APEX DYNAMICS, INC.

Linear Drive System
For Laser Cutting Industry

Performance

Ratio[1]		5		7	
Pinion Module No.		2			
Pinion Teeth No.		33	37	33	37
Nominal Output Torque T_{2N}	Nm	165		130	
Max. Acceleration Torque T_{2B}	Nm	247.5		195	
Emergency Stop Torque T_{2NOT}	Nm	495		390	
Max. Drive Force F_{2T}	N	6913	6172	5447	4863
No Load Running Torque	Nm	0.7			
Backlash[2]	arcmin	≦ 3			
Torsional Rigidity	Nm/arcmin	22			
Nominal Input Speed n_{1N}	rpm	3,600			
Max. Input Speed n_{1B}	rpm	6,000			
Max. Drive Speed V_{Max}	m/s	4.4	3.1	4.9	3.5
Service Life[3]	hr	20,000			
Operating Temp.	°C	-10° C~ 90° C			
Lubrication		Synthetic Lubrication Grease			
Mounting Position		All Directions			
Running Noise[4]	dB(A)	≦ 59			
Efficiency η	%	≧ 97%			
Inertia	$kg.cm^2$	4.52			

Order Code

L - 24 - 5 - 33

- 33: Teeth No. 33T / 37T
- 5: Ratio R5 / R7
- 24: Motor Shaft[5] 19 / 22 / 24

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

(2) Backlash is measured at 2% of Nominal Output Torque T_{2N}

(3) Continuous operation is not recommended

(4) These values are measured by gearbox with ratio 7 at 3,000 rpm without loading

(5) Motor adapter specification please refer to the dimension of linear drive system

APEX DYNAMICS, INC.

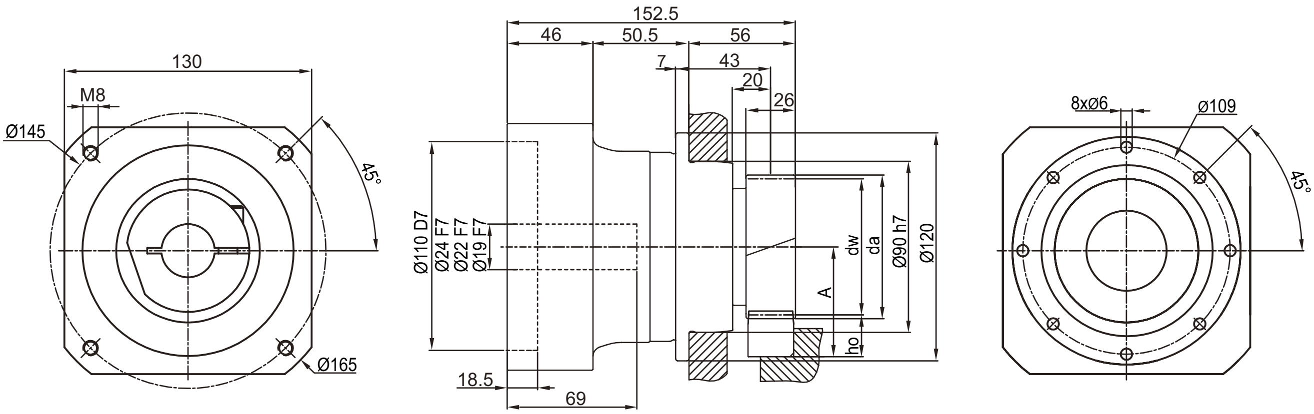
No.10, Keyuan 3rd Rd., Xitun Dist., Taichung City 407, Taiwan (R.O.C.)

Tel:886-4-24650219 | Fax:886-4-24650118

sales@apexdyna.com | http://www.apexdyna.com

APEX-2019-10-L24 Series-1.0En-TWN

Linear Drive System Dimension



Pinion

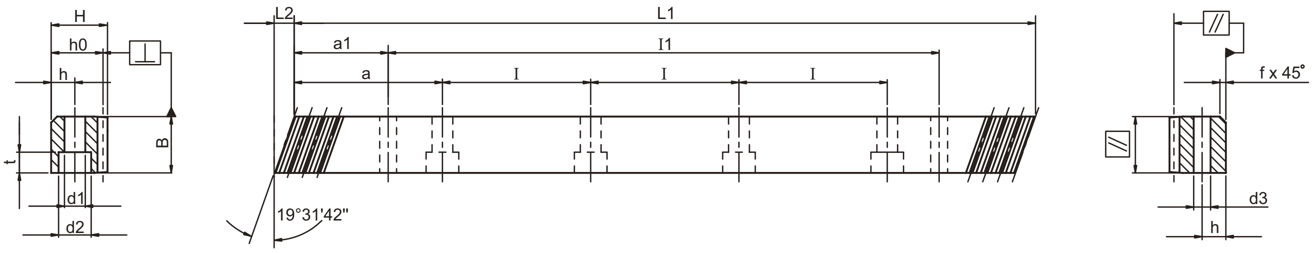
Quality DIN4 / Alloy Steel
Tooth Thickness Tolerance : e24
Left-Hand Helical Teeth
Case-Hardened and Teeth Ground

