

Compact Motorized Cylinder

DR Series Rod type with guide

OPERATING MANUAL Actuator Edition

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Thank you for purchasing an Oriental Motor product.

This Manual describes product handling procedures and safety precautions.

- Please read it thoroughly to ensure safe operation.
- Always keep the manual where it is readily available.

1 Introduction

1-1 Before use

Only qualified personnel of electrical and mechanical engineering should work with the product.

Use the product correctly after thoroughly reading the section "2 Safety precautions" on p.4. In addition, be sure to observe the contents described in warning, caution, and note in this manual.

The product described in this manual is designed and manufactured to be incorporated in general industrial equipment. Do not use for any other purpose. Oriental Motor Co., Ltd. is not responsible for any compensation for damage caused through failure to observe this warning.

1-2 Overview of the product

The compact motorized cylinder **DR Series** (hereinafter described as cylinder) is an actuator of a linear motion mechanism that a stepping motor is integrated with a ball screw.

The following two types of motors are provided.

- 2-Phase Stepping Motor **PKP Series**
- Stepping Motor **αSTEP AZ Series**

1-3 Related operating manuals

For operating manuals, download from Oriental Motor Website Download Page or contact your nearest Oriental Motor sales office.

■ Cylinder equipped with the PKP Series

- **DR Series OPERATING MANUAL Actuator Edition** (this document)
- Motorized actuator Compact Motorized Cylinder Function Setting Edition *

* Be sure to read the operating manual "Function Setting Edition" which is exclusively for compact motorized cylinders.

Refer to the operating manual of the driver for contents not described in these manuals.

■ Cylinder equipped with the **AZ** Series

- **DR** Series OPERATING MANUAL Actuator Edition (this document)
- **AZ** Series/Motorized actuator equipped with **AZ** Series OPERATING MANUAL Function Edition
- Motorized actuator Compact Motorized Cylinder Function Setting Edition *

* Be sure to read the operating manual "Function Setting Edition" which is exclusively for compact motorized cylinders.

Refer to the operating manual of the driver for contents not described in these manuals.




2 Safety precautions

The precautions described below are intended to ensure the safe and correct use of the product, and to prevent the customer and others from exposure to the risk of injury. Use the product only after carefully reading and fully understanding these instructions.



You must not operate the cylinder (operate the equipment for the specified purpose) if the machine in which the cylinder is installed does not satisfy the related safety standards. The factory safety manager or safety personnel in charge of the applicable machine must ensure that the machine is operated only by qualified personnel who are familiar with the operation of electronic equipment, and thereby prevent injury or damage to the equipment.

The term "qualified personnel" refers to persons who have received the necessary training or education and have pertinent experience; who are familiar with the relevant standards, regulations, accident-prevention rules and inspection conditions; who are authorized by the factory safety manager to engage in the necessary activities; and who have the ability to discern and prevent potential dangers.

Description of signs

 WARNING	Handling the product without observing the instructions that accompany a "WARNING" symbol may result in serious injury or death.
 CAUTION	Handling the product without observing the instructions that accompany a "CAUTION" symbol may result in injury or property damage.
 Note	The items under this heading contain important handling instructions that the user should observe to ensure the safe use of the product.

Description of graphic symbols

	Indicates "prohibited" actions that must not be performed.
	Indicates "compulsory" actions that must be performed.

WARNING






- Do not use the cylinder in explosive or corrosive environments, in the presence of flammable gases, in places subjected to splashing water, or near combustibles. Doing so may result in fire or injury.
- Do not transport, install, connect or inspect the cylinder while the power is supplied. Doing so may result in electric shock.
- Do not forcibly bend, pull or pinch the cable. Doing so may result in fire.
- Do not disassemble or modify the cylinder. Doing so may result in injury or damage to equipment.
- Never use the cylinder in a medical device used in connection with the maintenance or management of human life or health, or in a transportation system whose purpose is to move or carry people.
- Be sure to provide a safety cage conforming to EN ISO 13857 to prevent persons from entering the moving range of the cylinder while power is supplied to the cylinder. Turn off the main power to the driver before performing adjustment or inspection in which the moving part is moved manually. Failure to do so may result in injury.
- Do not hit the ball screw with the mechanical stopper in operations other than push-motion operation. Doing so may result in injury or damage to equipment.



- Assign qualified personnel to the task of installing, wiring, operating/controlling, inspecting and troubleshooting the cylinder. Failure to do so may result in fire, injury or damage to equipment.
- When setting the data, do so outside the safety cage. Failure to do so may result in injury.
- Take measures to keep the moving part in position if the cylinder is used in vertical operations such as elevating equipment. Failure to do so may result in injury or damage to equipment.
- When an alarm is generated in the driver (any of the driver's protective functions is triggered), take measures to hold the moving part in a specific position since the cylinder stops and loses its holding torque. Failure to do so may result in injury or damage to equipment.
- Install the cylinder inside an enclosure. Failure to do so may result in injury.
- Provide an emergency stop device or emergency stop circuit external to the equipment so that the entire equipment will operate safely in the event of a system failure or malfunction. Failure to do so may result in injury.
- After replacing the driver, set the resolution, traveling direction or other parameters before operating the cylinder. If the cylinder is operated without setting parameters, the ball screw may move to unexpected directions or run at unexpected speeds, causing injury or damage to equipment.

CAUTION

	<ul style="list-style-type: none">• Do not use the cylinder beyond its specifications. Doing so may result in injury or damage to equipment.• Keep your fingers and objects out of the openings in the cylinder. Failure to do so may result in fire or injury.• Do not touch the cylinder during operation or immediately after stopping. Doing so may result in a skin burn(s).• Do not carry the cylinder by holding the moving part or cable. Doing so may cause injury.• Keep the area around the cylinder free of combustible materials. Failure to do so may result in fire or a skin burn(s).• Do not leave anything around the cylinder that would obstruct ventilation. Doing so may result in damage to equipment.• Do not touch the moving part during operation. Doing so may result in injury.• Do not touch the terminals while conducting the insulation resistance measurement or dielectric strength test. Doing so may result in electric shock.• While the cylinder is operated, do not make the cable contact with the moving part. Doing so may result in disconnection in the cable, leading to damage.
	<ul style="list-style-type: none">• Use the cylinder and driver only in the specified combination. Failure to do so may result in fire.• Wear a helmet, safety shoes, gloves or other protective gear when transporting or installing the cylinder. Failure to do so may result in injury.• The motor surface temperature may exceed 70 °C (158 °F) even under normal operating conditions. If the operator is allowed to approach the cylinder in operation, affix a warning label shown in the figure on a conspicuous position. Failure to do so may result in a skin burn(s).  <p>Warning label</p>

3 Precautions for use

This chapter covers restrictions and requirements the user should consider when using the product.

■ General

- **Be sure to use our cable to connect the cylinder and driver.**

Check on the Oriental Motor Website for the model name of cables.

- **Do not detach the load mounting plate or loosen the screws.**

If the load mounting plate is detached or the screws secured the load mounting plate is loosened, the installation accuracy of the ball screw to decrease, resulting in malfunction or shorter service life of the cylinder.

In the case of the cylinder equipped with the **AZ** Series, the home set in the encoder (ABZO sensor) at the time of shipment may be deviated, and this may cause unexpected movements, leading to damage to equipment.

- **When conducting the insulation resistance measurement or the dielectric strength test, be sure to separate the connection between the cylinder and the driver.**

Conducting the insulation resistance measurement or dielectric strength test with the cylinder and driver connected may result in damage to the product.

- **Do not make an impact on the cylinder.**

Do not drop the cylinder. Also, do not hit or strike the cylinder. Making an impact on the cylinder may cause the positioning accuracy to decrease, the cylinder to damage, or the lifetime to reduce.

- **For cylinder with adjusting knob**

Use the adjusting knob to adjust the position manually while the power is turned off. Rotating the adjusting knob by one revolution moves by a lead amount of the ball screw. Adjust the position within the effective stroke range of the cylinder.

Do not touch the adjusting knob during operation. Doing so may cause the cylinder to malfunction or damage.

■ Temperature

- **Use the cylinder equipped with the PKP Series in conditions where the motor surface temperature does not exceed 90 °C (194 °F).**

The motor does not have a function to protect from overheating. The motor surface temperature may exceed 90 °C (194 °F) under certain conditions (ambient temperature, operating speed, duty cycle, etc.). In order to prevent the bearings (ball bearings) of the motor from reaching its usable life quickly, use the motor in conditions where the motor surface temperature does not exceed 90 °C (194 °F).

- **Use the cylinder equipped with the AZ Series in conditions where the motor surface temperature does not exceed 80 °C (176 °F).**

The motor surface temperature may exceed 80 °C (176 °F) under certain conditions (ambient temperature, operating speed, duty cycle, etc.). In order to protect the encoder (ABZO sensor), use the motor in conditions where the motor surface temperature does not exceed 80 °C (176 °F).

If the encoder (ABZO sensor) temperature reaches the upper limit, the motor overheat protection alarm will generate.

- **Operate the cylinder in the range of the operating ambient temperature.**

If the cylinder is used outside of the operating ambient temperature, it may not operate properly.

- **When our home-sensor set is used**

Use our home-sensor set in conditions where the motor surface temperature does not exceed 55 °C (131°F).

■ Operation

- **Set the wiring distance between the cylinder and driver to less than the specification value.**

Set to 10 m (32.8 ft.) or less for the cylinder equipped with the PKP Series and to 20 m (65.6 ft.) or less for the cylinder equipped with the AZ Series.

Exceeding the specification value may cause the thrust to reduce.

- **Holding torque at standstill**

The holding force at standstill for the cylinder is a value when the current cutback function (stop current 50%) is enabled. Note the holding force is reduced in the current cutback state. In addition, turning off the power supply causes the holding force of the cylinder to lose. Make sure a load does not fall.

