PPLX Series
Size selection method

Product specifications

Compact

Standard

Table

Wide angle

Basic

Roller gear cam drive

Parallel cam drive

Linear Circular

Pick and Place drive

Option

When you select specifications and model of a P&P drive, first determine the following primary specifications.
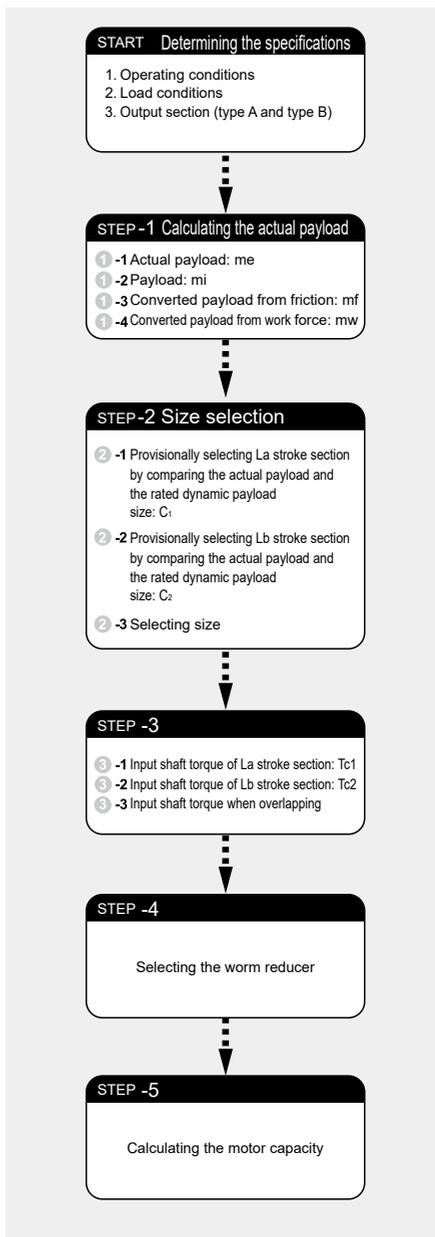
Operating conditions
- La stroke length
- Lb stroke length
- Index angle
- Input shaft speed
- Driving method

Load conditions
- Payload
- External load

Compare the actual payload calculated from the payload determined from above and the external load with the rated dynamic payload based on the La and Lb stroke sections, index angle and input shaft speed, and choose the size.

Size selection flow chart

START Determining the specifications
1. Operating conditions
2. Load conditions
3. Output section (type A and type B)

STEP-1 Calculating the actual payload
- ❶-1 Actual payload: me
- ❶-2 Payload: mi
- ❶-3 Converted payload from friction: mf
- ❶-4 Converted payload from work force: mw

STEP-2 Size selection
- ❷-1 Provisionally selecting La stroke section by comparing the actual payload and the rated dynamic payload size: C_1
- ❷-2 Provisionally selecting Lb stroke section by comparing the actual payload and the rated dynamic payload size: C_2
- ❷-3 Selecting size

STEP-3
- ❸-1 Input shaft torque of La stroke section: Tc1
- ❸-2 Input shaft torque of Lb stroke section: Tc2
- ❸-3 Input shaft torque when overlapping

STEP-4
Selecting the worm reducer

STEP-5
Calculating the motor capacity

1 Calculating the actual payload

① - 1. Calculating the actual payload: me

The actual payload is the total of payload, converted payload from friction and converted payload from work force.

$$me = mi + mf + mw \text{ (kg)}$$

Here, mi : Payload (kg)

mf : Converted payload from friction (kg)

mw : Converted payload from work force (kg)

① - 2. Payload: mi

This is the weight of the jig and workpiece determined for the specifications.

① - 3. Converted payload from friction: mf

Frictional force is the force which applies to the output arm or table because of friction of bearings and sliding surfaces, and this force is converted to payload.

$$mf = \frac{\mu \cdot F}{g} \text{ (kg)}$$

Here, g : Gravitational acceleration 9.81 m/s^2

F : Force applying to sliding surfaces and bearings (N)

μ : Coefficient of friction

Rolling friction	Sliding friction
μ = 0.03 to 0.05	μ = 0.1 to 0.3

① - 4. Converted payload from work force: mw

Work force is the external load which is applied to the output arm or table as load when the system is running, and this work force is converted to payload.
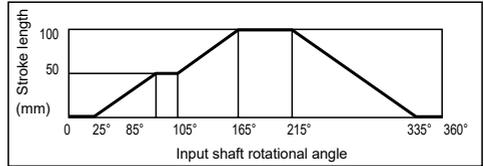
$$mw = \frac{Fw}{g} \text{ (kg)}$$

Here, Fw : Work force (N)

g : Gravitational acceleration 9.81 (m/s^2)

2 Size selection

Create a timing chart. Calculate the min. rated dynamic payload from the payload table for each lead range as Mm, and choose this value.

