E
PAIIR : PAIIR 042, PAIIR 060, PAIIR 090, PAIIR 115, PAIIR 142
PEIIR : PEIIR 050, PEIIR 070, PEIIR 090, PEIIR 120, PEIIR 155
PGIIR : PGIIR 040, PGIIR 060, PGIIR 080, PGIIR 120, PGIIR 160

Ordering Example : PEIIR 090 - 010 / SIEMENS 1FT6 041 - 4AF71
PAIIR 090 - 010 - S1 / SIEMENS 1FT6 041 - 4AF71

(1) Ratio ($i = N_{in} / N_{out}$) .
(2) S1 = Smooth Output Shaft. S1 shaft is only provided for PAII / PAIIR series.
S2 = Output Shaft with Key. This is the standard shaft for PII / PIIR gearbox.
(3) Only provided for PSII / PSIIR and PAII / PAIIR series.

PII Gearbox Performance

Model No.		Stages	Ratio(1)	Type	PSII A / PEII 050 / PAII 042 / PGII 040	PSII B / PEII 070 / PAII 060 / PGII 060	PSII C / PEII 090 / PAII 090 / PGII 080	PSII D / PEII 120 / PAII 115 / PGII 120	PSII E / PEII 155 / PAII 142 / PGII 160
Nominal Output Torque T_{2N}	Nm	1	3	All	16	42	110	217	430
			4		16	42	113	223	440
			5		15	40	118	220	435
			7		12	35	96	198	366
			9(2)		8	24	60	125	273
			10		10	27	68	155	295
		2	15		15	40	109	213	424
			16		16	42	116	228	452
			20		16	42	116	230	454
			25		15	40	123	228	450
			30		15	40	108	212	422
			35		12	35	100	206	382
			40		16	43	117	232	459
			50		15	40	123	228	450
			70		12	35	100	206	382
			81(2)		8	24	59	131	285
			100		10	27	70	162	308
Emergency Stop Torque T_{2NOT}	Nm	1,2	3~100	All	3 times T_{2N}				
Max. Acceleration Torque T_{2B}	Nm	1,2	3~100	All	T_{2B} = 60% of T_{2NOT}				
No Load Running Torque(5)	Nm	1	3~10	All	0.05	0.1	0.4	0.8	2.5
		2	15~100		0.05	0.1	0.3	0.4	0.8
Backlash(3)	arcmin	1	3~10	All	≦ 8	≦ 7	≦ 6	≦ 6	≦ 6
		2	15~100	All	≦ 10	≦ 9	≦ 8	≦ 8	≦ 8
Torsional Rigidity(5)	Nm/arcmin	1,2	3~100	PSII	0.6	1.5	6	10.5	18
				PEII	0.9	2.2	8	12	16
				PAII	0.9	2.2	8	12	16
				PGII	0.5	2	8	12	16
Nominal Input Speed n_{1N}	rpm	1,2	3~100	All	4,500	4,000	3,600	3,600	2,500
Max. Input Speed n_{1B}	rpm	1,2	3~100	All	8,000	6,000	6,000	4,800	3,600
Max. Radial Load F_{2rB}(4)	N	1,2	3~100	PSII	840	1,290	1,510	3,780	5,420
				PEII	810	1,150	1,530	3,260	4,550
				PAII	810	1,150	1,530	3,470	4,640
				PGII	520	1,030	1,570	3,590	4,690
Max. Axial Load F_{2aB}(4)	N	1,2	3~100	PSII	420	645	755	1,890	2,710
				PEII	405	575	765	1,630	2,275
				PAII	405	575	765	1,735	2,320
				PGII	260	515	785	1,795	2,345
Service Life(6)	hr	1,2	3~100	All	20,000				
Operating Temp	° C	1,2	3~100	All	0° C~ +90° C				
Degree of Gearbox Protection		1,2	3~100	All	IP65				
Lubrication		1,2	3~100	All	Synthetic lubrication grease				
Mounting Position		1,2	3~100	All	All directions				
Running Noise(5)	dB(A)	1,2	3~100	All	≦ 60	≦ 62	≦ 64	≦ 66	≦ 68
Efficiency η	%	1	3~10	All	≧ 97%				
		2	15~100		≧ 94%				

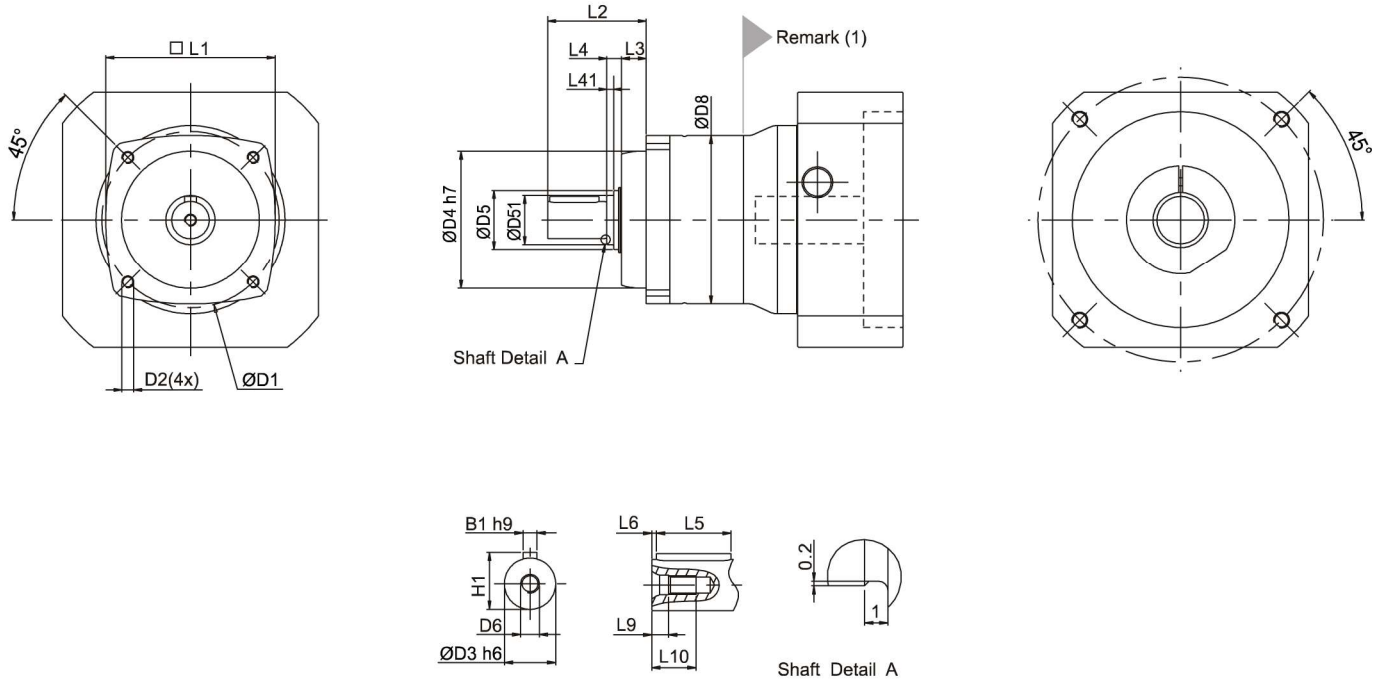
(1) Ratio (i= N_{in} / N_{out}) .
(2) Ratio 9 and 81 are only provided for PSII and PAII series.
(3) Backlash is measured at 2% of Nominal Output Torque T_{2N}.
(4) Applied to the output shaft center at 100 rpm.
(5) These values are measured by gearbox with ratio = 10 (1-stage) or ratio = 100 (2-stage) at 3,000 rpm without load.
(6) For continuous operation, the service life time is less than 10,000 hrs.

