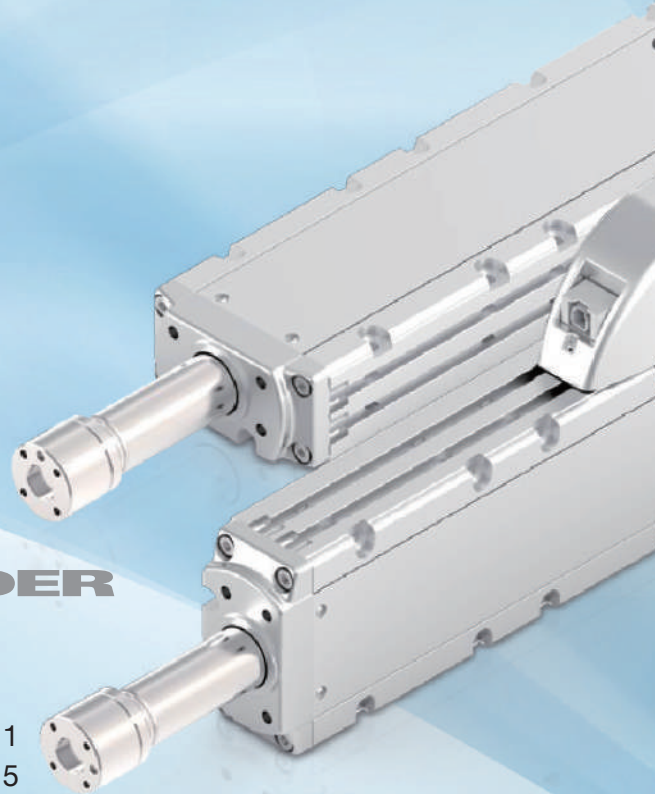




Easy Automation Concept

~ Lower Costs with the ROBO Cylinder® ~

Volume 4



1. Application Examples

| | |
|----------------------------|--------|
| Deburring System | Page 1 |
| Work Transfer System | Page 5 |

2. Basic Functions of the ROBO Cylinder

| | |
|----------------------------------|--------|
| 4: Multi-point Positioning | Page 9 |
|----------------------------------|--------|

3. Maintenance

| | |
|--------------------------------|---------|
| Visual Inspection Method | Page 10 |
|--------------------------------|---------|

4. Basics of Sequence Control

| | |
|-------------------------------------|---------|
| 4: AND Circuit and OR Circuit | Page 11 |
|-------------------------------------|---------|

5. Basics of SEL Program

| | |
|---------------------------------------|---------|
| 4: Repeated Operations and Jump | Page 13 |
|---------------------------------------|---------|

6. Product Information

| | |
|------------------------------|---------|
| RCP6 Series Table Type | Page 14 |
|------------------------------|---------|

1. Application Examples

Deburring System

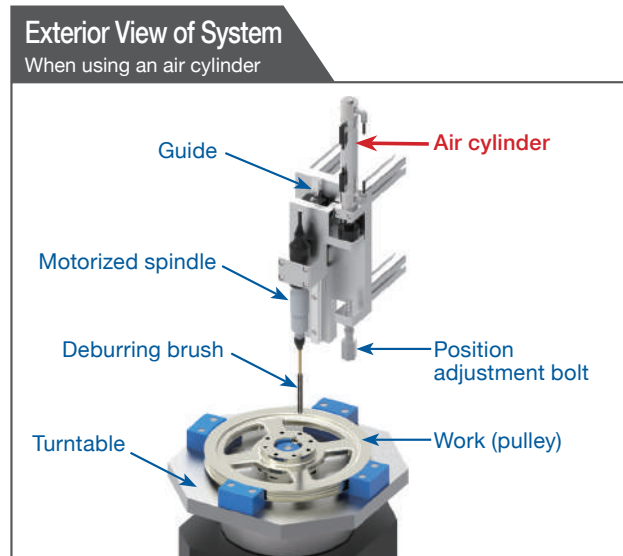
There is no need to reposition tools, which significantly reduces the cycle time.

1 System Overview

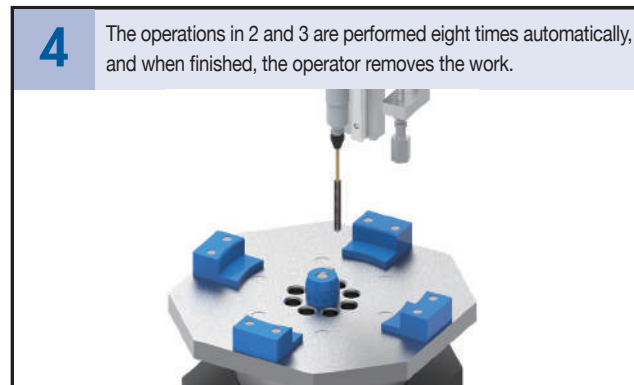
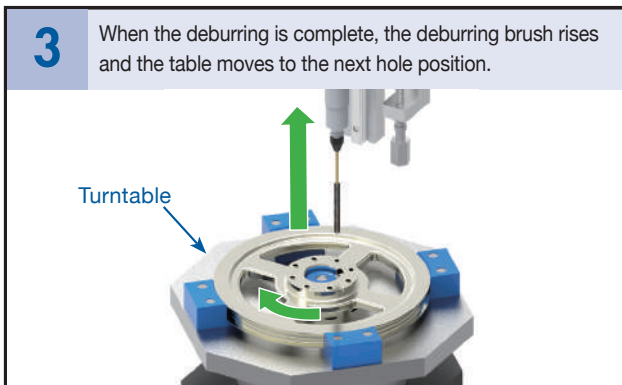
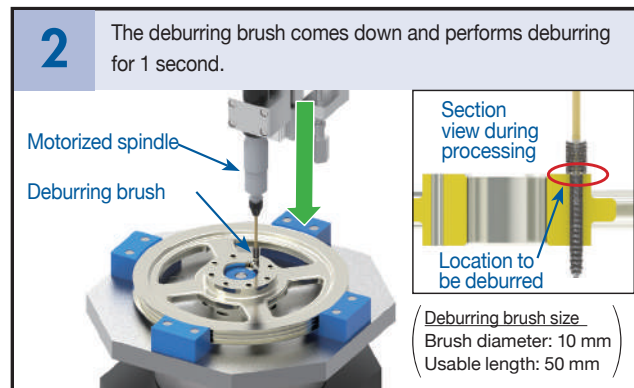
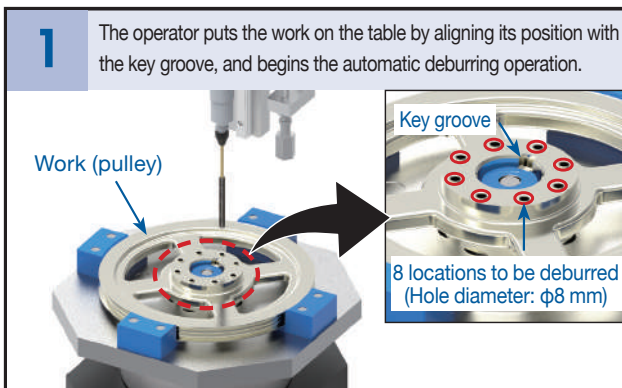
(1) Explanation of Process

This system removes burrs around holes drilled in a pulley*¹. Eight locations are deburred. The deburring brush attached to the motorized spindle*² is used to remove the burrs along the edge of holes. An air cylinder is used to move the deburring brush up and down.

