Rotary Hollow
Actuator

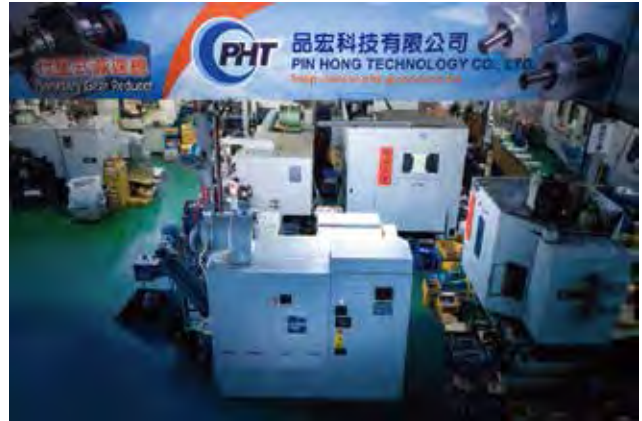**P**ROFESSIONAL TEAM
HIGH-LEVEL INSPECTION
TECHNICAL CONSULTATION
VERTEX PRECISION
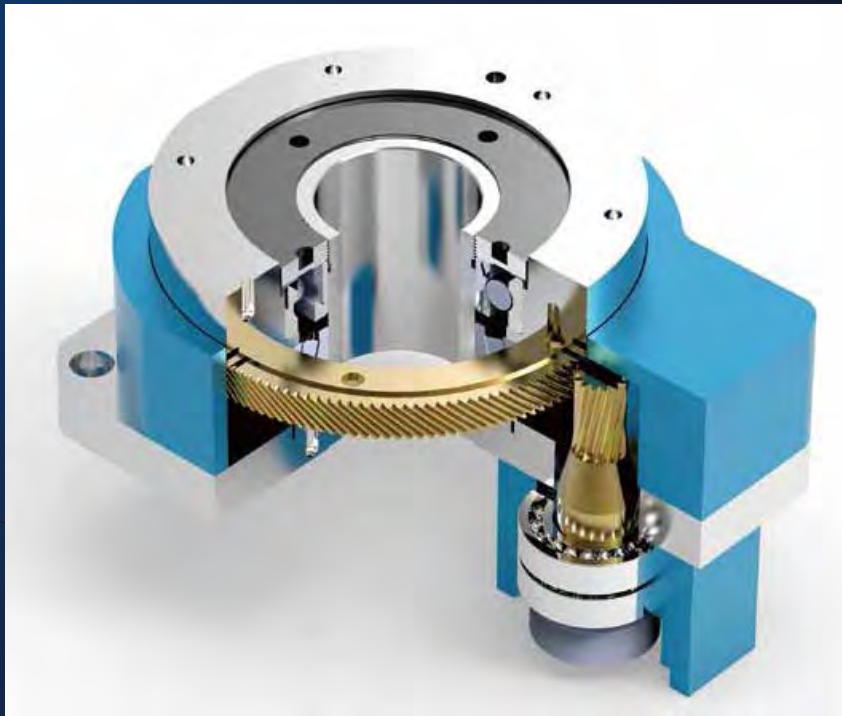
About PHT Vertex Precision

As a major manufacturer of precise planetary gearboxes, **PHT Vertex Precision** offers the integral solution in the field of motion control application. Established in 1982 with the objective of producing the highest quality planetary gearboxes in the market, PHT Vertex Precision has achieved this goal with a new state of the art manufacturing facility. Utilizing the latest in machine tools and metrology equipment, PHT Vertex Precision is able to provide a high quality, competitiveness alternatives to that of the competition.

Through years' effort in the field of motion control application, for integrating the application of power transmission and linear motion, PHT Vertex Precision invested and established the factories of gear racks and rolled ball screws during the period of time from 2009 to 2012. The integral combination paved the way for PHT Vertex Precision of being a professional manufacturer who made a significant milestone during the developing history.

Now we have helped thousands of clients reach their full potential in the fields of Machines tools, Robotized Production Line, Conveyer System, Solar Energy, Industrial Print Machine, and so on. If you're looking for alternative and professional manufacturer with guaranteed products plus the advantages of competitiveness and compatibility for increasing products' added values, then, PHT Vertex Precision will be here for supporting you always.
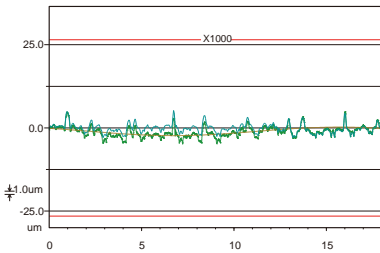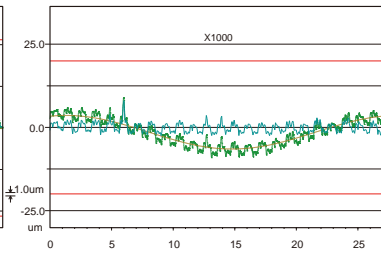
Quality Control Equipment

+ Gear Rolling Tester

Double flank gear rolling test
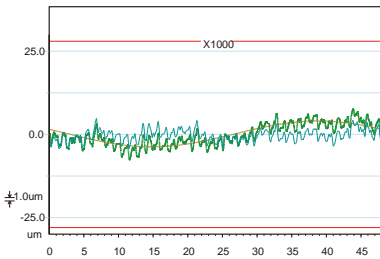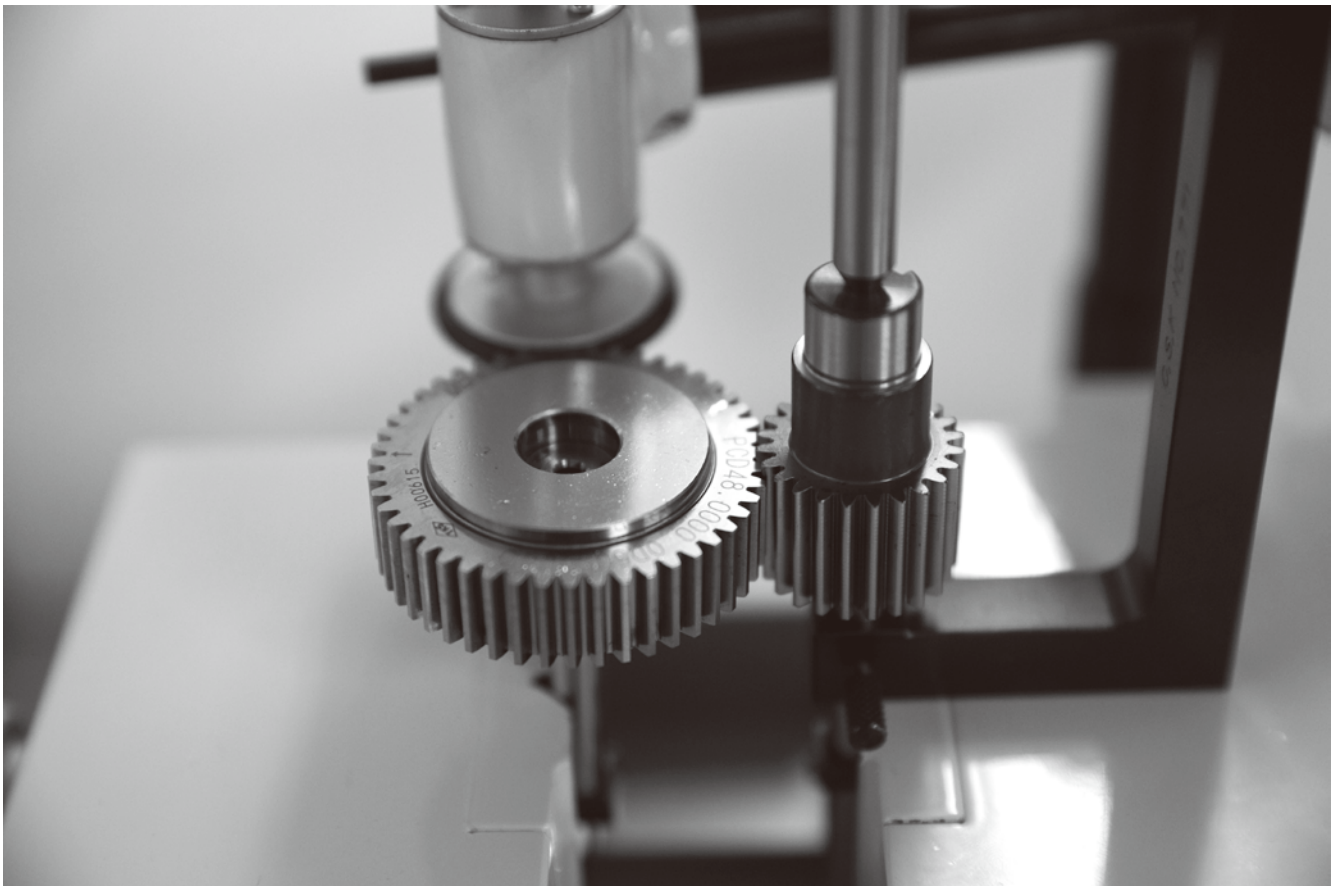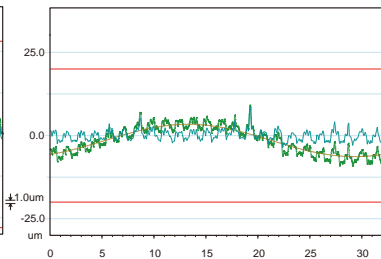
DS120-C21-3