PII Gearbox Inertia

Model No.		PSII A		PSII B		PSII C		PSII D		PSII E	
		PEII 050		PEII 070		PEII 090		PEII 120		PEII 155	
		PAII 042		PAII 060		PAII 090		PAII 115		PAII 142	
		PGII 040		PGII 060		PGII 080		PGII 120		PGII 160	
Ø(A) (C3)		1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
8	kg.cm²	0.10	0.10	0.10~ 0.12	0.10	-	-	-	-	-	-
11		0.16	0.16	0.16~ 0.19	0.16	-	-	-	-	-	-
14		0.19~ 0.20	0.19~ 0.20	0.20~ 0.22	0.20	0.20~ 0.36	0.20~ 0.24	-	-	-	-
19		-	-	1.51~ 1.53	1.51	1.54~ 1.70	1.54~ 1.58	1.60~ 2.20	1.60~ 1.73	-	1.69~ 2.18
24		-	-	-	-	2.09~ 2.24	2.09~ 2.12	2.14~ 2.74	2.14~ 2.27	2.23~ 4.52	2.23~ 2.73
28		-	-	-	-	2.52~ 2.68	2.52~ 2.55	2.57~ 3.17	2.57~ 2.70	2.65~ 4.94	2.65~ 3.15
32		-	-	-	-	-	-	7.17~ 7.77	7.17~ 7.30	7.41~ 9.70	7.41~ 7.91
35		-	-	-	-	-	-	10.20~ 10.80	10.20~ 10.30	10.50~ 12.80	10.50~ 11.00
38		-	-	-	-	-	-	13.40~ 14.00	13.40~ 13.50	13.70~ 16.00	13.70~ 14.20
42		-	-	-	-	-	-	-	-	22.20~ 24.50	-

(A) Ø = Input shaft diameter.

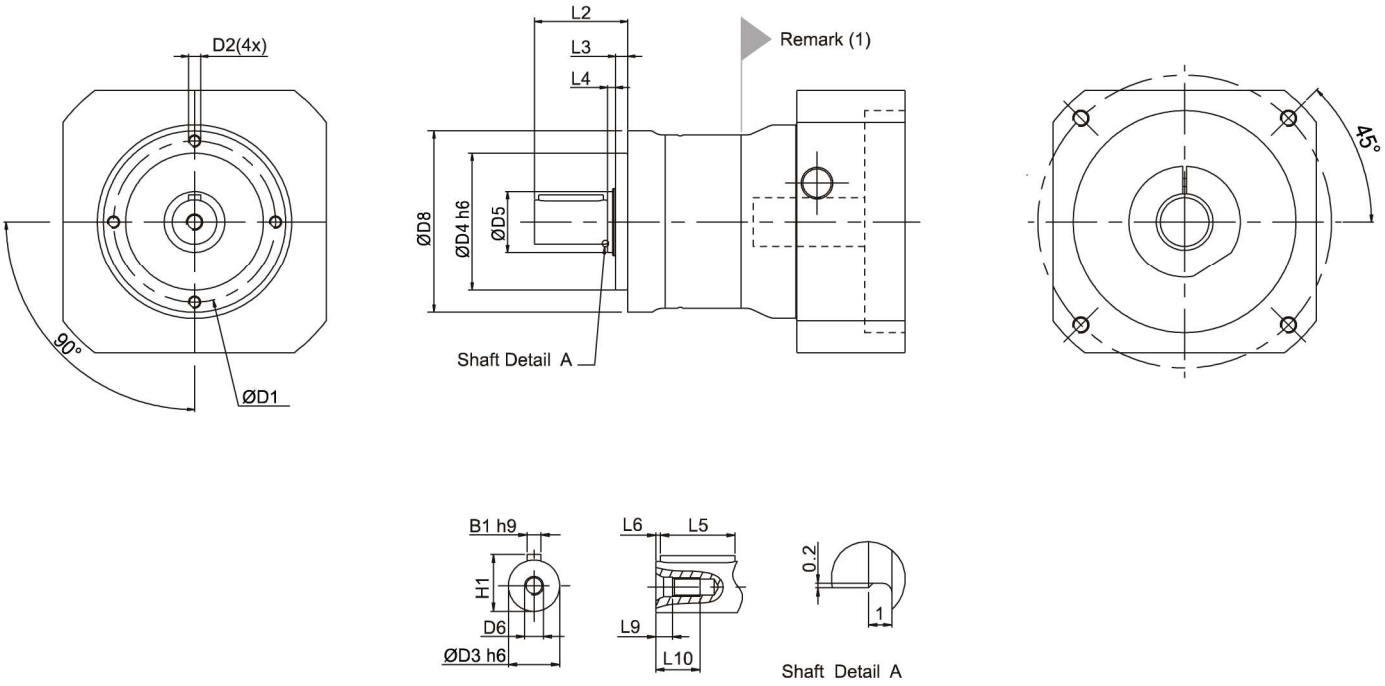
PSII Series Dimension



Dimension		PSII A		PSII B		PSII C		PSII D		PSII E	
		1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1		47		60		90		115		135	
D2		M4X9		M5X10		M6X12		M8X18.5		M10X18	
D3	h6	10		12		19		24		32	
D4	h7	38		50		70		90		110	
D5		17		22		30		40		55	
D51		-		-		25		-		-	
D6		M3X0.5P		M4X0.7P		M6X1P		M8X1.25P		M12X1.75P	
D8		44		60		86		114		140	
L1		44		60		86		114		140	
L2		25		32		50		61		75	
L3		6.5		8.5		12.5		16		14.5	
L4		2.5		3.5		7.5		5		5.5	
L41		-		-		3.5		-		-	
L5		10		16		25		32		50	
L6		3		2		1		3		2	
L9		2.6		4.5		5		7.2		10	
L10		9		10		16.5		19		28	
B1	h9	3		4		6		8		10	
H1		11.2		13.5		21.5		27		35	

(1) Dimensions are related to motor interface.