- **With the cylinder equipped with the AZ Series, do not perform push-motion operation at the speed exceeding the maximum push speed or the maximum push-motion return-to-home speed.**

The mechanical impact may cause damage to the cylinder. If the ball screw was pressed at high speed, take measures by referring to "8 Troubleshooting" on p.41.

- **Do not perform push-motion operation with the cylinder of ball screw lead 1 mm equipped with the AZ Series.**

The TLC output may be turned ON before push-motion operation is complete. (Push-motion return-to-home operation can be performed.)

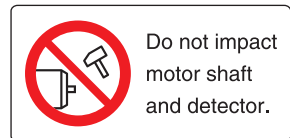
■ Inspection

- **Grease**

Grease on the ball screw or linear guide may darken during the initial operation (one to three weeks). Refer to p.38, and wipe off the dirty grease to apply new grease.

3-1 Note about using the cylinder equipped with the AZ Series

- **Make sure not to hit or apply a strong impact on the encoder (ABZO sensor).**
 - Making a strong impact on an encoder (ABZO sensor) may cause the cylinder malfunction or damage to the encoder (ABZO sensor).
 - When transporting the cylinder or installing a load, handle the cylinder carefully not to make a strong impact on the moving part.
 - The warning label shown in the figure is indicated on the cylinder.



Warning label

- **Do not move the encoder (ABZO sensor) toward a strong magnetic field.**

A magnetic sensor is built into the encoder (ABZO sensor). If the cylinder is installed close to equipment which generates a strong magnetic field, the encoder (ABZO sensor) may break or malfunction. Make sure the environment at transportation and storage as well as the installation location in use. Keep the magnetic flux density on the surface of the encoder (ABZO sensor) so as not to exceed the values in the table.

Model	Magnetic flux density	
	When transporting and storing	When operating
DR28	5 mT	2 mT *

* When the magnetic flux density is exceeding 1 mT and 2 mT or less, use in an environment where the operating ambient temperature is exceeding 20 °C (68 °F) and 40 °C (104 °F) or less.

- **Meshing noise of mechanical sensor**

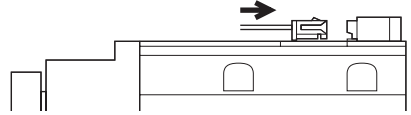
A gear type mechanical sensor is built into the encoder (ABZO sensor). Although the meshing noise of gears may generate, it is not malfunction.

Note the following points when our cable is used.

■ Cylinder equipped with the PKP Series

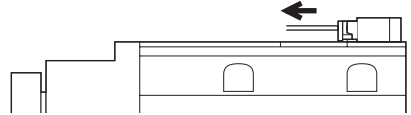
● When inserting the connector

Hold the connector main body, and insert it in straight securely. Inserting the connector in an inclined state may result in damage to connector or a connection failure.



● When pulling out the connector

Pull out the connector in straight. Pulling out the connector with holding the lead wire may result in damage to the connector.



Secure the lead wires at the connection part of the connector to prevent the connector or terminals from receiving stress due to bending or self-weight of lead wires. Also, do not excessively bend the lead wires near the connection part of the connector. Applying stress on the lead wires may cause poor contact or disconnection, leading to malfunction or heat generation.

■ Cylinder equipped with the AZ Series

● When inserting the connector

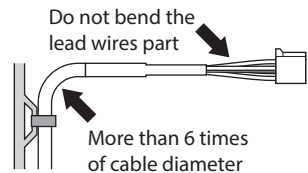
Hold the connector main body, and insert it in straight securely. Inserting the connector in an inclined state may result in damage to terminals or a connection failure.

● When pulling out the connector

Pull out the connector in straight while releasing the lock part of the connector. Pulling out the connector with holding the cable may result in damage to the connector.

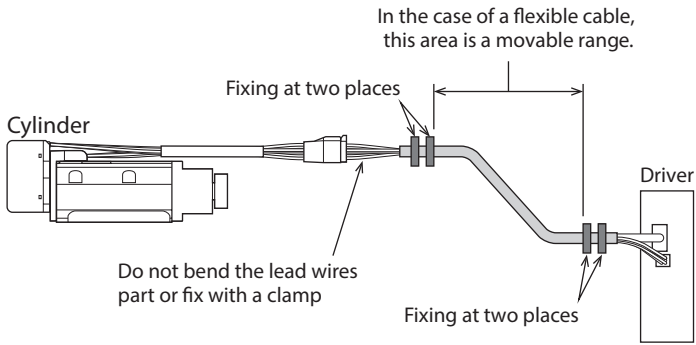
● Bending radius of cable

Use the cable in a state where the bending radius of the cable is more than six times of the cable diameter. Do not bend the lead wires part or fix it with a clamp. Doing so may cause damage to the connector.



● **How to fix the cable**

Fix the cable near the connectors at two places as shown in the figure or fix it with a wide clamp to take measures to prevent stress from being applied to the connectors.



4 Preparation

4-1 Checking the product

Verify that the items listed below are included. Report any missing or damaged items to the Oriental Motor sales office from which you purchased the product.

- Compact motorized cylinder 1 unit
- Instructions and Precautions for Safe Use..... 1 copy

4-2 How to identify the product model

Verify the model name of the purchased against the number shown on the nameplate.

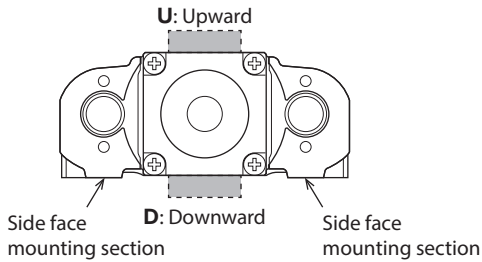
DR 28 G 2.5 BC 03 - P2 A K U
 1 2 3 4 5 6 7 8 9 10

1	Series	DR: DR Series
2	Frame size of the equipped motor	28: 28 mm
3	Type	G: Rod type with guide
4	Ball screw lead	1: 1 mm 2.5: 2.5 mm
5	Ball screw type	A: Rolled ball screw AC: Rolled ball screw with cover B: Precision ball screw BC: Precision ball screw with cover
6	Stroke	03: 30 mm
7	Equipped motor	P2: PKP Series AZ: AZ Series
8	Additional function	A: Blank N: With adjusting knob
9	Motor power supply type	K: DC power supply input
10	Cable outlet direction *	U: Upward direction D: Downward direction

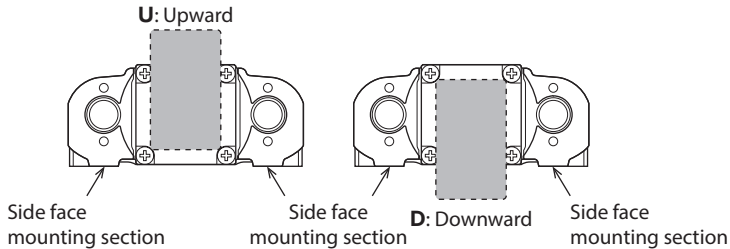
* The cable outlet direction represents the direction as viewed from the opposite side of the ball screw in a state of placing the side face mounting sections downward.

■ Cable outlet direction

● Cylinder equipped with the PKP Series

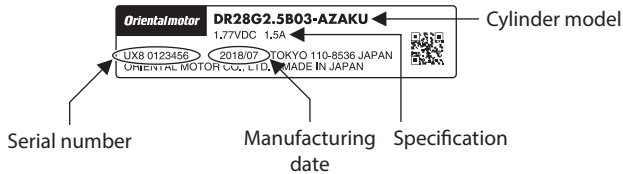


● Cylinder equipped with the AZ Series



4-3 Information about nameplate

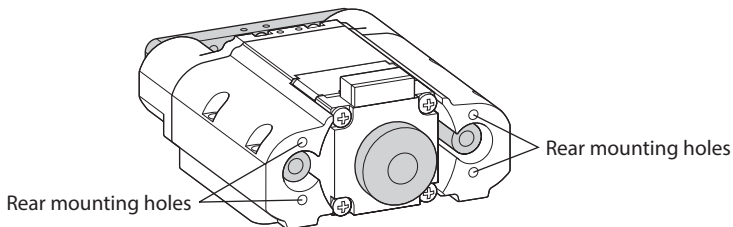
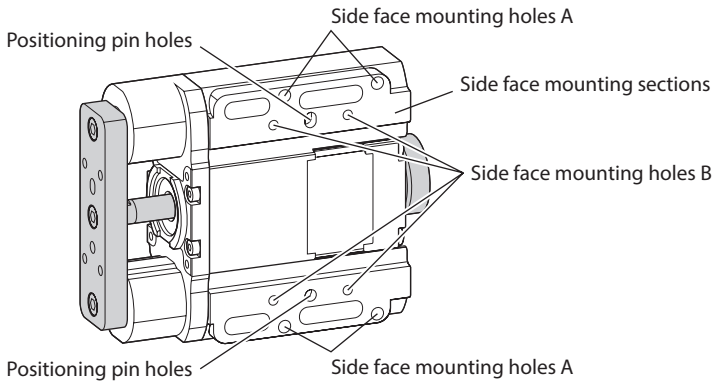
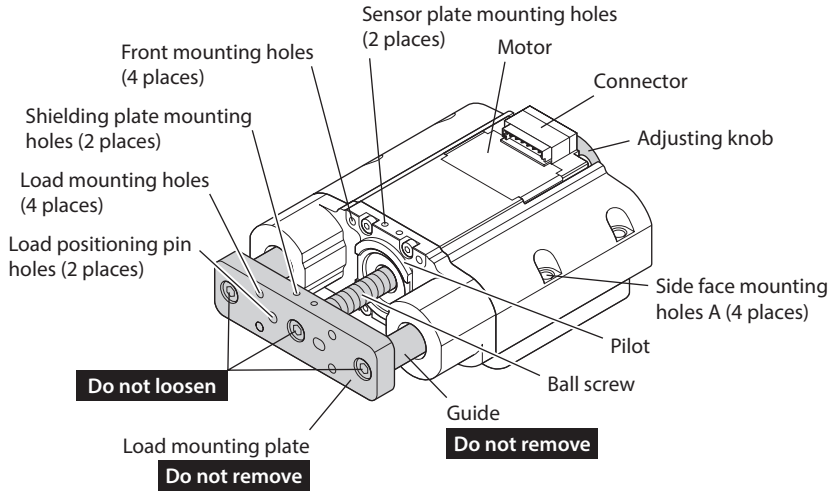
The figure shows an example.