DH060C31-5
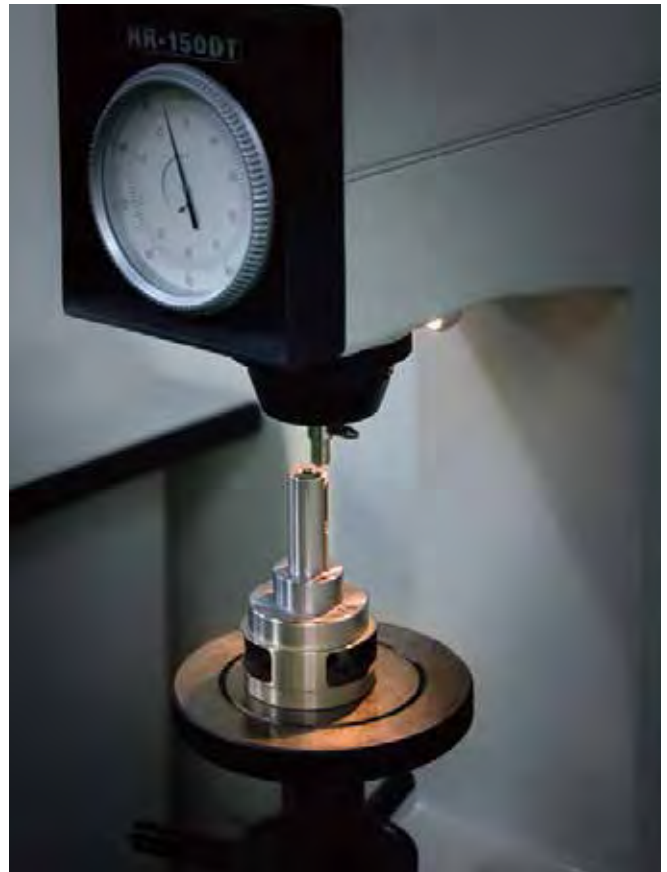
DH090-C31-5
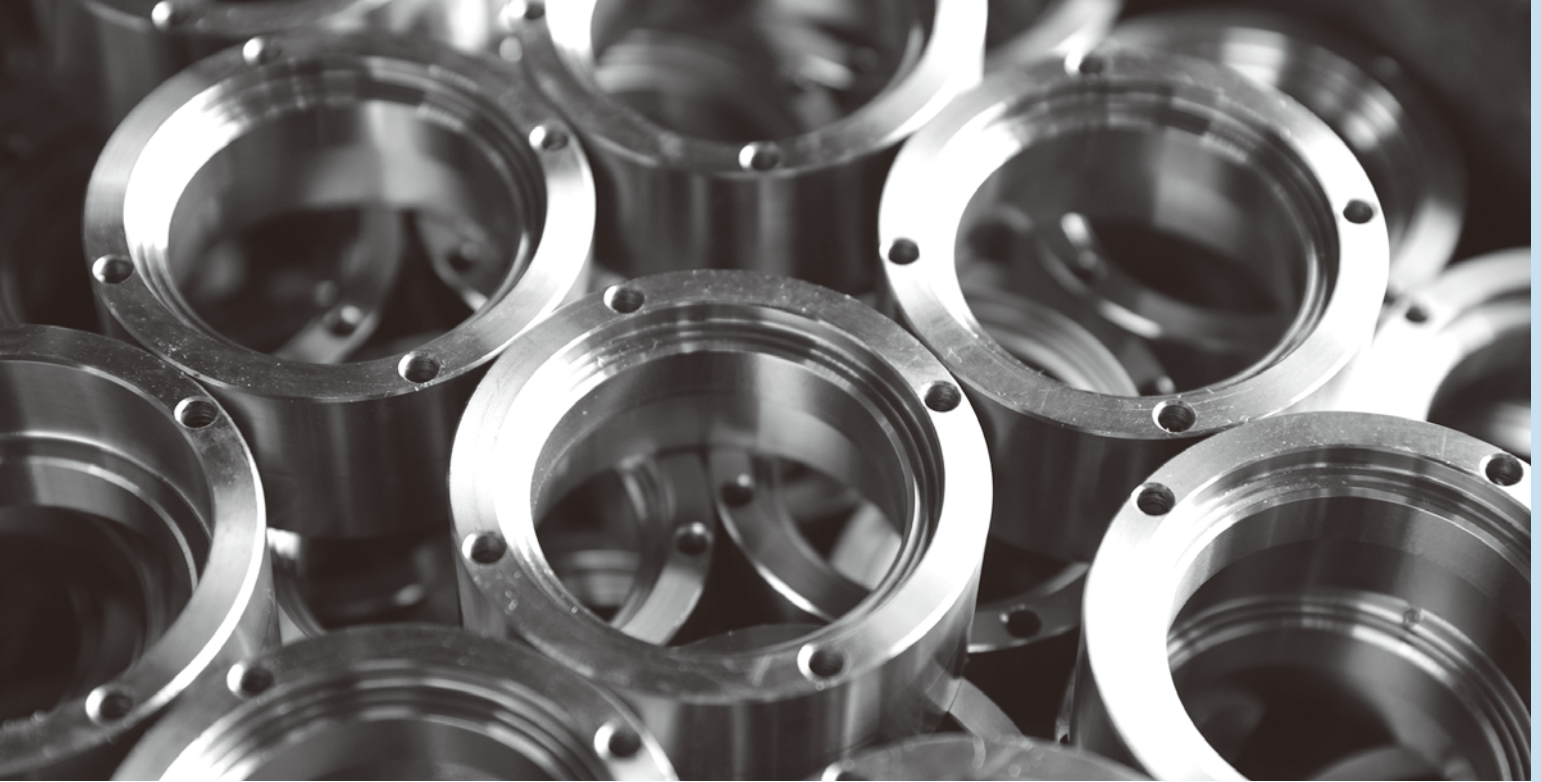
DS150C31-3

+ Noise Inspection Machine

+ Rockwell Hardness Testing Machine ▸

+ Optical Image Measuring Machine ▾

+ Concentricity Tester

+ Backlash Inspection Machine

+ 3D Coordinate Measuring Machine

Statistical Data Analysis	
Total Numbers	50
Average Value	500.088
Minimum Value	499.430
Maximum Value	500.220
Range	1.260
Relative Error	0.00%
Repeatability Error	0.78%
Accuracy	100%
$\sum N$	0.281
$\sum$	0.284
Cp	56.89%
Cpk	56.89%

