



APEX DYNAMICS, INC.

**PLANETARY GEARBOX
NEW GENERATION P-SERIES**

**PEII / PGII / PAII / PSII / PD / PL
PEIIR / PGIIR / PAIIR / PSIIR / PDR / PLR**



New Generation P 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

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



PEII



PEIIR



PGII



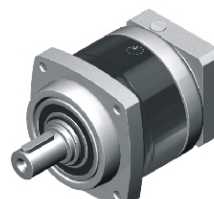
PGIIR



PAII



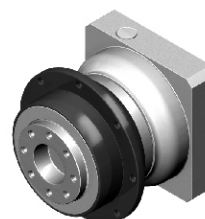
PAIIR



PSII



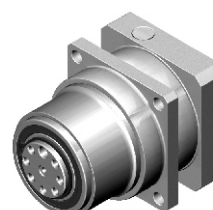
PSIIR



PD



PDR



PL



PLR

ORDERING CODE

PEII 090

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010⁽¹⁾

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()⁽²⁾

/

MOTOR

PEIIR 090

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010⁽¹⁾

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()⁽²⁾

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MOTOR

Motor Type :
Manufacturer and Model

Ratio⁽¹⁾:1-stage: 3, 4, 5, 7, 9⁽³⁾, 102-stage: 12⁽⁵⁾, 15, 16, 20, 25, 30, 35, 40, 50, 70, 81⁽³⁾, 1003-stage⁽⁴⁾: 120, 160, 200, 280, 350, 500, 700, 1000

Gearbox Size:

PEII: PEII 050, PEII 070, PEII 090, PEII 120, PEII 155

PGII: PGII 040, PGII 060, PGII 080, PGII 120, PGII 160

PAII: PAII 042, PAII 060, PAII 090, PAII 115, PAII 142

PSII: PSII A, PSII B, PSII C, PSII D, PSII E

PD : PD 053, PD 064, PD 090, PD 110

PL : PL 070, PL 090, PL 120,

Ordering Example : PEII090 - 010 / SIEMENS 1FT6 041 - 4AF71
PAII090 - 010 - S1 / SIEMENS 1FT6 041 - 4AF71

Gearbox Size:

PEIIR: PEIIR 050, PEIIR 070, PEIIR 090, PEIIR 120, PEIIR 155

PGIIR: PGIIR 040, PGIIR 060, PGIIR 080, PGIIR 120, PGIIR 160

PAIIR: PAIIR 042, PAIIR 060, PAIIR 090, PAIIR 115, PAIIR 142

PSIIR: PSIIR A, PSIIR B, PSIIR C, PSIIR D, PSIIR E

PDR : PDR 053, PDR 064, PDR 090, PDR 110

PLR : PLR 070, PLR 090, PLR 120

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.

(4) Only provided for PGII and PGIIR series.

(5) Only provided for PL and PLR series.

PEII / PEIIR Gearbox Performance

Model No.	Stages	Ratio ⁽¹⁾	Type	PEII 050	PEII 070	PEII 090	PEII 120	PEII 155
				PEIIR 050	PEIIR 070	PEIIR 090	PEIIR 120	PEIIR 155
Nominal Output Torque T_{2N}	1	3	AII	16	42	110	217	430
		4		16	42	113	223	440
		5		15	40	118	220	435
		7		12	35	96	198	366
		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
		100		10	27	70	162	308
Emergency Stop Torque T_{2NOT}	Nm	1,2	3~100	AII	3 times T_{2N}			
Max. Acceleration Torque T_{2B}	Nm	1,2	3~100	AII	$T_{2B} = 60\%$ of T_{2NOT}			
No Load Running Torque ⁽⁴⁾	1	3~10	PEII	0.05	0.10	0.40	0.80	2.50
			PEIIR	0.10	0.15	0.45	0.85	2.55
	2	15~100	PEII	0.05	0.10	0.30	0.40	0.80
			PEIIR	0.10	0.15	0.35	0.45	0.85
Backlash ⁽²⁾	1	3~10	PEII	≤ 8	≤ 7	≤ 6	≤ 6	≤ 6
			PEIIR	≤ 12	≤ 11	≤ 10	≤ 10	≤ 10
	2	15~100	PEII	≤ 10	≤ 9	≤ 8	≤ 8	≤ 8
			PEIIR	≤ 14	≤ 13	≤ 12	≤ 12	≤ 12
Torsional Rigidity	Nm/arcmin	1,2	3~100	AII	0.9	2.2	8	16
Nominal Input Speed n_{1N}	rpm	1,2	3~100	AII	4,500	4,000	3,600	3,600
Max. Input Speed n_{1B}	rpm	1,2	3~100	AII	8,000	6,000	6,000	4,800
Max. Radial Load F_{2RB} ⁽³⁾	N	1,2	3~100	AII	810	1,150	1,530	3,260
Max. Axial Load F_{2aB} ⁽³⁾	N	1,2	3~100	AII	405	575	765	1,630
Service Life ⁽⁵⁾	hr	1,2	3~100	AII	20,000			
Operating Temp	°C	1,2	3~100	AII	0° C ~ +90° C			
Degree of Gearbox Protection		1,2	3~100	AII	IP65			
Lubrication		1,2	3~100	AII	Synthetic lubrication grease			
Mounting Position		1,2	3~100	AII	All directions			
Running Noise ⁽⁴⁾	dB(A)	1,2	3~100	PEII	≤ 60	≤ 62	≤ 64	≤ 66
				PEIIR	≤ 70	≤ 72	≤ 74	≤ 75
Efficiency η	%	1	3~10	PEII	$\geq 97\%$			
				PEIIR	$\geq 93\%$			
	%	2	15~100	PEII	$\geq 94\%$			
				PEIIR	$\geq 90\%$			