4-4 Names of parts

■ Cylinder equipped with the PKP Series

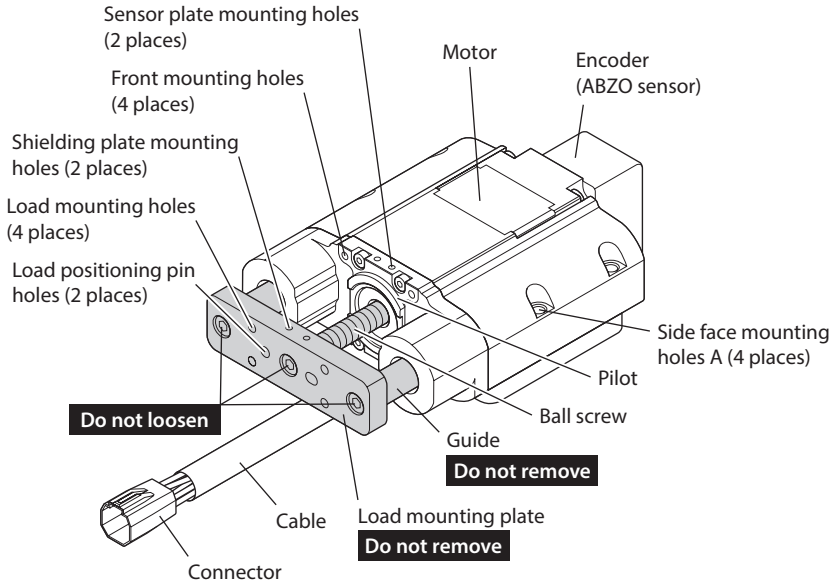
The areas indicated in gray color represents a moving part.
The figure shows the cylinder with adjusting knob.



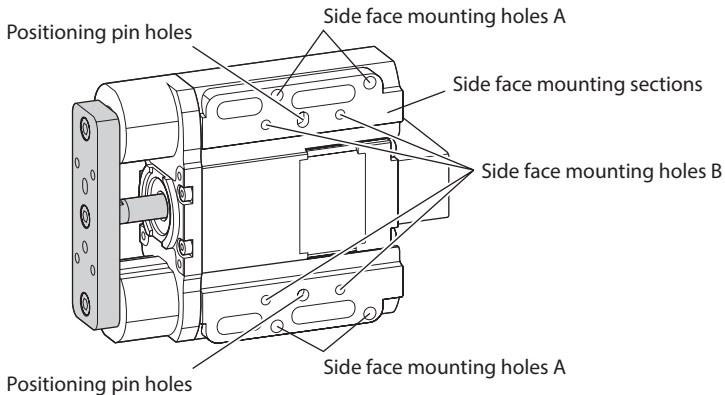
■ Cylinder equipped with the AZ Series

The areas indicated in gray color represents a moving part.

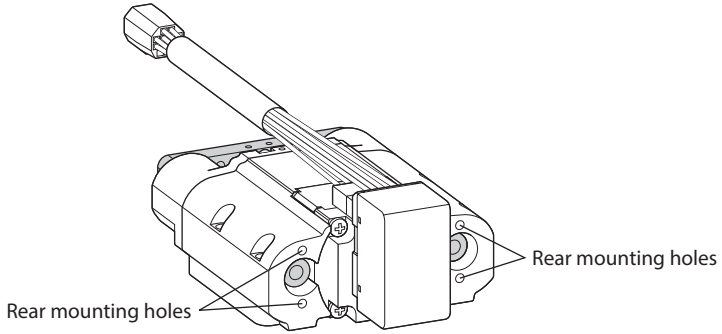
The following figure shows a product which cable outlet direction is downward.



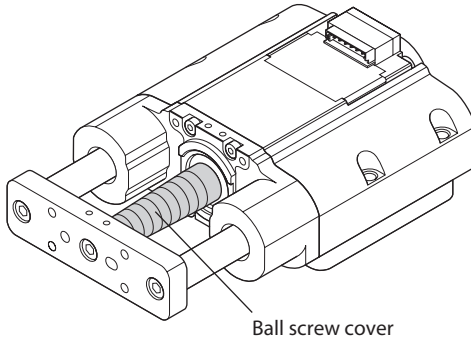
The following figure shows a product which cable outlet direction is upward.



The following figure shows a product which cable outlet direction is upward.



■ With ball screw cover



4-5 Driver for possible combinations

Use the **DR** Series in combination with the drivers shown in the table.

Equipped motor	Driver combination
PKP Series	CVD215BR-K, CVD215B-K, CVD215-K
AZ Series	DC power input driver

5 Installation

5-1 Installation location

The cylinder is designed and manufactured to be incorporated in equipment. Install it in a well-ventilated location that provides easy access for inspection. The location must also satisfy the following conditions:

- Inside an enclosure that is installed indoors (provide vent holes)
- Operating ambient temperature: 0 to +40 °C [+32 to +104 °F] (non-freezing)
- Operating ambient humidity: 85% or less (non-condensing)
- Area free of explosive atmosphere or toxic gas (such as sulfuric gas) or liquid
- Area not exposed to direct sun
- Area free of excessive amount of dust, iron particles or the like
- Area not subject to splashing water (rain, water droplets), oil (oil droplets) or other liquids
- Area free of excessive salt
- Area not subject to continuous vibrations or excessive shocks
- Area free of excessive electromagnetic noise (from welders, power machinery, etc.)
- Area free of radioactive materials, magnetic fields or vacuum
- Up to 1,000 m (3,300 ft.) above sea level

5-2 Installation overview

The cylinder can be installed in any direction.

Install the cylinder onto an appropriate flat mounting plate [thickness approximately 5 mm (0.2 in.) or more] having excellent vibration resistance and heat conductivity. If a high accuracy is required, design the thickness of the plate in consideration of installation conditions such as load condition, rigidity, vibration, and others.

Values of the tightening torque are recommended. Tighten with an appropriate torque according to the design conditions of the mounting plate and load.

The following four methods are available for installation.

- Installation using side face mounting holes A
- Installation using side face mounting holes B
- Installation using rear mounting holes
- Installation using front mounting holes

■ If the cylinder is installed in an environment where a magnetic field is generated

A magnetic sensor is built into the encoder (ABZO sensor). If the cylinder is installed close to equipment which generates a strong magnetic field, the encoder (ABZO sensor) may break or malfunction. Keep the magnetic flux density on the surface of the encoder (ABZO sensor) so as not to exceed the values in the table.

Model	Magnetic flux density
DR28	2 mT *

* When the magnetic flux density is exceeding 1 mT and 2 mT or less, use in an environment where the operating ambient temperature is exceeding 20 °C (68 °F) and 40 °C (104 °F) or less.

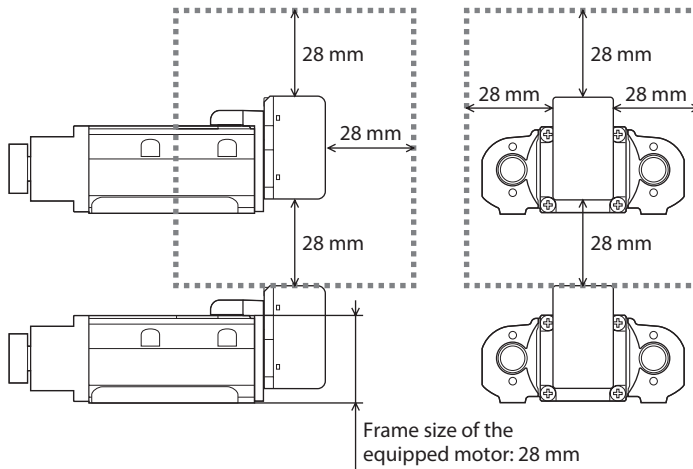


Do not install the cylinder close to equipment which generates a strong magnetic field.

■ Installing the cylinder equipped with the AZ Series

The encoder (ABZO sensor) of the cylinder equipped with the **AZ** Series is easily affected by a magnetic field, so make sure the installation location.

When cylinders are installed side by side, ensure the distance in horizontal and vertical directions among cylinders to be equal to or more than the frame size of the equipped motor.

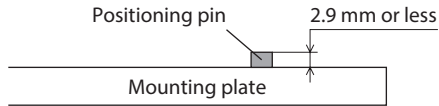


5-4 Installation using side face mounting holes A

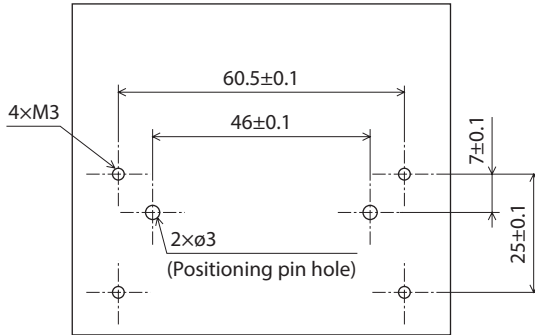
■ Design for mounting plate [Unit: mm]

The following shows the recommended design dimensions of a mounting plate required when the cylinder is installed.