+ Torque Inspection Machine

DL090L2-20-19-70 (500Nm)
NCS3000

(N.m)

550.000	
495.000	
440.000	
385.000	
330.000	
275.000	
220.000	
165.000	
110.000	
55.000	
0.000	

Time(S)   1247(SEC)

DL090L2-20-19-70 (500Nm)
NCS3000

(N.m)

550.000	
495.000	
440.000	
385.000	
330.000	
275.000	
220.000	
165.000	
110.000	
55.000	
0.000	

Time(S)   997(SEC)
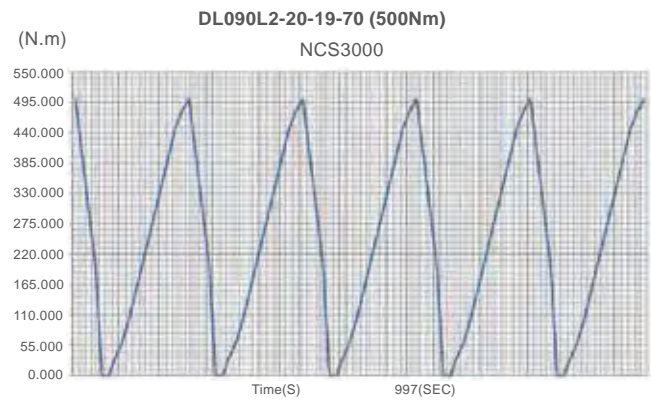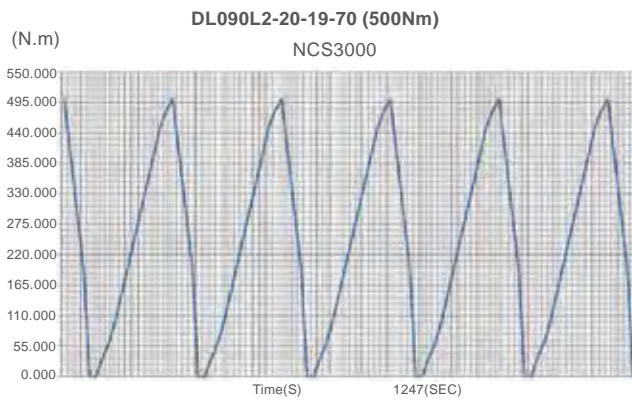
+ Inner Gear Inspection

What is Planetary Gearbox?

A planetary gearbox is a mechanical device consisting of sun gear, the planet gears, the planet gears' carrier, and the ring gear. Sun gear is located at the center that transmits torque to planet gears orbiting around the sun gear. Planet and sun gears are located inside the ring gear.

Multi-staged planetary gearbox is available by connecting the individual stage in sequence. With the gear unit combination the individual stage is sized to the torque requirement.

> **Sun Gear**
> **Planet Gears**
> **Planet Gears' Carrier (output shaft)**
> **Internal Ring**

Function of Planetary Gearbox

A planetary gearbox is a gear system utilized to increase the output torque and reduce load inertia while slowdown the speed.

A gearbox provides speed and torque conversions from a rotating power source to another device using gear ratio. It can be used in various situations, such as precise machine tools, and anywhere else mechanical equipment.

How to select a proper Planetary Gearbox?

How to select a proper Planetary Gearbox for meeting specific application requirement, following factors need to be considered:

Gear Ratio

Generally speaking, the reduction ratio can be simply explained by the formula: **Reduction Ratio = RPM-servo motor / RPM-gearbox output**

Gear ratio also can be defined as the correlation between the numbers of teeth of two different gears. Commonly, the number of teeth a gear has is proportional to its circumference. This means that the gear with a larger circumference will have more gear teeth, therefore, the relationship between the circumferences of the two gears can also give an accurate gear ratio.

Output Torque

Output torque is important parameter when choosing a planetary gearbox. Gear reduction reduces the relatively high rotational speed of motor, delivering a lower rotational speed at the output end.

Overload Torque

Peak overload torque is the short-term overloading of the permitted output torque.

Speed (rpm)

Speed is proportional to the gear ratio of the system. If the input gear has more teeth than the output gear, the result will be increase in speed at the output shaft. On the other hand, having the reverse scenario with more gear teeth at the output compared to the input will result in a decrease of speed at the output shaft. In general, the output speed can be determined by dividing the input speed by the gear ratio. The higher the ratio the lower the output speed will be and vice versa.

Backlash

Backlash is the angle in which the output shaft of a gearbox can rotate without the input shaft moving or the gap between the teeth of two adjacent gears. It is not necessary to consider backlash for applications which do not involve load reversals. If the motion cycle is exactly repeated the backlash of planetary gearbox has theoretically not influence on the repeatability. However, in precision applications with load reversals like Robotics, Automation, CNC Machines, etc., backlash is crucial for accuracy and positioning.

Choosing an applicable Reduction Ratio

Ideal Reduction Ratio

Reduction Ratio = RPM servo motor / RPM gearbox output

Usually we are used to describe the power of the electronic device with a load capacity possessed, but for servo motor system, the main part is the output torque which could guide the relative concepts. From the notion of the motor driving circuit design, the power is focused especially. For the purpose we must clarify the relationship among the power, the torque, and the speed as following:

1. Power (P_W) = Force (F) x Linear Velocity (V)
2. Force (F) = Torque (T_{Nm}) / Radius (r)
3. Linear Velocity (V) = 2 π r x Angular Velocity (n_{RPS}) = (2 π r x n_{RPM}) / 60 = (π r x n_{RPM}) / 30

> Guide formula 2 and 3 into formula 1, and then we can get:
> Power (P_W) = (T_{Nm} / r) x (π r x n_{RPM} / 30) = (π / 30) x T_{Nm} x n_{RPM}

We can transfer the unit of Power from (P_W) to (P_{KW}), and then get the following:

> Power (P_{KW}) = { (π / 30) x T_{Nm} x n_{RPM} } / 1000
> Power (P_{KW}) = (3.1415926 / 30000) x T_{Nm} x n_{RPM}
> Power (P_{KW}) = (T_{Nm} x n_{RPM}) / 9549.297 ≒ (T_{Nm} x n_{RPM}) / 9550

Through this finalized fomula: Power (P_{KW}) = (T_{Nm} x n_{RPM}) / 9549.297 ≒ (T_{Nm} x n_{RPM}) / 9550 we can make the choice for selecting the proper planetary gearbox. For example:

1. Select the servo motor with proper power capacity
   > example: 100W / defined output speed 3000 RPM
2. Checking the required working speed (RPM) and Torque (Nm) for applying machine
   > example: 10 RPM / 70 Nm
3. Reduction ratio of gearbox
   > sevo motor output speed 3000 RPM / gearbox output speed 10 RPM = 1:300
4. The defined output torque of servo motor
   > (100W / 1000) x 9550 = (T_{Nm} x 3000 RPM), T_{Nm} = (0.1 KW x 9550) / 3000 RPM = 0.3183 Nm
5. Result:
   > through reduction ratio (1:300) of gearbox, the output speed is 10 RPM, and the output torque = 0.3183 Nm x 300=
   > 95.49 Nm, and then, according to the output torque we can choose the proper gearbox in applying.

Application of Planetary Gearbox

Planetary Gearbox is used on high precision motion control application that requires high torque, torsional stiffness and low backlash, specifics of which will vary by application.

Planetary Gearbox increases the torque by the stage of reduction ratio, making it possible to run the motor at a higher, more efficient speed. The inertia reflects back to the motor is reduced for increased stability. Using a planetary gearbox allows machine builder using a smaller, less expensive motion control package.

