Produced upon receipt of order

# Air Servo Cylinder

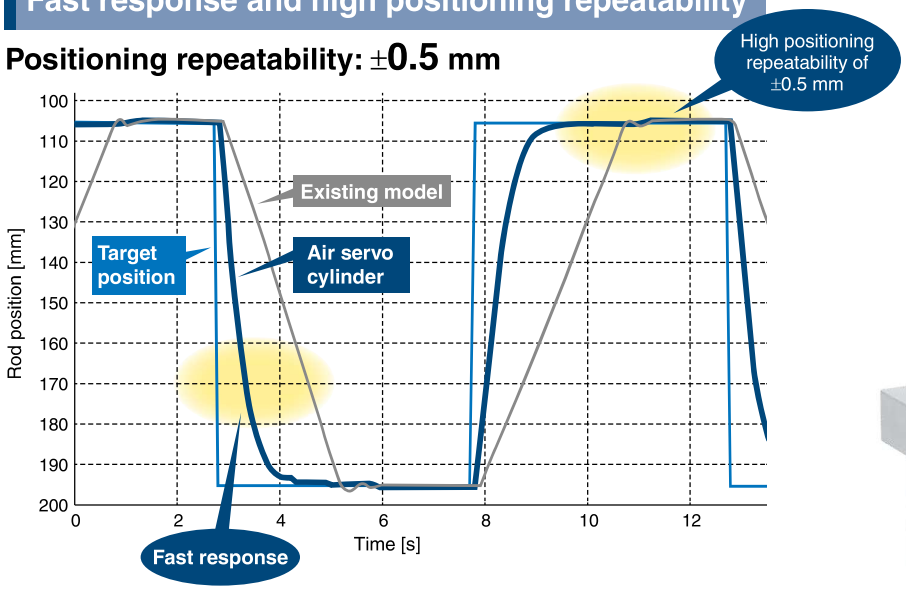
## ø125, ø160, ø200, ø250, ø320

IP67

## Capable of air cylinder multipoint positioning and control

### Fast response and high positioning repeatability

**Positioning repeatability: ±0.5 mm**




Measuring conditions Bore size: ø200 mm, Cylinder stroke: 200 mm, Load mass: 70 kg

### Easier maintenance due to unitization

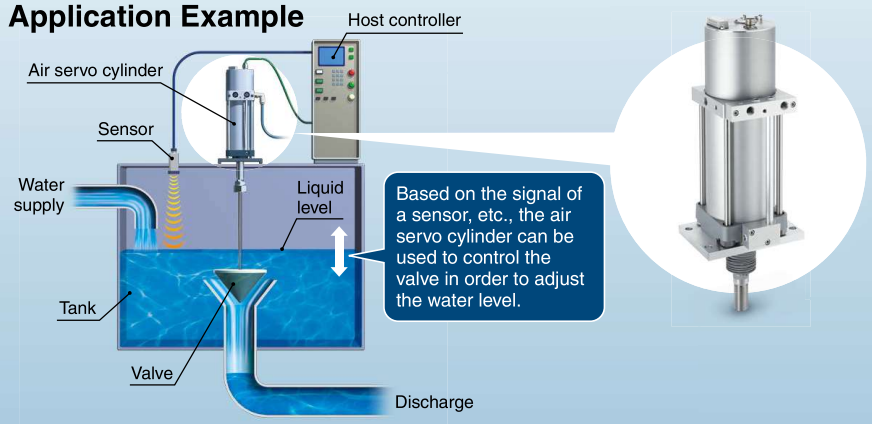
**The valve unit, pilot valve, controller assembly, seal kit, etc., are replaceable.**