(1) Ratio ($i = N_{in} / N_{out}$).(2) Backlash is measured at 2% of Nominal Output Torque T_{2N} .

(3) Applied to the output shaft center at 100 rpm.

(4) These values are measured by gearbox with ratio = 10 (1-stage) or ratio = 100 (2-stage) at 3,000 rpm without load.

(5) For continuous operation, the service life time is less than 10,000 hrs.

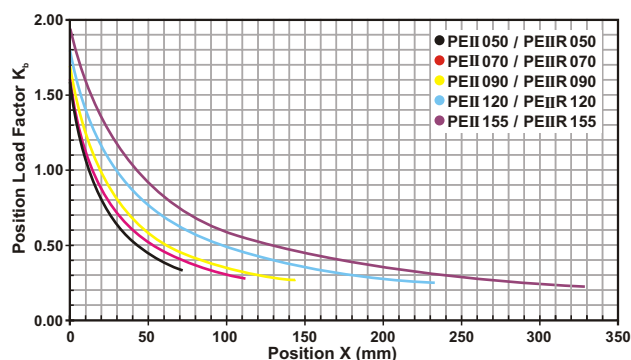
PEII Gearbox Inertia

Model No.		PEII 050		PEII 070		PEII 090		PEII 120		PEII 155	
$\varnothing^{(A)}$ (C3)		1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
8	kg.cm ²	0.10	0.10	0.12	0.10	-	-	-	-	-	-
11		0.16	0.16	0.19	0.16	-	-	-	-	-	-
14		0.20	0.20	0.22	0.20	0.36	0.24	-	-	-	-
19		-	-	1.53	1.51	1.70	1.58	2.20	1.73	-	2.18
24		-	-	-	-	2.24	2.12	2.74	2.27	4.52	2.73
28		-	-	-	-	2.68	2.55	3.17	2.70	4.94	3.15
32		-	-	-	-	-	-	7.77	7.30	9.70	7.91
35		-	-	-	-	-	-	10.80	10.30	12.80	11.00
38		-	-	-	-	-	-	14.00	13.50	16.00	14.20
42		-	-	-	-	-	-	-	-	24.50	-

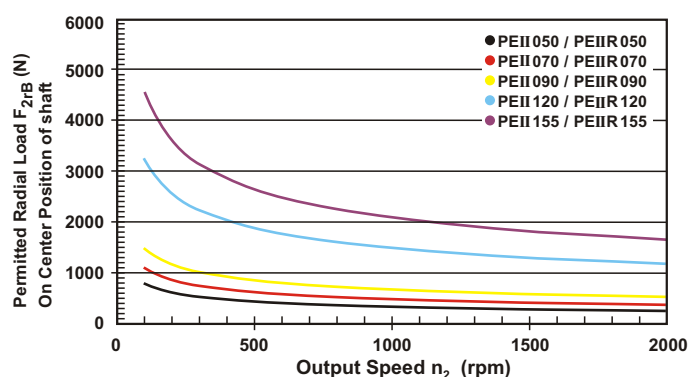
PEIIR Gearbox Inertia

Model No.		PEIIR 050		PEIIR 070		PEIIR 090		PEIIR 120		PEIIR 155	
$\varnothing^{(A)}$ (C3)		1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage	1-stage	2-stage
8	kg.cm ²	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	-