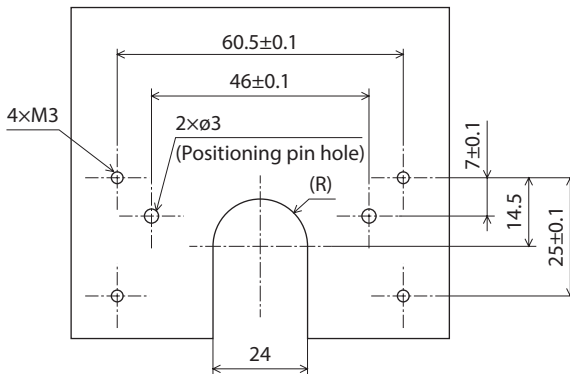
Note When the positioning pins are installed on the mounting plate, the height of the positioning pins should be 2.9 mm or less from the upper surface of the mounting plate. Exceeding 2.9 mm may cause the cylinder to break, leading to injury or mechanical damage.



● When the cable outlet direction is upward



● When the cable outlet direction is downward

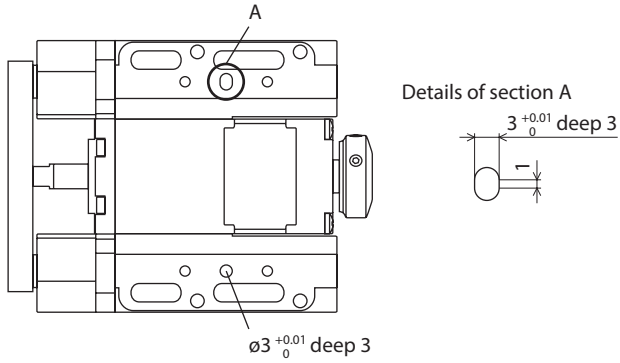


■ Specification of side face mounting holes A

Model	Nominal size	Tightening torque	Depth
DR28	M3	1 N·m (142 oz-in)	18.5 mm

■ Specification of positioning pin holes of cylinder [Unit: mm]

Recommended size of positioning pin: $\varnothing 3 \begin{smallmatrix} 0 \\ -0.01 \end{smallmatrix}$



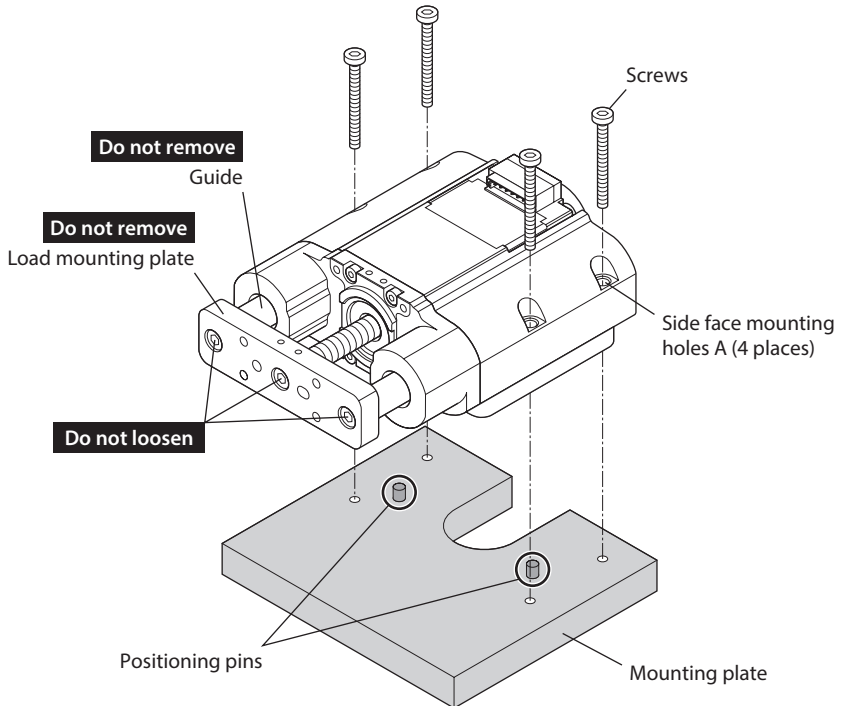
■ Installation method

1. Install the positioning pins on the mounting plate.

Note Be sure to install the positioning pins on the mounting plate. Pressing the positioning pins into the cylinder may cause damage.

memo When a squareness is required with respect to the traveling direction of the load mounting plate, adjust the load mounting plate so that it is perpendicular to the traveling direction using only the round positioning pin hole.

2. Install the cylinder while the positioning pins are inserted into the positioning pin holes of the cylinder, and secure the side face mounting holes A with screws (not included).



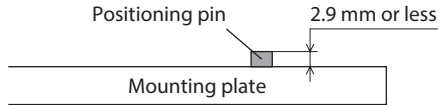
Note Do not detach the load mounting plate or loosen the screws of the load mounting plate. Doing so may decrease the installation accuracy of the ball screw, resulting in malfunction or shorter service life of the cylinder. In the case of the cylinder equipped with the **AZ** Series, the home set in the encoder (ABZO sensor) at the time of shipment may be deviated, and this may cause unexpected movements, leading to damage to equipment.

■ Design for mounting plate [Unit: mm]

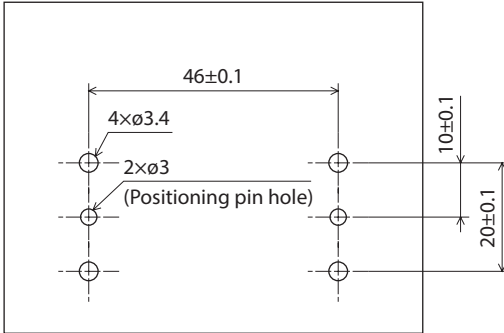
The following shows the recommended design dimensions of a mounting plate required when the cylinder is installed.



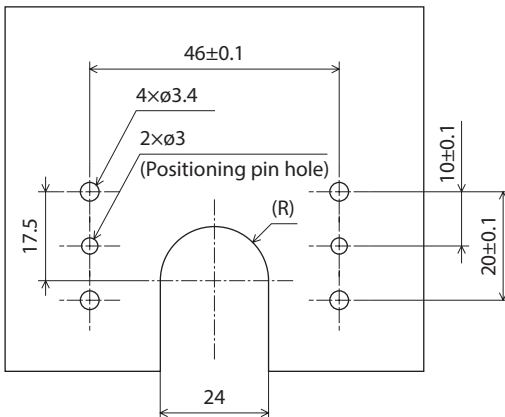
When the positioning pins are installed on the mounting plate, the height of the positioning pins should be 2.9 mm or less from the upper surface of the mounting plate. Exceeding 2.9 mm may cause the cylinder to break, leading to injury or mechanical damage.



● When the cable outlet direction is upward



● When the cable outlet direction is downward

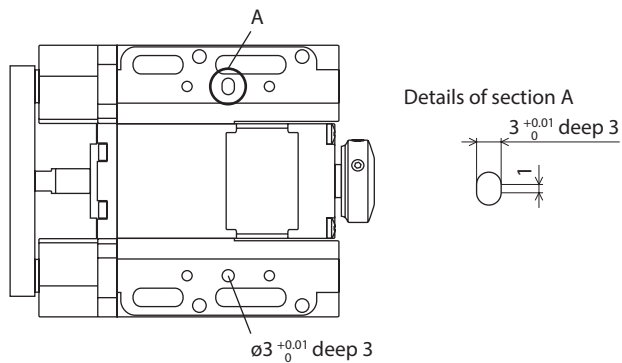


■ Specification of side face mounting holes B

Model	Nominal size	Tightening torque	Effective depth of screw thread
DR28	M3	1 N·m (142 oz-in)	5 mm

■ Specification of positioning pin holes of cylinder [Unit: mm]

Recommended size of positioning pin: $\varnothing 3 \begin{smallmatrix} 0 \\ -0.01 \end{smallmatrix}$



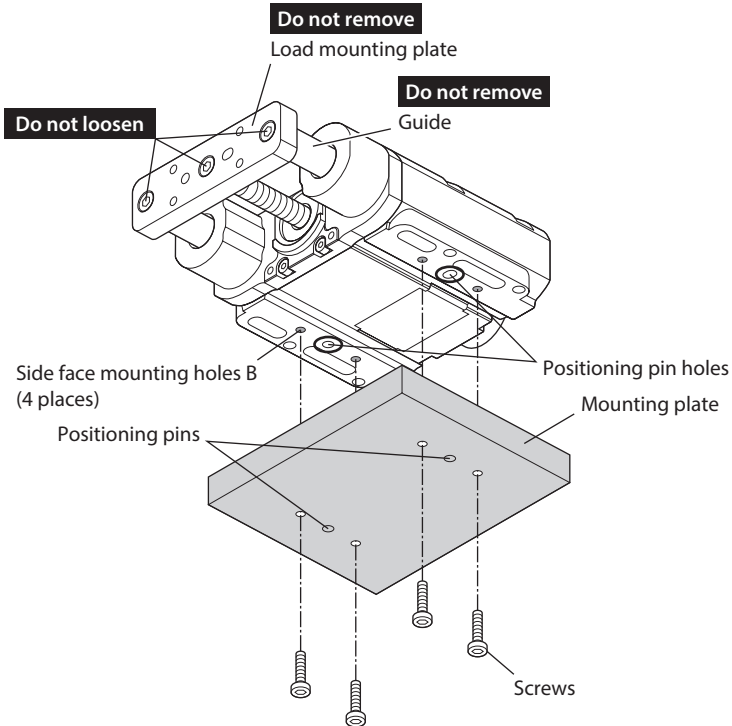
■ Installation method

1. Install the positioning pins on the mounting plate.

Note Be sure to install the positioning pins on the mounting plate. Pressing the positioning pins into the cylinder may cause damage.

memo When a squareness is required with respect to the traveling direction of the load mounting plate, adjust the load mounting plate so that it is perpendicular to the traveling direction using only the round positioning pin hole.

2. Install the cylinder while the positioning pins are inserted into the positioning pin holes of the cylinder, and secure the side face mounting holes B with screws (not included).



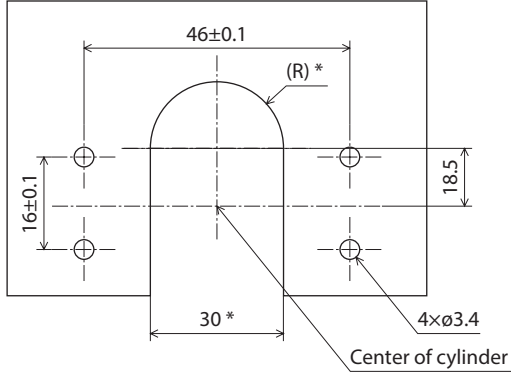
Note Do not detach the load mounting plate or loosen the screws of the load mounting plate. Doing so may decrease the installation accuracy of the ball screw, resulting in malfunction or shorter service life of the cylinder. In the case of the cylinder equipped with the **AZ** Series, the home set in the encoder (ABZO sensor) at the time of shipment may be deviated, and this may cause unexpected movements, leading to damage to equipment.

5-6 Installation using rear mounting holes

■ Design for mounting plate [Unit: mm]

The following shows the recommended design dimensions of a mounting plate required when the cylinder is installed.

Provide a space for passing the encoder (ABZO sensor), the adjusting knob, and the cable to the mounting plate.



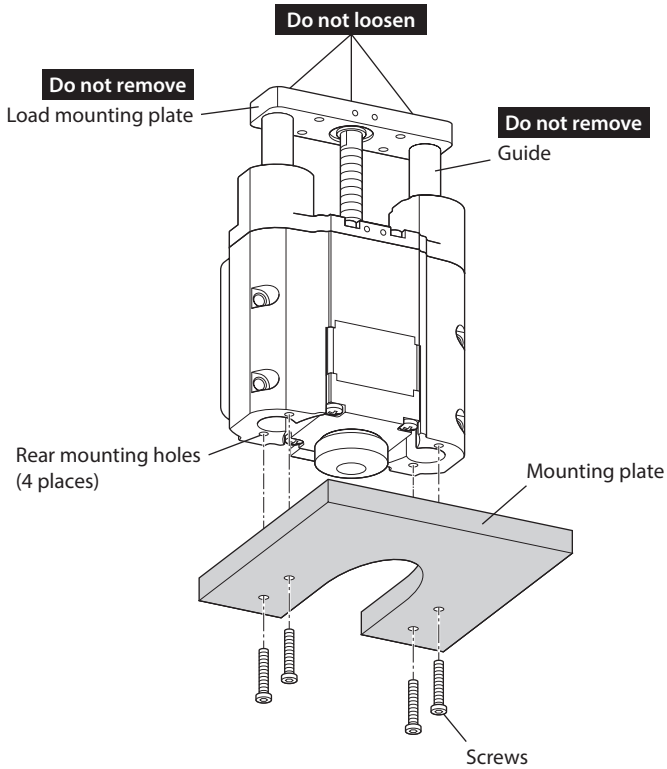
* When the cylinder without adjusting knob equipped with the **PKP** Series is used, it is not required to provide a space for passing.

■ Specifications of rear mounting holes

Model	Nominal size	Tightening torque	Effective depth of screw thread
DR28	M3	1 N·m (142 oz-in)	5 mm

■ Installation method

Install the cylinder on the mounting plate and secure the mounting holes with screws (not included).



Note

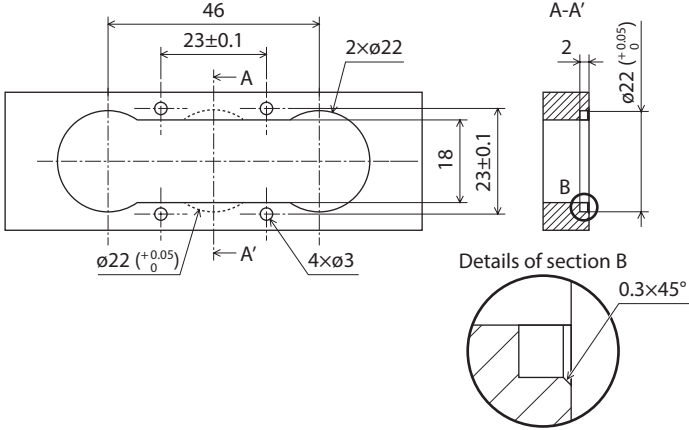
Do not detach the load mounting plate or loosen the screws of the load mounting plate. Doing so may decrease the installation accuracy of the ball screw, resulting in malfunction or shorter service life of the cylinder. In the case of the cylinder equipped with the **AZ** Series, the home set in the encoder (ABZO sensor) at the time of shipment may be deviated, and this may cause unexpected movements, leading to damage to equipment.

5-7 Installation using front mounting holes

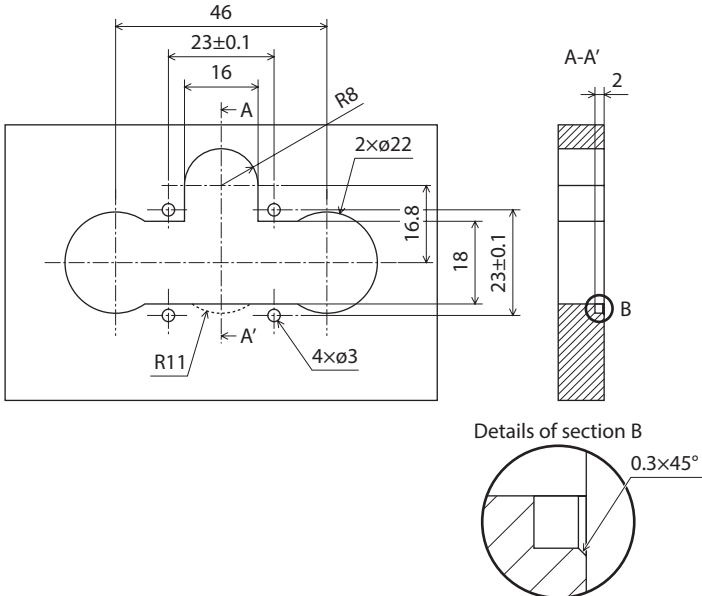
■ Design for mounting plate [Unit: mm]

The following shows the recommended design dimensions of a mounting plate required when the cylinder is installed.

● When no sensor is used



● When using our home-sensor set

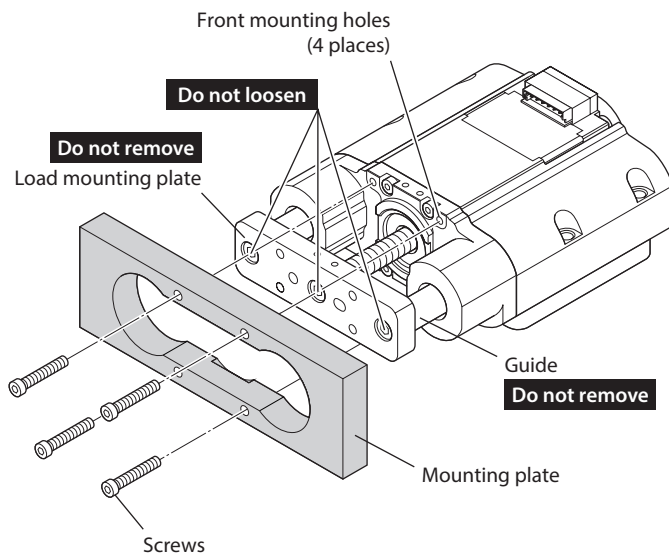


■ Specifications of front mounting holes

Model	Nominal size	Tightening torque	Effective depth of screw thread
DR28	M2.5	0.5 N·m (71 oz-in)	5 mm

■ Installation method

Install the cylinder on the mounting plate and secure the mounting holes with screws (not included).



Note

Do not detach the load mounting plate or loosen the screws of the load mounting plate. Doing so may decrease the installation accuracy of the ball screw, resulting in malfunction or shorter service life of the cylinder. In the case of the cylinder equipped with the **AZ** Series, the home set in the encoder (ABZO sensor) at the time of shipment may be deviated, and this may cause unexpected movements, leading to damage to equipment.

5-8 Installing a load

■ Notes when installing a load

Although the rod type with guide cylinder can receive a load moment, use it less than the specifications. Continuing to operate the cylinder under an excessive load moment may cause malfunction or shorter service life of the cylinder. Check the specifications of the products on p.42.

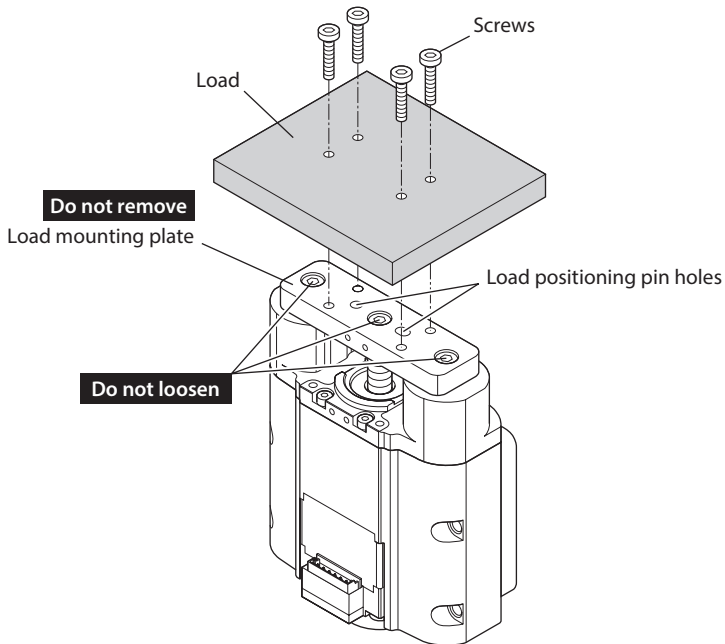
■ Specification of load mounting holes

Model	Nominal size	Tightening torque	Effective depth of screw thread
DR28	M3	1 N·m (142 oz-in)	6 mm

The value in the table is for reference. Use screws according to the material and board thickness of a load, and tighten with a suitable torque.