### Easy initial setting

### Built-in self-diagnosis function (LED lamp and signal output)

### Emergency stop of the piston when the air or power supply is cut

### Application Example





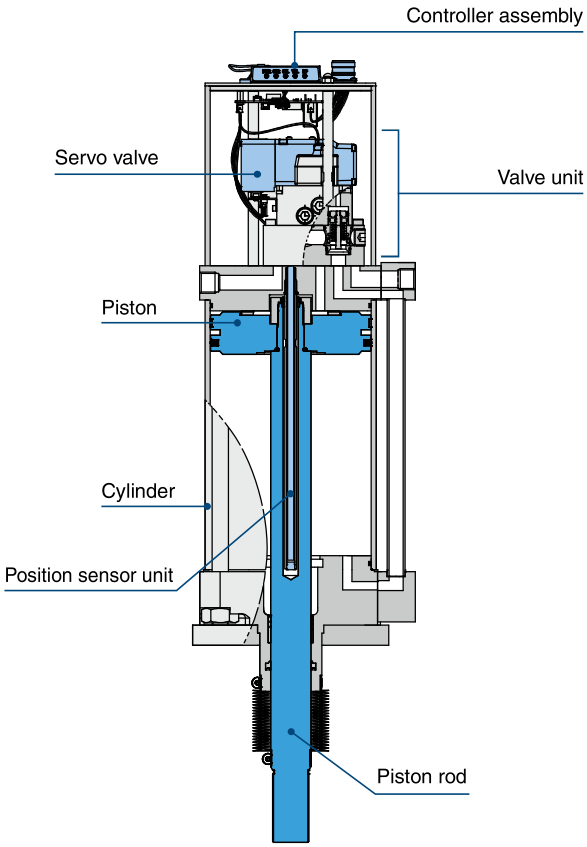

*IN-777*

P-E19-18

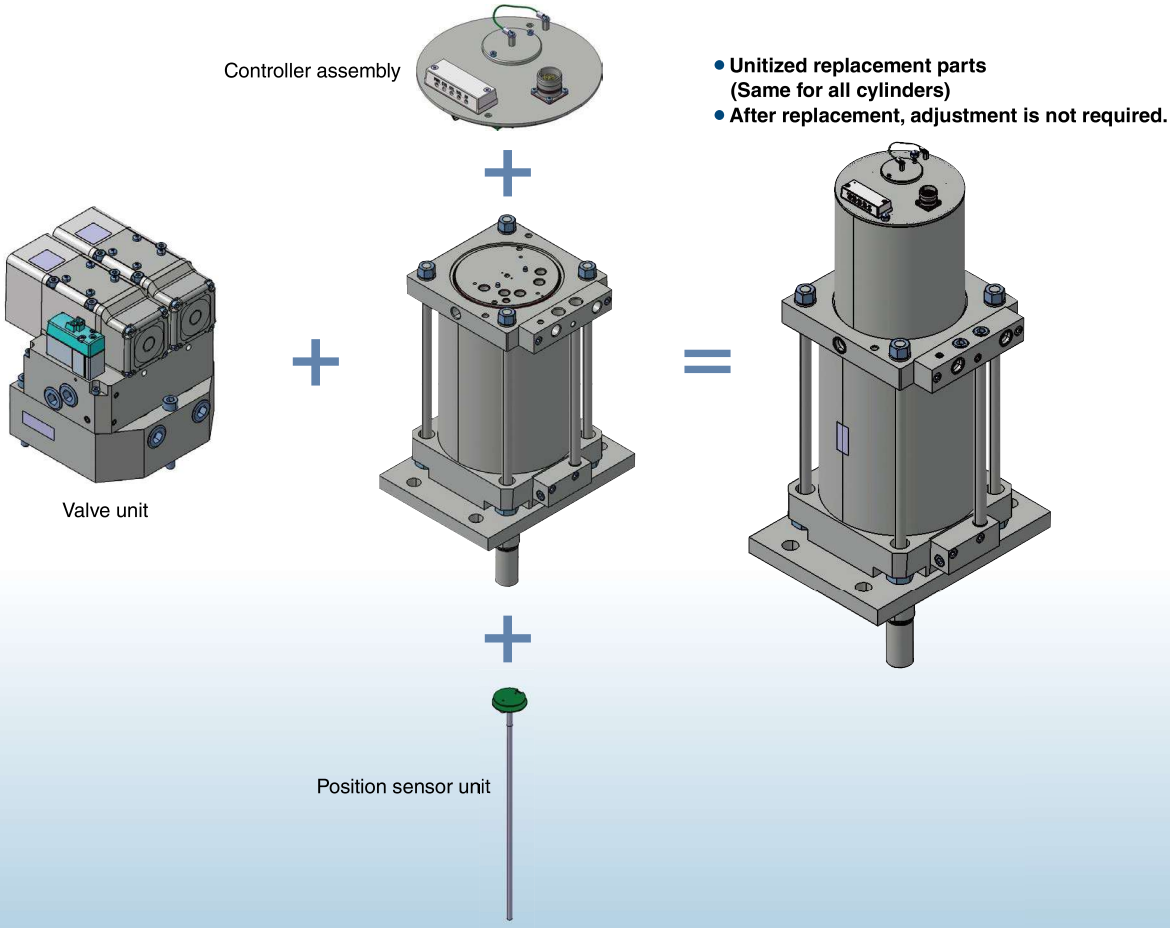
## Capable of air cylinder multipoint positioning and control