The application of planetary gearbox covers the entire range of automation. It is frequently found in fields following:

> **Pick and Place Systems**
> **Loading and unloading gantry Robots**
> **Driving Rotary and Linear Actuators**
> **Packaging Machines**
> **Positioning Tables**
> **Material Handling Systems**

> **CNC Routers**
> **Plasma Cutting Machines**
> **Machine Tools**
> **Industrial Conveyor**
> **Industrial Printing Machines**
> **Feeding Machines**

Hollow Rotary Actuator, HRP series

Introduction

Hollow Rotary Actuator, HRP series, features a hollow table that allows inertia-large discs or arms to be installed directly, offers optimized load capacity, torque, speed, and resolution. The compact mechanism can be mounted in any position which are suitable for use in manufacturing, inspection, positioning, research, tracking, and medical applications. It offers the easiest possible installation of rotary table applications. Depending on your application you can choose between servo and stepper motors – with or without built-in (absolute) encoders.

HRP series rotary actuator comes in five frame sizes: 60 mm, 100 mm, 130 mm, 200 mm, and 275 mm.

The rotary actuators can be a combination of servo or stepping motor and turntable. They are ideal for applications featuring an indexing drive. The actuator has an internal speed reduction mechanism (gear ratio 5, 8, 10), which makes high power driving possible.

HRP series

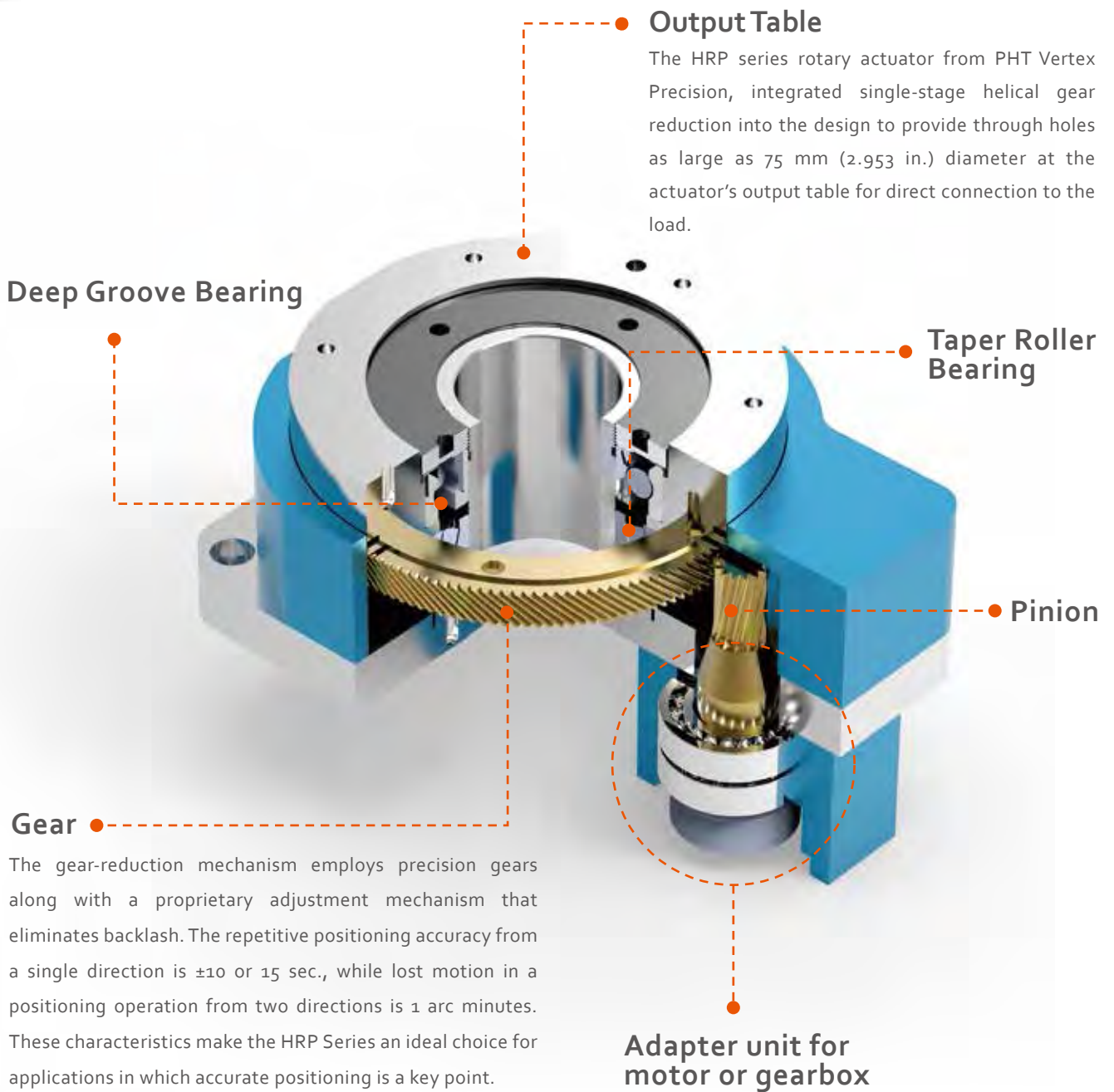|	
Type:	HRP series
Feature:	Mounted with motor by fix ratio
Accuracy:	1 arc min (Positioning Accuracy)
	10~15 arc sec (Repetitive Accuracy)
Size:	60, 100, 130, 200, 275
Speed:	200 rpm (output)
Life Time:	15,000 ~ 20,000 hrs. (for accuracy)