Mn.	Z(1)	X(2)	da(3)	d(4)	dw(5)	L(6)	A
2	33	0.393	75.599	70.028	71.599	220.000	57.799
	37	0.421	84.200	78.517	80.200	246.667	62.100

(1) Number of teeth (2) Profile modification factor (3) Diameter of addendum circle
(4) Pitch circle diameter (5) Working pitch circle diameter (6) Pitch circle length L = π x d

Rack

Quality 6 / Carbon Steel
Tooth Thickness Tolerance : -22~0 um
Right-Hand Helical Teeth



(mm)

Mn	Pt(7)	L1	L2	Teeth No.	B	H	ho	f	a	l	Hole No.	h	d1	d2	t	a1	l1	d3	fp(8)	Fp(9)	Process	Order Code
2	6.66668	500	8.5	75	24	24	22	2	62.5	125	4	8	7	11	7	31.7	436.6	5.7	0.008	0.029	(10)	0206R050C10
2	6.66668	1,000	8.5	150	24	24	22	2	62.5	125	8	8	7	11	7	31.7	936.6	5.7	0.008	0.034		0206R100C10
2	6.66668	1246.7	8.5	187	24	24	22	2	62.5	125	10	8	7	11	7	31.7	1183.3	5.7	0.008	0.034		0206R125C10
2	6.66668	1,500	8.5	225	24	24	22	2	62.5	125	12	8	7	11	7	31.7	1436.6	5.7	0.008	0.034		0206R150C10
2	6.66668	1746.7	8.5	262	24	24	22	2	62.5	125	14	8	7	11	7	31.7	1683.3	5.7	0.009	0.034		0206R175C10
2	6.66668	2000	8.5	300	24	24	22	2	62.5	125	16	8	7	11	7	31.7	1936.6	5.7	0.009	0.038		0206R200C10
2	6.66668	500	8.5	75	24	24	22	2	62.5	125	4	8	7	11	7	31.7	436.6	5.7	0.008	0.029	(11)	026MR050C10
2	6.66668	1000	8.5	150	24	24	22	2	62.5	125	8	8	7	11	7	31.7	936.6	5.7	0.008	0.034		026MR100C10
2	6.66668	500	8.5	75	24	24	22	2	62.5	125	4	8	7	11	7	31.7	436.6	5.7	0.008	0.029	(12)	026CR050C10
2	6.66668	1000	8.5	150	24	24	22	2	62.5	125	8	8	7	11	7	31.7	936.6	5.7	0.008	0.034		026CR100C10

(7) Teeth Pitch Pt = Mn x π / cos (19˚31'42") (8) fp = Single Pitch Error (9) Fp = Total Pitch Error (10) Teeth Induction Hardened and Ground, All Sides Ground (11) Teeth Induction Hardened and Ground, All Sides Milled (12) Teeth Ground, All Sides Milled

Gapbetween Rack and Pinion(13)