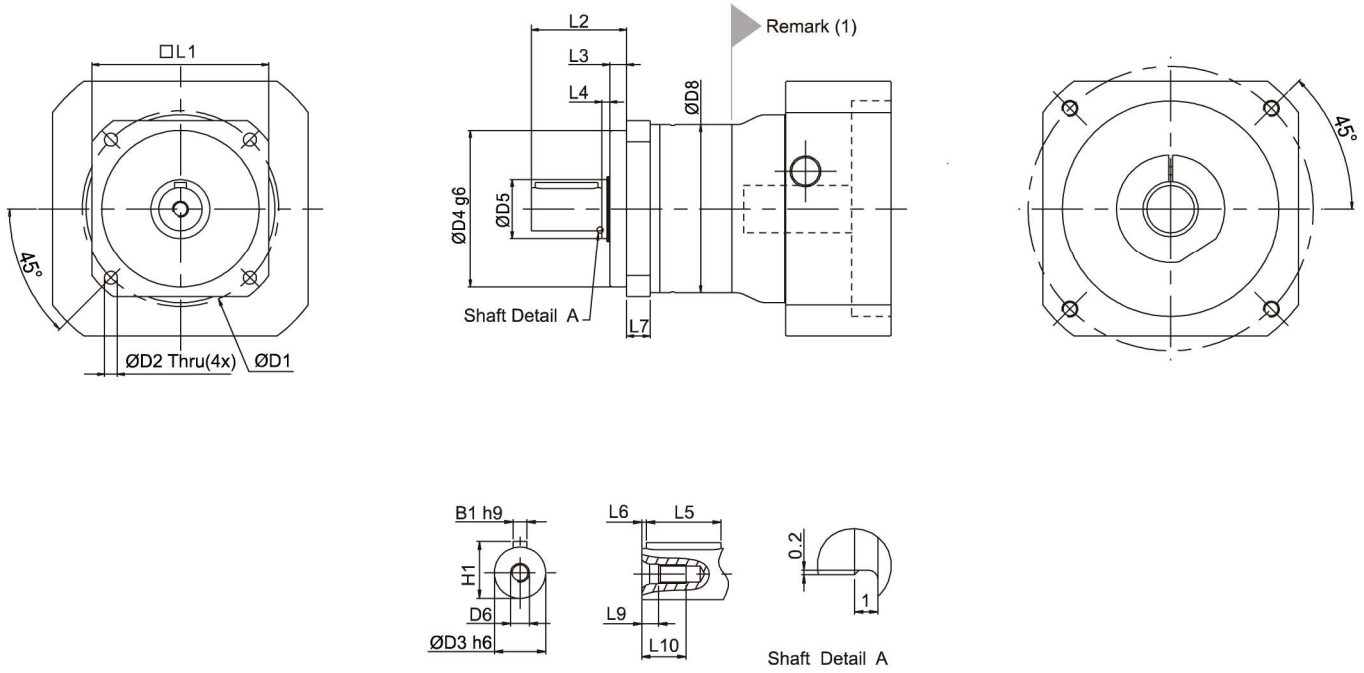
PEII Series Dimension



Dimension		PEII 050		PEII 070		PEII 090		PEII 120		PEII 155	
		1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1		44		62		80		108		140	
D2		M4X9		M5X10		M6X12		M8X15		M10X18	
D3	h6	12		16		22		32		40	
D4	h6	35		52		68		90		120	
D5		17		22		30		40		55	
D6		M4X0.7P		M5X0.8P		M8X1.25P		M12X1.75P		M16X2P	
D8		50		70		90		120		155	
L2		24.5		36		46		70		97	
L3		4		4.5		6		7		9.5	
L4		2.5		3.5		4		5		5.5	
L5		14		25		32		50		70	
L6		2		2		2		4		6	
L9		4.5		4.8		7.2		10		12	
L10		10		12.5		19		28		36	
B1	h9	4		5		6		10		12	
H1		13.5		18		24.5		35		43	

(1) Dimensions are related to motor interface.