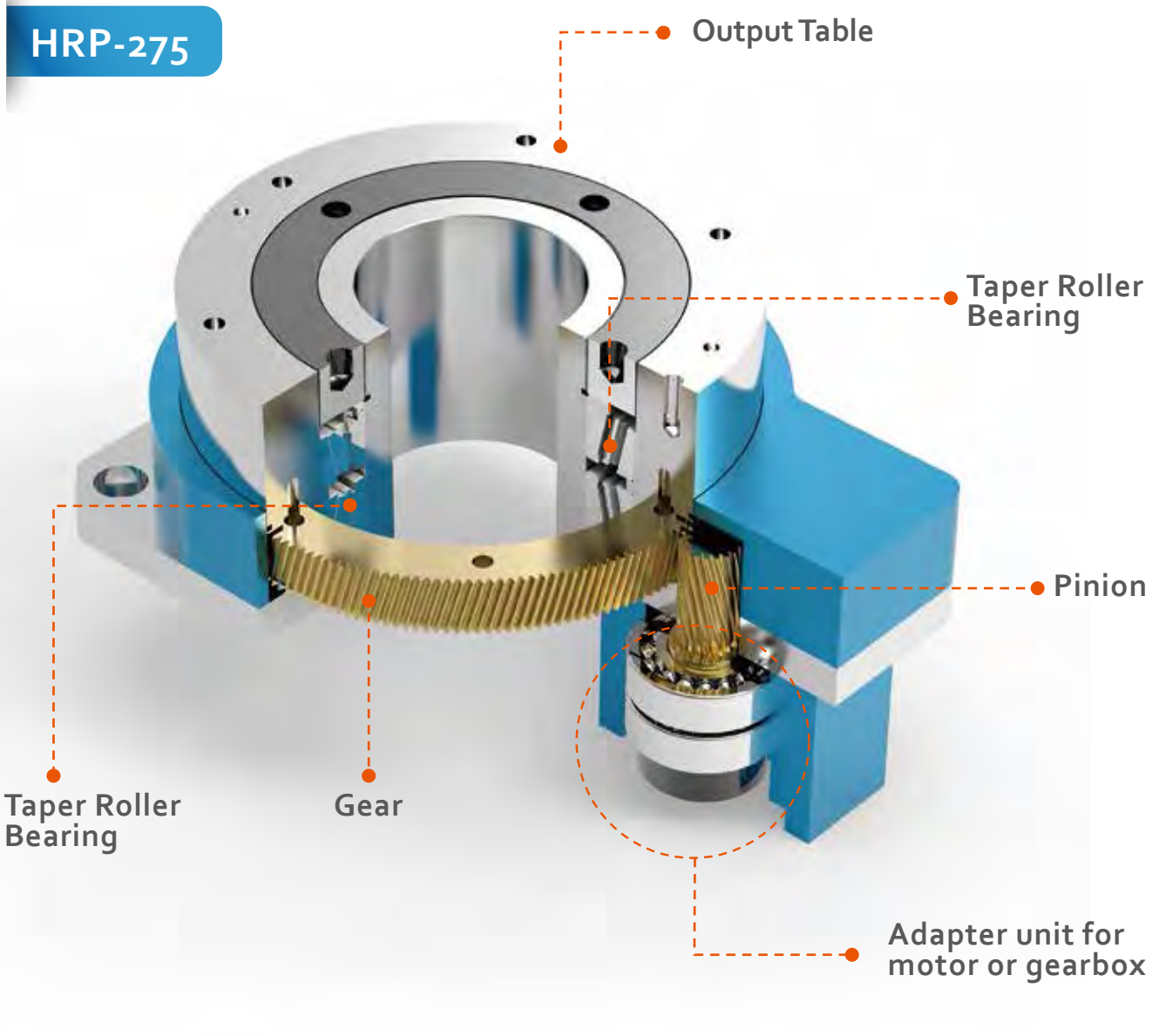**HRP-H** series

Type:	HRP-H series
Feature:	Combined with gearbox by available ratio
Accuracy:	1 ~ 2 arc min (Positioning Accuracy)
	60~70 arc sec (Repetitive Accuracy)
Size:	60, 100, 130, 200, 275
Speed:	200 rpm (output)
Life Time:	15,000 ~ 20,000 hrs. (for accuracy)

HRP series

HRP-130

Output Table

The HRP series rotary actuator from PHT Vertex Precision, integrated single-stage helical gear reduction into the design to provide through holes as large as 75 mm (2.953 in.) diameter at the actuator's output table for direct connection to the load.

Deep Groove Bearing

Taper Roller Bearing

Pinion

Gear

The gear-reduction mechanism employs precision gears along with a proprietary adjustment mechanism that eliminates backlash. The repetitive positioning accuracy from a single direction is ±10 or 15 sec., while lost motion in a positioning operation from two directions is 1 arc minutes. These characteristics make the HRP Series an ideal choice for applications in which accurate positioning is a key point.

Adapter unit for motor or gearbox

Except for the fixed ratio by the internal speed reduction mechanism, the HRP series can be also combined with planetary gearboxes from PHT Vertex Precision for the purpose of diverse applications of different reduction ratios. The combination of Hollow Rotary Actuator with planetary gearboxes we named it: HRP-H series.

HRP-275

Output Table

Taper Roller Bearing

Pinion

Taper Roller Bearing

Gear

Adapter unit for motor or gearbox

Features:

> Accurate Positioning

> Low Backlash ($\leqq$ 1 arc min)

> Large hollow rotary platform

> Accurate and stable position in inertia load

> Easy installation and space saving

Application:

> Applications subject to changing load inertia, such like Indexing Plate.

> Applications where a moment load is applied, such like Pick and Place System.

> Optical applications.

> High accurate positioning applications, such like Material Handling Machine and Positioning Platform.

Information	HRP60	HRP60-H
Supporting Bearing	◎ Deep Groove Bearing　◎ Thrust Roller Bearing	
Permissible Torque (Nm)	5	
Permissible Thrust Load (kgf)	20	
Life time of Accuracy (hrs.)	15000	
Permissible Speed (RPM)	200 (output)	
Gear Ratio	5	15, 20, 25, 35, 50
Repetitive Positioning Accuracy (arc-sec)	≤15	≤70
Positioning Accuracy (arc-min)	≤1	≤1
Parallelism of Output Table (mm)	≤0.02	
Concentricity of Output Table (mm)	≤0.02	
Degree of Protection	IP40	
Weight (kg)	1	1.4

▼ **HRP060**-5-8-30-46-M4
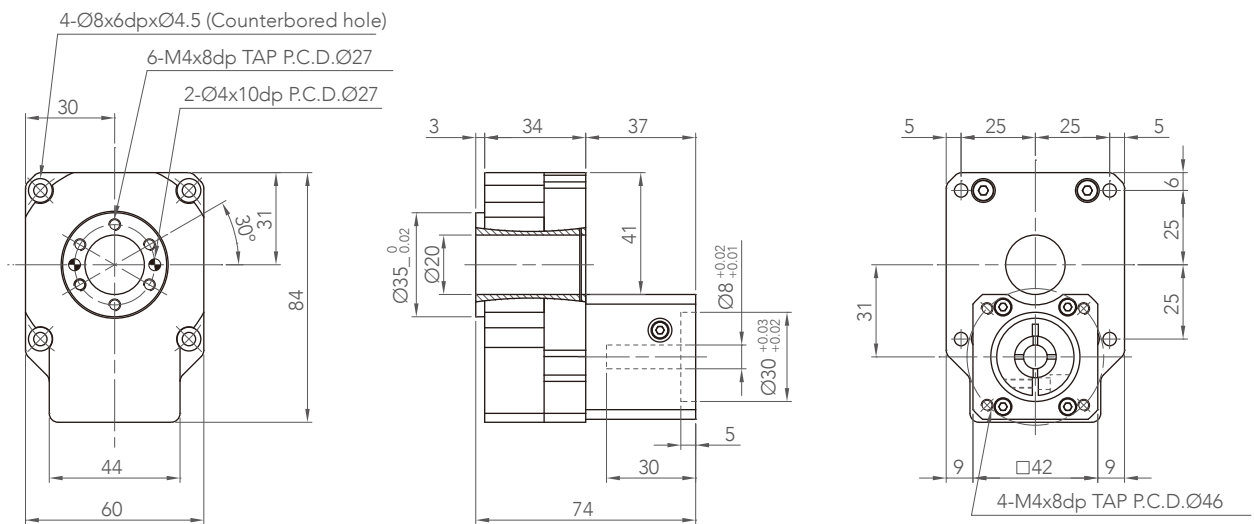
▼ **HRP060-H**-XX-8-30-46-M4
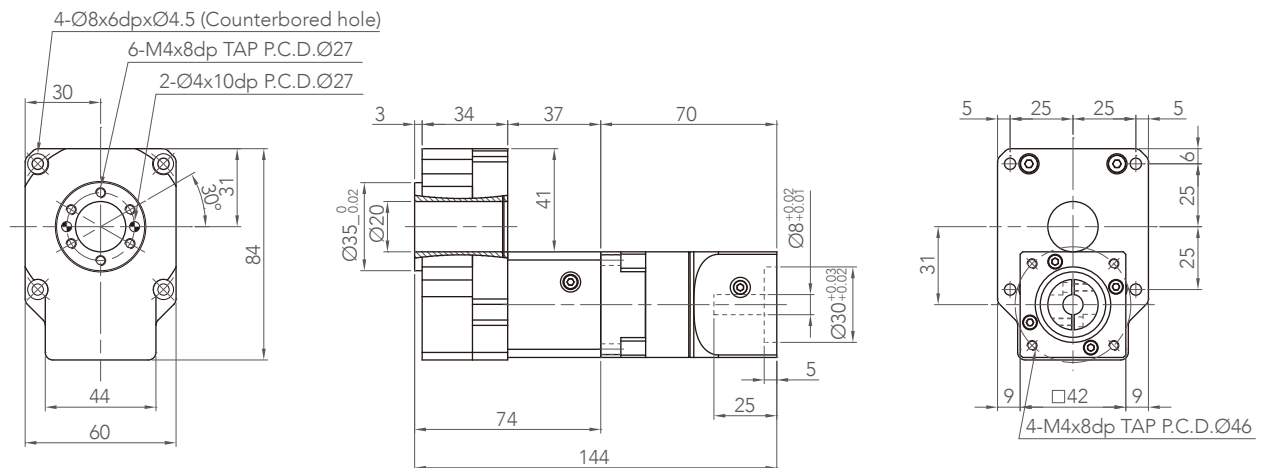
Information	HRP100	HRP100-H
Supporting Bearing	◎ TAPER ROLLER BEARING ◎ DEEP GROOVE BEARING	
Permissible Torque (Nm)	45	
Permissible Thrust Load (kgf)	200	
Life time of Accuracy (hrs.)	20000	
Permissible Speed (RPM)	200 (output)	
Gear Ratio	8	24, 32, 40, 56, 80
Repetitive Positioning Accuracy (arc-sec)	≤10	≤60
Positioning Accuracy (arc-min)	≤1	≤1
Parallelism of Output Table (mm)	≤0.02	
Concentricity of Output Table (mm)	≤0.0015	
Degree of Protection	IP40	
Weight (kg)	3	4.3