*1 Pulley: A gear that transmits motive power through a belt, etc., passed around it.
 *2 Motorized spindle: A unit that uses a motor to turn and has chucks at its tip to hold a tool in place.



(2) Explanation of Operation



Issues Requiring Improvement

1. Eliminates tool repositioning
2. Longer tool life
3. Shortens the cycle time

2 Improvements Achieved by the ROBO Cylinder

The issues were resolved by replacing the air cylinder of the deburring system with a ROBO Cylinder.

Point 1 Eliminating the need to change the tool stopping position and achieving a longer life

(1) Condition When using an Air Cylinder

The air cylinder is used to move up and down the motorized spindle to which the deburring brush is attached.

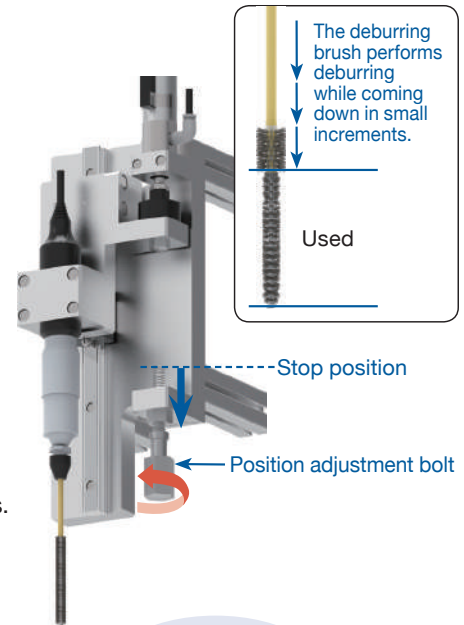
The deburring brush will wear after repeated deburring at the same position. Accordingly, the position of the deburring brush must be changed periodically.

The condition of the work is visually inspected, and if the work has not been deburred sufficiently, the stopping position of the air cylinder rod is lowered by approx. 1 mm to perform deburring again.

The operator changes the position using the adjustment bolt. This operation takes approximately 2 minutes and is performed every 15 minutes or so. (Average 43 times/day)

This adjustment is repeated and when the deburring brush is finally consumed, the brush is replaced.

One deburring brush can perform an average of 6,000 deburring cycles.



(2) Improvements Found with the ROBO Cylinder

The ROBO Cylinder lets you program operation patterns beforehand.

As for repositioning of the deburring brush, a test was conducted to examine and program optimal values for the number of deburring cycles and the pitch of downward feed.

When the deburring brush reaches its life, a lamp turns on to notify the operator.

By programming the ROBO cylinder and automating the operation, the need to reposition the deburring brush was eliminated. Also, the stopping position can now be changed in 0.5-mm increments, allowing one deburring brush to increase its performance to 8,000 deburring cycles.

The stopping position of the deburring brush is changed automatically.



Number of times the tool stopping position is changed

Air cylinder

Average **43** times/day

ROBO Cylinder

0 times/day

Number of deburring cycles (Tool life)

Air cylinder

Average **6,000** times/piece

ROBO Cylinder

8,000 times/piece

Point 2

Significantly shorter cycle time,

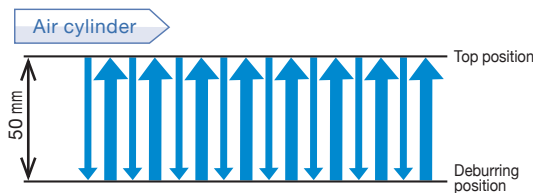
achieved by speed change during use and optimized operation pattern

Operation pattern per cycle



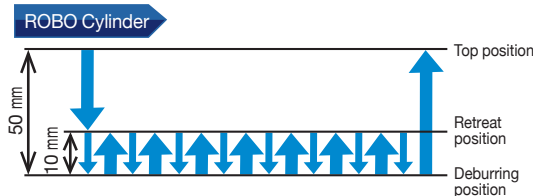
(1) Condition When using an Air Cylinder

With the air cylinder, the speed cannot be changed during operation.
 To suppress impact when the deburring brush contacts the work, the brush comes down at low speed and rises at high speed.
 The cycle time per work (deburring of 8 locations) is 28.0 seconds.



(2) Improvements Found with the ROBO Cylinder

The ROBO Cylinder lets you change the operating speed while the system is in operation.
 The brush comes down at high speed to immediately before the deburring position, after which the speed changes to low.
 After the deburring, the brush can now rise at high speed.
 Also, the ROBO Cylinder can move to any desired position, so the distance of rise can be minimized (10 mm).



As a result, the cycle time was reduced to 18.4 seconds.

Processing cycle time (Average time excluding work setting/removal time)



28.0 seconds



18.4 seconds

Point 3

Number of replacement units required when the system is used for 10 years:

6 Air Cylinders = 0 ROBO Cylinder

(1) Condition When using an Air Cylinder

The air cylinder drops its speed (thrust force) after 2 million operations or so due to deterioration of gaskets, etc.
 The air cylinder reaches its life expectancy in approximately 1.5 years and then needs to be replaced.

(2) Improvements Found with the ROBO Cylinder

By adopting the ROBO Cylinder, the service life was extended. In this example, the ROBO Cylinders will last for 10 years or longer.

Service life (in this example)



Approx. 1.5 year



10 years or longer

7 Benefits of the ROBO Cylinder

- With the ROBO Cylinder, the speed, acceleration, and deceleration can be set for each position.
 A stable movement is possible by setting the best speed, acceleration, and deceleration.
- You can also change the speed during use.



Please visit here for "The 7 Benefits of the ROBO Cylinder"



www.intelligentactuator.com/7

3 Cost Cutting Effect

(1) Conditions

| | |
|------------------------------|------------------------------|
| Required production quantity | 650 pieces/day |
| Labor cost | \$18*/hour (1 person/system) |
| Deburring brush | \$20*/piece |
| Annual operation days | 250 days |

(2) Prices of adopted ROBO Cylinders

| Product model | Price |
|--------------------------------|--------|
| RCP3-SA4C-I-35P-2.5-100-P1-S-B | \$443* |
| PSEL-CS-1-35PIB-NP-2-0 | \$440* |


(3) Comparison of air cylinder and ROBO Cylinder

| Item | System using air cylinder | System using ROBO Cylinder |
|---|--|--|
| Cycle Time | 58.0 seconds/piece [1] Processing cycle time 28.0 seconds [2] Work changeover by operator Average 30 seconds [1] + [2] = 58.0 seconds | 48.4 seconds/piece [1] Processing cycle time 18.4 seconds [2] Work changeover by operator Average 30 seconds [1] + [2] = 48.4 seconds |
| Line operating hours | 11.9 hours/day [1] Manufacturing time 10.5 hours [2] Tool height adjustment time 2 minutes x 43 times = 1.43 hours [1] + [2] ≈ 11.9 hours | 8.7 hours/day * There is no adjustment time, because the height is adjusted automatically. |
| Labor cost | \$53,550*/year 11.9 hours x 250 days x \$18* = \$53,550* | \$39,150*/year 8.7 hours x 250 days x \$18* = \$39,150* |
| Annual tool cost | \$4,340*/year 217 pieces x \$20* = \$4,340* (Average processing runs per piece: 6,000 times) | \$3,260*/year 163 pieces x \$20* = \$3,260* (Average processing runs per piece: 8,000 times) |
| Purchase Cost of Replacement Cylinder (Assuming 10 years) | \$720*/10 years Air cylinder \$120*/unit x Approximately 6 replacements (Service life 1.5 years/unit) = \$720* | \$0*/10 years |

Exterior View after Improvement (ROBO Cylinder adopted)


Please visit here for the video.
www.intelligentactuator.com/eac-v04





RCP3-SA4C

Conventional system



Guide

◆ Facility Benefits of Adopting ROBO Cylinders

- Reduction of component parts (guides, etc.)

(4) Annual cutting effect

| | Air Cylinder | ROBO Cylinder | | |
|---------------------------------------|----------------------------|---------------|---|------------------|
| Labor cost | \$53,550* | \$39,150* | = | \$14,400* |
| Annual tool cost | \$4,340* | \$3,260* | = | \$1,080* |
| Purchase Cost of Replacement Cylinder | \$72* (\$720*/10 years) | \$0* | = | \$72* |
| Difference = | | | | \$15,552* |

Result

There is **no more adjustment** work during processing, while the tool life increased to **1.3 times** and the cycle time decreased by **17%**.

This resulted in significant labor cost reduction of **\$15,552*** a year.

What's more, the ROBO Cylinder need not be replaced for at least 10 years.

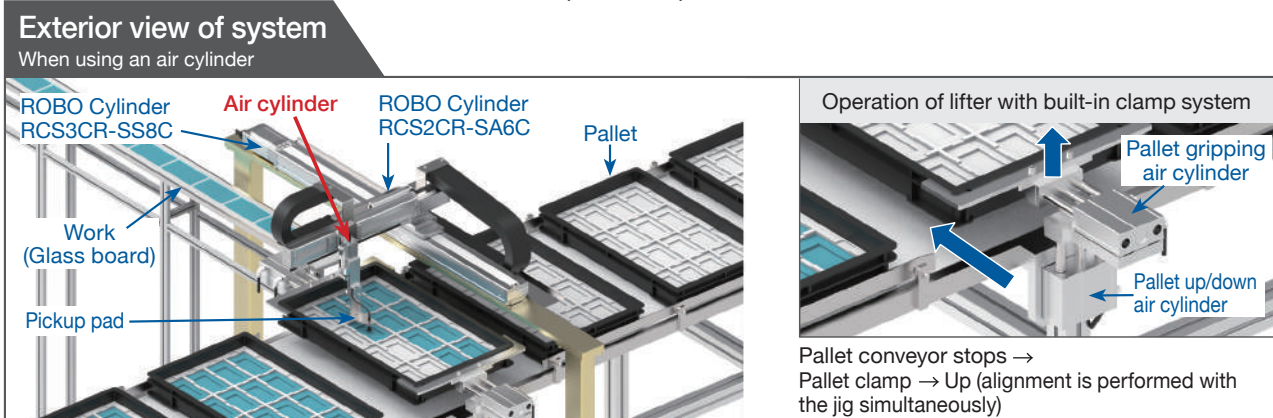
* Exchange Rate: 1(USD)=100(Japanese Yen)

Archiving the operation path to reduce the cycle time by 25%

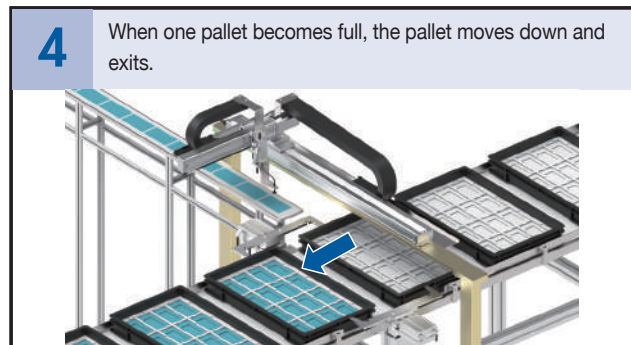
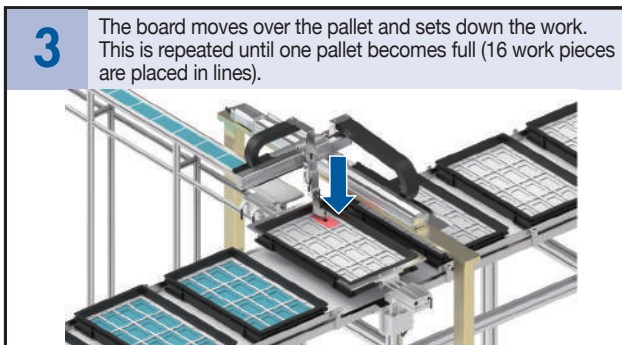
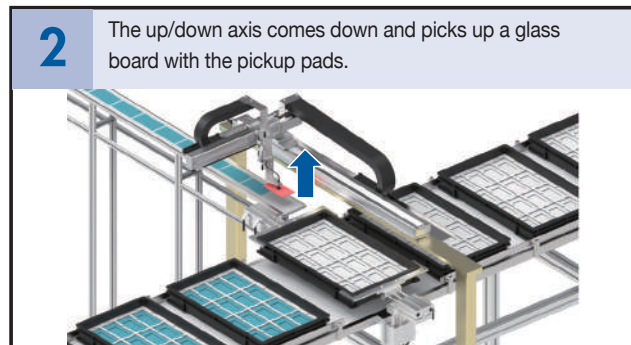
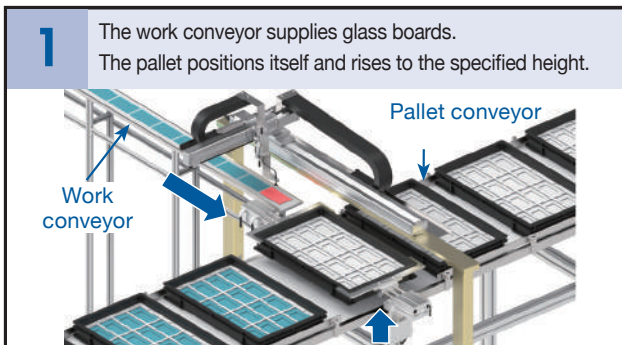
1 System Overview

(1) Explanation of Process

Glass boards are placed on a pallet in this process.
 16 work pieces are placed in lines on one pallet.
 This process is performed in a clean room.