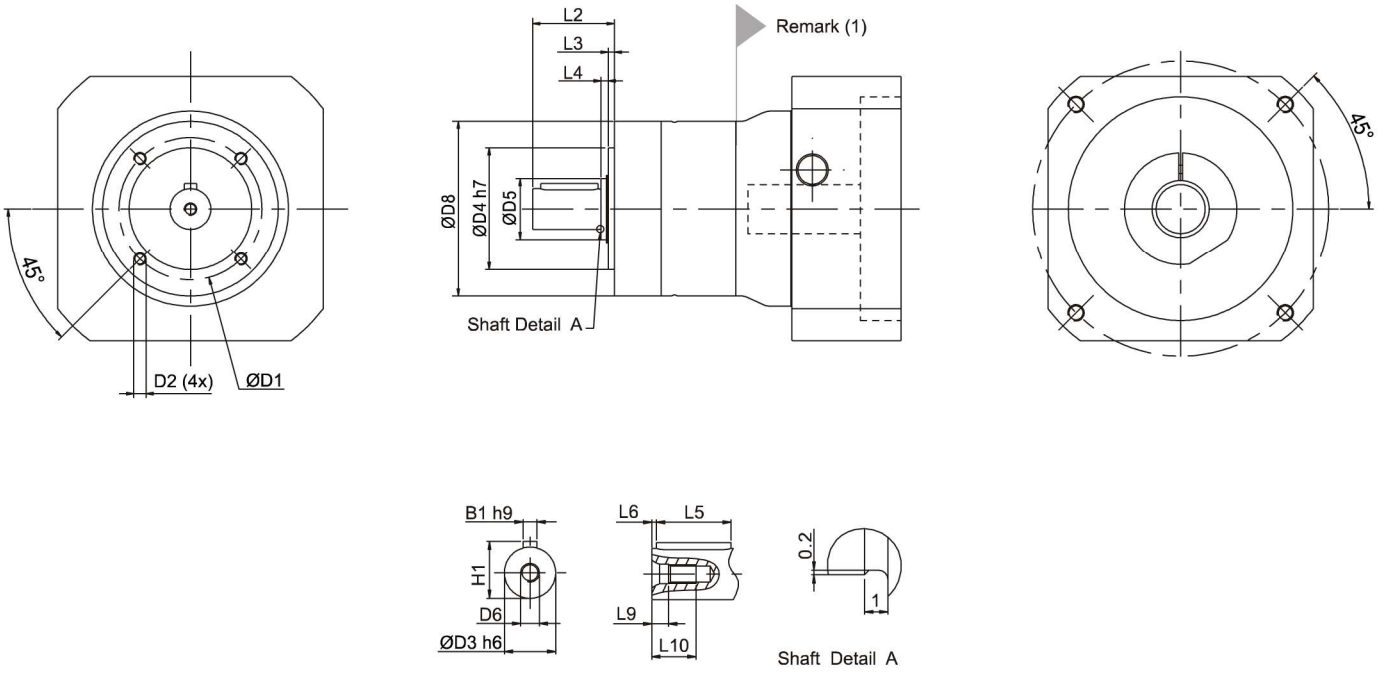
PAII Series Dimension



Dimension		PAII 042		PAII 060		PAII 090		PAII 115		PAII 142	
		1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1		50		70		100		130		165	
D2		3.4		5.5		6.6		9		11	
D3	h6	13		16		22		32		40	
D4	g6	35		50		80		110		130	
D5		17		22		30		40		55	
D6		M4X0.7P		M5X0.8P		M8X1.25P		M12X1.75P		M16X2P	
D8		44		60		86		114		140	
L1		42		60		90		115		142	
L2		26		37		48.5		65		97	
L3		5.5		5.5		8.5		10		12.5	
L4		2.5		3.5		4		5		5.5	
L5		14		25		32		40		63	
L6		2		2		2		5		5	
L7		6.5		10		12		16		20	
L9		4.5		4.8		7.2		10		12	
L10		10		12.5		19		28		36	
B1	h9	5		5		6		10		12	
H1		15		18		24.5		35		43	

(1) Dimensions are related to motor interface.

PGII Series Dimension



Dimension		PGII 040		PGII 060		PGII 080		PGII 120		PGII 160	
		1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1		34		52		70		100		145	
D2		M4X9		M5X10		M6X12		M10X18		M12X22	
D3	h6	10		14		20		25		40	
D4	h7	26		40		60		80		130	
D5		17		17		30		40		55	
D6		M3X0.5P		M5X0.8P		M6X1P		M10X1.5P		M16X2P	
D8		44		60		86		114		160	
L2		26		35		40		55		87	
L3		2		3		3		4		5	
L4		1		2		3.5		5		5.5	
L5		18		25		28		40		65	
L6		2.5		2.5		4		5		8	
L9		2.6		4.8		5		7.5		12	
L10		9		12.5		16.5		22		36	
B1	h9	3		5		6		8		12	
H1		11.2		16		22.5		28		43	

(1) Dimensions are related to motor interface.

PIIR Gearbox Performance

Model No.		Stages	Ratio[1]	Type	PSIIR A / PEIIR 050 / PAIIR 042 / PGIIR 040	PSIIR B / PEIIR 070 / PAIIR 060 / PGIIR 060	PSIIR C / PEIIR 090 / PAIIR 090 / PGIIR 080	PSIIR D / PEIIR 120 / PAIIR 115 / PGIIR 120	PSIIR E / PEIIR 155 / PAIIR 142 / PGIIR 160
Nominal Output Torque T_{2N}	Nm	1	3	All	16	42	110	217	430
			4		16	42	113	223	440
			5		15	40	118	220	435
			7		12	35	96	198	366
			9[2]		8	24	60	125	273
			10		10	27	68	155	295
		2	15		15	40	109	213	424
			16		16	42	116	228	452
			20		16	42	116	230	454
			25		15	40	123	228	450
			30		15	40	108	212	422
			35		12	35	100	206	382
			40		16	43	117	232	459
			50		15	40	123	228	450
			70		12	35	100	206	382
			81[2]		8	24	59	131	285
			100		10	27	70	162	308
Emergency Stop Torque T_{2NOT}	Nm	1,2	3~100	All	3 times T_{2N}				
Max. Acceleration Torque T_{2B}	Nm	1,2	3~100	All	T_{2B} = 60% of T_{2NOT}				
No Load Running Torque[5]	Nm	1	3~10	All	0.1	0.15	0.45	0.85	2.55
		2	15~100		0.1	0.15	0.35	0.45	0.85
Backlash[3]	arcmin	1	3~10	All	≦ 12	≦ 11	≦ 10	≦ 10	≦10
		2	15~100	All	≦ 14	≦ 13	≦ 12	≦ 12	≦ 12
Torsional Rigidity[5]	Nm/arcmin	1,2	3~100	PSIIR	0.6	1.5	6	10.5	18
				PEIIR	0.9	2.2	8	12	16
				PAIIR	0.9	2.2	8	12	16
				PGIIR	0.5	2	8	12	16
Nominal Input Speed n_{1N}	rpm	1,2	3~100	All	4,500	4,000	3,600	3,600	2,500
Max. Input Speed n_{1B}	rpm	1,2	3~100	All	8,000	6,000	6,000	4,800	3,600
Max. Radial Load F_{2rB}[4]	N	1,2	3~100	PSIIR	840	1,290	1,510	3,780	5,420
				PEIIR	810	1,150	1,530	3,260	4,550
				PAIIR	810	1,150	1,530	3,470	4,640
				PGIIR	520	1,030	1,570	3,590	4,690
Max. Axial Load F_{2aB}[4]	N	1,2	3~100	PSIIR	420	645	755	1,890	2,710
				PEIIR	405	575	765	1,630	2,275
				PAIIR	405	575	765	1,735	2,320
				PGIIR	260	515	785	1,795	2,345
Service Life[6]	hr	1,2	3~100	All	20,000				
Operating Temp	° C	1,2	3~100	All	0° C~ +90° C				
Degree of Gearbox Protection		1,2	3~100	All	IP65				
Lubrication		1,2	3~100	All	Synthetic lubrication grease				
Mounting Position		1,2	3~100	All	All directions				
Running Noise[5]	dB(A)	1,2	3~100	All	≦ 70	≦72	≦ 74	≦ 75	≦77
Efficiency η	%	1	3~10	All	≧ 93%				
		2	15~100		≧ 90%				