▼ **HRP100**-8-14-50-70-M5
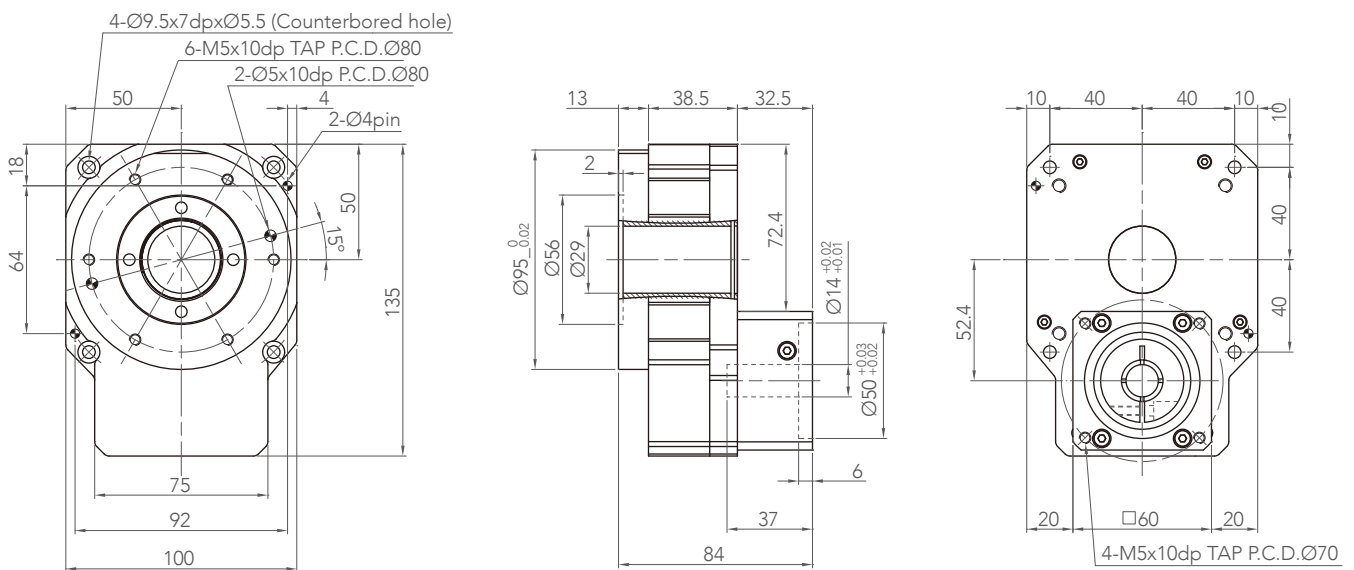
▼ **HRP100-H**-XX-14-50-70-M5
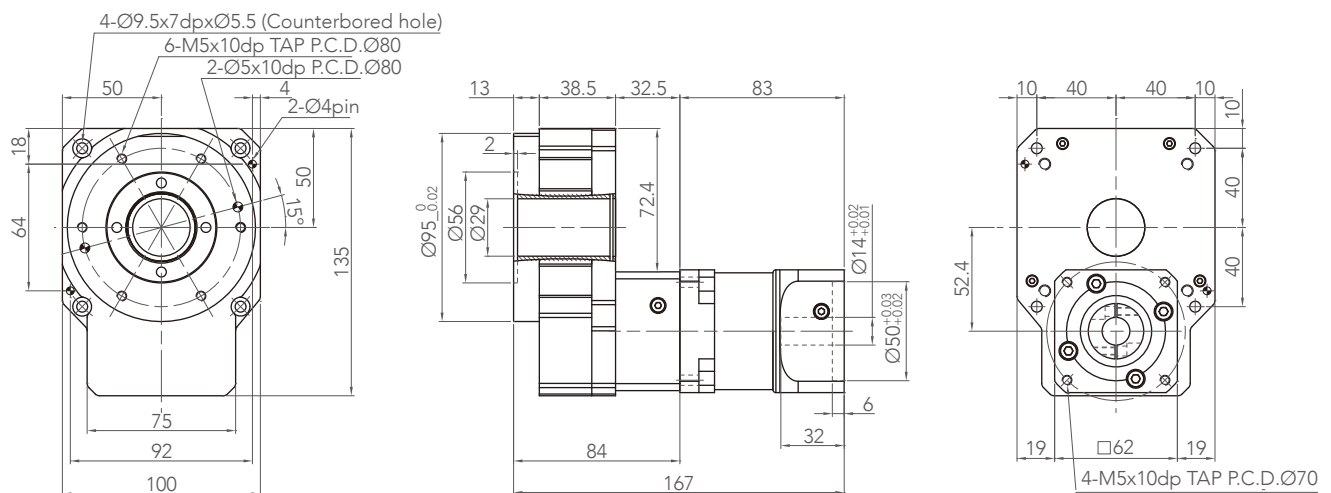
Information	HRP130	HRP130-H
Supporting Bearing	◎ TAPER ROLLER BEARING ◎ DEEP GROOVE BEARING	
Permissible Torque (Nm)	45	
Permissible Thrust Load (kgf)	200	
Life time of Accuracy (hrs.)	20000	
Permissible Speed (RPM)	200 (output)	
Gear Ratio	10	30, 40, 50, 70, 100
Repetitive Positioning Accuracy (arc-sec)	≤10	≤60
Positioning Accuracy (arc-min)	≤1	≤2
Parallelism of Output Table (mm)	≤0.02	
Concentricity of Output Table (mm)	≤0.0015	
Degree of Protection	IP40	
Weight (kg)	5.6	6.9