(2) Explanation of Operation



Issues Requiring Improvement

1. Shorten the cycle time
2. Shorten the changeover time

2 Improvements Achieved by the ROBO Cylinder

The issues were resolved by replacing the air cylinder used for the up/down axis of the transfer system with a ROBO Cylinder.

Point 1 Reducing the travel time with arch motion

(1) Problems Experienced While Using the Air Cylinder

It takes an average of 4 seconds* to transfer one work piece.

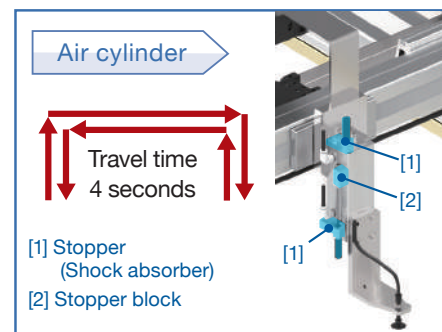
* Time needed to pick up a work piece from the conveyor and put it on the pallet, and then return to above the work conveyor. The transfer speed varies at different positions within the pallet depending on how close or far the position is to/from the work conveyor.

It takes 64 seconds to position work pieces on one pallet.

The cycle time must be reduced to meet the customer's request for production increase.

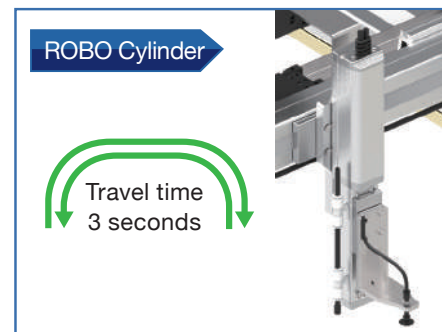
The request cannot be met with the current system that uses an air cylinder for the up/down axis.

Operation path of up/down axis per cycle



(2) Improvements Found with the ROBO Cylinder

By replacing the up/down axis with one based on the ROBO Cylinder, the axis can be interlocked with the horizontal axis to perform arch-motion operation (figure on the right). This enabled the shortest travel path.



As a result, the transfer time was reduced.

It now takes an average of 3 seconds to transfer one work piece, and 48 seconds to line up all the work pieces.

Work positioning time (Time needed to place all 16 work pieces on one pallet, excluding pallet changeover time)

Air cylinder

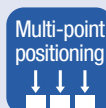
64 seconds

ROBO Cylinder

48 seconds

7 Benefits of the ROBO Cylinder

- With the ROBO Cylinder, the speed, acceleration, and deceleration can be set for each position. A stable movement is possible by setting the best speed, acceleration, and deceleration.
- You can also change the speed during use.



Please visit here for "The 7 benefits of the ROBO Cylinder"

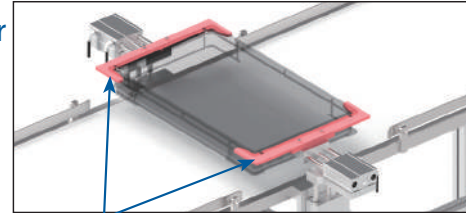


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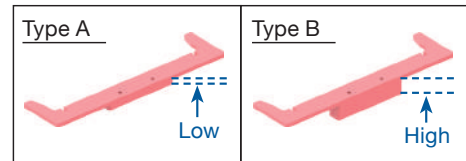
Point 2 Shorter changeover time

(1) Problems Experienced While Using the Air Cylinder

Several types of pallets are used, each having a different height. With an air cylinder, dedicated jigs are used to adjust the pallet heights because the travel distance remains the same (figure on the right). Changeover of these dedicated jigs takes approx 10 minutes, and two changeovers are required per day.



Dedicated jigs for pallet height adjustment



(2) Improvements Found with the ROBO Cylinder

The ROBO Cylinder can be stopped at desired positions. Programs are created beforehand for different pallet heights. This eliminates the need to replace dedicated jigs to adjust the pallet heights.



When changing pallets, all you need to do is switch the programs.

| Changeover time | |
|---------------------------|----------------------------|
| Air cylinder → 10 minutes | ROBO Cylinder → 0.2 minute |

Point 3 Number of replacement units required when the system is used for 10 years:
13 Air Cylinders = 0 ROBO Cylinder

Air cylinders have an average service life of approx. 2 million operations, which translates to approx. 0.7 year in this example. ROBO Cylinders have a service life of 10 years or longer.

| Service life (in this example) | |
|---------------------------------|------------------------------------|
| Air cylinder → Approx. 0.7 year | ROBO Cylinder → 10 years or longer |

3 Cost Cutting Effect

(1) Conditions

| | |
|------------------------------|--|
| Required production quantity | 12,000 pieces/day |
| Labor cost | \$18*/hour One operator oversees three lines. |
| Annual operation days | 240 days |

(2) Prices of adopted ROBO Cylinders

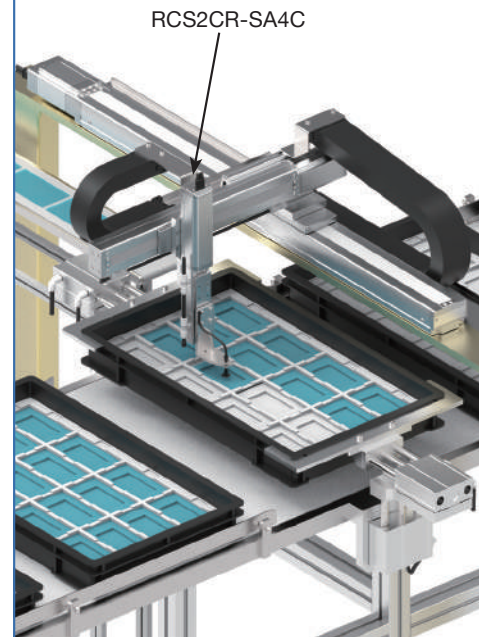
| Product model | Price |
|--|----------|
| RCS2CR-SA4C-WA-20-10-50-T2-S-B | \$1,080* |
| XSEL-P-3-150WAI-30DWAI-20WAIB-NI-EEE-3-3 | \$3,405* |

(3) Comparison of air cylinder and ROBO Cylinder

| Item | System using air cylinder | System using ROBO Cylinder |
|---|--|--|
| Cycle Time | 80 seconds/pallet | 64 seconds/pallet |
| | [1] Transfer of 1 work piece 4 seconds [2] Pallet changeover time 16 seconds [1] x 16 times + [2] = 80 seconds | [1] Transfer of 1 work piece 3 seconds [2] Pallet changeover time 16 seconds [1] x 16 times + [2] = 64 seconds |
| Line operating hours | 17 hours/day | 13.34 hours/day |
| | [1] Manufacturing time 16.67 hours [2] Changeover time 0.33 hour [1] + [2] = 17 hours | [1] Manufacturing time 13.33 hour [2] Changeover time 0.01 hour [1] + [2] = 13.34 hours |
| Labor cost | \$73,440*/year | \$57,628.8*/year |
| | 17 hours x 240 days x \$18* = \$73,440* | 13.34 hours x 240 days x \$18* = \$57,628.8* |
| Purchase Cost of Replacement Cylinder (Assuming 10 years) | \$7,800*/10 years | \$0*/10 years |
| | Air cylinder \$600*/unit x 13 replacements (Service life 0.7 year) = \$7,800* | |

Exterior View after Improvement (ROBO Cylinder adopted)

Please visit here for the video.
www.intelligentactuator.com/eac-v04



(4) Annual Cutting Effect

| | Air cylinder | ROBO Cylinder | Difference |
|---------------------------------------|--|---------------|----------------------------------|
| Labor cost | \$73,440* | \$57,628.8* | \$15,811.2* |
| Purchase Cost of Replacement Cylinder | \$780* (Air cylinder \$7,800* / 10 years) | \$0* | \$780* |
| | | | Difference = \$16,591.20* |

Result

The cycle time decreased by **25%** and the changeover time dropped to 1/50th or less.

This resulted in significant labor cost reduction of **\$16,591.20*** a year.

What's more, the ROBO Cylinder need not be replaced for at least 10 years.

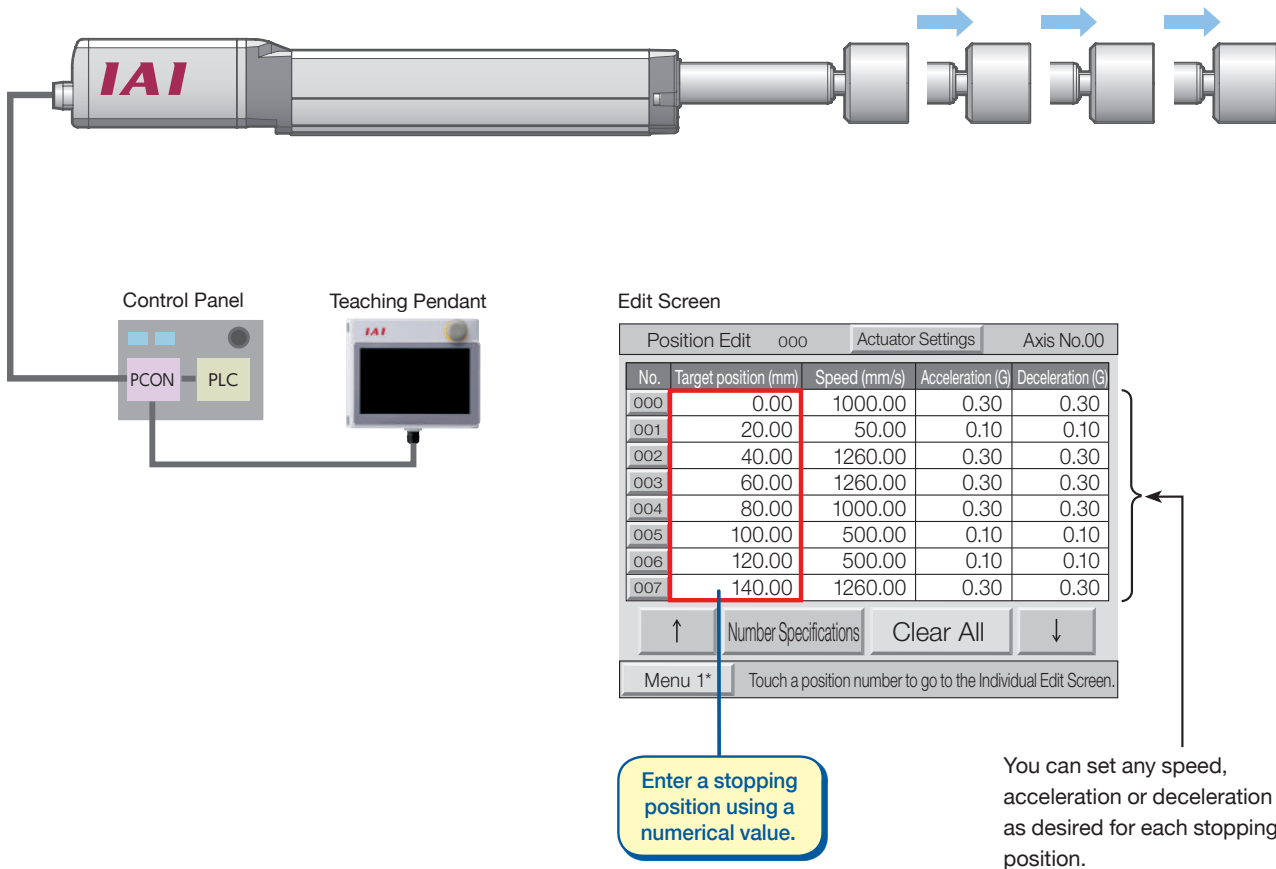
* Exchange Rate: 1(USD)=100(Japanese Yen)

4: Multi-point Positioning

The ROBO Cylinder supports multi-point positioning.

The ROBO Cylinder lets you set stopping positions easily from the teaching pendant using numerical values (coordinates from the home position).

Accurate positioning can be performed, to a maximum of 512 points.



[Air Cylinder]

Air cylinders are rarely used for multi-point positioning.

An air cylinder can be stopped at a given position by setting a stopper. To perform multi-point positioning, another air cylinder is needed to drive the stopper.

Also, a shock absorber is needed to prevent impact upon stopping.

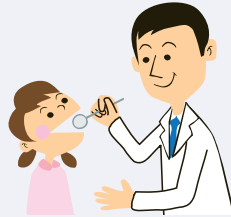
Visual Inspection Method

Purpose of Visual Inspection

The purpose is to prevent problems.
 Find abnormalities early and remove their causes to eliminate problems.

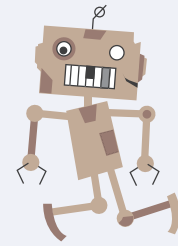


It's like visiting a dentist regularly to eliminate cavities!

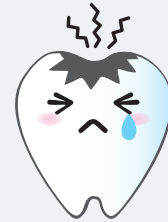


What happens if nothing is done?

Failure may occur and the line may stop.



You may have cavities.



What to inspect?

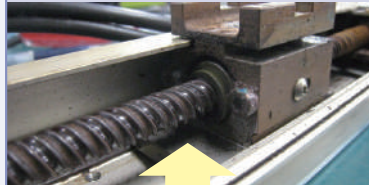
Visually inspect both the interior and exterior of the equipment.

Cable



Sheath worn or scratched?

Ball screw, guide



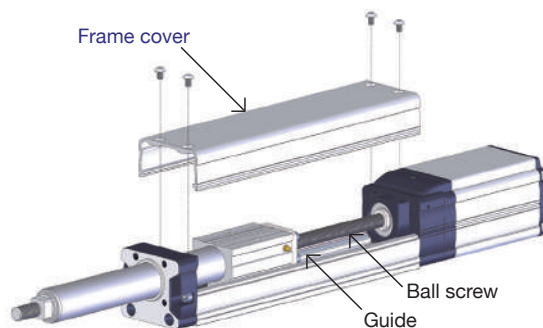
Grease dried up, or any dust or dirt?
 Any cracks or dents?

Stainless sheet



Any cracks or dents?

Checking the interior of the rod-type actuator is so easy!



The reference drawing shows the rod-type radial cylinder RCP5.

[Visual Inspection Procedure]

- [1] Remove the frame cover. ^(Note)
- [2] Visually check the rod, ball screw, and guide groove.
- [3] Clean and add grease, if necessary.
- [4] Install the frame cover.

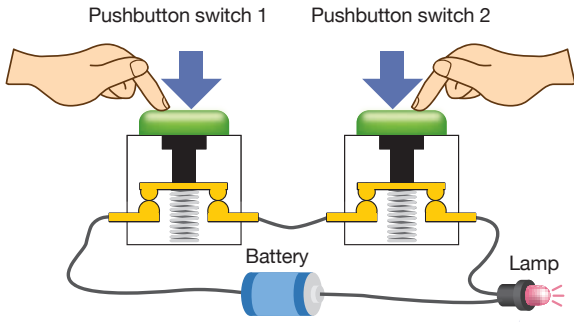
(Note) The cover is removed differently depending on the model, and the inspection intervals also vary according to the conditions of use. For details, refer to the operation manual.

4: AND Circuit and OR Circuit

AND circuit

In sequence control, a circuit that actuates when two or more contacts connected in series turn ON, is called an “AND Circuit.” The example below shows an “AND Circuit” that turns on a lamp using two pushbuttons.

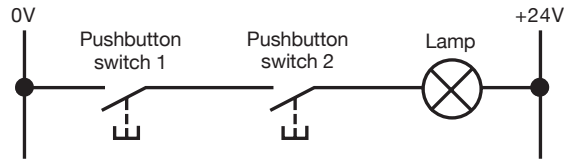
1. Example of Wiring



The lamp is off when either switch is not pressed. The lamp turns on when both switches is pressed.

2. Circuit Diagram

The circuit diagram below assumes a 24-VDC power supply ^(Note) commonly used for control circuits of actual mechanical systems. This circuit diagram is called a “Development Connection Diagram.” The symbols used on the diagram are specified by JIS C 0617.

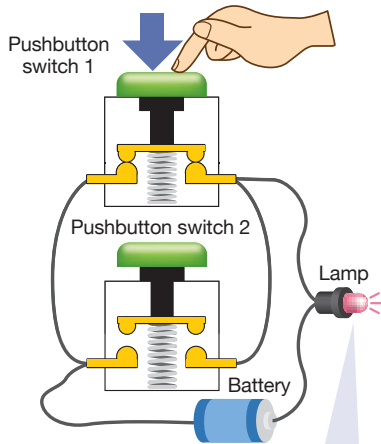


(Note) The power-supply circuit is not shown.

OR circuit

A circuit that actuates when at least one of two or more contacts connected in parallel turns ON, is called an “OR Circuit.” The example below shows an “OR Circuit” that turns on a lamp using two pushbuttons.

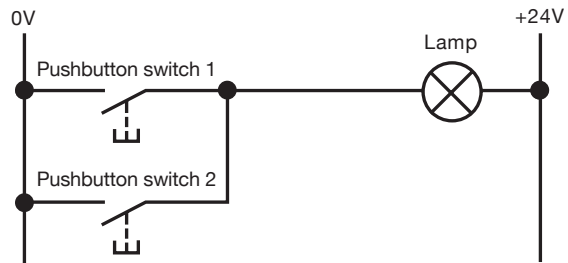
1. Example of Wiring



The lamp is off when both switches are not pressed. The lamp turns on when either switch is pressed.

2. Circuit Diagram

The circuit diagram below assumes a 24-VDC power supply ^(Note).

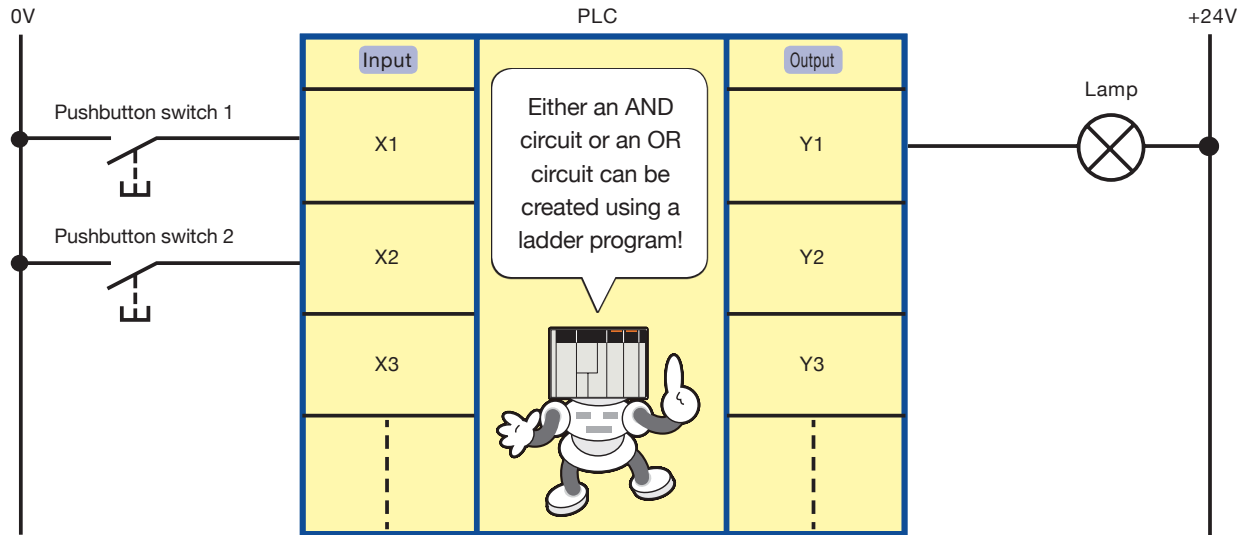


(Note) The power-supply circuit is not shown.

“AND Circuit” and “OR Circuit” Using PLC

If a PLC is used, connect the pushbutton switch wires to input terminals of the PLC, and connect the lamp wire to an output terminal of the PLC.
 The wiring is the same for an “AND circuit” and an “OR circuit,” because both are created by writing a ladder program in the PLC.

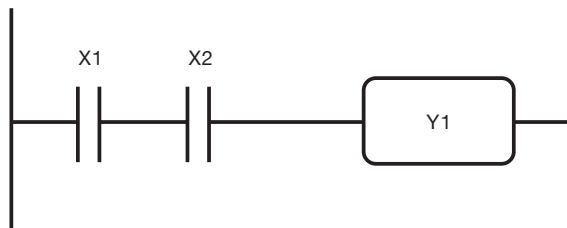
1. PLC I/O Circuit Diagram



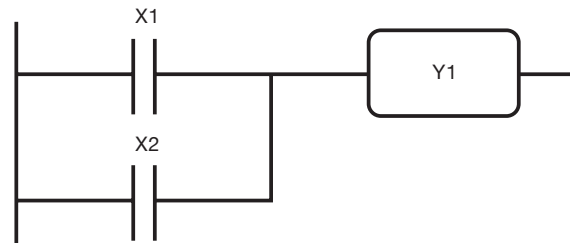
2. Ladder Program

A PLC lets you design circuits using software, instead of traditional relays.
 A dedicated software program is used to create circuits as if drawing relay circuits. This program is called “Ladder Program.”
 Under a ladder program, pushbutton switch 1 is replaced by contact X1, pushbutton switch 2 is replaced by contact X2, and the lamp is replaced by relay coil Y1. X1, X2 and Y1 are called “Addresses.”

(1) AND circuit



(2) OR circuit



4: Repeated Operations and Jump

Use the TAG command and GOTO command if you want to repeat the same operation, or ignore an operation depending on the condition, in the program.

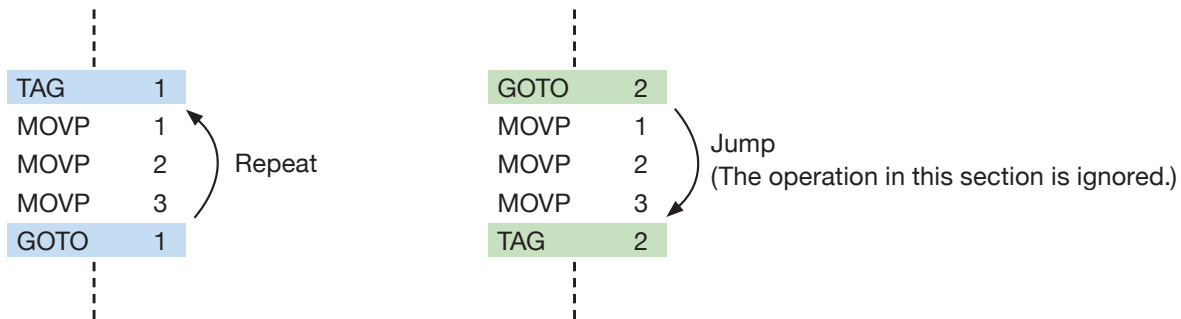
1. Commands and their functions

(1) TAG (Jump To)

Used as a destination for the GOTO (Jump) command.
 This command is used to indicate where to jump to after the GOTO command, using a number.
 The TAG command can appear before or after the GOTO command.

(2) GOTO (Jump)

This command lets you repeat a section of the program and jump to a specified location.
 Processing jumps to a tag of the same number as the one specified by GOTO.
 If a tag of the specified number exists before the current position, processing returns to that tag and repeats the applicable section of the program.
 If a tag of the specified number exists after the current position, processing jumps to that tag and ignores the skipped section of the program.

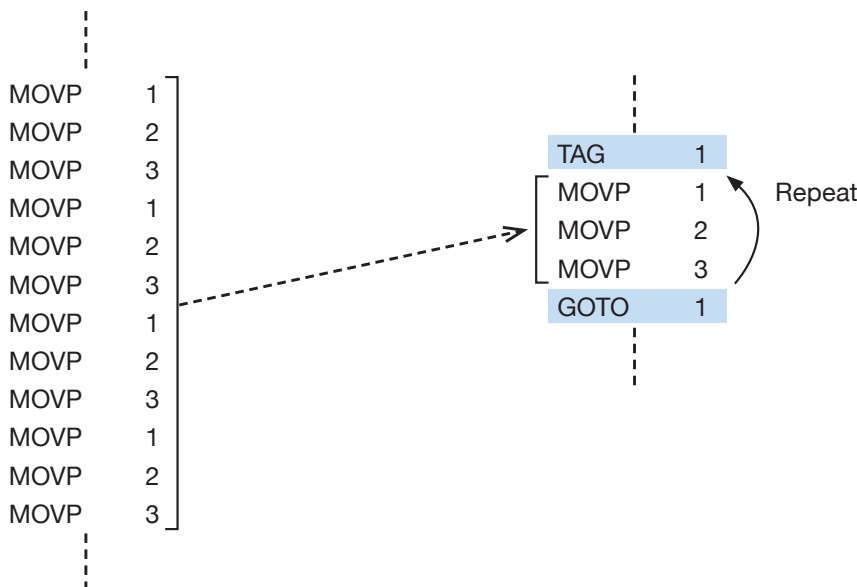


2. Using TAG/GOTO

Assume you want to repeat positioning to Nos. 1, 2 and 3

[1] Without the TAG/GOTO commands, you must continue to write the same commands.

[2] By using the TAG/GOTO commands, all you need are five lines.



The program has become so short.



Product Information

Battery-less Absolute Encoder (877) SERV098
 Toll Free Fax (877) SERV099
 No Battery, No Maintenance, No Homing, and No Power Increase
 www.electromate.com
 sales@electromate.com

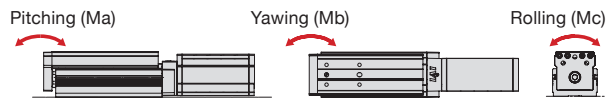
ROBO Cylinder® RCP6 Series Table Type (TA)

– All models come standard with battery-less absolute encoder –

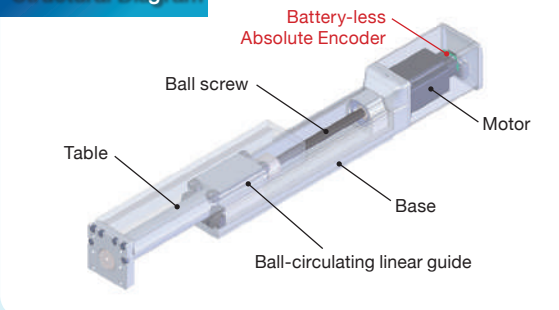
Feature

- You can mount tooling using the tapped holes in the table top and the end plate.
- The table has built-in ball-circulating guides to handle pitching (Ma), yawing (Mb) and rolling (Mc) moments.

<Moment directions for table type>



Structural Diagram

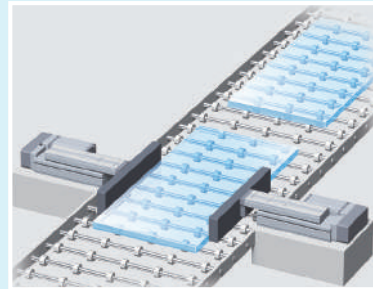


Applications

- Replacing table-type air cylinders
- Clamping work pieces from left and right
- Aligning work pieces to one side on a conveyor
- Positioning and pressing work pieces at the front face of a table
- Vertically moving axes in orthogonal axis combinations

Example of Use

Positioning work pieces on a conveyor



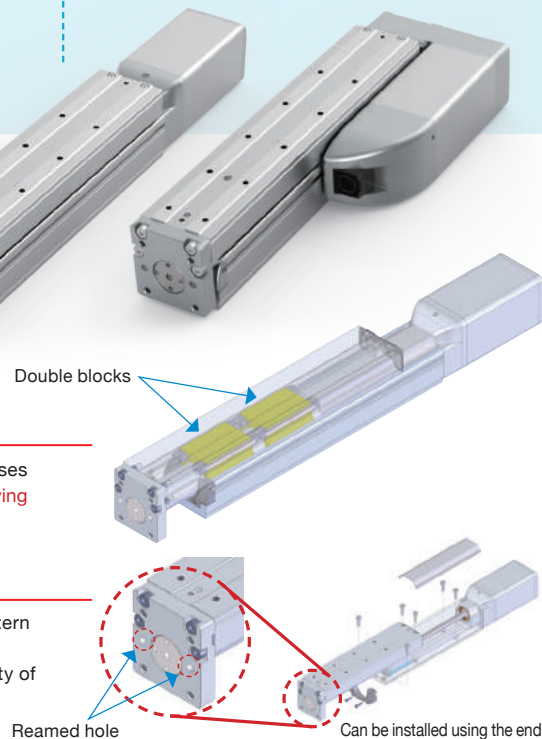
New Function

Double-block specification (optional) is available

Compared to the single block specification, the use of two guide blocks increases the allowable dynamic moment to up to **4.3 times** in the **pitching (Ma)** and **yawing (Mb)** directions and also **doubles** the payload (horizontal).

Easy to install

The actuator can now be installed on its end plate. The added mounting pattern allows you to use the actuator in additional configurations. Also, the reamed holes added to the end plate ensure positioning repeatability of work pieces.



Please visit here for detailed information.
<http://www.intelligentactuator.com/rcp6>



SPH04-1A (0417)
 IAI AMERICA, INC.
 2690 W. 237th STREET
 TORRANCE, CA 90505

Next-generation
 New ROBO Cylinder®

RCP6

Advantages of Products
 Equipped with
 Battery-less Absolute Encoder.



Customers can choose from an abundant lineup of 92 models that best suits their needs.

Cartesian Robots have never
 been more affordable.

IK Series

ROBO Cylinder® configurations
 Cartesian Robot

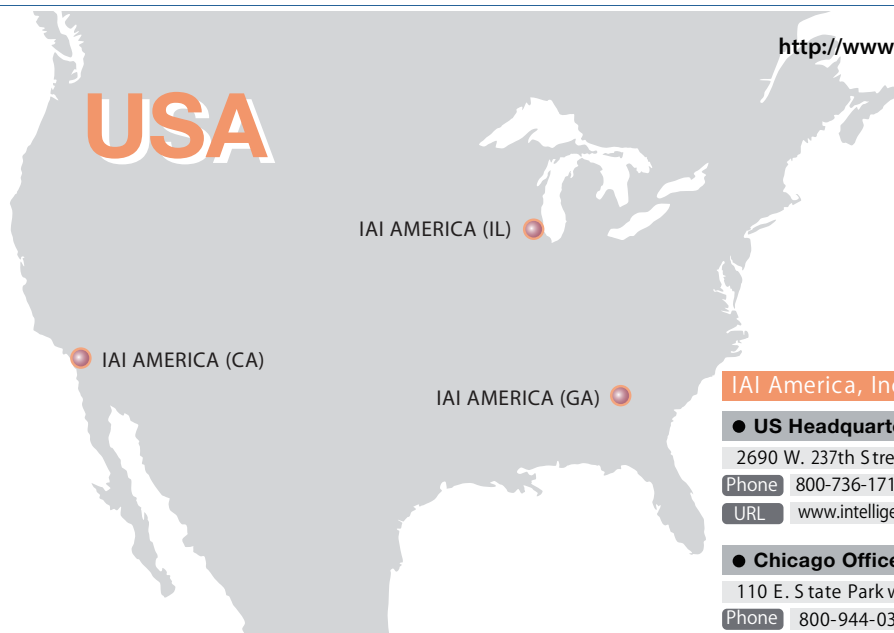
The ROBO Cylinder® equipped as standard with a Battery-less Absolute Encoder has been added to the "IK Series". It helps reduce the design and assembly steps. The ROBO Cylinder® RCP6 Series has been adopted to achieve even higher speeds compared with conventional models.



* Most product catalogs and overview catalog are also available. Please visit our website to download them.

SUPPORT Three IAI offices are available in the US to serve you.

Support for phase of planning, product selection, quotation, problem solving, maintenance, training, etc.



<http://www.intelligentactuator.com/inquiry/>



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The information contained in this booklet may change without prior notice due to product improvement.