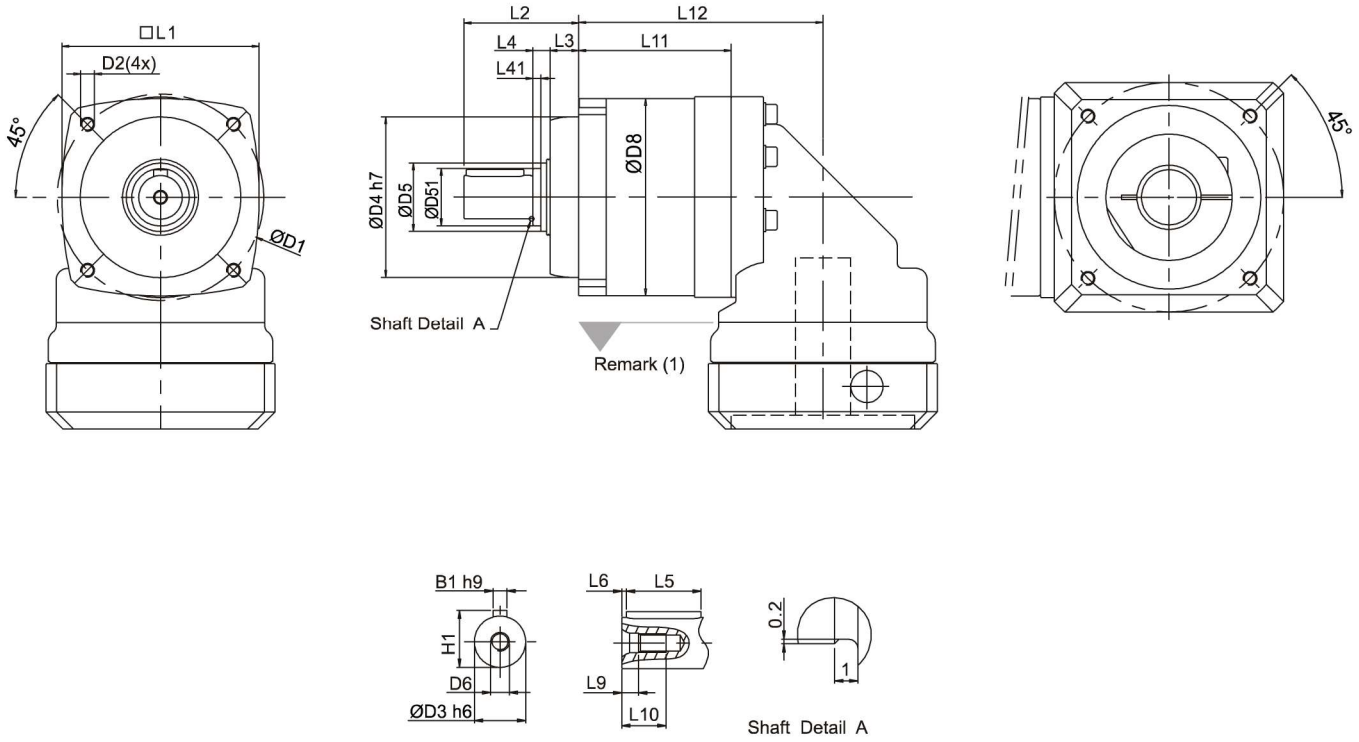
(1) Ratio (i= N_{in} / N_{out}) .
(2) Ratio 9 and 81 are only provided for PSIIR and PAIIR series.
(3) Backlash is measured at 2% of Nominal Output Torque T_{2N}.
(4) Applied to the output shaft center at 100 rpm.
(5) These values are measured by gearbox with ratio = 10 (1-stage) or ratio = 100 (2-stage) at 3,000 rpm without load.
(6) For continuous operation, the service life time is less than 10,000 hrs.

PIIR Gearbox Inertia

Model No.		PSIIR A		PSIIR B		PSIIR C		PSIIR D		PSIIR E	
		PEIIR 050		PEIIR 070		PEIIR 090		PEIIR 120		PEIIR 155	
		PAIIR 042		PAIIR 060		PAIIR 090		PAIIR 115		PAIIR 142	
		PGIIR 040		PGIIR 060		PGIIR 080		PGIIR 120		PGIIR 160	
Ø[A] (C3)		1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
8	kg.cm²	0.18	0.18	0.36	0.36	-	-	-	-	-	-
11		0.20	0.20	0.39	0.39	-	-	-	-	-	-
14		0.24	0.24	0.43	0.43	1.87	1.87	-	-	-	-
19		-	-	1.24	1.24	2.67	2.67	6.80	6.80	-	13.57
24		-	-	-	-	2.97	2.97	7.10	7.10	13.87	13.87
28		-	-	-	-	3.47	3.47	7.59	7.59	14.36	14.36
32		-	-	-	-	-	-	10.56	10.56	17.33	17.33
35		-	-	-	-	-	-	11.97	11.97	18.74	18.74
38		-	-	-	-	-	-	13.95	13.95	20.79	20.79
42		-	-	-	-	-	-	-	-	26.54	-

(A) Ø = Input shaft diameter.