**With a built-in position sensor, the servo valve can be used to control the flow rate on both the head side and the rod side of the cylinder, and it can also be used to position the cylinder.**

## Cylinder with an integrated servo valve and controller



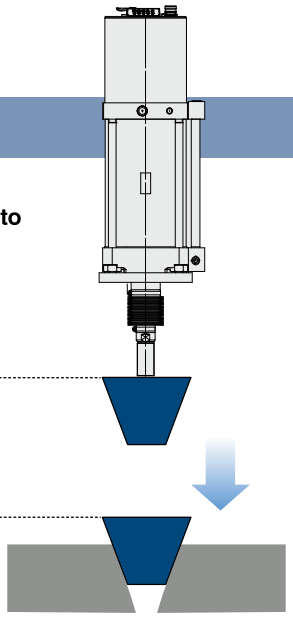

## Easier maintenance due to unitization p. 9




- **Unitized replacement parts (Same for all cylinders)**
- **After replacement, adjustment is not required.**

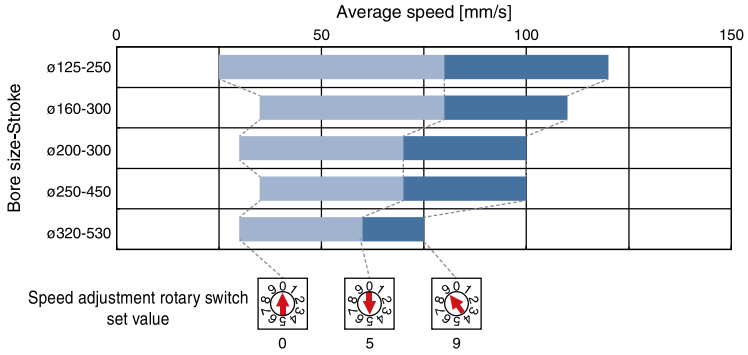
## Easy initial setting

**Input an I/O signal to move the rod forward, and set the rod stop position to 20 mA (or 4 mA).**




## Speed adjustment function

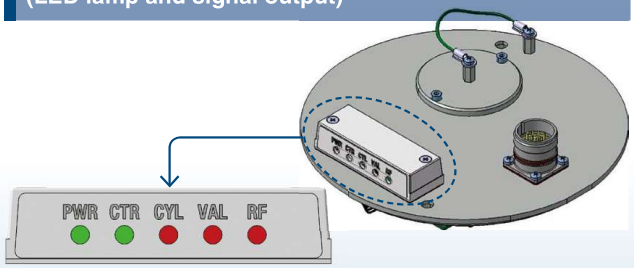
**Capable of 10-level speed setting**




| Measuring conditions | Supply pressure: 0.55 Mpa, Mounting: Vertical downward, Load: no-load, Operating direction: Upward |
|---|---|

* The average speed value is the stroke divided by the "full stroke time."
  The "full stroke time" refers to the time from when the target position operation signal is input until the piston stops.
* The average speed adjustment range of each cylinder size varies according to the operating conditions.
* The data above provide a guide for selection but is not guaranteed.