Compare the rated dynamic payload Mm and the actual payload me, and select the size.

$$Mm \geq me \text{ (kg)}$$

Here, Mm : Rated dynamic payload (kg)

me: Actual payload (kg)

② - 1. Provisionally selecting the size by comparing the rated dynamic payload of the La stroke section and the actual payload: C_1

$$Mma \geq mea \text{ (kg)}$$

Here, Mma : Rated dynamic payload of La stroke (kg)

mea: Actual payload of La stroke (kg)

② - 2. Provisionally selecting the size by comparing the rated dynamic payload of the Lb stroke section and the actual payload: C_2

$$Mmb \geq meb \text{ (kg)}$$

Here, Mmb : Rated dynamic payload of Lb stroke (kg)

meb: Actual payload of Lb stroke (kg)

② - 3. Selecting the size

Selecting the larger P&P size between C1 and C2, which are obtained by comparing the rated dynamic payload of La stroke and Lb stroke with the actual payload.

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Parallel cam drive

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Pick and Place drive

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Roller gear cam drive

3　Calculating the input shaft torque

For general P&P motions, calculate the input shaft torque for La stroke section and Lb stroke section, and choose the larger value.

If La stroke motion and Lb stroke motion overlap, choose the sum of these 2 values.

3 - 1. Input shaft torque of La stroke section: Tc1

$$Tc1 = \frac{2.06 \times 10^{-3} \cdot Am \cdot Qm \cdot (mi+moa) \cdot Loa^2 \cdot N^2}{\theta h^3} + \frac{0.057 \cdot Vm \cdot \{ (mi+moa) \times 9.81 + Ff + Fw \} \cdot Loa}{\theta h} + Tin$$

3 - 2. Input shaft torque of Lb stroke section: Tc2

$$Tc2 = \frac{2.06 \times 10^{-3} \cdot Am \cdot Qm \cdot (mi+mob) \cdot Lob^2 \cdot N^2}{\theta h^3} + \frac{0.057 \cdot Vm \cdot \{ (mi+mob) \times 9.81 + Ff + Fw \} \cdot Lob}{\theta h} + Tin$$

Here, Loa : La stroke (mm)　　　　　　　Ff　: Frictional force (N)

　　　Lob　: Lb stroke (mm)　　　　　　　Fw　: work force (N)

　　　N　　: Input shaft rotational speed (rpm)　　Am : 5.53

　　　θh　: Index angle (°)　　　　　　　　Vm : 1.76

　　　moa : Internal weight of La stroke section (kg)　　Qm : 0.99

　　　mob : Internal weight of Lb stroke section (kg)　　Tin　: Internal frictional torque (N·m)
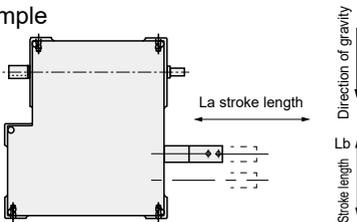
3 - 3. Input shaft torque when overlapping: Tc

$$Tc = Tc1 + Tc2 - Tin$$

(CAUTION)

(1) Calculate (mi + moa) × 9.81 and

　　　(mi + mob) × 9.81 in the formula

only when the direction of motion is the same as gravity.

(2) The input shaft torque obtained here is a torque required to drive the P&P drive. You also have to consider a torque externally applied as load to the input shaft.

Example

* You just have to calculate this for Lb stroke; there is no need to calculate this for La stroke.

4   Selecting the worm reducer

Calculate a torque Ter of the output shaft of the reducer (TE series) using the following formula.

$$Ter = Tc \cdot fr \ (N \cdot m)$$

Here, Ter : Load torque (N·m) of the reducer

    Tc: PPLX input shaft torque (N·m)

    fr: Reducer usage factor

	Operational hours per day		
	2 time	10 time	24 time
Continuous operation	0.90	1.25	1.50
Intermittent operation	1.25	1.50	1.75

Compare Ter obtained here in the worm reducer (TE series) rated output torque table to verify that the reducer can be used in combination with the P&P drive.

If Ter is greater than the worm reducer rated output torque in the standard combination, the size of the reducer should be increased. For details, contact CKD.

5   Calculating the motor capacity

You can obtain the motor capacity for the P&P drive itself from the input shaft torque and input shaft rotational speed of the P&P drive.

$$P = \frac{Tc \cdot N}{9550 \cdot \eta} \ (kW)$$

Here, P : motor capacity (kW)

    Tc: Input shaft torque (N·m)

    N: Input shaft rotational speed (rpm)

    η: Efficiency of the reducer ($\eta < 1$)

* Add Pr (motor capacity of the worm reducer itself) to the above formula when you use a work reducer.

$$Pr = \frac{Tinr \cdot Nr}{9550} \ (kW)$$

Here, Tinr = Internal frictional torque of the reducer (N·m).

TE reducer size	Oil level			
	5°C	10°C	15°C	20°C
TE35	0.38	0.33	0.29	0.26
TE42	0.61	0.52	0.45	0.40

    Nr: Worm shaft rotational speed (rpm)

• When we make calculations, we assume the oil temperature to be 10 degrees C unless otherwise stated.

• When you use a worm reducer other than TE series, add to Pr the value obtained by converting the internal frictional torque given in the technical data into the motor capacity.

• In addition, since the viscosity of the lubricating oil in the reducer becomes high in the cold climate region or during cold winter mornings, a higher motor capacity will become necessary. As a result, the motor capacity may become insufficient. This may lead to a speed lower than expected, or in the worst case, the motor may become unable to start or get seized.

• Therefore, select a motor with sufficient margin for the calculation.

Product specifications

Compact

Standard

Table

Wide angle

Basic

Roller gear cam drive

Parallel cam drive

Circular

Linear

Pick and Place drive

Option

PPLX
Specification check sheet for selecting a P&P drive

Product specifications

Compact

Standard

Table

Wide angle

Basic

Parallel cam drive   Roller gear cam drive

Linear   Circular
Pick and Place drive

Option

Date

CKD Corporation

TO:

Company name: Name:

Department/Section:
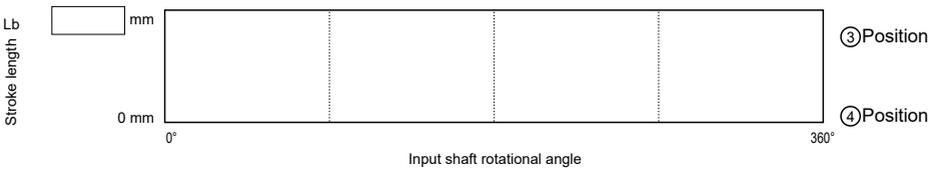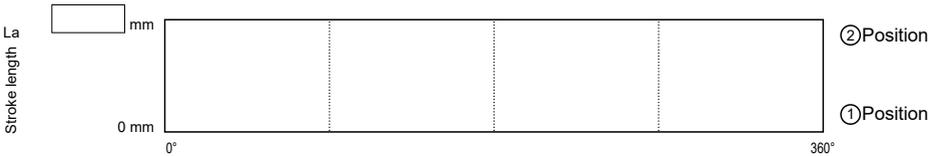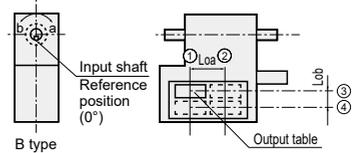
TEL: FAX:

Operating conditions

1. Output section: ☐ Type A ☐ Type B
2. Installation position: ☐ 1 ☐ 2
3. La stroke length   : Loa = [   ] mm
4. Lb stroke length   : Lob = [   ] mm
5. Input shaft rotating direction: ☐ Direction a ☐ Direction b
6. Input shaft rotational speed N = [   ] rpm
7. Input shaft driving method: ☐ Worm reducer direct connection (with TE reducer)

   ☐ Geared motor
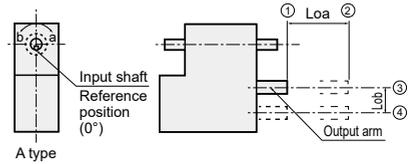
8. Timing chart

   * Create the timing chart referring to the following points.
   • Input shaft reference point (keyway position)
   • Input shaft rotating direction
   • Relationship between the output sections 1, 2, 3 and 4, positions and the input shaft rotational angle

A type

b ⊕ a
Input shaft
Reference position (0°)

① Loa ②
Output arm
③
④
Lob

B type

b ⊕ a
Input shaft
Reference position (0°)

① Loa ②
Output table
③
④
Lob

La
Stroke length

[   ] mm

0 mm

0°   360°

②Position

①Position

Lb
Stroke length

[   ] mm

0 mm

0°   360°

Input shaft rotational angle

③Position

④Position

Load conditions and others