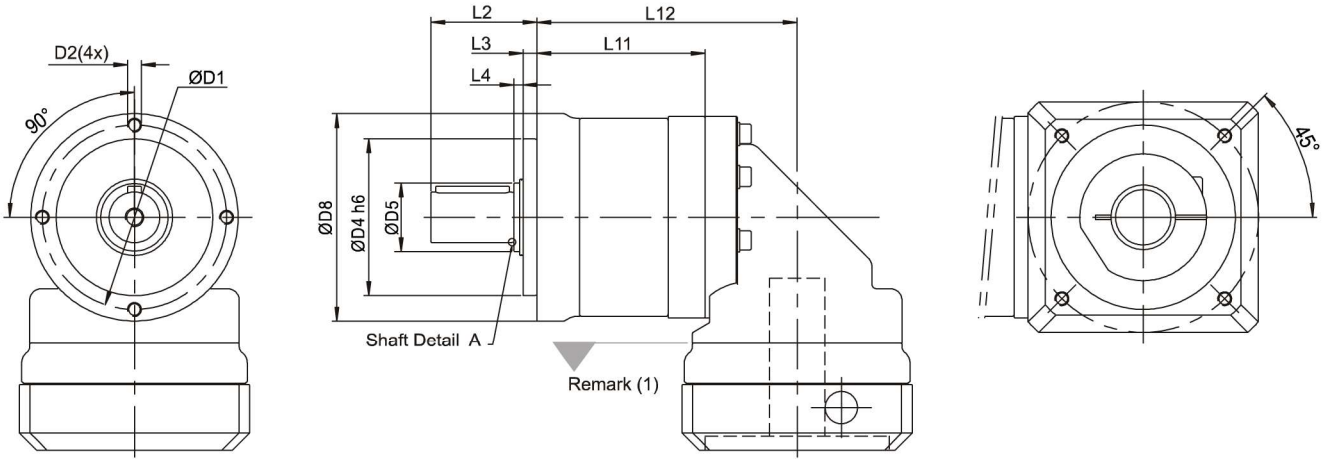
PSIIR Series Dimension

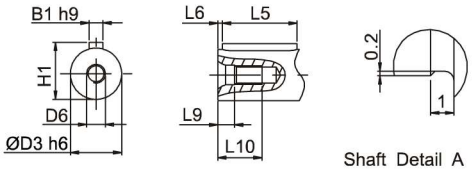


Dimension		PSIIR A		PSIIR B		PSIIR C		PSIIR D		PSIIR E	
		1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1		47		60		90		115		135	
D2		M4X9		M5X10		M6X12		M8X18.5		M10X18	
D3	h6	10		12		19		24		32	
D4	h7	38		50		70		90		110	
D5		17		22		30		40		55	
D51		-		-		25		-		-	
D6		M3X0.5P		M4X0.7P		M6X1P		M8X1.25P		M12X1.75P	
D8		44		60		86		114		140	
L1		44		60		86		114		140	
L2		25		32		50		61		75	
L3		6.5		8.5		12.5		16		14.5	
L4		2.5		3.5		7.5		5		5.5	
L41		-		-		3.5		-		-	
L5		10		16		25		32		50	
L6		3		2		1		3		2	
L9		2.6		4.5		5		7.2		10	
L10		9		10		16.5		19		28	
L11		47	62	56	76	66.5	93	92	128	116	163.5
L12		72	87	85.5	105.5	106.5	133	143	179	173	220.5
B1	h9	3		4		6		8		10	
H1		11.2		13.5		21.5		27		35	

(1) Dimensions are related to motor interface.

PEIIR Series Dimension

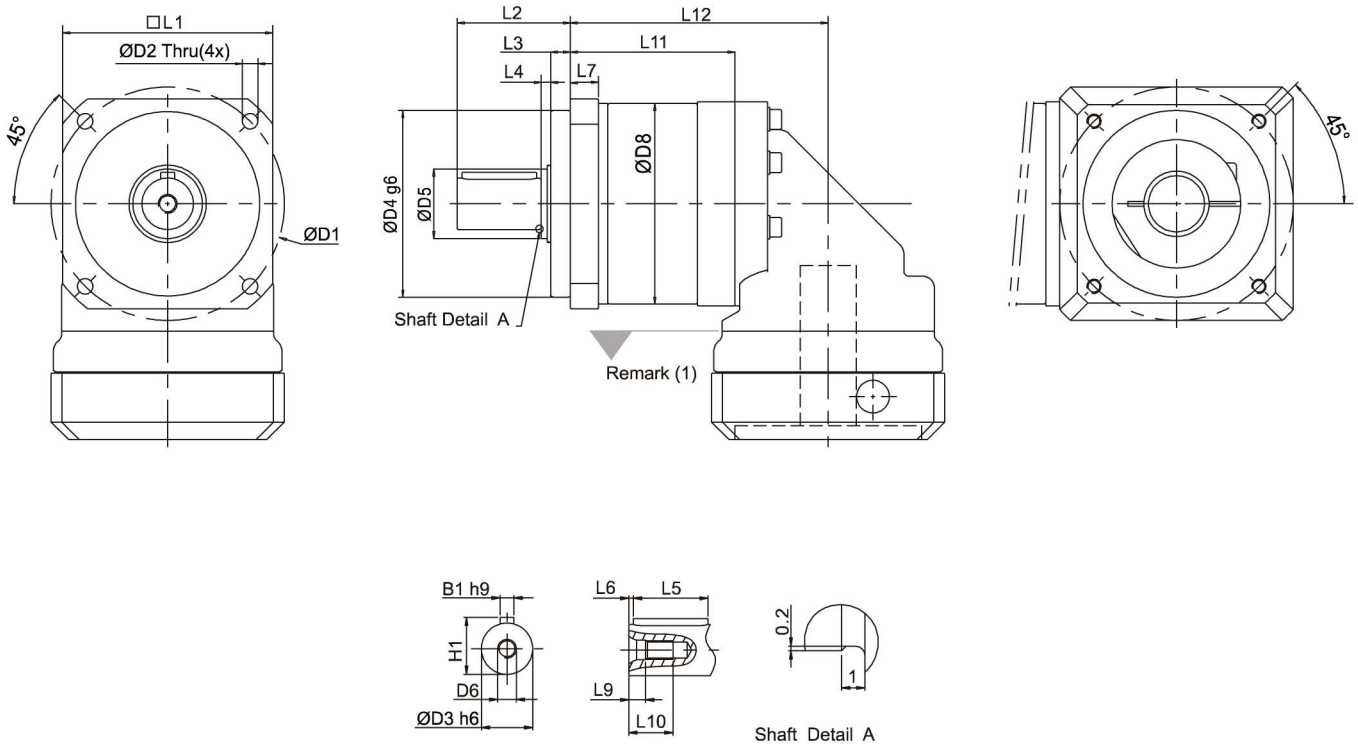




Dimension		PEIIR 050		PEIIR 070		PEIIR 090		PEIIR 120		PEIIR 155	
		1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1		44		62		80		108		140	
D2		M4X9		M5X10		M6X12		M8X15		M10X18	
D3	h6	12		16		22		32		40	
D4	h6	35		52		68		90		120	
D5		17		22		30		40		55	
D6		M4X0.7P		M5X0.8P		M8X1.25P		M12X1.75P		M16X2P	
D8		50		70		90		120		155	
L2		24.5		36		46		70		97	
L3		4		4.5		6		7		9.5	
L4		2.5		3.5		4		5		5.5	
L5		14		25		32		50		70	
L6		2		2		2		4		6	
L9		4.5		4.8		7.2		10		12	
L10		10		12.5		19		28		36	
L11		49.5	64.5	60	80	73	99.5	101	137	121	168.5
L12		74.5	89.5	89.5	109.5	113	139.5	152	188	178	225.5
B1	h9	4		5		6		10		12	
H1		13.5		18		24.5		35		43	

(1) Dimensions are related to motor interface.