Permitted Radial And Axial Loads^(B)



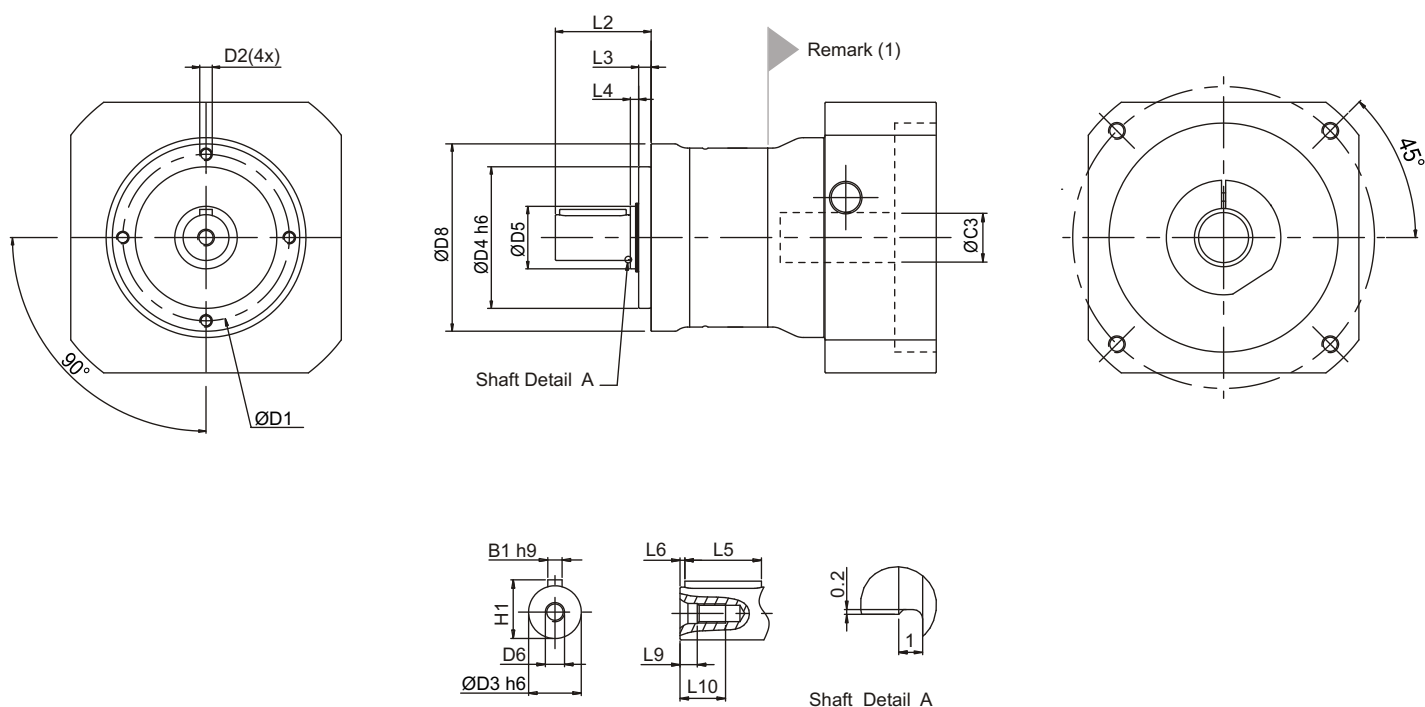
If radial force F_{2r} is not exerted on the center of the output shaft $X < 1/2 L$ or $X > 1/2 L$, the permitted radial and axial loads can be calculated by the position load factor K_0 on the above diagram.



Permitted radial load F_{2r} on center of output shaft $X = 1/2 L$ for various output speeds. Values provided are for 20,000 hours^(C) life.

- (A) $\varnothing$ = Input shaft diameter.
 (B) Permitted loading values on the output shaft. Please refer to P. 29 glossary.
 (C) For Continuous Operation(S1), the service life reduced to 50%.