## Built-in self-diagnosis function
### (LED lamp and signal output)

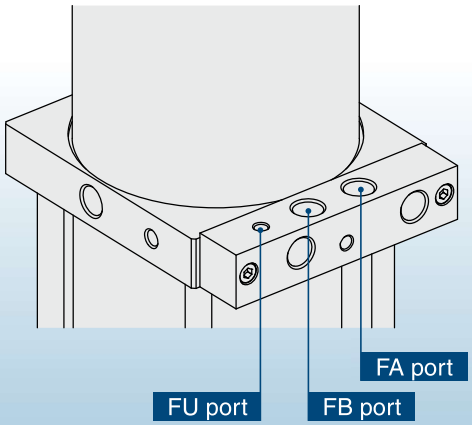



- LED display
- It is possible to output digital signals.

| LED display | |
|---|---|
| **PWR** | Power supply status |
| **CTR** | Controller status |
| **CYL** | Cylinder position sensor error |
| **VAL** | Valve error |
| **RF** | Rod friction error |

## Fail-safe ports

If the air servo cylinder air or power supply is cut, air from the emergency tank can be supplied via the FA/FB port in order to allow for the manual operation of the air cylinder rod.



# Air Servo Cylinder

# *IN-777*

## ø125, ø160, ø200, ø250, ø320

**Produced upon receipt of order**

CE RoHS

## How to Order

**IN – 777 – 160 TF – 300 F J – H L**

**Bore size**

| | |
|---|---|
| **125** | 125 mm |
| **160** | 160 mm |
| **200** | 200 mm |
| **250** | 250 mm |
| **320** | 320 mm |

**Port thread type**

| | |
|---|---|
| **TF** | G |

**Stroke [mm]**

| | |
|---|---|
| **125** | 250 |
| **160** | 200, 300 |
| **200** | 200, 300 |
| **250** | 350, 450 |
| **320** | 200, 350, 530*1 |

**Mounting**

| | |
|---|---|
| **F** | With rod flange |

**Rod boot**

| Symbol | Material | Ambient temperature |
|---|---|---|
| **J** | Silicone rubber | –20°C to 60°C (No freezing) |
| **A** | Nylon tarpaulin | –10°C to 60°C (No freezing) |
| **Nil** | None | –20°C to 60°C (No freezing) |

**Communication protocol**

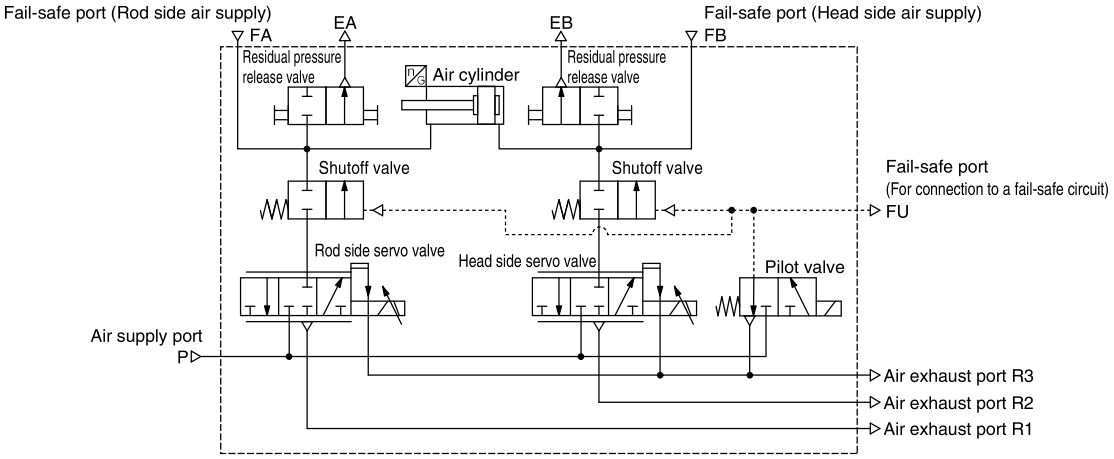
| | |
|---|---|
| **H** | 4-20 mA/HART communication |

**LED alarm display**

| | |
|---|---|
| **L** | With LED alarm display |

*1 The models specified above are classified as Class-2 Pressure Vessels, as stipulated in the order for enforcement of the Industrial Safety and Health Act, and they are therefore not for use within Japan.