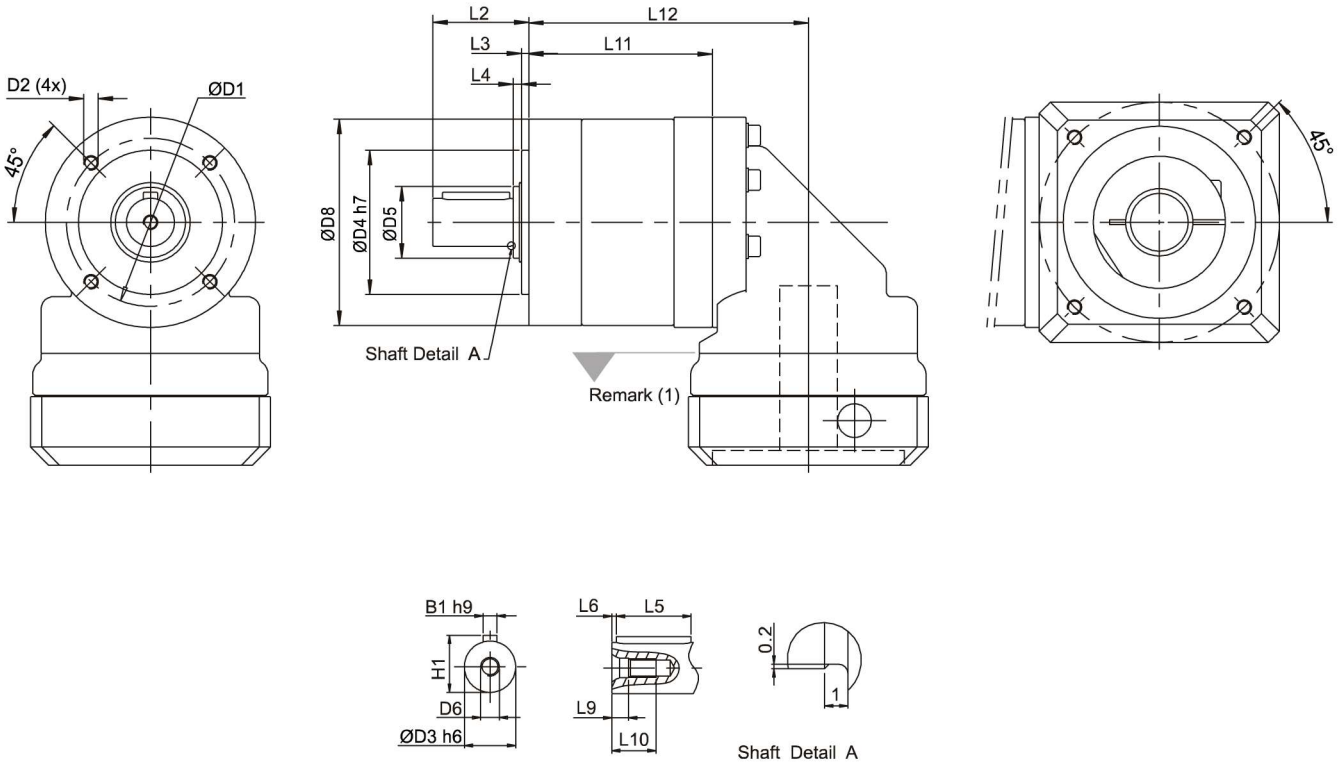
PAIIR Series Dimension



Dimension		PAIIR 042		PAIIR 060		PAIIR 090		PAIIR 115		PAIIR 142	
		1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1		50		70		100		130		165	
D2		3.4		5.5		6.6		9		11	
D3	h6	13		16		22		32		40	
D4	g6	35		50		80		110		130	
D5		17		22		30		40		55	
D6		M4X0.7P		M5X0.8P		M8X1.25P		M12X1.75P		M16X2P	
D8		44		60		86		114		140	
L1		42		60		90		115		142	
L2		26		37		48.5		65		97	
L3		5.5		5.5		8.5		10		12.5	
L4		2.5		3.5		4		5		5.5	
L5		14		25		32		40		63	
L6		2		2		2		5		5	
L7		6.5		10		12		16		20	
L9		4.5		4.8		7.2		10		12	
L10		10		12.5		19		28		36	
L11		48	63	59	79	70.5	97	98	134	118	165.5
L12		73	88	88.5	108.5	110.5	137	149	185	175	222.5
B1	h9	5		5		6		10		12	
H1		15		18		24.5		35		43	

(1) Dimensions are related to motor interface.

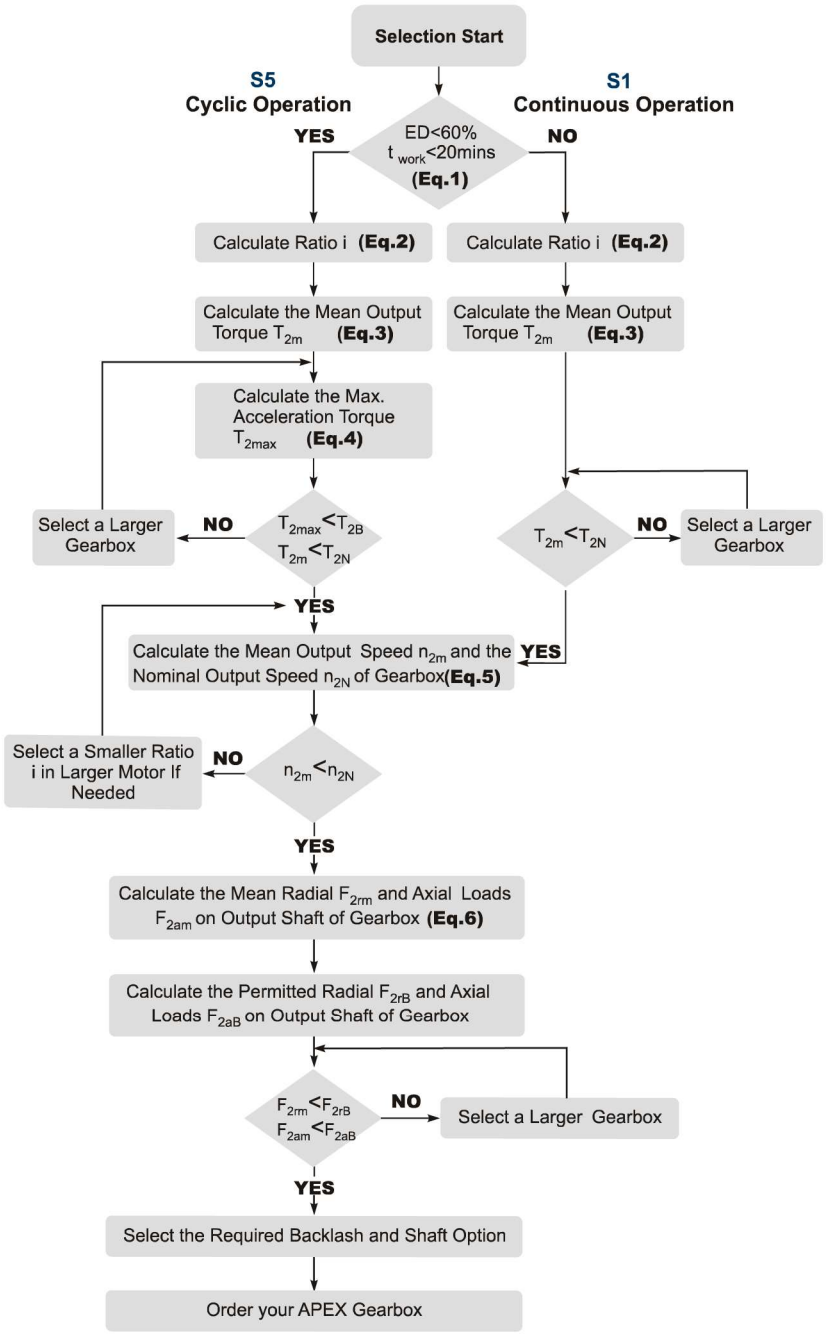
PGIIR Series Dimension



Dimension		PGIIR 040		PGIIR 060		PGIIR 080		PGIIR 120		PGIIR 160	
		1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
D1		34		52		70		100		145	
D2		M4X9		M5X10		M6X12		M10X18		M12X22	
D3	h6	10		14		20		25		40	
D4	h7	26		40		60		80		130	
D5		17		17		30		40		55	
D6		M3X0.5P		M5X0.8P		M6X1P		M10X1.5P		M16X2P	
D8		44		60		86		114		160	
L2		26		35		40		55		87	
L3		2		3		3		4		5	
L4		1		2		3.5		5		5.5	
L5		18		25		28		40		65	
L6		2.5		2.5		4		5		8	
L9		2.6		4.8		5		7.5		12	
L10		9		12.5		16.5		22		36	
L11		53	68	66.5	86.5	76.5	103	104	140	125.5	173
L12		78	93	96	116	116.5	143	155	191	182.5	230
B1	h9	3		5		6		8		12	
H1		11.2		16		22.5		28		43	

(1) Dimensions are related to motor interface.

Selection of the optimum gearbox



Recommended (for S5 Cycle Operation)

The general design is given for

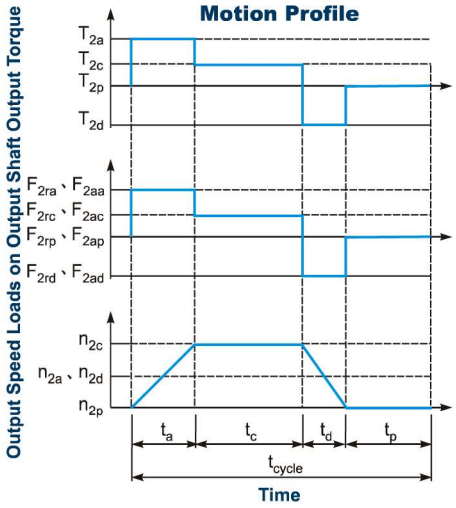
$$\frac{J_L}{i^2} \leq 4 \times J_m$$

The optimal design is given for

$$\frac{J_L}{i^2} \cong J_m$$

J_L Load Inertia

J_m Motor Inertia



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.1)**

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

n_m Output Speed of the Motor

n_{work} Working Speed **(Eq.2)**

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.3)

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 Efficency of the Gearbox **(Eq.4)**

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

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

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

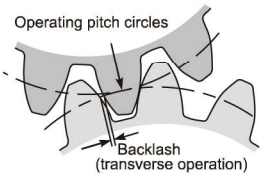
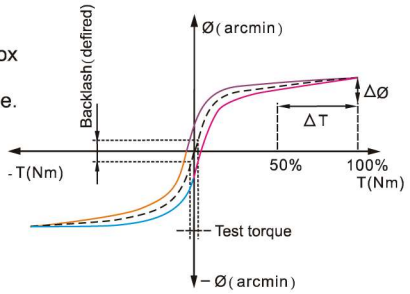
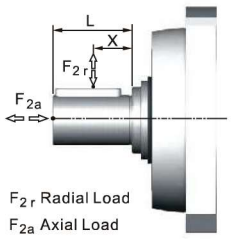
(Eq.5)

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

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

(Eq.6)

Glossary

Emergency Stop Torque T_{2NOT}	Nm	The Emergency Stop Torque is the maximum permitted torque at the output of gearbox. This may happen only occasionally and may not exceed 1,000 times during the whole service life.
Max. Acceleration Torque T_{2B}	Nm	Under the Cyclic Operation (S5), the Max. Acceleration Torque is the maximum torque which can be transmitted only briefly to the output of gearbox up to 1,000 cycles/hr.
No Load Running Torque	Nm	The No Load Running Torque is the min. torque to overcome the internal friction of a gearbox without loading*.
Nominal Input Speed n_{1N}	rpm	The Nominal Input Speed is the permitted input speed of gearbox by the Continuous Operation (S1) while the housing temperature does not exceed 90°C. This value is measured at environment temperature 25°C.
Max. Input Speed n_{1B}	rpm	The Max. Input Speed is the max. permitted input speed of gearbox by the Cyclic operation (S5). This value is measured at environment temperature 25°C and serves as the absolute limit of the gearbox.
Backlash	arcmin	The Backlash is the maximum angular measurement between two teeth of gears when the transverse operation occurs (refer to Diagram 1). The arcmin is the measurement unit for the backlash. One arcmin equals 1/ 60 degree, symbolized as 1'. 
Torsional Rigidity	Nm/arcmin	Torsional Rigidity is the quotient (△T / △ Ø) between the applied torque and resulting torsion angle. This value indicates how many torque needed on gearbox to rotate the output shaft for 1 arcmin. The Torsional Rigidity can be determined by Hysteresis Curve. Hysteresis Curve When the input shaft is locked, increase torque at the output slowly up to T_{2B} in both directions and then release the torque gradually. According to the measured torque and torsion angle, a closed curve will be acquired as Diagram 2. 
Radial Load And Axial Load	N	The permitted radial and axial loads on output shaft of the gearbox depend on the design of the gearbox supporting bearings. For more information, please refer to APEX website. 
Efficiency η	%	The transmission efficiency of the gears inside a gearbox (without friction).
Operating Temperature	° C	The Operating Temperature indicates the temperature of gearbox housing.
Degree of Protection		IP code stands for International Protection standard. The IP65 as example: the first IP number stands for protection degree against dust; the second IP number stands for protection against liquid.
Lubrication		APEX uses synthetic lubrication grease. There are other grease available, please contact APEX.
Running Noise	dB(A)	The Running Noise is measured depends on gearbox size, the ratio and the speed*. Higher speed induces usually higher noise level, while higher ratio induces lower noise level.
Moment of Inertia J_1	$kg.cm^2$	The Moment of Inertia J1 is a measurement of the effort applied to an object to maintain its momentary condition at rest or rotating.
Breakaway Torque	Nm	The Breakaway Torque is the minimum torque to start the rotation from the input side of gearbox. A smaller size or a higher ratio gearbox requests less Breakaway Torque.
Back Driving Torque	Nm	The Back Driving Torque is the minimum torque to start the rotation from the output side of gearbox. A larger size or a higher ratio gearbox requests greater Back Driving Torque.

* This value is measured at environment temperature 25°C and the input speed 3,000 rpm. If the Nominal Input Speed n_{1N} of gearbox is over 3,000 rpm, this value is measured by that specific Nominal Input Speed.