▼ **HRP130**-10-14-50-70-M5
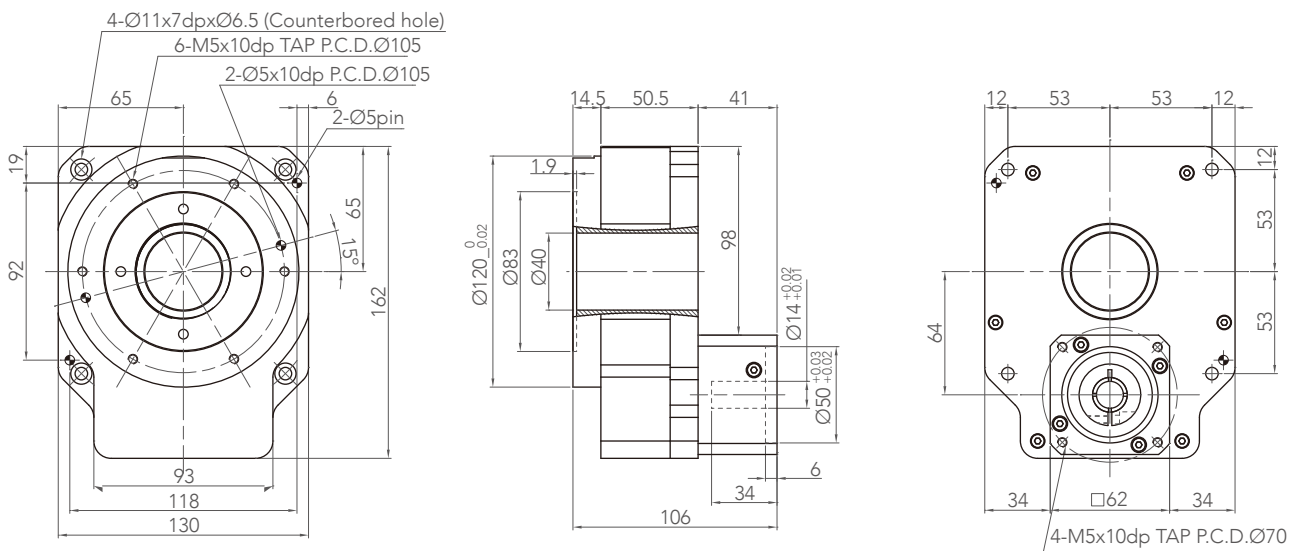
▼ **HRP130-H**-XX-14-50-70-M5
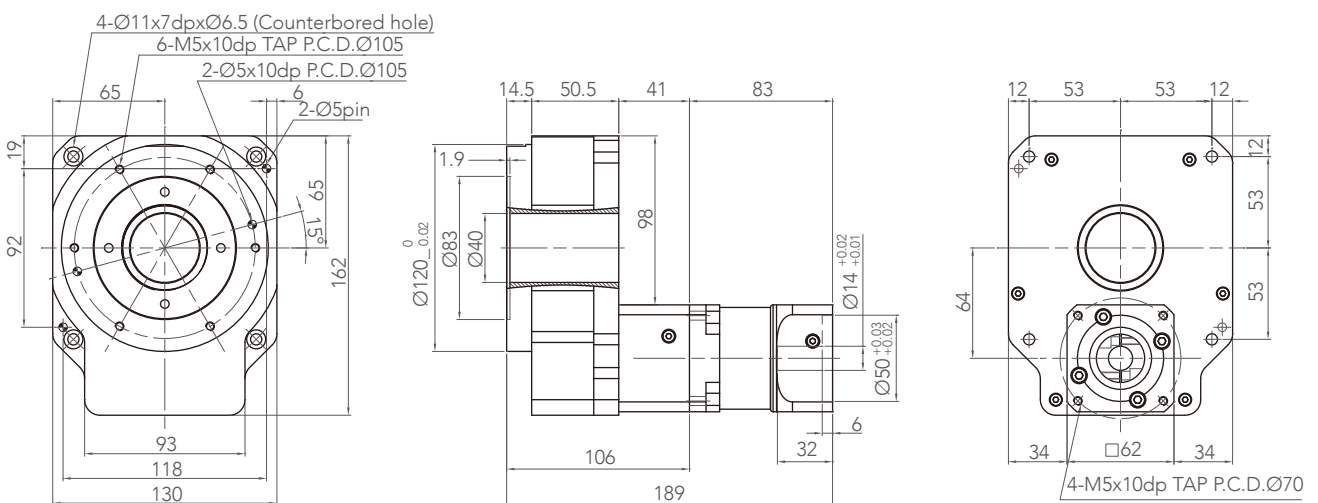
Information	HRP200	HRP200-H
Supporting Bearing	◎ Taper Roller Bearing	
Permissible Torque (Nm)	80	
Permissible Thrust Load (kgf)	500	
Life time of Accuracy (hrs.)	20000	
Permissible Speed (RPM)	200 (output)	
Gear Ratio	10	30, 40, 50, 70, 100
Repetitive Positioning Accuracy (arc-sec)	≤10	≤60
Positioning Accuracy (arc-min)	≤1	≤2
Parallelism of Output Table (mm)	≤0.02	
Concentricity of Output Table (mm)	≤0.0015	
Degree of Protection	IP40	
Weight (kg)	17.1	20.6

▼ **HRP200**-10-19-70-90-M6
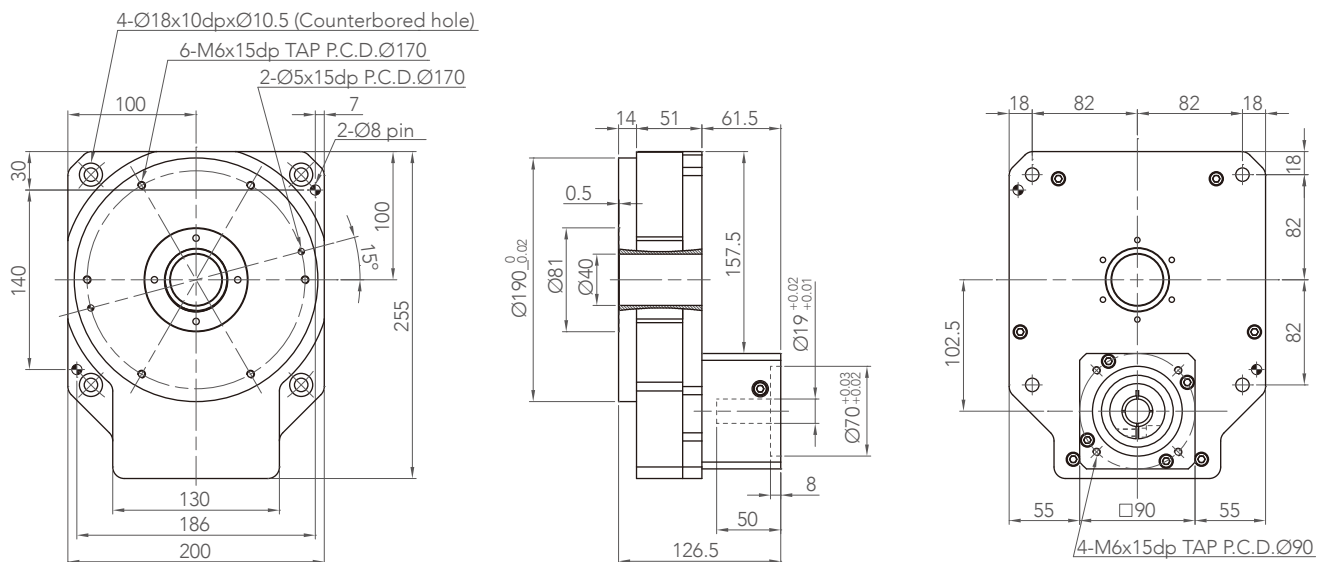
▼ **HRP200-H**-XX-19-70-90-M6
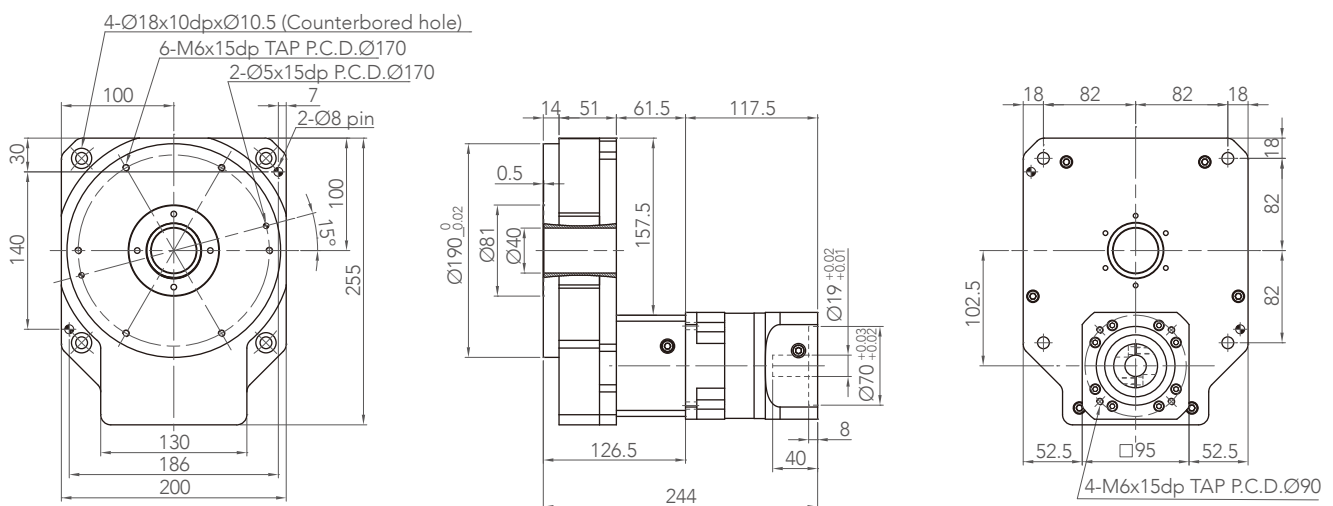
Information	HRP275	HRP275-H
Supporting Bearing	◎ Taper Roller Bearing	
Permissible Torque (Nm)	80	
Permissible Thrust Load (kgf)	500	
Life time of Accuracy (hrs.)	20000	
Permissible Speed (RPM)	200 (output)	
Gear Ratio	10	30, 40, 50, 70, 100
Repetitive Positioning Accuracy (arc-sec)	≤10	≤60
Positioning Accuracy (arc-min)	≤1	≤2
Parallelism of Output Table (mm)	≤0.02	
Concentricity of Output Table (mm)	≤0.0015	
Degree of Protection	IP40	
Weight (kg)	20.5	24