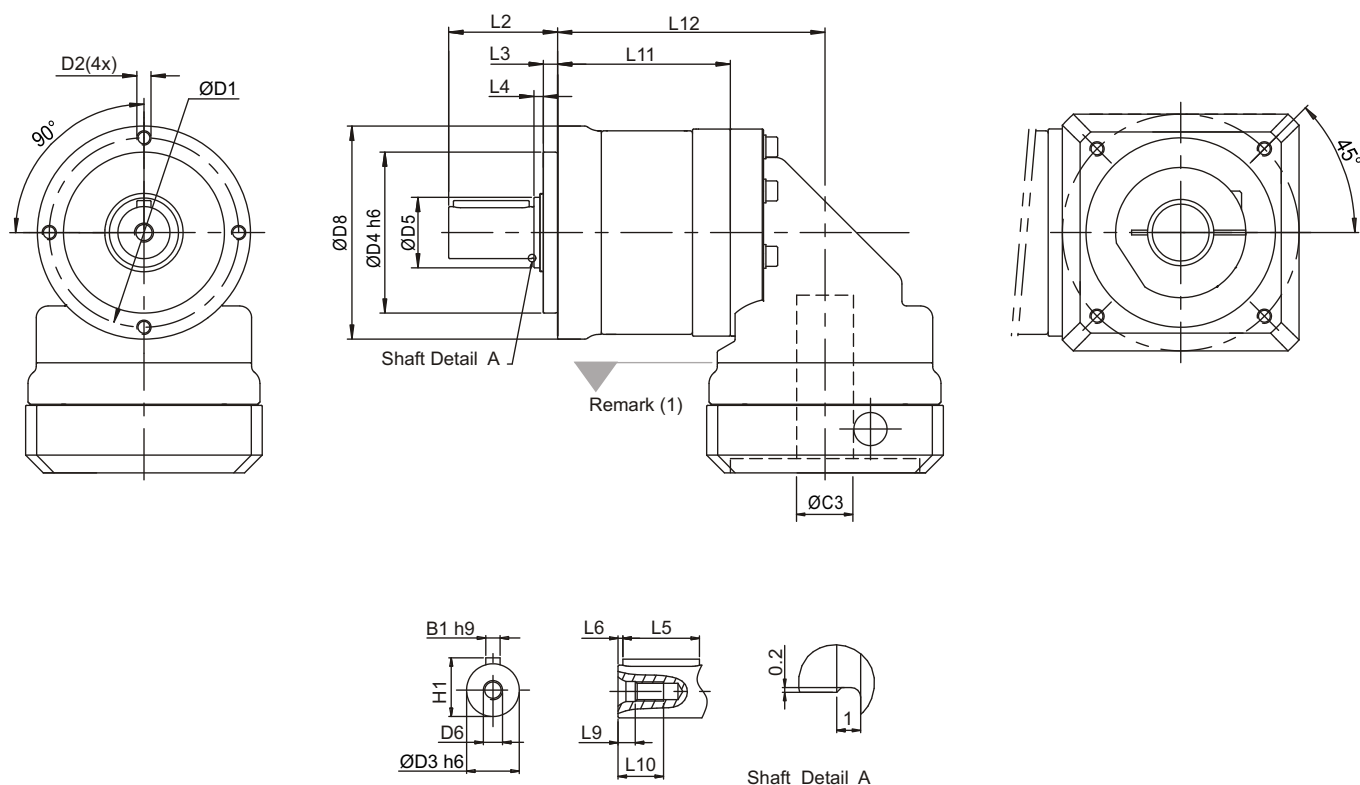
PEII Series Dimension



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. Please contact APEX for details.

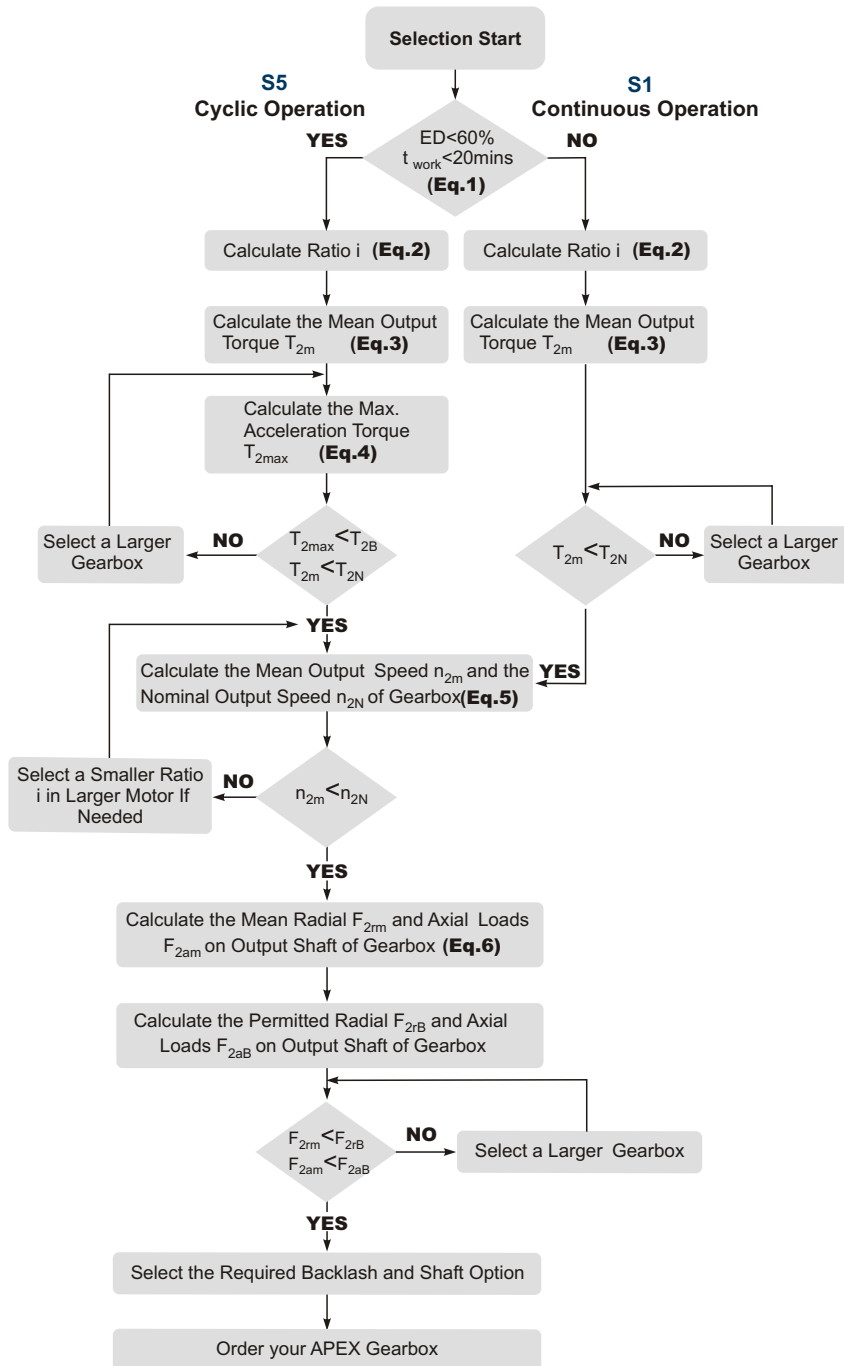
PEIR Series Dimension



Dimension	PEIR 050		PEIR 070		PEIR 090		PEIR 120		PEIR 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. Please contact APEX for details.

Selection of the optimum gearbox



Recommended (for S5 Cycle Operation)

The general design is given for

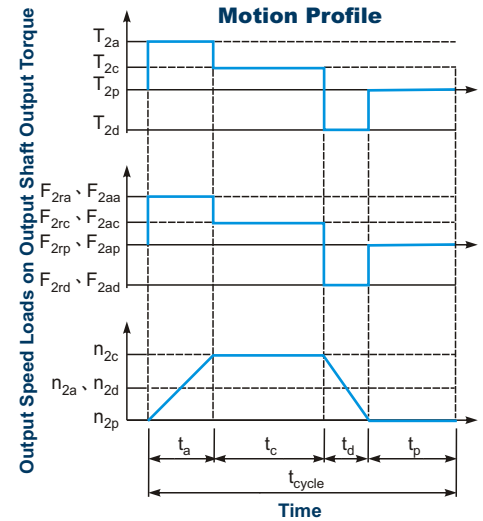
$$\frac{J_L}{i^2} \leq 4 \times J_m$$

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)

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

(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 Efficiency of the Gearbox (Eq.4)

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

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

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

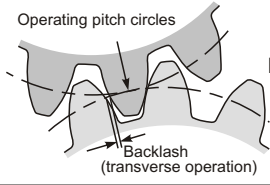
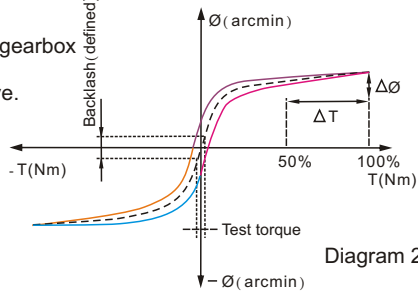
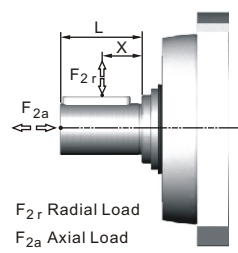
(Eq.5)

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

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

(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'.  Diagram 1
Torsional Rigidity	Nm/arcmin	Torsional Rigidity is the quotient ($\Delta T / \Delta \theta$) between the applied torque and resulting torsion angle. This value indicates how much torque is needed on the 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 in the Diagram 2.  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.  F_{2r} Radial Load F_{2a} Axial Load
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. Alternate greases are available, please contact APEX.
Running Noise	dB(A)	The Running Noise is measured depends on gearbox size, the ratio and the speed*. Higher speed usually induces higher noise level, while higher ratio induces lower noise level.
Moment of Inertia J_1	kg.cm ²	The Moment of Inertia J_1 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 requires greater Back Driving Torque.

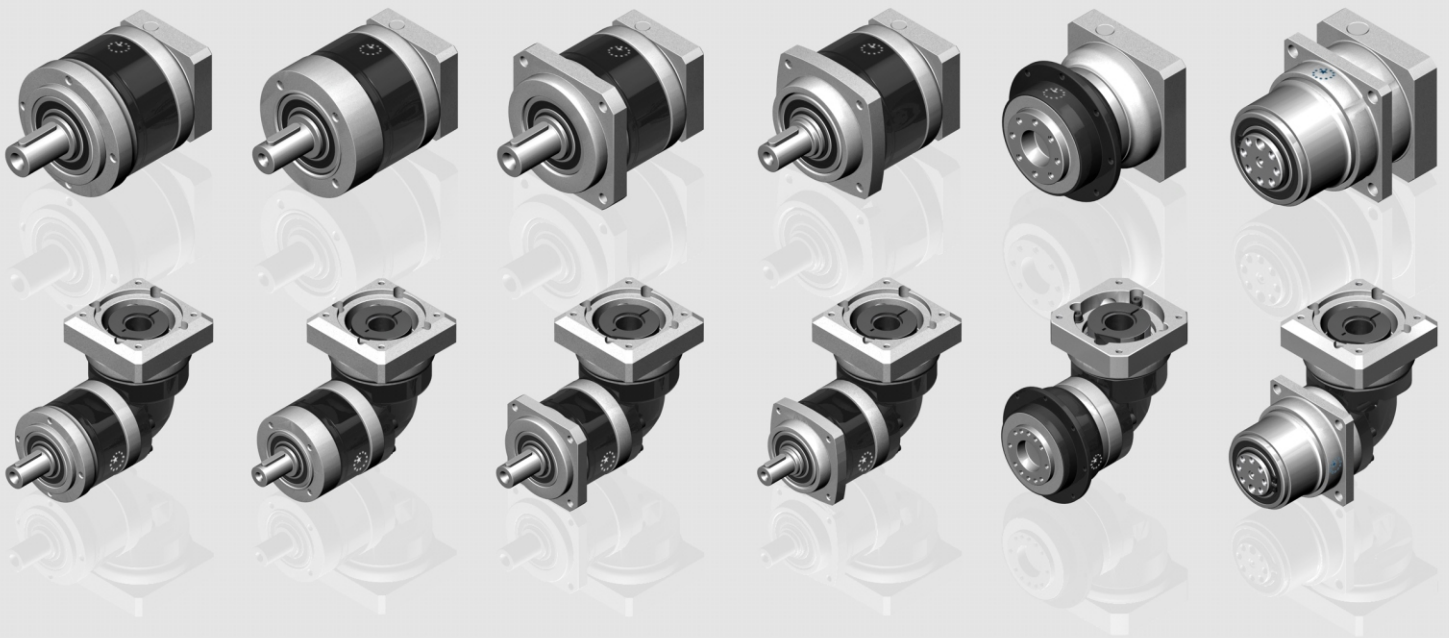
* This value is measured at environment temperature 25°C and the input speed 3,000 rpm. If the Nominal Input Speed n_{1N} of gearbox is over 3,000 rpm, this value is measured by that specific Nominal Input Speed.

Note

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APEX-2015-08-PII/PIIR SERIES-1.0E-1.0V