Mn	Gap【mm】
2	Max. 0.082
	Min. 0.038

(13) Measured on Theoretical Center Height

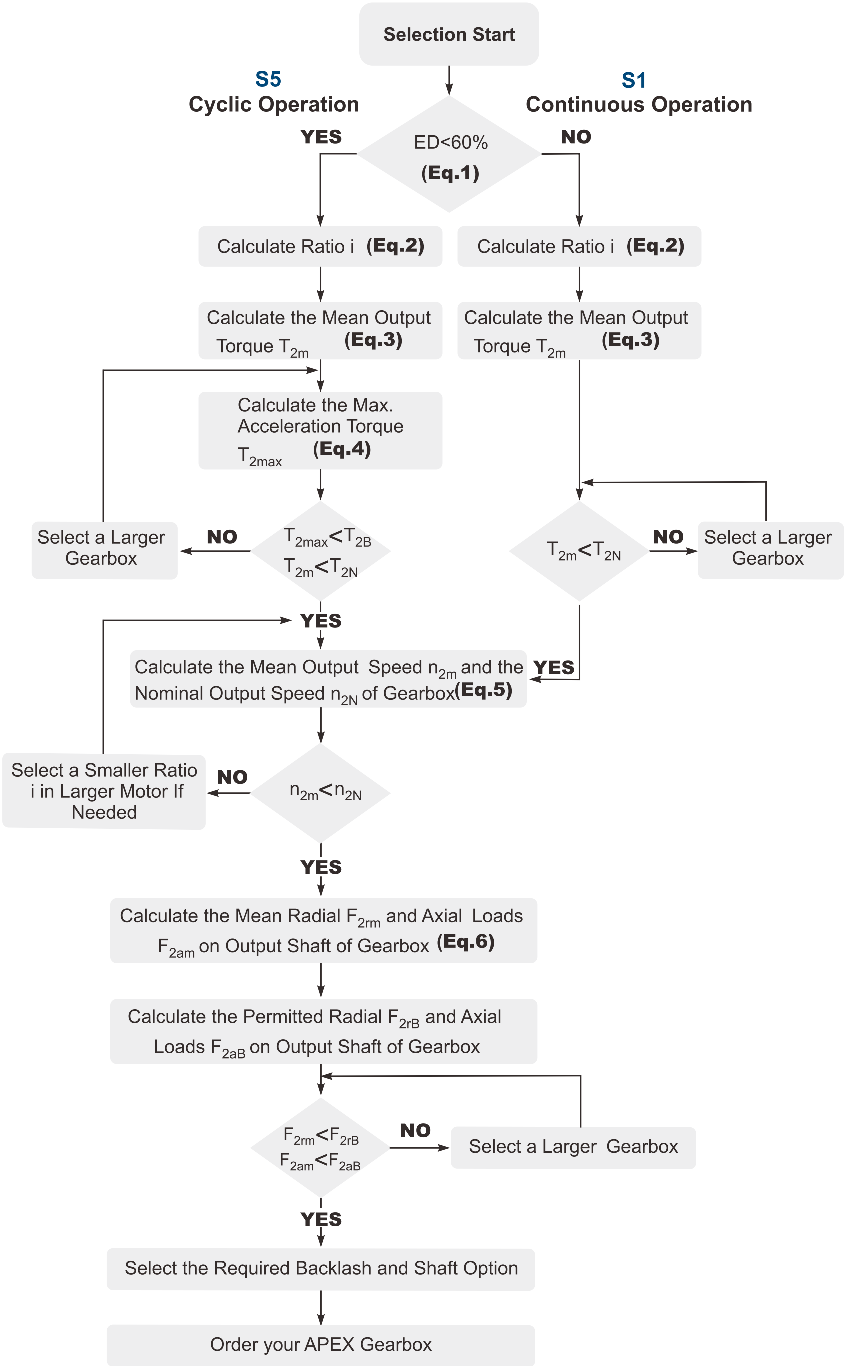
Total Pitch Error by Installation of Racks

Total Pitch Error (E) = 【$N_R^{(14)}$ x F_p】 + 【$N_J^{(15)}$ x $D_p^{(16)}$ 】

(14) Number of Racks
(15) Number of Racks connecting
(16) Total Pitch Error of Mn 2 Rack Gauge = 0.013 mm

Example : Select 6000 mm Rack
Case 1: Select 3 piece 2000 mm Racks, F_P= 0.038 mm , D_P= 0.013 mm
E = 【3 x 0.038】 + 【2 x 0.013】 = 0.14 mm =140 μm
Case 2: Select 6 piece 1000 mm Racks, F_P= 0.034 mm , D_P= 0.013 mm
E = 【6 x 0.034】 + 【5 x 0.013】 = 0.269 mm = 269 μm

Selection of the optimum gearbox



Recommended (for S5 Cycle Operation)

The general design is given for

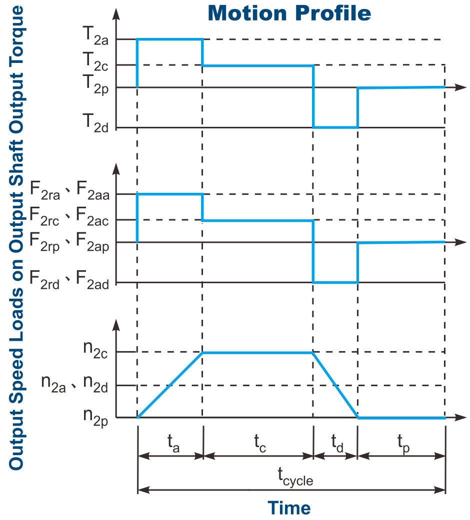
$$\frac{J_L}{i^2} \leq 4 \times J_m$$

The optimal design is given for

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

J_L Load Inertia

J_m Motor Inertia



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

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)