▼ **HRP275**-10-19-70-90-M6
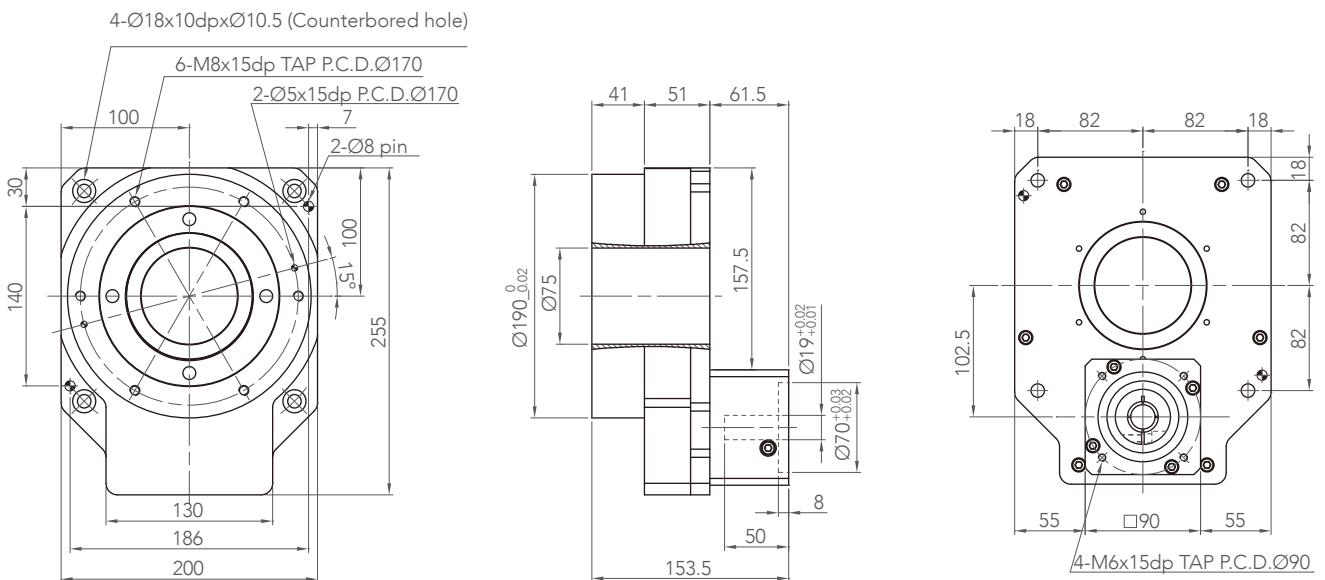
▼ **HRP275-H**-XX-19-70-90-M6
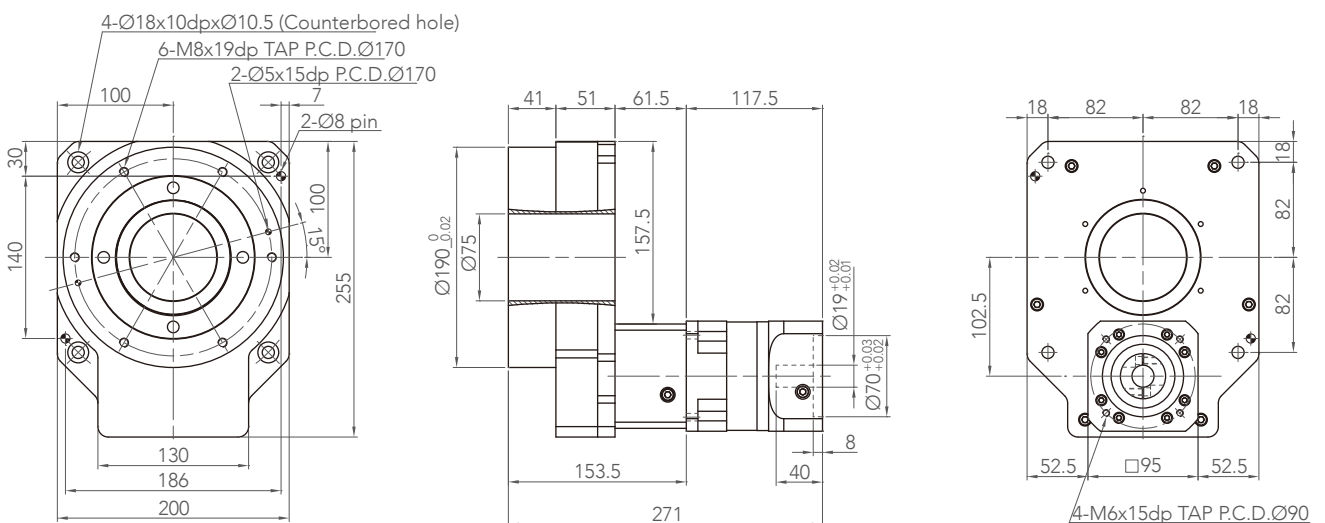
Planetary Gearbox Application Form

Company:	Website:
Contact:	E-mail:
Address:	Phone:
City:	Fax:
Zip:	Nation:

Motor Specifications:

Unit: ☐ mm   ☐ in

Bolt Circle Diameter (D1):	Pilot Thickness (L1):
Hole Diameter (D4):	Pilot Diameter (D3):
Shaft Diameter (D2):	Shaft Length (L2):
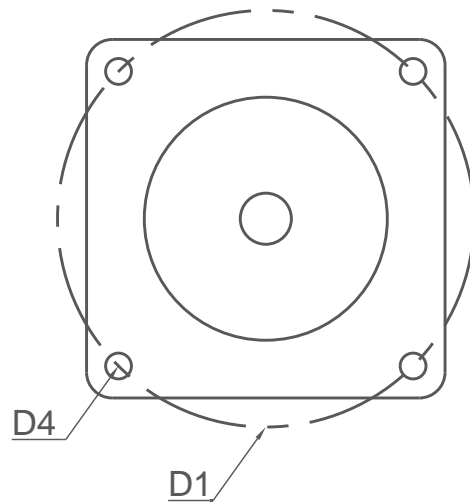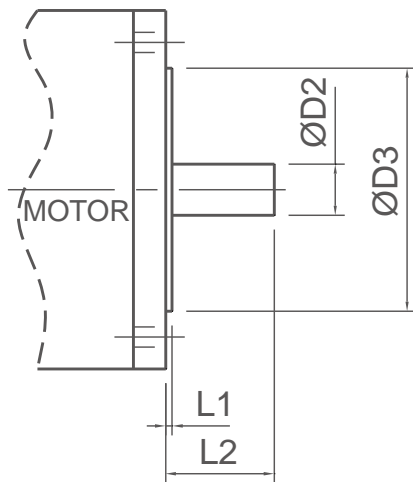
Planetary Gearbox Specifications:

Ratio:	Current Quantity:
Backlash:	Annual Requirement:

Please provide any additional information below: