ROBO CYLINDER

Thin and Small ROBO Cylinder
Mini Cylinder
RCD Actuator
Operation Manual

Second Edition

Rod Type RA1D, RA1DA

IAI America, Inc.

ROBO CYLINDER

Please Read Before Use

Thank you for purchasing our product.

This Operation Manual explains the handling methods, structure and maintenance of this product, among others, providing the information you need to know to use the product safely.

Before using the product, be sure to read this manual and fully understand the contents explained herein to ensure safe use of the product.
The CD/DVD that comes with the product contains operation manuals for IAI products.
When using the product, refer to the necessary portions of the applicable operation manual by printing them out or displaying them on a PC.

After reading the Operation Manual, keep it in a convenient place so that whoever is handling this product can reference it quickly when necessary.

[Important]

- This Operation Manual is original.
- The product cannot be operated in any way unless expressly specified in this Operation Manual. IAI shall assume no responsibility for the outcome of any operation not specified herein.
- Information contained in this Operation Manual is subject to change without notice for the purpose of product improvement.
- If you have any question or comment regarding the content of this manual, please contact the IAI sales office near you.
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Safety Guide

"Safety Guide" has been written to use the machine safely and so prevent personal injury or property damage beforehand. Make sure to read it before the operation of this product.

Safety Precautions for Our Products

The common safety precautions for the use of any of our robots in each operation.

No.	Operation Description	Description
1	Model Selection	● This product has not been planned and designed for the application where high level of safety is required, so the guarantee of the protection of human life is impossible. Accordingly, do not use it in any of the following applications. 1) Medical equipment used to maintain, control or otherwise affect human life or physical health. 2) Mechanisms and machinery designed for the purpose of moving or transporting people (For vehicle, railway facility or air navigation facility) 3) Important safety parts of machinery (Safety device, etc.) ● Do not use the product outside the specifications. Failure to do so may considerably shorten the life of the product. ● Do not use it in any of the following environments. 1) Location where there is any inflammable gas, inflammable object or explosive 2) Place with potential exposure to radiation 3) Location with the ambient temperature or relative humidity exceeding the specification range 4) Location where radiant heat is added from direct sunlight or other large heat source 5) Location where condensation occurs due to abrupt temperature changes 6) Location where there is any corrosive gas (sulfuric acid or hydrochloric acid) 7) Location exposed to significant amount of dust, salt or iron powder 8) Location subject to direct vibration or impact ● For an actuator used in vertical orientation, select a model which is equipped with a brake. If selecting a model with no brake, the moving part may drop when the power is turned OFF and may cause an accident such as an injury or damage on the work piece.

No.	Operation Description	Description
2	Transportation	● When carrying a heavy object, do the work with two or more persons or utilize equipment such as crane. ● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● When in transportation, consider well about the positions to hold, weight and weight balance and pay special attention to the carried object so it would not get hit or dropped. ● Transport it using an appropriate transportation measure. The actuators available for transportation with a crane have eyebolts attached or there are tapped holes to attach bolts. Follow the instructions in the operation manual for each model. ● Do not step or sit on the package. ● Do not put any heavy thing that can deform the package, on it. ● When using a crane capable of 1t or more of weight, have an operator who has qualifications for crane operation and sling work. ● When using a crane or equivalent equipments, make sure not to hang a load that weighs more than the equipment's capability limit. ● Use a hook that is suitable for the load. Consider the safety factor of the hook in such factors as shear strength. ● Do not get on the load that is hung on a crane. ● Do not leave a load hung up with a crane. ● Do not stand under the load that is hung up with a crane.
3	Storage and Preservation	● The storage and preservation environment conforms to the installation environment. However, especially give consideration to the prevention of condensation. ● Store the products with a consideration not to fall them over or drop due to an act of God such as earthquake.
4	Installation and Start	(1) Installation of Robot Main Body and Controller, etc. ● Make sure to securely hold and fix the product (including the work part). A fall, drop or abnormal motion of the product may cause a damage or injury. Also, be equipped for a fall–over or drop due to an act of God such as earthquake. ● Do not get on or put anything on the product. Failure to do so may cause an accidental fall, injury or damage to the product due to a drop of anything, malfunction of the product, performance degradation, or shortening of its life. ● When using the product in any of the places specified below, provide a sufficient shield. 1) Location where electric noise is generated 2) Location where high electrical or magnetic field is present 3) Location with the mains or power lines passing nearby 4) Location where the product may come in contact with water, oil or chemical droplets

No.	Operation Description	Description
4	Installation and Start	(2) Cable Wiring ● Use our company's genuine cables for connecting between the actuator and controller, and for the teaching tool. ● Do not scratch on the cable. Do not bend it forcibly. Do not pull it. Do not coil it around. Do not insert it. Do not put any heavy thing on it. Failure to do so may cause a fire, electric shock or malfunction due to leakage or continuity error. ● Perform the wiring for the product, after turning OFF the power to the unit, so that there is no wiring error. ● When the direct current power (+24V) is connected, take the great care of the directions of positive and negative poles. If the connection direction is not correct, it might cause a fire, product breakdown or malfunction. ● Connect the cable connector securely so that there is no disconnection or looseness. Failure to do so may cause a fire, electric shock or malfunction of the product. ● Never cut and/or reconnect the cables supplied with the product for the purpose of extending or shortening the cable length. Failure to do so may cause the product to malfunction or cause fire.
		(3) Grounding ● The grounding operation should be performed to prevent an electric shock or electrostatic charge, enhance the noise−resistance ability and control the unnecessary electromagnetic radiation. ● For the ground terminal on the AC power cable of the controller and the grounding plate in the control panel, make sure to use a twisted pair cable with wire thickness 0.5mm^2 (AWG20 or equivalent) or more for grounding work. For security grounding, it is necessary to select an appropriate wire thickness suitable for the load. Perform wiring that satisfies the specifications (electrical equipment technical standards). ● Perform Class D Grounding (former Class 3 Grounding with ground resistance 100Ω or below).

No.	Operation Description	Description
4	Installation and Start	(4) Safety Measures ● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● When the product is under operation or in the ready mode, take the safety measures (such as the installation of safety and protection fence) so that nobody can enter the area within the robot's movable range. When the robot under operation is touched, it may result in death or serious injury. ● Make sure to install the emergency stop circuit so that the unit can be stopped immediately in an emergency during the unit operation. ● Take the safety measure not to start up the unit only with the power turning ON. Failure to do so may start up the machine suddenly and cause an injury or damage to the product. ● Take the safety measure not to start up the machine only with the emergency stop cancellation or recovery after the power failure. Failure to do so may result in an electric shock or injury due to unexpected power input. ● When the installation or adjustment operation is to be performed, give clear warnings such as "Under Operation; Do not turn ON the power!" etc. Sudden power input may cause an electric shock or injury. ● Take the measure so that the work part is not dropped in power failure or emergency stop. ● Wear protection gloves, goggle or safety shoes, as necessary, to secure safety. ● Do not insert a finger or object in the openings in the product. Failure to do so may cause an injury, electric shock, damage to the product or fire. ● When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity.
5	Teaching	● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● Perform the teaching operation from outside the safety protection fence, if possible. In the case that the operation is to be performed unavoidably inside the safety protection fence, prepare the "Stipulations for the Operation" and make sure that all the workers acknowledge and understand them well. ● When the operation is to be performed inside the safety protection fence, the worker should have an emergency stop switch at hand with him so that the unit can be stopped any time in an emergency. ● When the operation is to be performed inside the safety protection fence, in addition to the workers, arrange a watchman so that the machine can be stopped any time in an emergency. Also, keep watch on the operation so that any third person can not operate the switches carelessly. ● Place a sign "Under Operation" at the position easy to see. ● When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity. * Safety protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.

No.	Operation Description	Description
6	Trial Operation	● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● After the teaching or programming operation, perform the check operation one step by one step and then shift to the automatic operation. ● When the check operation is to be performed inside the safety protection fence, perform the check operation using the previously specified work procedure like the teaching operation. ● Make sure to perform the programmed operation check at the safety speed. Failure to do so may result in an accident due to unexpected motion caused by a program error, etc. ● Do not touch the terminal block or any of the various setting switches in the power ON mode. Failure to do so may result in an electric shock or malfunction.
7	Automatic Operation	● Check before starting the automatic operation or rebooting after operation stop that there is nobody in the safety protection fence. ● Before starting automatic operation, make sure that all peripheral equipment is in an automatic−operation−ready state and there is no alarm indication. ● Make sure to operate automatic operation start from outside of the safety protection fence. ● In the case that there is any abnormal heating, smoke, offensive smell, or abnormal noise in the product, immediately stop the machine and turn OFF the power switch. Failure to do so may result in a fire or damage to the product. ● When a power failure occurs, turn OFF the power switch. Failure to do so may cause an injury or damage to the product, due to a sudden motion of the product in the recovery operation from the power failure.

No.	Operation Description	Description
8	Maintenance and Inspection	● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● Perform the work out of the safety protection fence, if possible. In the case that the operation is to be performed unavoidably inside the safety protection fence, prepare the “Stipulations for the Operation” and make sure that all the workers acknowledge and understand them well. ● When the work is to be performed inside the safety protection fence, basically turn OFF the power switch. ● When the operation is to be performed inside the safety protection fence, the worker should have an emergency stop switch at hand with him so that the unit can be stopped any time in an emergency. ● When the operation is to be performed inside the safety protection fence, in addition to the workers, arrange a watchman so that the machine can be stopped any time in an emergency. Also, keep watch on the operation so that any third person can not operate the switches carelessly. ● Place a sign “Under Operation” at the position easy to see. ● For the grease for the guide or ball screw, use appropriate grease according to the Operation Manual for each model. ● Do not perform the dielectric strength test. Failure to do so may result in a damage to the product. ● When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity. ● The slider or rod may get misaligned OFF the stop position if the servo is turned OFF. Be careful not to get injured or damaged due to an unnecessary operation. ● Pay attention not to lose the cover or untightened screws, and make sure to put the product back to the original condition after maintenance and inspection works. Use in incomplete condition may cause damage to the product or an injury. * Safety protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.
9	Modification and Dismantle	● Do not modify, disassemble, assemble or use of maintenance parts not specified based at your own discretion.
10	Disposal	● When the product becomes no longer usable or necessary, dispose of it properly as an industrial waste. ● When removing the actuator for disposal, pay attention to drop of components when detaching screws. ● Do not put the product in a fire when disposing of it. The product may burst or generate toxic gases.
11	Other	● Do not come close to the product or the harnesses if you are a person who requires a support of medical devices such as a pacemaker. Doing so may affect the performance of your medical device. ● See Overseas Specifications Compliance Manual to check whether complies if necessary. ● For the handling of actuators and controllers, follow the dedicated operation manual of each unit to ensure the safety.

Alert Indication

The safety precautions are divided into “Danger”, “Warning”, “Caution” and “Notice” according to the warning level, as follows, and described in the Operation Manual for each model.

Level	Degree of Danger and Damage	Symbol
Danger	This indicates an imminently hazardous situation which, if the product is not handled correctly, will result in death or serious injury.	 Danger
Warning	This indicates a potentially hazardous situation which, if the product is not handled correctly, could result in death or serious injury.	 Warning
Caution	This indicates a potentially hazardous situation which, if the product is not handled correctly, may result in minor injury or property damage.	 Caution
Notice	This indicates lower possibility for the injury, but should be kept to use this product properly.	 Notice

Caution in Handling

1. Do not set speeds and accelerations/decelerations equal to or greater than the respective ratings.
   If the actuator is operated at a speed or acceleration/deceleration exceeding the allowable value, abnormal noise or vibration, failure, or shorter life may result.
   In the case of interpolated operation of combined axes, the speed and acceleration/deceleration settings should correspond to the minimum values among all combined axes.

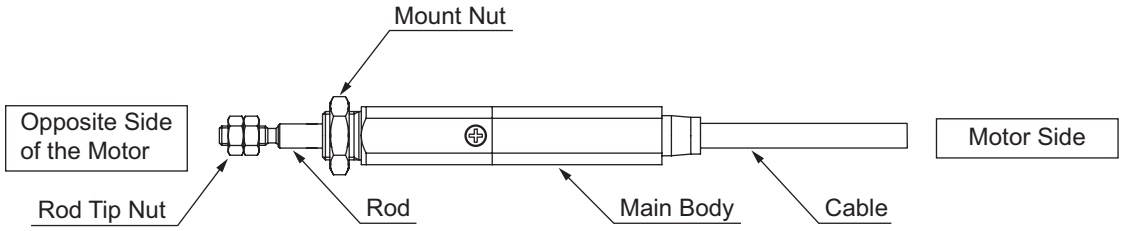
2. In the case of moving it in low speed, the difference of the speed grows.
   In the case of moving it with 10mm/s or less, note that the difference of the speed grows in addition.

3. When operating, the main body is likely to become a high temperature though.

> ⚠ Warning: When operating, the temperature of the main body is likely to become a high temperature though.
> Note that you may get burned and injured if you touch the actuator.

Names of the Parts

In this Operation Manual, the left and right sides are indicated by looking at the actuator from the motor end, with the actuator placed horizontally, as shown in the figure below.



1. Product Check

If based on a standard configuration, this product consists of the items listed below.

> ⚠ Caution: Check the packed items against the packing specification. Should you find a wrong model or any missing item, please contact your IAI dealer or IAI.

1.1 Parts

No.	Name	Model number	Remarks
1	Actuator	Refer to “How to Read the Model Nameplate” and “How to Read the Model Number.”	
Accessories			
2	Motor • Encoder Cables *1		
3	Nut		Refer to list below
4	First Step Guide		
5	Operation Manual (CD/DVD)		
6	Safety Guide		

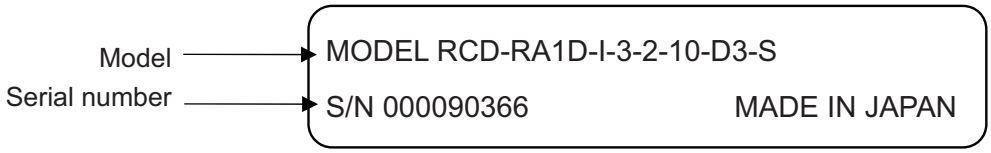
*1 Refer to “9. Motor • Encoder Cables” for the enclosed motor • encoder cables.

Type	Attachment Nut (M10 × 1.0)	Rod Tip Nut (M4 × 0.7)
RA1D, RA1DA	1	2

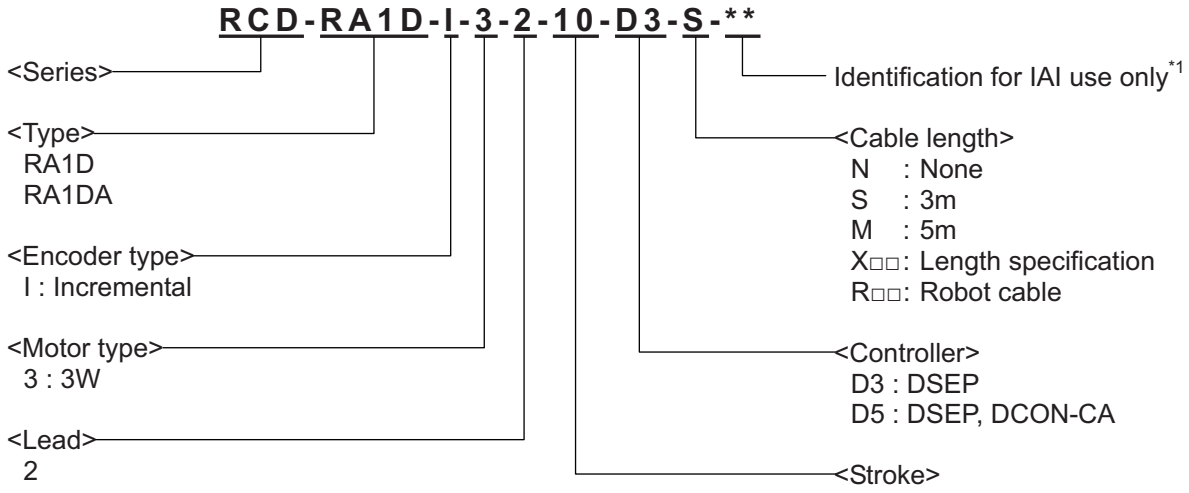
1.2 Related Operation Manuals for the Each Controller Supported by this Product

No.	Name	Control No.
1	ASEP/PSEP/DSEP Controller Operation Manual	ME0267
2	ACON-CA/DCON-CA Controller Operation Manual	ME0326
3	RC PC Software RCM-101-MW/RCM-101-USB Operation Manual	ME0155
4	CON-PTA/PDA/PGA Operation Manual	ME0295
5	Touch Panel Teaching Pendant TB-01/01D/01DR Operation Manual (Applicable for Position Controller)	ME0324

1.3 How to Read the Model Nameplate



1.4 How to Read the Model Number



*1 This may be displayed for the manufacturing reason.
(This is not to indicate the manufacturing model code.)

2. Specification

(1) Maximum Speed
The maximum speed of the actuator is limited to prevent resonance of the lead screw shaft by the motor speed limit.
Be sure to observe the applicable maximum speed shown in the table below.

Strokes and maximum speed limits (Unit: mm/s)

Type	Motor Type [W]	Lead [mm]	Horizontal/ Vertical	Stroke [mm]		
				10	20	30
RA1D RA1DA	3	2	Horizontal	300		
			Vertical			

(Note) For short strokes, the rated speed may not be achieved.

⚠ Caution: Do not set speeds and accelerations/decelerations equal to or greater than the respective ratings. Doing so may result in vibration, failure or shorter life.

(2) Rated Acceleration and Payload Capacity

Type	Motor Type [W]	Lead [mm]	Horizontal/ Vertical	Rated Acceleration [G]	Payload Capacity [kg]
RA1D RA1DA	3	2	Horizontal	1.0	0.7
			Vertical		0.3

⚠ Caution: Do not set speeds and accelerations/decelerations equal to or greater than the respective ratings. Doing so may result in vibration, failure or shorter life.

(3) Driving System • Position Detector
The drive system is a rectangular lead screw.

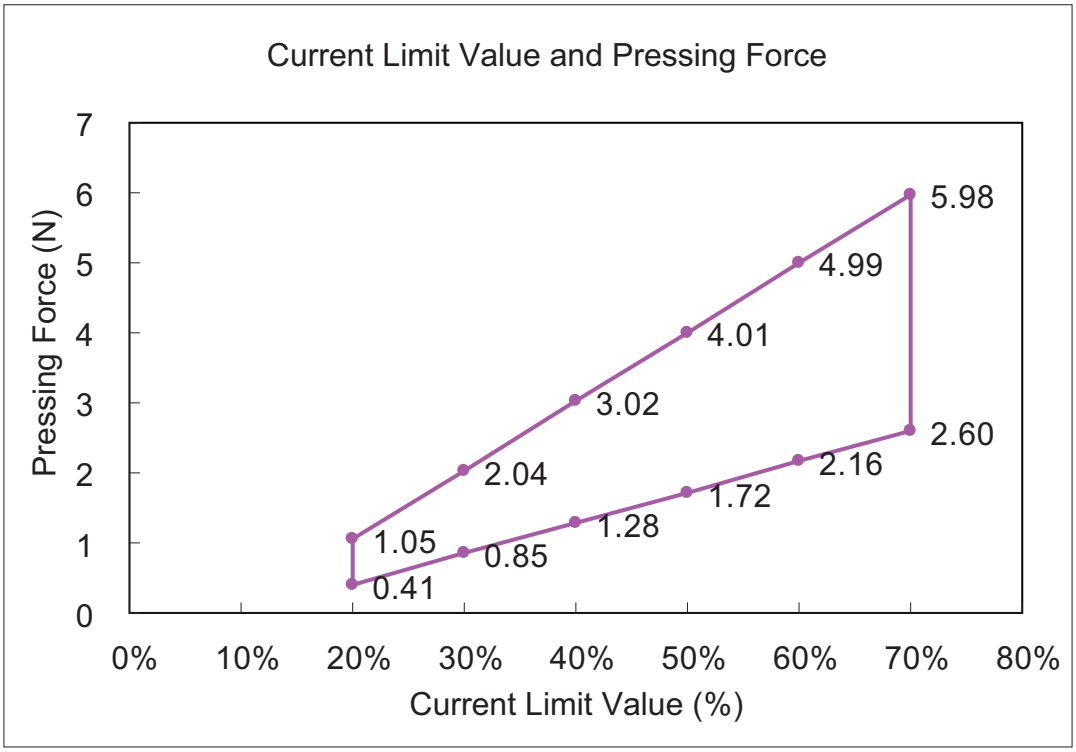
Type	Motor Type [W]	Lead [mm]	No. of Encoder Pluses	Lead Screw Diameter
RA1D	3	2	400	ϕ3mm
RA1DA	3	2	480	ϕ3mm

(4) Positioning Precision

Type	Lead [mm]	Item	Performance
RA1D RA1DA	2	Positioning Repeatability (Note 1)	±0.05mm
		Lost Motion (Note 1)	0.2mm or less
		Allowable Static Load Moment	0.02N•m
		Non-Rotating Accuracy	±3°

Note 1 This is an option already attached when it is shipped out from the factory.
It does not include the consideration of time-dependent change as it is used.

(5) Current Limit Value and Pressing Force



⚠ Caution: (1) The relation of the pressing force and current limiting value is a reference. There will be a little variance in the actual pressing force.
(2) If the current limiting value is low, the pressing force may largely vary.
(3) The movement speed at the pressing operation is fixed to 5mm/s.
The graph, shows the values when pressing at 5mm/s, and it differs if the speed changes.

3. Product Life

This actuator applies a lead screw and the plastic nut gets worn away. As the plastic nut is worn, the accuracy of the lost motion mainly gets worse. Based on the abrasion of the plastic nut and the degradation in the performance of the grease on the screw, the product life is determined as it is described below. (It is the value when an external guide and a free joint are used.)

Horizontal/vertical 10,000,000 cycles

4. Installation and Storage • Preservation Environment

4.1 Installation Environment

The actuator should be installed in a location other than those specified below.
In general, the installation environment should be one in which an operator can work without protective gear.
Also provide sufficient work space required for maintenance inspection.

- Where the actuator receives radiant heat from strong heat sources such as heat treatment furnaces
- Where the ambient temperature exceeds the range of 0 to 40°C
- Where the temperature changes rapidly and condensation occurs
- Where the relative humidity exceeds 85% RH
- Where the actuator receives direct sunlight
- Where the actuator is exposed to corrosive or combustible gases
- Where the ambient air contains a large amount of powder dust, salt or iron (at level exceeding what is normally expected in an assembly plant)
- Where the actuator is subject to splashed water, oil (including oil mist or cutting fluid) or chemical solutions
- Where the actuator receives impact or vibration

If the actuator is used in any of the following locations, provide sufficient shielding measures:
- Where noise generates due to static electricity, etc.
- Where the actuator is subject to a strong electric or magnetic field
- Where the actuator is subject to ultraviolet ray or radiation

4.2 Storage • Preservation Environment

The storage • preservation environment should be similar to the installation environment. In addition, make sure condensation will not occur when the actuator is to be stored or preserved for a long period of time. Unless specified, we do not include drying agents when shipping the actuator. If you are storing the actuator in an environment where condensation might occur, you must treat the entire shipping box, or treat the actuator itself after unpacking, to prevent condensation. The unit can withstand temperatures up to 60ºC during a short storage/preservation period, but only up to 50ºC if the storage/preservation period is longer than one month.

The actuator should be lying flat during storage • preservation.
If the actuator is to be stored in a packed state, follow the specified actuator position if indicated.

5. Transportation

5.1 Handling of Robot

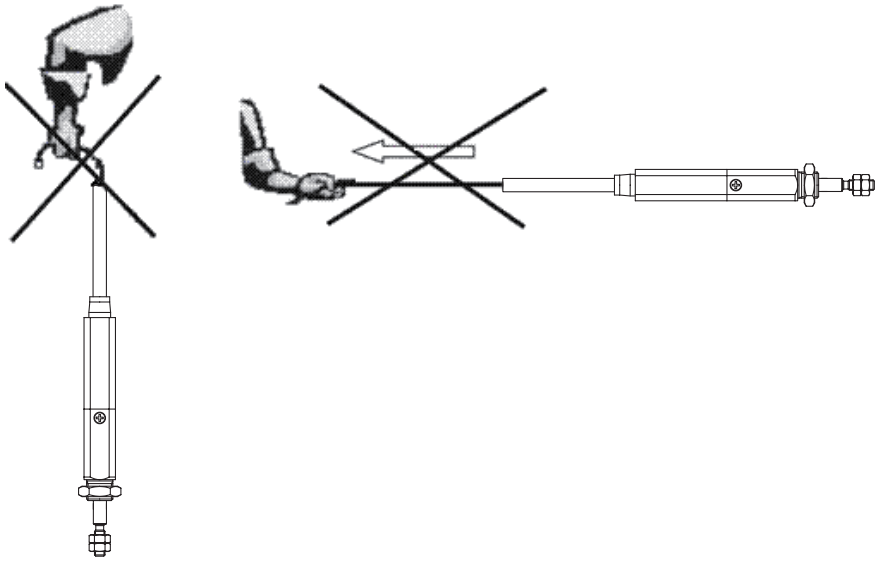
5.1.1 Handling the Packed Unit

Unless otherwise specified, the actuator is shipped with each axis packaged separately.

- Do not damage or drop. The package is not applied with any special treatment that enables it to resist an impact caused by a drop or crash.
- Transport a heavy package with at least more than two operators. Consider an appropriate method for transportation.
- Keep the unit in horizontal orientation when placing it on the ground or transporting. Follow the operation if there is any for the packaging condition.
- Do not step or sit on the package.
- Do not put any load that may cause a deformation or breakage of the package.

5.1.2 Handling the Actuator After Unpacking

- Do not carry an actuator by a cable or attempt to move it by pulling the cable.



- Hold the body base when transporting the actuator.
- Be careful not to bump the actuator into anything when moving it.
- Do not apply an excessive force to each part of the actuator.

Supplement) For the names of each part of the actuator, refer to “Names of the Parts”.

5.2 Handling in Assembled Condition

- When carrying the actuator, exercise caution not to bump it against nearby objects or structures.
- Secure the rods to prevent sudden movement during transport.
- If any end of the actuator is overhanging, secure it properly to avoid significant movement due to external vibration.
- If the actuator assembly is transported without the ends being secured, do not apply an impact of 0.3G or more.
- When suspending the mechanical equipment (system) with ropes, avoid applying force to actuator, connector box, etc. Also, avoid the cables being pinched or caused an excessive deformation.

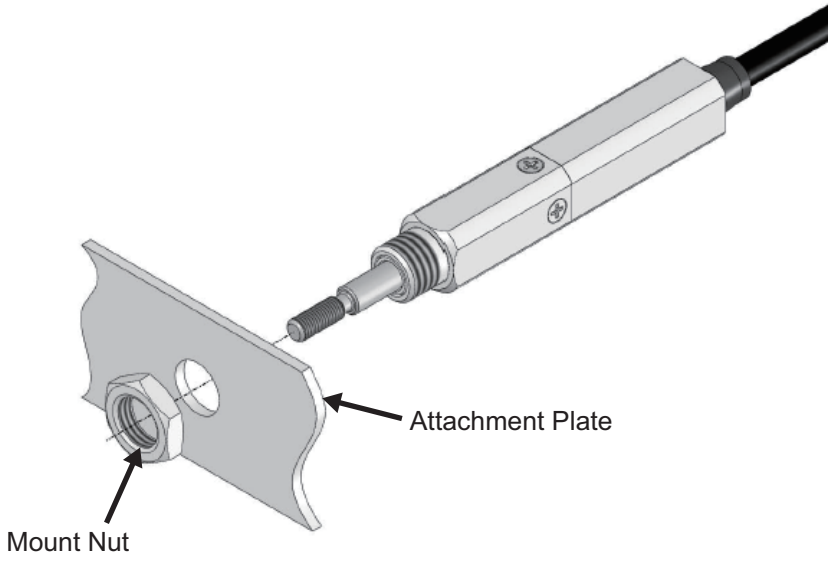
6. Installation

6.1 Installation of Main Unit

- The installation bracket should possess enough stiffness, and also prevent vibration exceeding 0.3G from being applied to the main unit.
- Have enough space for the maintenance work.

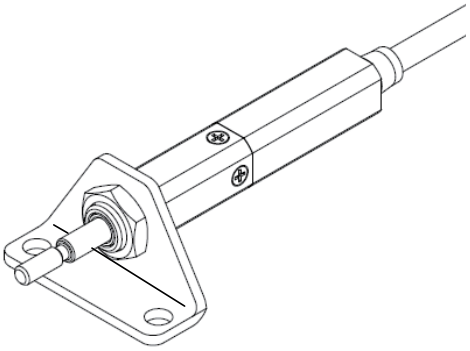
Install the main body in the clearance hole (ϕ10) of a smooth plate of about 1 to 3mm in thickness and fix it. Both horizontal and vertical are available for the installation orientation.

- The root of the male screw on the unit possesses (M10 × 1.0) the accuracy of h8. Utilize it for fitting.
- The maximum tightening torque should be 9.0N•m when using a mount nut including the enclosed one. Tightening with higher torque may break the unit.

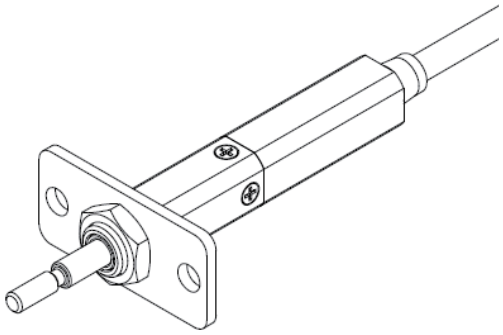


General-purposed products as shown below can be used for the foot bracket and flange bracket.
Please contact directly to the supplier for the foot bracket and flange bracket.

Foot brackets



Flange brackets



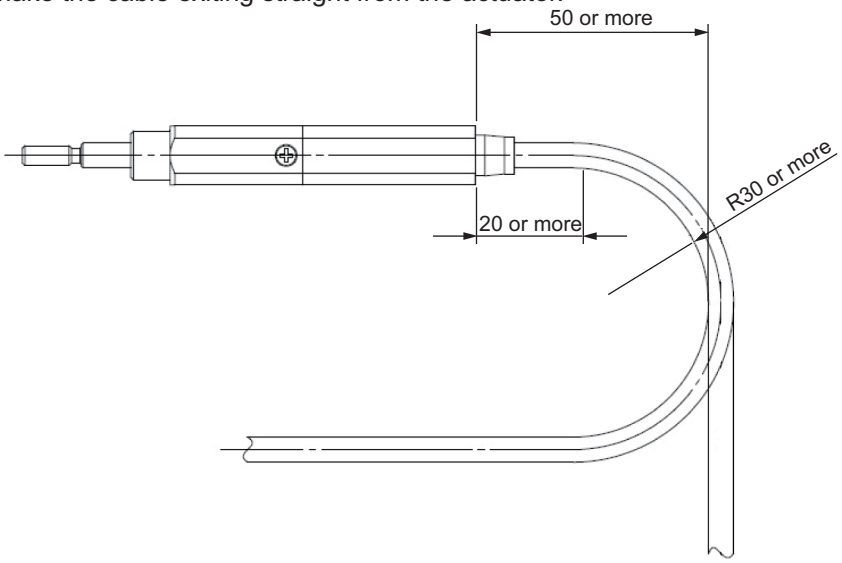
	SMC Co., Ltd.	CKD Co., Ltd.	KOGANEI Co., Ltd.
Foot brackets	CJ-L016B	P2-LS-16	1A-PBDA-16
Flange brackets	CJ-F016B	P2-FA-16	3-PBDA-16

6.2 Attachment of Work Piece (Object to Transport)

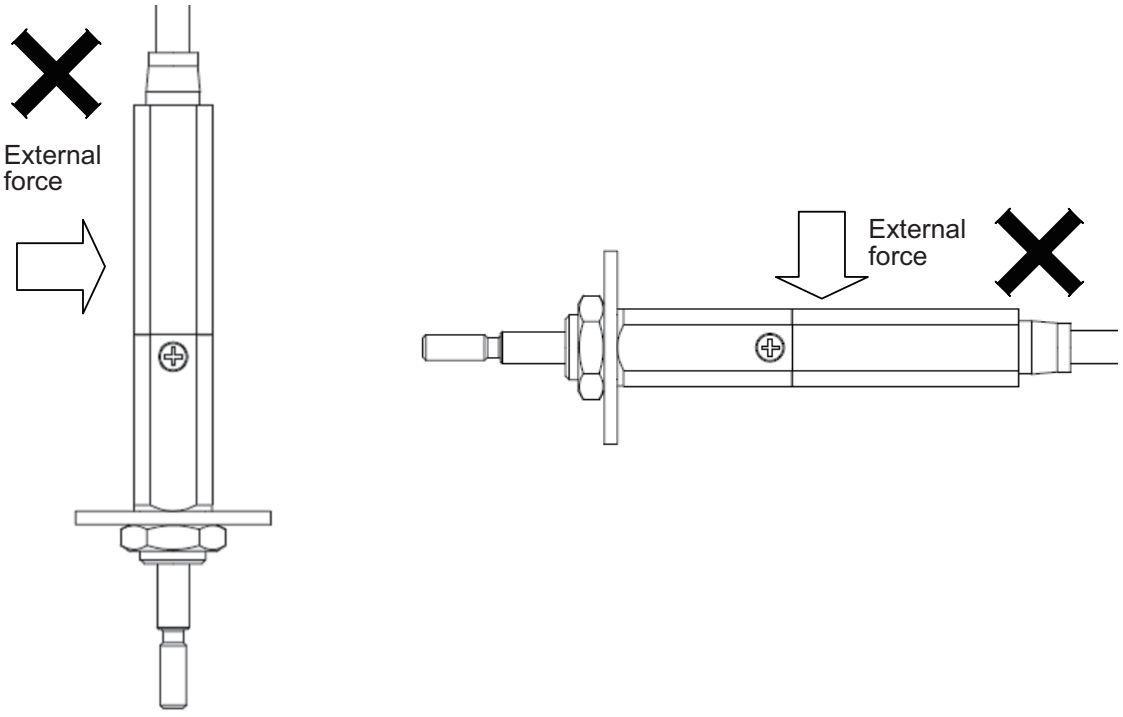
- Attach the work piece (object to transport) with using the male screw (M4 × 0.7) on the rod tip and enclosed nut. Do not attempt to apply torque of 0.2N•m or more to the rod when attaching the work piece. Doing so may cause risk of a breakage or malfunction of the actuator.
- When transporting a heavy work piece (0.02kg or more), make sure to join either the work piece or the rod to the external guide. In this case, use a free joint to eliminate the difference in the moving directions of the work piece and the rod (traveling parallelism).
  (Refer to 8.1 Load Applied to Actuator)
- The specified transportable weight may not be able to be carried if the guide load is large while in move of the work piece. Be careful.

6.3 Precaution in Installation

1) Keep a space for allocating the cable at the rear side of the motor side of the actuator.
Also, attempt to make the cable exiting straight from the actuator.



2) Prevent external force being applied on the body when installed. It may cause a risk of an operation failure or breakage.

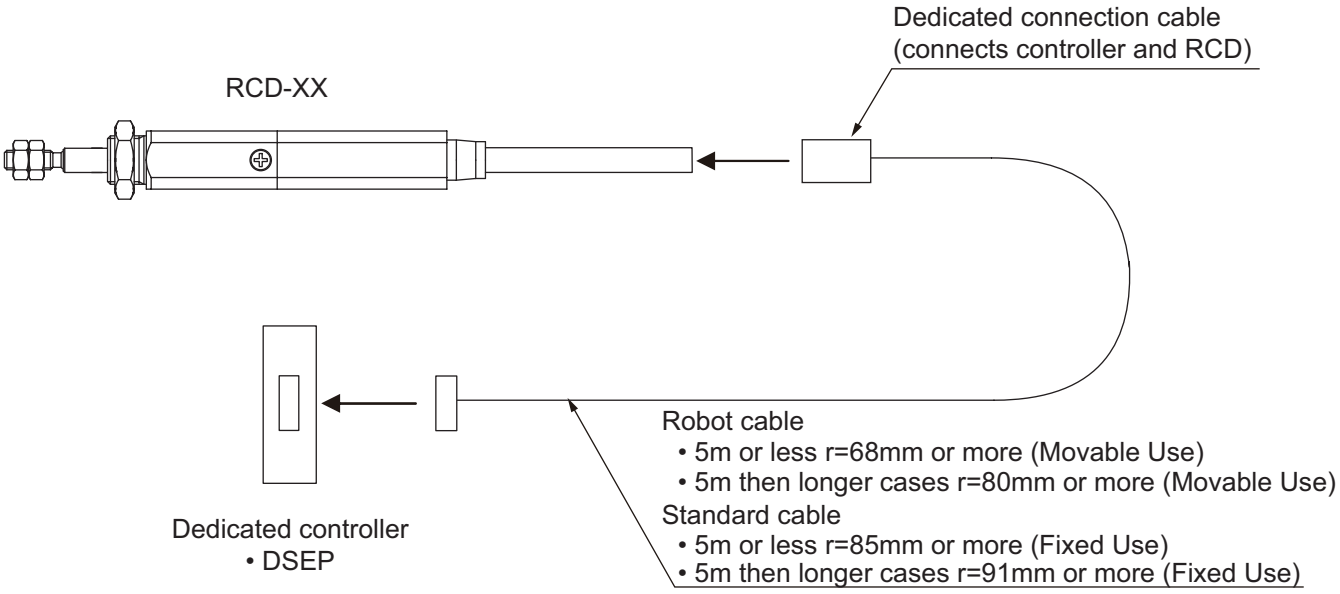


7. Connecting with Controller

Both for the controller itself and for the connection cable between the controller and RCD (this actuator), use a dedicated IAI controller and dedicated connection cable.
This section explains the wiring method for a single axis.

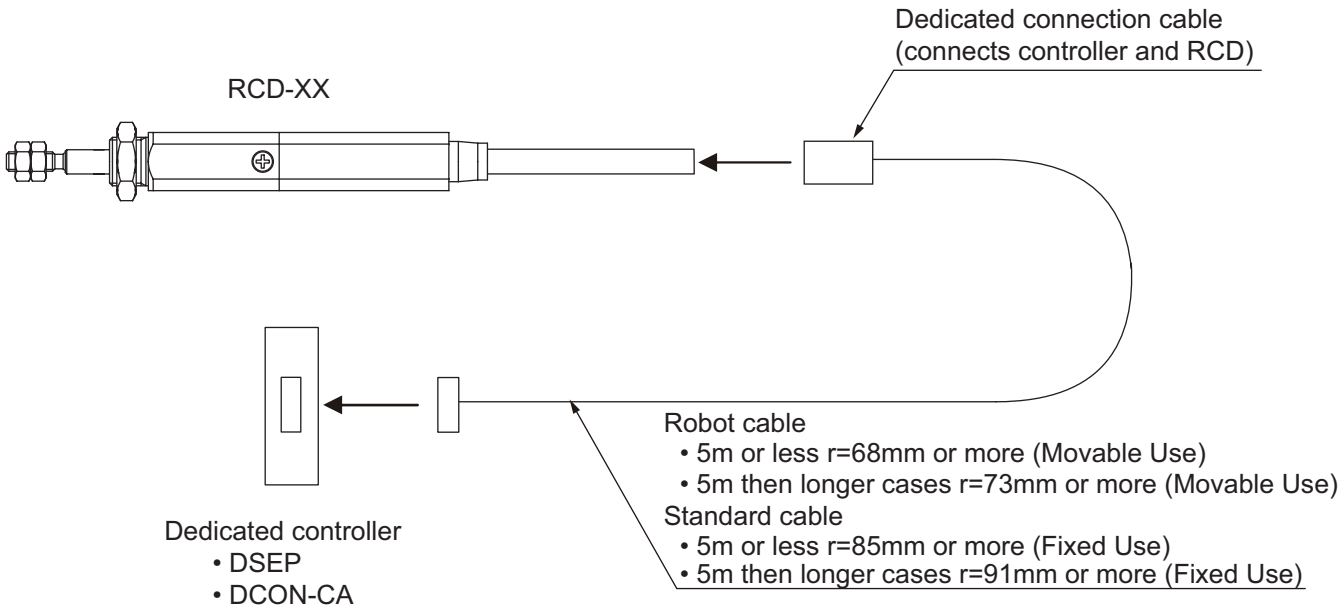
- If the dedicated connection cable cannot be secured, reduce the load on the cable by allowing it to deflect only by the weight of the cable or wire it in a self-standing cable hose, etc., having a large radius.
- Do not cut and reconnect the dedicated connection cable for extension or shorten the cable.
- Do not pull on the dedicated connection cable or bend it forcibly.
- The actuator cable coming out of the motor unit is that for fixing.
  Fix the cable so it would not be bent repeatedly.

Please consult with IAI if you require a different kind of cable than the one supplied.



Dedicated connection cable
- Motor-encoder cable: CB-CA-MPA***
- Motor-encoder cable robot cable: CB-CA-MPA***- RB

*) *** indicates the cable length. Up to 20m can be specified.
Example) 080 = 8 m

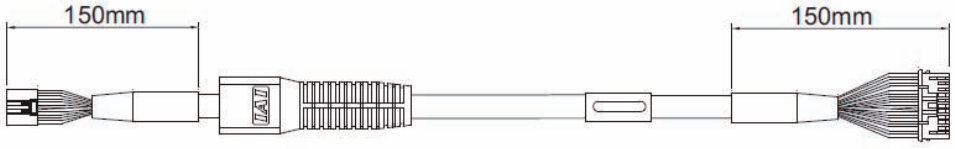


Dedicated connection cable
- Motor-encoder cable: CB-CAN-MPA***
- Motor-encoder cable robot cable: CB-CAN-MPA***- RB

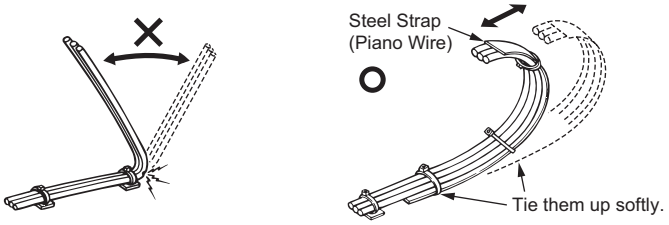
*) *** indicates the cable length. Up to 20m can be specified.
Example) 080 = 8 m

⚠ Warning: For wiring, please follow the warnings stated below. When constructing a system as the machinery equipment, pay attention to the wiring and connection of each cable so they are conducted properly. Not following them may cause not only a malfunction such as cable breakage or connection failure, or an operation error, but also electric shock or electric leakage, or may even cause a fire.

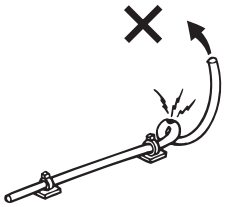
- Use dedicated cables of IAI indicated in this instruction manual. Contact us if you wish to have a change to the specifications of the dedicated cables.
- Make sure to turn the power off in the process of power line or cable connection or disconnection.
- Do not attempt to cut a dedicated cable with connectors on both ends to extend, shorten or re-joint it.
- Hold the dedicated cable to avoid mechanical force being applied to the terminals and connectors.
- Use a cable pipe or duct to have an appropriate protection when there is a possibility of mechanical damage on a dedicated cable.
- In case a dedicated cable is to be used at a moving part, make sure to lay out the cable without applying any force to pull the connector or extreme bend on the cable. Do not attempt to use the cable with a bending radius below the allowable value.
- Make certain that the connectors are plugged properly. Insufficient connection may cause an operation error, thus it is extremely risky.
- Do not lay out the cables to where the machine runs over them.
- Pay attention to the cable layout so it would not hit peripherals during an operation. In case it does, have an appropriate protection such as a cable track.
- When a cable is used hanging on the ceiling, prevent an environment that the cable swings with acceleration or wind velocity.
- Make sure there is not too much friction inside the cable storage equipment.
- Do not apply radiated heat to power line or cables.
  CB-CAN-MPA□□□, CB-CAN-MPA□□□-RB
- Do not bend the cable in the area from the connector tip inward to 150mm on both ends.
  Motor • Encoder Integrated Cables CB-CA-MPA□□□, CB-CAN-MPA□□□
  Motor • Encoder Integrated Cables Robot Type CB-CA-MPA□□□-RB, CB-CAN-MPA□□□-RB



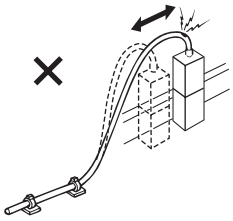
- Have a sufficient radius for bending, and avoid a bend concentrating on one point.



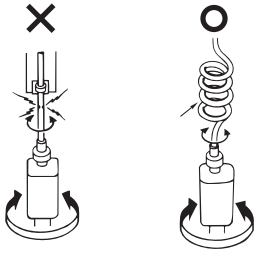
- Do not let the cable bend, kink or twist.



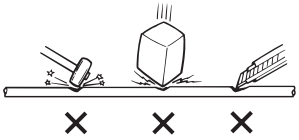
- Do not pull the cable with a strong force.



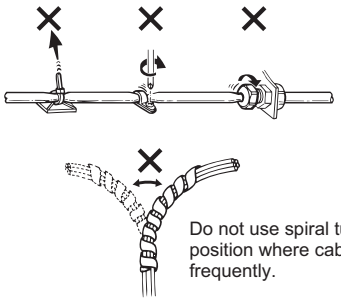
- Pay attention not to concentrate the twisting force to one point on a cable.



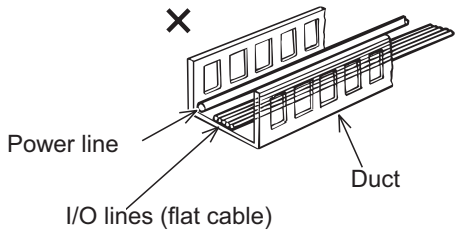
- Do not pinch, drop a heavy object onto or cut the cable.



- When a cable is fastened to affix, make sure to have an appropriate force and do not tighten too much.

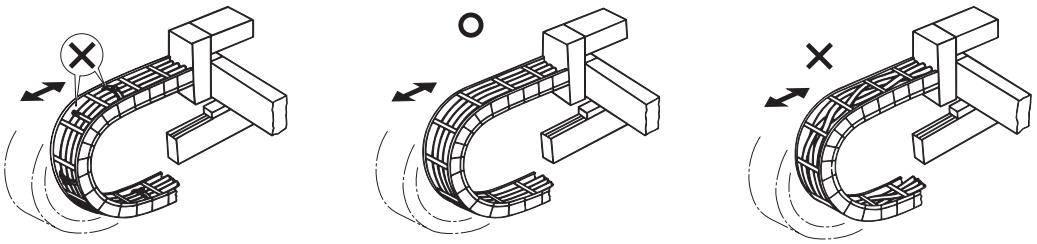


- PIO line, communication line, power and driving lines are to be put separately from each other and do not tie them together. Arrange so that such lines are independently routed in the duct.



Follow the instructions below when using a cable track.

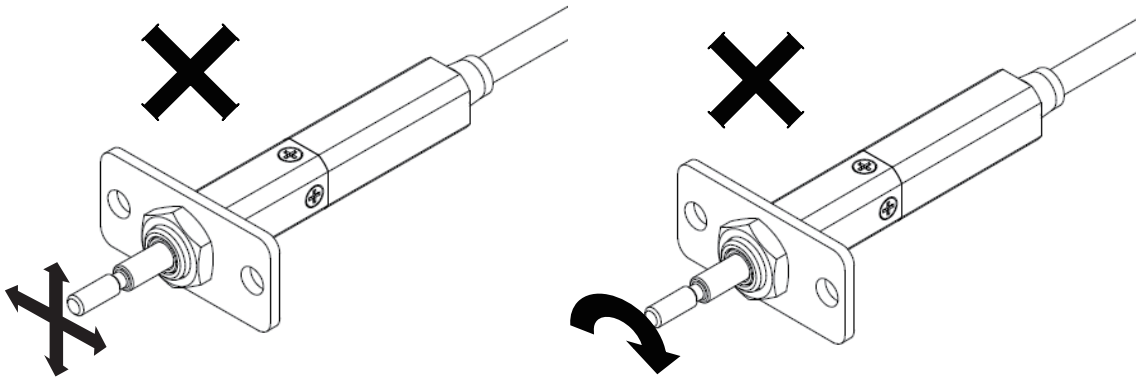
- If there is an indication to the cable for the space factor in a cable track, refer to the wiring instruction given by the supplier when storing the cable in the cable track.
- Avoid the cables to get twined or twisted in the cable track, and also to have the cables move freely and do not tie them up. (Avoid tension being applied when the cables are bent.)
  Do not pile up cables. It may cause faster abrasion of the sheaths or cable breakage.



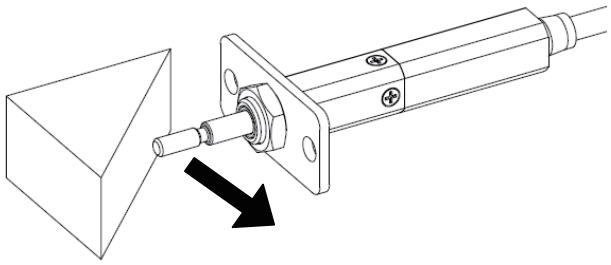
8. Caution for Operation

8.1 Load Applied to Actuator

- RCD-RA1D actuator cannot accept the load from sides (radial load) or rotation torque. Applying these types of load may cause an operation failure, breakage of components or shortened life. Use a device such as the external guide.

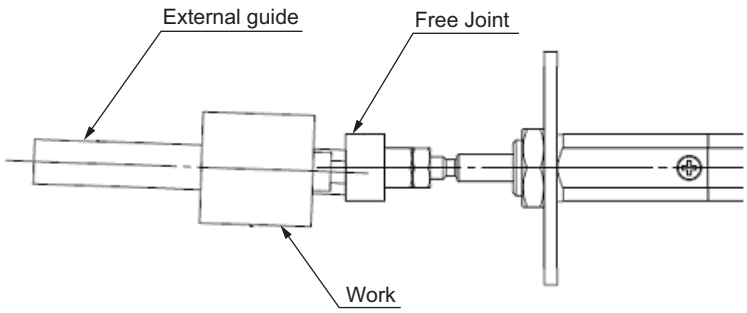


- Pay attention to the reaction force so it would not become the load from a side. Utilize a guide so it receives the side load.



Pay attention to the direction of the reaction force.

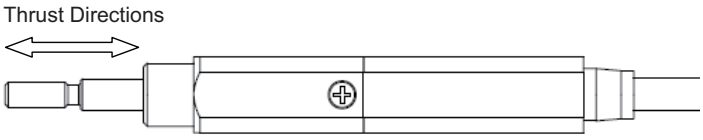
- When joining a work piece guided by an external guide with the rod, pay attention to the difference in the moving directions of the external guide and the rod (traveling parallelism). Use a free joint that gives a freedom to the joint of the work piece and the rod to eliminate the variance in the attachment and the difference in the moving direction. Not using it may cause a generation of abnormal noise or shortened product life.



- Be careful not to apply a huge load on the side of the rod due to the attaching variance when joining a guide to the work piece.

8.2 External Force Applied in Thrust Directions

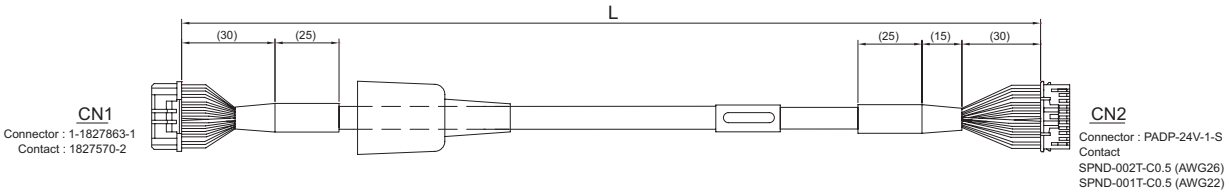
- Do not attempt to apply an excessive external force on the rod.
- Avoid applying an external force or impact that exceeds the allowable external force in the thrust directions. The allowable external force (maximum pressing force) is 6.0N.



9. Motor • Encoder Cables

9.1 Motor • Encoder Integrated Cable Connection

CB-CA-MPA□□□



Connection diagram

CN1
1-1827863-1(AMP)

Pin No.	Symbol	Color
A1	ϕA/U	BL(AWG22/19)
B1	VMM/V	OR(AWG22/19)
A2	ϕ_A/W	GN(AWG22/19)
B2	ϕB/-	BR(AWG22/19)
A3	VMM/-	GY(AWG22/19)
B3	ϕ_B/-	RD(AWG22/19)
A4	LS+/BK+	BK(AWG26)
B4	LS-/BK-	YW(AWG26)
A6	-/A+	BL(AWG26)
B6	-/A-	OR(AWG26)
A7	A+/B+	GN(AWG26)
B7	A-/B-	BR(AWG26)
A8	B+/Z+	GY(AWG26)
B8	B-/Z-	RD(AWG26)
A5	BK+/LS+	BL(AWG26)
B5	BK-/LS-	OR(AWG26)
A9	LS_GND	GN(AWG26)
B9	VPS	BR(AWG26)
A10	VCC	GY(AWG26)
B10	GND	RD(AWG26)
A11	—	—
B11	FG	BK

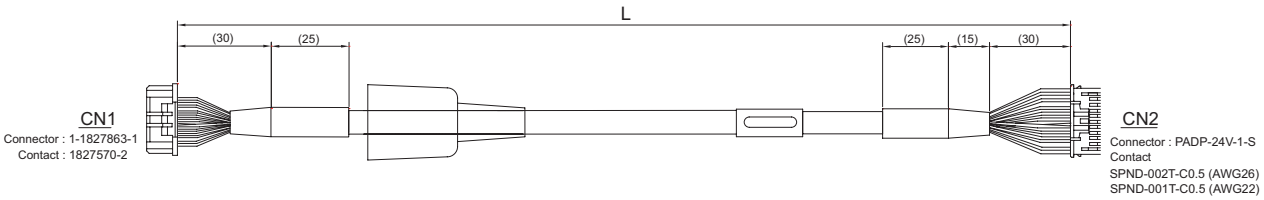
Center Intervention

CN2
PADP-24V-1-S(JST)

Pin No.	Symbol	Color
1	ϕA/U	BL(AWG22/19)
2	VMM/V	OR(AWG22/19)
5	ϕ_A/W	GN(AWG22/19)
3	ϕB/-	BR(AWG22/19)
4	VMM/-	GY(AWG22/19)
6	ϕ_B/-	RD(AWG22/19)
7	LS+/BK+	BK(AWG26)
8	LS-/BK-	YW(AWG26)
11	-/A+	BL(AWG26)
12	-/A-	OR(AWG26)
13	A+/B+	GN(AWG26)
14	A-/B-	BR(AWG26)
15	B+/Z+	GY(AWG26)
16	B-/Z-	RD(AWG26)
9	BK+/LS+	BL(AWG26)
10	BK-/LS-	OR(AWG26)
20	LS_GND	GN(AWG26)
18	VPS	BR(AWG26)
17	VCC	GY(AWG26)
19	GND	RD(AWG26)
21	—	—
22	—	—
23	—	—
24	FG	BK

9.2 Motor • Encoder Integrated Cables Robot Type

CB-CA-MPA□□□-RB



Connection diagram

CN1
1-1827863-1(AMP)

Pin No.	Symbol	Color
A1	ϕA/U	BK(AWG22/19)
B1	VMM/V	WT(AWG22/19)
A2	ϕ_A/W	BR(AWG22/19)
B2	ϕB/-	GN(AWG22/19)
A3	VMM/-	YW(AWG22/19)
B3	ϕ_B/-	RD(AWG22/19)
A4	LS+/BK+	OR(AWG25)
B4	LS-/BK-	GY(AWG25)
A6	-/A+	WT(AWG25)
B6	-/A-	YW(AWG25)
A7	A+/B+	RD(AWG25)
B7	A-/B-	GN(AWG25)
A8	B+/Z+	BK(AWG25)
B8	B-/Z-	BR(AWG25)
A5	BK+/LS+	BK(AWG25)
B5	BK-/LS-	BRAWG25)
A9	LS_GND	GN(AWG25)
B9	VPS	RD(AWG25)
A10	VCC	WT(AWG25)
B10	GND	YW(AWG25)
A11	—	—
B11	FG	

Center Intervention

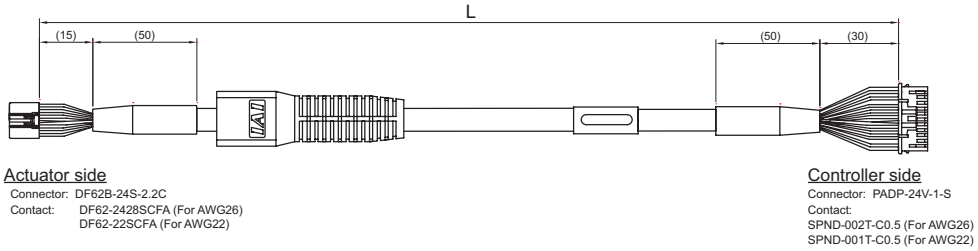
CN2
PADP-24V-1-S (JST)

Pin No.	Symbol	Color
1	ϕA/U	BK(AWG22/19)
2	VMM/V	WT(AWG22/19)
5	ϕ_A/W	BR(AWG22/19)
3	ϕB/-	GN(AWG22/19)
4	VMM/-	YW(AWG22/19)
6	ϕ_B/-	RD(AWG22/19)
7	LS+/BK+	OR(AWG25)
8	LS-/BK-	GY(AWG25)
11	-/A+	WT(AWG25)
12	-/A-	YW(AWG25)
13	A+/B+	RD(AWG25)
14	A-/B-	GN(AWG25)
15	B+/Z+	BK(AWG25)
16	B-/Z-	BR(AWG25)
9	BK+/LS+	BK(AWG25)
10	BK-/LS-	BR(AWG25)
20	LS_GND	GN(AWG25)
18	VPS	RD(AWG25)
17	VCC	WT(AWG25)
19	GND	YW(AWG25)
21	—	—
22	—	—
23	—	—
24	FG	Shield

9.3 Motor • Encoder Integrated Cables

CB-CAN-MPA□□□

□□□ indicates the cable length (L) (Example: 030=3m), Max.20m



Connection diagram

Actuator side

Thickness	Electric Wire Color	Symbol	Pin No.
AWG22/19	Blue	ϕA	3
AWG22/19	Orange	VMM	5
AWG22/19	Brown	ϕB	10
AWG22/19	Gray	VMM	9
AWG22/19	Green	ϕ_A	4
AWG22/19	Red	ϕ_B	15
AWG26	Black	LS+	8
AWG26	Yellow	LS-	14
AWG26	Blue	SA	12
AWG26	Orange	SB	17
AWG26	Green	A+	1
AWG26	Brown	A-	6
AWG26	Gray	B+	11
AWG26	Red	B-	16
AWG26	Blue	BK+	20
AWG26	Orange	BK-	2
AWG26	Gray	VCC	21
AWG26	Red	GND	7
AWG26	Brown	VPS	18
AWG26	Green	LS_GND	13
-	-	-	19
AWG26	Pink	-	22
-	-	-	23
AWG26	Black	FG	24

Controller side

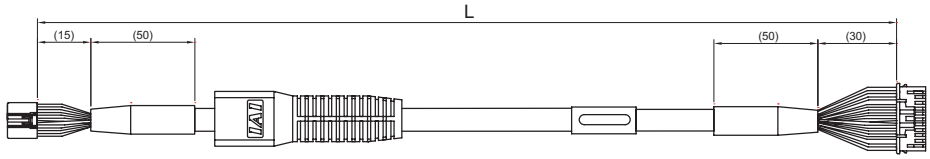
Pin No.	Symbol	Electric Wire Color	Thickness
1	ϕA	Blue	AWG22/19
2	VMM	Orange	AWG22/19
3	ϕB	Brown	AWG22/19
4	VMM	Gray	AWG22/19
5	ϕ_A	Green	AWG22/19
6	ϕ_B	Red	AWG22/19
7	LS+	Black	AWG26
8	LS-	Yellow	AWG26
11	SA	Blue	AWG26
12	SB	Orange	AWG26
13	A+	Green	AWG26
14	A-	Brown	AWG26
15	B+	Gray	AWG26
16	B-	Red	AWG26
9	BK+	Blue	AWG26
10	BK-	Orange	AWG26
17	VCC	Gray	AWG26
19	GND	Red	AWG26
18	VPS	Brown	AWG26
20	LS_GND	Green	AWG26
22	-		-
21	-	Pink	AWG26
23	-		-
24	FG	Black	AWG26

(Note) About thickness AWG22/19
The thickness is AWG22 when the cable length is 5m or less, and AWG19 when longer than 5m.

9.4 Motor • Encoder Integrated Cables Robot Type

CB-CAN-MPA□□□-RB

□□□ indicates the cable length (L) (Example: 030=3m), Max.20m



Actuator side
Connector: DF62B-24S-2.2C
Contact: DF62-2428SCFA (For AWG26)
DF62-22SCFA (For AWG22)

Controller side
Connector: PADP-24V-1-S
Contact:
SPND-002T-C0.5 (For AWG26)
SPND-001T-C0.5 (For AWG22)

Connection diagram

Actuator side

Thickness	Electric Wire Color	Symbol	Pin No.
AWG22/19	Blue	ϕA	3
AWG22/19	Orange	VMM	5
AWG22/19	Brown	ϕB	10
AWG22/19	Gray	VMM	9
AWG22/19	Green	ϕ_A	4
AWG22/19	Red	ϕ_B	15
AWG26	Black	LS+	8
AWG26	Yellow	LS-	14
AWG26	Blue	SA	12
AWG26	Orange	SB	17
AWG26	Green	A+	1
AWG26	Brown	A-	6
AWG26	Gray	B+	11
AWG26	Red	B-	16
AWG26	Blue	BK+	20
AWG26	Orange	BK-	2
AWG26	Gray	VCC	21
AWG26	Red	GND	7
AWG26	Brown	VPS	18
AWG26	Green	LS_GND	13
-	-	-	19
AWG26	Pink	-	22
-	-	-	23
AWG26	Black	FG	24

Controller side

Pin No.	Symbol	Electric Wire Color	Thickness
1	ϕA	Blue	AWG22/19
2	VMM	Orange	AWG22/19
3	ϕB	Brown	AWG22/19
4	VMM	Gray	AWG22/19
5	ϕ_A	Green	AWG22/19
6	ϕ_B	Red	AWG22/19
7	LS+	Black	AWG26
8	LS-	Yellow	AWG26
11	SA	Blue	AWG26
12	SB	Orange	AWG26
13	A+	Green	AWG26
14	A-	Brown	AWG26
15	B+	Gray	AWG26
16	B-	Red	AWG26
9	BK+	Blue	AWG26
10	BK-	Orange	AWG26
17	VCC	Gray	AWG26
19	GND	Red	AWG26
18	VPS	Brown	AWG26
20	LS_GND	Green	AWG26
22	-		-
21	-	Pink	AWG26
23	-		-
24	FG	Black	AWG26

(Note) About thickness AWG22/19
The thickness is AWG22 when the cable length is 5m or less, and AWG19 when longer than 5m.

10. Maintenance Inspection

10.1 Inspection Items and Schedule

Follow the maintenance inspection schedule below.
It is assumed that the equipment is operating 8 hours per day.
If the equipment is running continuously night and day or otherwise running at a high operating rate, inspect more often as needed.

	External visual inspection	Greasing
Start of work inspection	○	
1-month inspection	○	
3-month inspection	○	
6-month inspection	○	○ (Rod sliding surface)
Every 6-month since	○	○ (Rod sliding surface)

10.2 External Visual Inspection

An external visual inspection should check the following things.

Main unit	Loose actuator mounting bolts, other loose items
Rod	Lubrication, dust, foreign object on sliding surfaces
Cables	Scratches, proper connections
Overall	Irregular noise, vibration

10.3 Cleaning

- Clean exterior surfaces as necessary.
- Use a soft cloth to wipe away dirt and buildup.
- Do not blow too hard with compressed air as it may cause dust to get in through the gaps.
- Do not use oil-based solvents as they can harm lacquered and painted surfaces.
- To remove severe buildup, wipe gently with a soft cloth soaked in a neutral detergent or alcohol.

10.4 Grease Supply

10.4.1 Grease to be applied on Rod (Sliding Surface)

The following grease is applied when the product is shipped out from IAI factory.

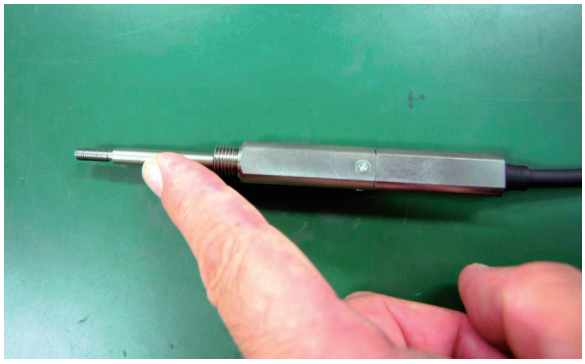
Rod (sliding surface)	Sumico Lubricant Co., Ltd.	Sumitec 308

Even though an equivalent type of grease can be purchased from other suppliers, please be very careful in selecting grease since an inappropriate choice may give an impact to the actuator life.

⚠ Caution: Do not attempt to apply any grease other than poly α olefin synthetic grease.
Mixing the grease with other types does not only drop the grease performance, but also may damage the actuator.

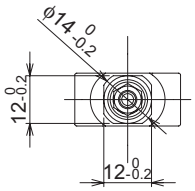
10.4.2 Applying the Grease on the Rod (Sliding Surface)

Pull out the rod, clean the sliding surface, and then supply grease with fingers on the rod sliding surface. Move the rod back and forth to evenly allocate the grease through the area. Lastly, wipe off the excess grease.

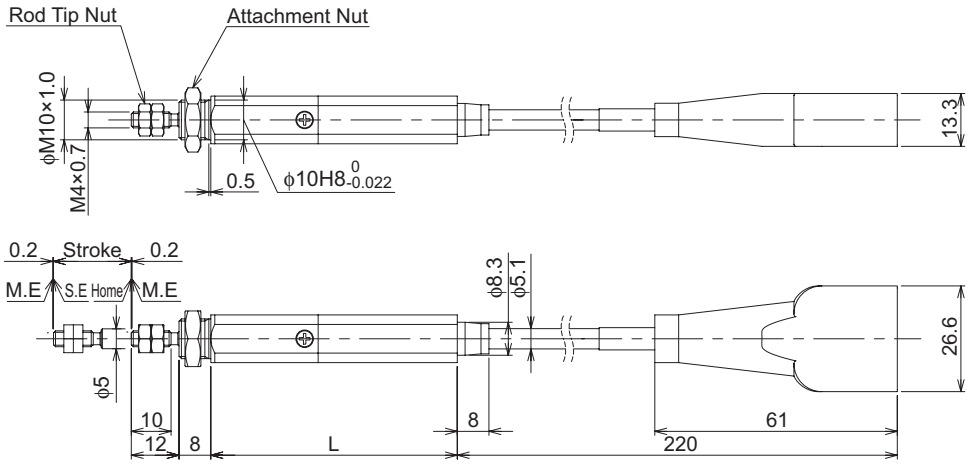


11. Appendix

11.1 External Dimensions



(Attachment nut not shown)



ORG : Home
M.E : Mechanical End
S.E : Stroke End

Stroke	L	Mass [g]
10	52	47
20	62	51
30	72	55

12. Warranty

12.1 Warranty Period

One of the following periods, whichever is shorter:

- 18 months after shipment from IAI
- 12 months after delivery to the location specified by the user
- 2,500 hours after start of operation

12.2 Scope of Warranty

Our products are covered by warranty when all of the following conditions are met. Faulty products covered by warranty will be replaced or repaired free of charge:

(1) The breakdown or problem in question pertains to our product as delivered by us or our authorized dealer.

(2) The breakdown or problem in question occurred during the warranty period.

(3) The breakdown or problem in question occurred while the product was in use for an appropriate purpose under the conditions and environment of use specified in the operation manual and catalog.

(4) The breakdown or problem in question was caused by a specification defect or problem, or by the poor quality of our product.

Note that breakdowns due to any of the following reasons are excluded from the scope of warranty:

[1] Anything other than our product
[2] Modification or repair performed by a party other than us (unless we have approved such modification or repair)
[3] Anything that could not be easily predicted with the level of science and technology available at the time of shipment from our company
[4] A natural disaster, man-made disaster, incident or accident for which we are not liable
[5] Natural fading of paint or other symptoms of aging
[6] Wear, depletion or other expected result of use
[7] Operation noise, vibration or other subjective sensation not affecting function or maintenance

Note that the warranty only covers our product as delivered and that any secondary loss arising from a breakdown of our product is excluded from the scope of warranty.

12.3 Honoring the Warranty

As a rule, the product must be brought to us for repair under warranty.

12.4 Limited Liability

(1) We shall assume no liability for any special damage, consequential loss or passive loss such as a loss of expected profit arising from or in connection with our product.
(2) We shall not be liable for any program or control method created by the customer to operate our product or for the result of such program or control method.

12.5 Conditions of Conformance with Applicable Standards/Regulations, Etc., and Applications

(1) If our product is combined with another product or any system, device, etc., used by the customer, the customer must first check the applicable standards, regulations and/or rules. The customer is also responsible for confirming that such combination with our product conforms to the applicable standards, etc. In such a case we will not be liable for the conformance of our product with the applicable standards, etc.

(2) Our product is for general industrial use. It is not intended or designed for the applications specified below, which require a high level of safety. Accordingly, as a rule our product cannot be used in these applications. Contact us if you must use our product for any of these applications:

[1] Medical equipment pertaining to maintenance or management of human life or health
[2] A mechanism or mechanical equipment intended to move or transport people (such as a vehicle, railway facility or aviation facility)
[3] Important safety parts of mechanical equipment (such as safety devices)
[4] Equipment used to handle cultural assets, art or other irreplaceable items

(3) Contact us at the earliest opportunity if our product is to be used in any condition or environment that differs from what is specified in the catalog or operation manual.

12.6 Other Items Excluded from Warranty

The price of the product delivered to you does not include expenses associated with programming, the dispatch of engineers, etc. Accordingly, a separate fee will be charged in the following cases even during the warranty period:

[1] Guidance for installation/adjustment and witnessing of test operation
[2] Maintenance and inspection
[3] Technical guidance and education on operating/wiring methods, etc.
[4] Technical guidance and education on programming and other items related to programs

Change History

Revision Date	Description of Revision
October 2011	First edition
July 2013	1B edition Pg. 13 Note corrected Non-Rotating Accuracy ±0.3° → ±3°
May 2014	Second edition ● RA1D added ● The contents of DCON-CA added

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