## Pneumatic Circuit




## Specifications

### Electrical Specifications

| | |
|---|---|
| **Power supply** | Supply voltage: 24 VDC ±10% |
| **Control system** | Closed loop |
| **Position sensor** | Absolute |
| **Analog input signal** | 4 to 20 mA DC |
| **Analog input impedance** | Approx. 250 Ω |
| **Analog output signal** | 4 to 20 mA DC |
| **Analog output impedance** | 500 Ω |
| **Voltage between terminals** | 12 VDC (Equivalent to 600 Ω input resistance at 20 mA DC) |
| **Switch input signal** | 4 inputs, Connect to +24 VDC ±10% |
| | Current consumption: 10 mA or less |
| **Switch output signal** | 5 outputs, n-type MOSFET open source output |
| | Max. load current: 100 mA |
| **Communication protocol** | HART communication |

### Functional Specifications

- JOG operation
- No signal operation
- Self-diagnosis function (Allows for controller, valve, and position sensor error output when an abnormality is present)
- Fail-safe operation
- Calibration (Automatic/Manual)
- Emergency stop
- Residual pressure release valve mounted
- Target position operation
- Speed adjustment (10-level)

# Specifications

## Mechanical Specifications

| | |
|---|---|
| **Action** | Double acting, Single rod |
| **Fluid** | Air |
| **Compressed air filtration** | 0.3 μm or less |
| **Proof pressure** | 1.2 MPa |
| **Operating pressure range** | 0.55 to 0.8 MPa |
| **Positioning repeatability** | ±0.5 mm or less |
| **Average speed** | Refer to **Table 1**. |
| **Ambient temperature** | Silicone rubber material with or without rod boot: –20°C to 60°C (No freezing)<br>Nylon tarpaulin with rod boot: –10°C to 60°C (No freezing) |
| **Fluid temperature** | –20°C to 60°C (No freezing) |
| **Operating humidity** | 35 to 85% (No condensation) |
| **Enclosure** | IP67 |
| **Standards** | CE, RoHS |
| **Weight** | Refer to **Table 2**. |
| **Lubrication** | Non-lube |
| **Mounting orientation** | Vertical downward/Vertical upward |
| **Vibration resistance** | Total amplitude or acceleration: 1.5 mm or 3 G<br>Vibration frequency: 5 to 100 Hz<br>Vibration applying direction: 3 directions (X, Y, and Z)<br>Sweep time/cycle: 12 min/10 cycles |
| **Impact resistance** | Acceleration: 15 G<br>Pulse applying time/waveform: 11 ms/Sine wave<br>Pulse applying direction: 3 times in each direction (X, Y, and Z axes) |
| **Allowable lateral load** | Refer to **Table 3**. |
| **Theoretical output/Work load** | Refer to **Table 4**. |
| **Power supply connector (body)** | M23 19-pin connector (Male): Refer to **Table 5**. |

## Table 1 Average speed [mm/s]

| Bore size [mm] | Stroke [mm] | Speed adjustment rotary switch set value 0 | 5 | 9 |
|---|---|---|---|---|
| **125** | 250 | 25 | 80 | 120 |
| **160** | 200 | 35 | 70 | 95 |
| | 300 | 35 | 80 | 110 |
| **200** | 200 | 30 | 60 | 85 |
| | 300 | 30 | 70 | 100 |
| **250** | 350 | 35 | 70 | 95 |
| | 450 | 35 | 70 | 100 |
| **320** | 200 | 30 | 55 | 70 |
| | 350 | 30 | 60 | 75 |
| | 530 | 30 | 60 | 75 |

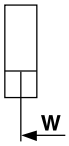
* The average speed value is the stroke divided by the "full stroke time." The "full stroke time" refers to the time from when the target position operation signal is input until the piston stops.
* The average speed adjustment range of each cylinder size varies according to the operating conditions.
* The data above shows values for the following measurement conditions. (Supply pressure: 0.55 MPa, Mounting: Vertical downward, Load: No load, and Operating direction: Upward)