■ Installation method

1. Retract the ball screw until the load mounting plate stops.
2. Secure the load with screws (not included).



Note

Do not detach the load mounting plate or loosen the screws of the load mounting plate. Doing so may decrease the installation accuracy of the ball screw, resulting in malfunction or shorter service life of the cylinder. In the case of the cylinder equipped with the **AZ** Series, the home set in the encoder (ABZO sensor) at the time of shipment may be deviated, and this may cause unexpected movements, leading to damage to equipment.

■ Load positioning pin holes of load mounting plate

Two types of load-positioning pin holes, which are an elongated hole and a round hole, are provided on the load mounting plate.

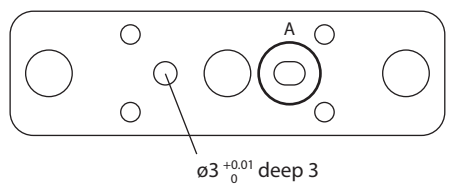
If installation repeatability is required when installing a load, use the load-positioning pin holes.

memo

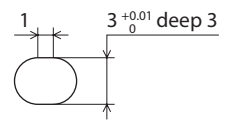
When a squareness is required with respect to the load mounting plate, adjust a load so that it is perpendicular to the load mounting plate using only the round positioning pin hole.

Specification of load positioning pin holes [Unit: mm]

Recommended size of positioning pin: $\phi 3 \begin{smallmatrix} 0 \\ -0.01 \end{smallmatrix}$



Details of section A

**Note**

Be sure to install the positioning pins to the load side. Pressing the positioning pins into the load mounting plate may cause the cylinder break.

5-9 Installing the home-sensor set

Our home-sensor set can be installed for the rod type cylinder with guide.

■ Details of home-sensor set

The following parts are used in the home-sensor set **PADR-SN28G** or **PADR-SP28G**.

Parts	Number of pieces
Sensor Model NPN output: PM-U25 PNP output: PM-U25-P (Panasonic Industrial Devices SUNX Co., Ltd.)	1 pc.
Shielding plate	1 pc.
Sensor plate	1 pc.
M2 screw with washer (for mounting the sensor)	2 pcs.
M2 screw (for mounting the shielding plate and sensor plate)	4 pcs.



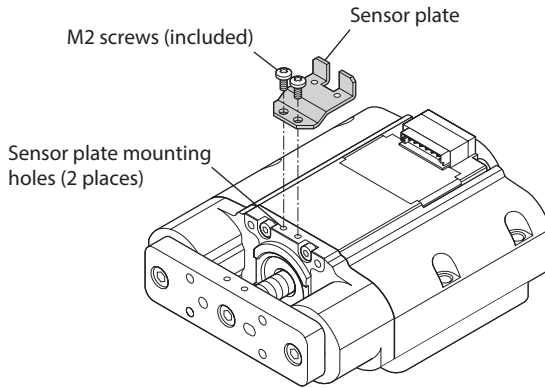
- Use the home-sensor set in conditions where the motor surface temperature does not exceed 55 °C (131 °F).
- Do not install the home-sensor set while the power is being supplied. Doing so may result in injury or damage to equipment.
- When installing the sensor plate and shielding plate to the cylinder, be sure to use the included screws.
- Install the sensor so as not to contact with the shielding plate.



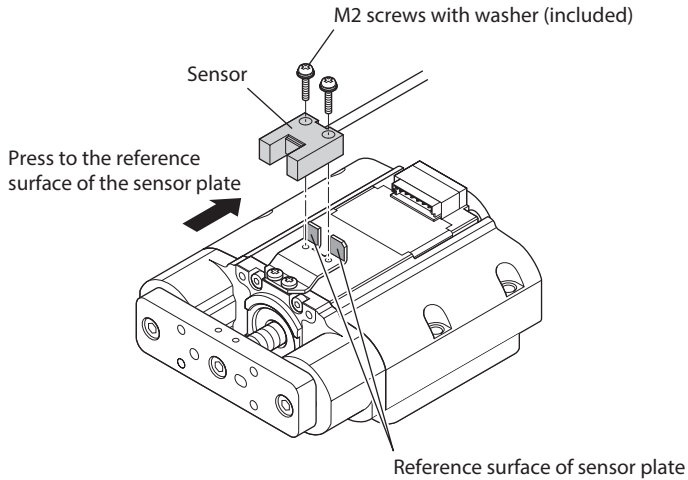
- The sensor has no special means of protection against disturbance light because it is designed to be incorporated in equipment. If the cylinder is to be used under an incandescent lamp or in conditions that are subject to disturbances from external light, provide the means to prevent such interference.
- Use the sensors after confirming that there is no looseness, play or other abnormality due to vibration, impact, etc.
- To prevent malfunctioning due to the adhesion of dust on the sensors, clean and/or replace the sensors regularly.

■ Installation method

1. Secure the sensor plate to the sensor plate mounting hole with M2 screws (included).
Tightening torque: 0.15 N·m (21 oz-in)

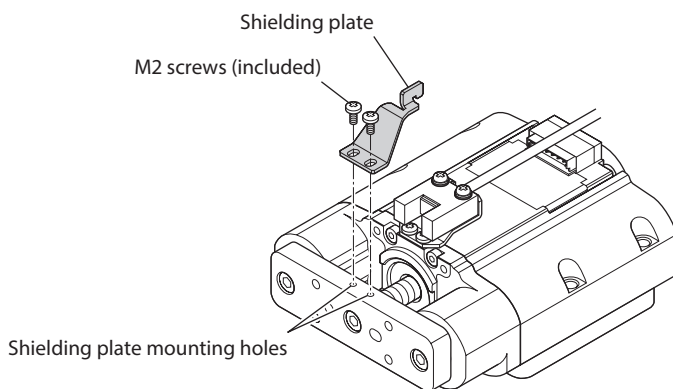


2. Secure the sensor to the sensor plate using M2 screws with washer (included) while pressing the sensor to the reference surface of the sensor plate.
Tightening torque: 0.15 N·m (21 oz-in)



- Secure the shielding plate to the shielding plate mounting hole with M2 screws (included). The position of the shielding plate can be adjusted because elongated holes are provided on the shielding plate. Adjust the installation position of the shielding plate so that the sensor can be detected.

Tightening torque: 0.15 N·m (21 oz-in)



- Connect a power supply to the sensor and check whether it operates properly. The sensor is lit in orange when it does not detect the shielding plate and unlit when detects.

■ Connecting the sensor signal

Use output signals of the sensor at 5 to 24 VDC, 50 mA or less. If the current value exceeds 50 mA, connect an external resistor R.

Output operation can be selected from either ON when light is shielded or ON when light is induced. Use either one of them as appropriate.

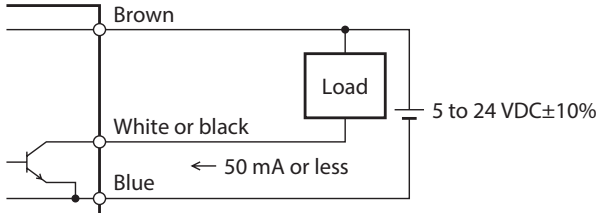
- Output operation turns ON when light is shielded: Connect white lead wire.
- Output operation turns ON when light is induced: Connect black lead wire.

Be sure to insulate the unconnected lead wire.

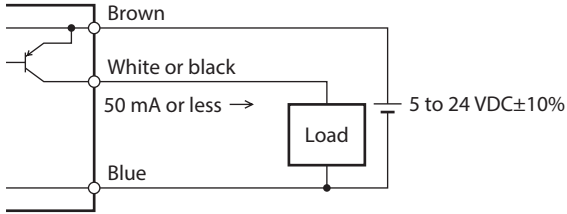


- Wire to separate the sensor lines away from the power lines such as the motor lead wires and cable for motor as far apart as possible. If the sensor lines and power lines have to cross, cross them at a right angle.
- Use a common GND for the sensor and driver. Any difference in GND potential will result in a sensor malfunction.

Connection example for NPN output (PADR-SN28G)



Connection example for PNP output (PADR-SP28G)

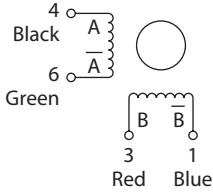


6 Connection

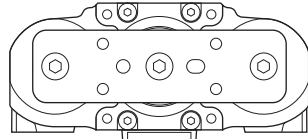
6-1 Cylinder equipped with the PKP Series

Pin Nos. 2 and 5 are not used.

• Wiring connection diagram



• Pin assignments



Pin number → 6 5 4 3 2 1

■ Applicable connector/lead wire

Cylinder model	Type	Model
DR28	Connector housing	51065-0600 (Molex Incorporated)
	Contact	50212-8XXX (Molex Incorporated)
	Designated crimping tool	63819-0500 (Molex Incorporated)
	Applicable lead wire	<ul style="list-style-type: none"> • Diameter of the lead wire: The diameter varies depending on the setting current. <ul style="list-style-type: none"> – When the current value is less than 1 A/phase: AWG28 to 24 (0.08 to 0.2 mm²) – When the current value is 1 A/phase or more: AWG26 to 24 (0.14 to 0.2 mm²) – When the current value is 1.5 A/phase or more: AWG24 (0.2 mm²) • Outer sheath diameter: ø0.8 to 1.4 mm (ø0.031 to 0.055 in.) • Stripping length of wire insulation: 1.3 to 1.8 mm (0.051 to 0.071 in.)

■ Connection with the CVD driver of Oriental Motor

Refer to the table when connecting with the **CVD** driver of Oriental Motor. "Color" in the table shows the colors of lead wires of our connection cable.

CVD driver CN2 Pin No.	Cylinder Pin No.	Color
1	1	Blue
2	3	Red
3	–	–
4	6	Green
5	4	Black

6-2 Cylinder equipped with the AZ Series

Refer to the operating manual of the driver for how to connect with the driver and the wiring distance between the cylinder and driver.

7 Inspection and maintenance

7-1 Maintenance item and timing

If the cylinder is operated eight hours a day, perform maintenance according to the applicable period specified in the table. Reduce maintenance intervals accordingly if the operating rate is high such as continuous operation for twenty-four hours.

Maintenance timing	External inspection	External cleaning	Internal inspection
When operated for the first time	○	○	—
A week after initial operation	○	○	○
Every a month thereafter	○	○	○

■ External inspection

Check the items specified in table.

Item	Inspection item	Remedial action
Cylinder	<ul style="list-style-type: none">• Check if any of the screws having installed the cylinder is loose.• Check if any of the screws having installed a load is loose.	Tighten the screws securely.
Cable, connector	<ul style="list-style-type: none">• Check if a damage or stress is applied on the cable.• Check if the connection part between the cylinder and driver is loose.	<ul style="list-style-type: none">• Replace the cable.• Disconnect and reconnect the connector.
Operation	Check if an unusual noise or vibration is generated from a bearing part (ball bearing).	Check the installation of the load and operation speed.

■ External cleaning

Clean the exterior surface of the cylinder whenever necessary.

- Wipe off any dirt and stains using a soft cloth.
- Do not apply compressed air. Dust may enter from a space, resulting in malfunction.
- To remove stubborn stains, wipe the area using a soft cloth moistened with neutral detergent.
- Do not use petroleum solvents, since they will damage the coated surface.

■ Internal inspection

Visually check the items specified in table. Even if the grease has turned brown, lubrication condition is deemed appropriate if the running surface still appears glossy. Refer to "7-2 Applying grease" for how to apply grease.

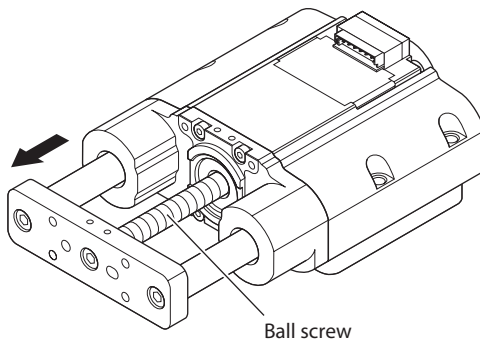
Item	Inspection item	Remedial action
Ball screw	Check if any of foreign objects such as dust is adhered.	Remove the foreign matter.
	Check if the grease has lost its gloss or has been consumed.	Clean the ball screw with a soft cloth and apply grease.
Guide	Check if any of foreign objects such as dust is adhered.	Remove the foreign matter.
	Check if the grease has lost its gloss or has been consumed.	Clean the guide with a soft cloth and apply grease.

7-2 Applying grease

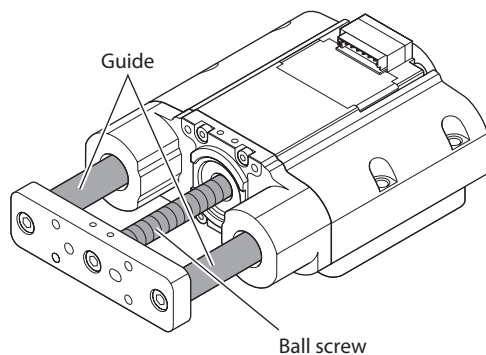


Wear protective goggles when applying grease. Pay attention to safety and handle the grease carefully by following the instructions provided with that product. If grease gets into the eyes or comes in contact with the skin, immediately flush the area thoroughly with water.

1. Turn the ball screw by hand to draw from the motor.
In the case of the cylinder with adjusting knob, draw the ball screw by turning the adjusting knob.



2. Wipe off the old grease and any dirt completely with a soft cloth, and apply new grease to the lubrication places shown in the figure.
Grease to be used : AFC grease (THK CO., LTD.)

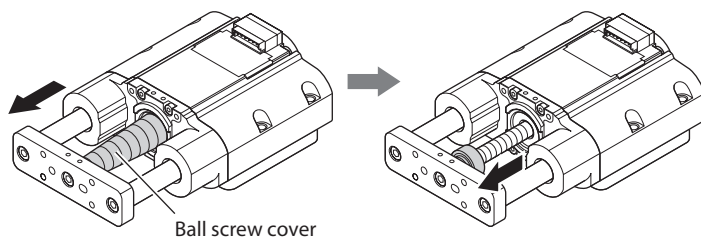


■ For cylinder with ball screw cover

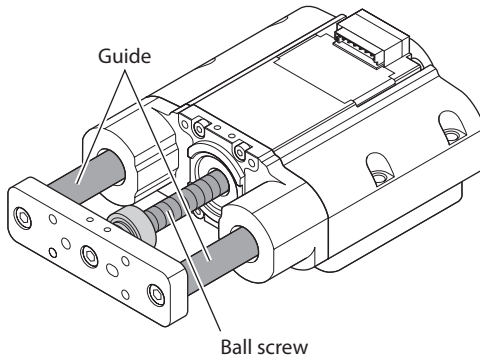
Apply grease to the cylinder with ball screw cover according to the following procedures.

Note Do not touch the ball screw cover with bare hands. Doing so may cut fingers or the like by the ball screw cover.

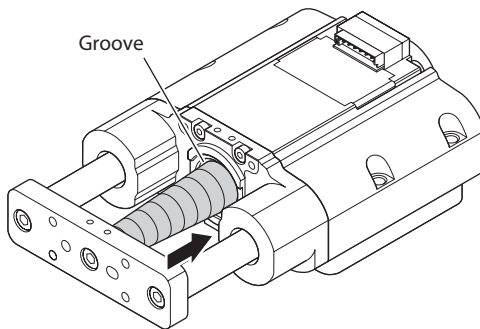
1. Turn the ball screw by hand to draw from the motor.
In the case of the cylinder with adjusting knob, draw the ball screw by turning the adjusting knob.
2. Draw the ball screw cover to the end of the ball screw.



3. Wipe off the old grease and any dirt completely with a soft cloth, and apply new grease to the lubrication places shown in the figure.
Grease to be used : AFC grease (THK CO., LTD.)



4. Return the ball screw cover, and check that it can be fit in the groove inside the pilot section.



7-3 Warranty

Check on the Oriental Motor Website for the product warranty.

7-4 Disposal

Dispose the product correctly in accordance with laws and regulations, or instructions of local governments.

8 Troubleshooting

During cylinder operation, the cylinder may fail to function properly due to an improper setting or wiring. When the cylinder cannot be operated properly, refer to the contents provided in this section and take an appropriate action. If the problem persists, contact your nearest Oriental Motor sales office.

Phenomenon	Possible cause	Remedial action
The ball screw does not move with being jammed.	The ball screw was hit against an object to stop.	Return the ball screw at the recommended starting speed shown in the table next. After that, check the following items. If the ball screw does not return, remove the load. <ul style="list-style-type: none"> • Is the screw for mounting a load come loose? • Are the ball screw and the load damaged? • Are the positions of the home displaced? • Is the mounting accuracy changed?
The ball screw does not operate at the command speed.	The thrust of the cylinder is not enough against a load.	Reconsider the load.
Malfunction of cylinder.	A load moment exceeding the specification value is applied.	Use the cylinder with a load moment of the specification value or smaller.
The thrust of the cylinder has lowered.	The wiring distance is exceeded the specification value.	Set the distance between the cylinder and driver within the specification value. Cylinder equipped with the PKP Series: 10 m (32.8 ft.) or less Cylinder equipped with the AZ Series: 20 m (65.6 ft.) or less
	The viscosity of the grease was changed.	Refer to "9-2 General specifications" on p.45, and check the operating ambient temperature.

Recommended starting speed

Model	Lead	Recommended starting speed
DR28	1 mm	0.2 mm/s
	2.5 mm	0.5 mm/s

9 Specifications

9-1 Product specifications

- The box (■) in the model name indicates **A** (without additional function) or **N** (with adjusting knob).
- The box (□) in the model name indicates **U** (upward direction) or **D** (downward direction) representing the cable outlet direction.

Cylinder model		Cylinder equipped with the PKP Series	
		DR28G2.5B03-P2■K□ DR28G2.5BC03-P2■K□	
Ball screw lead [mm]		2.5	
Ball screw type		Precision	
Repetitive positioning accuracy [mm]		±0.005	
Lost motion [mm]		0.05 or less	
Minimum travel amount [mm]		0.0125 *1	
Permissible moment [N·m] *2	Static permissible moment Dynamic permissible moment	M _p : 0.15 M _v : 0.15 M _R : 0.1	
Transportable mass [kg]		Horizontal	0.2 (4) *3
		Vertical	2
Thrust [N]		20	
Push force [N]		–	
Holding force [N]		20	
Stroke [mm]		30	
Maximum speed [mm/s] *4		100	
Maximum acceleration [m/s ²]		0.5	
Rated current [A/phase]		1.5	
Voltage [V]		1.77	
Winding resistance [Ω/phase]		1.18	
Connection method		Bipolar	
Inductance [mH/phase]		0.76±20%	

*1 When the base step angle is 1.8°/step.

*2 Ensure a load is below the value of the thrust.

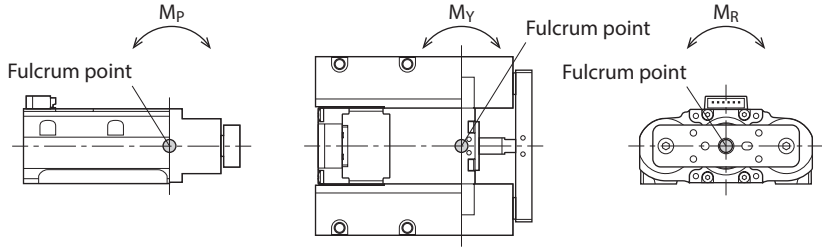
*3 The value in parentheses () indicates the specification when a linear guide is externally used in combination.

*4 The maximum speed may decrease depending on the ambient temperature or the connection cable length.

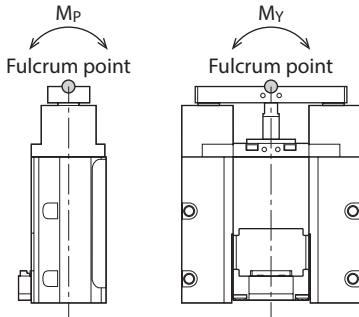
Cylinder equipped with the **AZ** Series

DR28G1A03-AZAK□ DR28G1AC03-AZAK□	DR28G1B03-AZAK□ DR28G1BC03-AZAK□	DR28G2.5B03-AZAK□ DR28G2.5BC03-AZAK□
1	1	2.5
Rolled	Precision	Precision
±0.01	±0.005	±0.005
0.05 or less	0.02 or less	0.02 or less
0.001	0.001	0.001
MP: 0.15 M _Y : 0.15 M _R : 0.1	MP: 0.15 M _Y : 0.15 M _R : 0.1	MP: 0.15 M _Y : 0.15 M _R : 0.1
0.2 (4) *3	0.2 (4) *3	0.2 (4) *3
4	4	2
40	40	20
–	–	50
40	40	20
30	30	30
40	40	100
0.2	0.2	0.5
–	–	–
–	–	–
–	–	–
–	–	–
–	–	–

● Permissible moment (Horizontal direction)

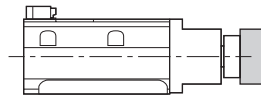


● Permissible moment (Vertical direction)

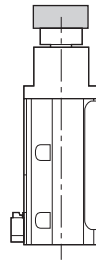


● Transportable mass

• Horizontal direction



• Vertical direction



Operating environment	Ambient temperature	0 to +40 °C [+32 to +104 °F] (non-freezing)
	Ambient humidity	85 % or less (non-condensing)
	Altitude	Up to 1,000 m (3,300 ft.) above sea level
	Surrounding atmosphere	No corrosive gas, dust, water or oil
Storage environment, Shipping environment	Ambient temperature	-20 to +60 °C [-4 to +140 °F] (non-freezing)
	Ambient humidity	85 % or less (non-condensing)
	Altitude	Up to 3,000 m (10,000 ft.) above sea level
	Surrounding atmosphere	No corrosive gas, dust, water or oil
Noise level		70 dB (A) or less
Heat resistance class		130 (B)
Insulation resistance		100 M Ω or more when 500 VDC megger is applied between the following places: <ul style="list-style-type: none"> • Case - Motor windings
Dielectric strength		Sufficient to withstand the following for 1 minute. <ul style="list-style-type: none"> • Case - Motor windings 0.5 kVAC 50 Hz or 60 Hz

10 Regulations and standards

10-1 CE Marking/UKCA Marking

■ EU EMC Directive/UK EMC Regulation

The driver combining with the actuator is affixed the marks under the EMC. For details about applicable standards and others, check with the operating manual of the driver.

10-2 EU RoHS Directive/UK RoHS Regulation

This product does not contain the substances exceeding the restriction values.

10-3 Machinery Directive

The cylinder and driver are designed and manufactured to be incorporated in general industrial equipment, and a Declaration of Incorporation of Partly Completed Machinery is issued with them according to the Machinery Directive.

Applicable Standards: EN ISO 12100

11 Accessory

■ Home-sensor set

These are sensor sets for the return to home operation.

Model	Sensor output
PADR-SN28G	NPN
PADR-SP28G	PNP

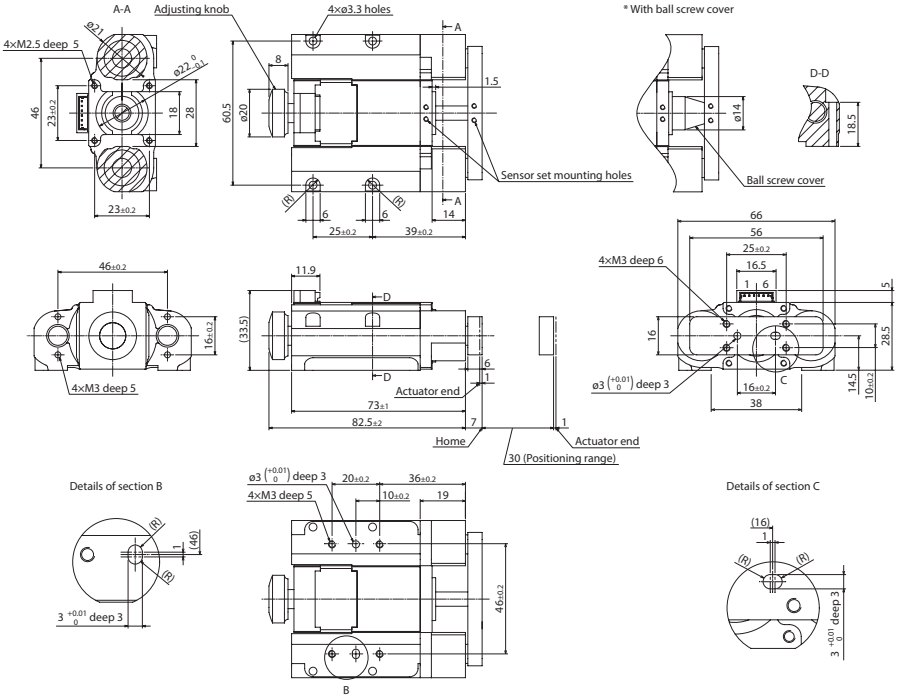
12 Dimension

■ Cylinder equipped with the PKP Series [Unit: mm]

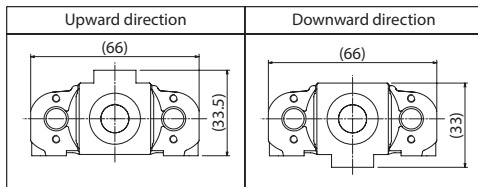
The box (□) in the model name indicates **U** (upward direction) or **D** (downward direction) representing the cable outlet direction.

The dimension shows the cylinder with adjusting knob.

Model	Mass [kg (oz.)]
DR28G2.5B03-P2AK□ DR28G2.5B03-P2NK□ DR28G2.5BC03-P2AK□ DR28G2.5BC03-P2NK□	0.4 (14.1)



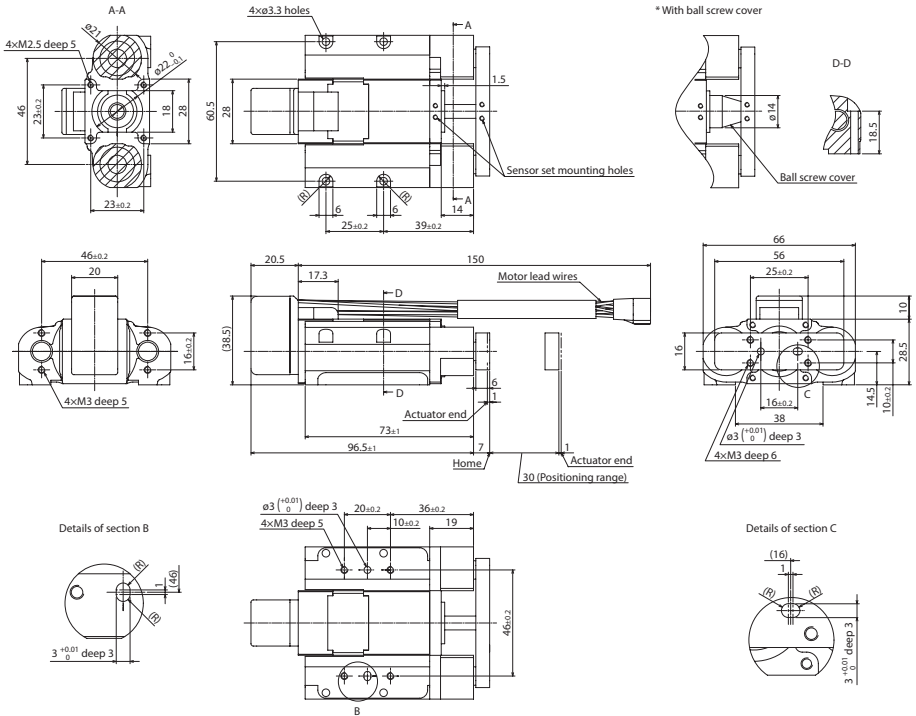
● Cable outlet direction



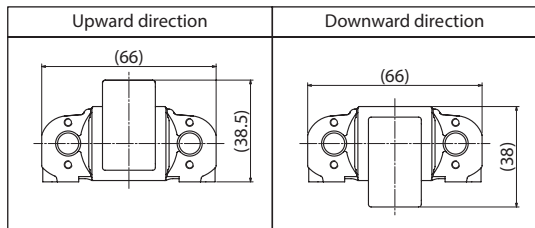
■ Cylinder equipped with the AZ Series [Unit: mm]

The box (□) in the model name indicates **U** (upward direction) or **D** (downward direction) representing the cable outlet direction.

Model	Mass [kg (oz.)]
DR28G1A03-AZAK□	0.43 (15.2)
DR28G1AC03-AZAK□	
DR28G1B03-AZAK□	
DR28G1BC03-AZAK□	
DR28G2.5B03-AZAK□	
DR28G2.5BC03-AZAK□	



● Cable outlet direction



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