## Table 2 Weight

| Bore size [mm] | Stroke [mm] | Weight [kg] |
|---|---|---|
| **125** | 250 | 24 |
| **160** | 200 | 37 |
| | 300 | 43 |
| **200** | 200 | 53 |
| | 300 | 61 |
| **250** | 350 | 86 |
| | 450 | 97 |
| **320** | 200 | 100 |
| | 350 | 129 |
| | 530 | 163 |

## Table 3 Allowable Lateral Load

| Bore size [mm] | Allowable lateral load [N] |
|---|---|
| **125** | 70 |
| **160** | 90 |
| **200** | 140 |
| **250** | 160 |
| **320** | 230 |




## Table 4 Theoretical Output/Max. Work Load

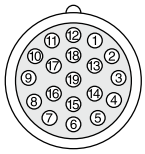
| Bore size [mm] | Theoretical output [N] Operating direction | Operating pressure [MPa] 0.55 | 0.8 | Max. work load [kg]*1 |
|---|---|---|---|---|
| **125** | IN | 6,400 | 9,200 | 160 |
| | OUT | 6,800 | 9,900 | |
| **160** | IN | 10,400 | 15,100 | 240 |
| | OUT | 11,100 | 16,100 | |
| **200** | IN | 16,600 | 24,200 | 240 |
| | OUT | 17,300 | 25,200 | |
| **250** | IN | 26,000 | 37,700 | 300 |
| | OUT | 27,000 | 39,300 | |
| **320** | IN | 42,700 | 62,100 | 300 |
| | OUT | 44,300 | 64,400 | |

Operating direction

↑ : IN
↓ : OUT

*1 Based on SMC's specific testing conditions

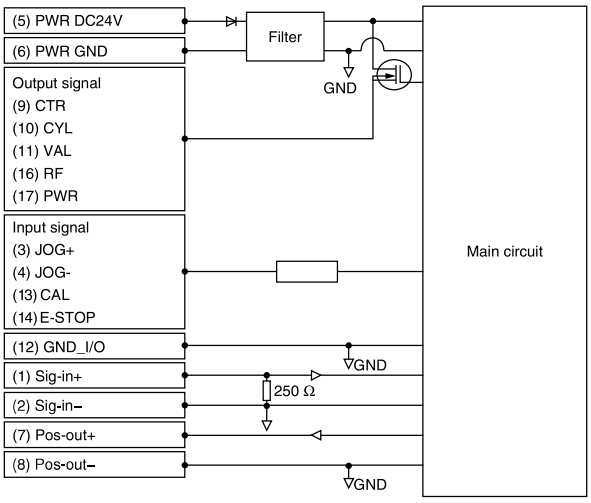
## Table 5 Connector Pin Numbers (Body Side)




| Pin no. | Signal name | IN/OUT | Description |
|---|---|---|---|
| 1 | Sig-in+ | IN | Analog signal (4-20 mA(+)), HART communication signal input |
| 2 | Sig-in– | IN | Analog signal (4-20 mA(–)), HART communication signal input |
| 3 | JOG+ | IN | JOG operation signal input (Moves to the rod side) |
| 4 | JOG– | IN | JOG operation signal input (Moves to the head side) |
| 5 | PWR DC24V | | Power supply +24 VDC |
| 6 | PWR GND | | Power supply GND |
| 7 | Pos-out+ | OUT | Analog position signal (+) output |
| 8 | Pos-out– | OUT | Analog position signal (–) output |
| 9 | CTR | OUT | Controller signal output |
| 10 | CYL | OUT | Position sensor error signal output |
| 11 | VAL | OUT | Valve error signal output |
| 12 | GND_I/O | | Signal GND |
| 13 | CAL | IN | Calibration signal input |
| 14 | E-STOP | IN | Emergency stop signal input*1 |
| 15 | — | | — |
| 16 | RF | OUT | Rod friction error signal output |
| 17 | PWR | OUT | Power supply error signal output |
| 18 | — | | — |
| 19 | — | | — |

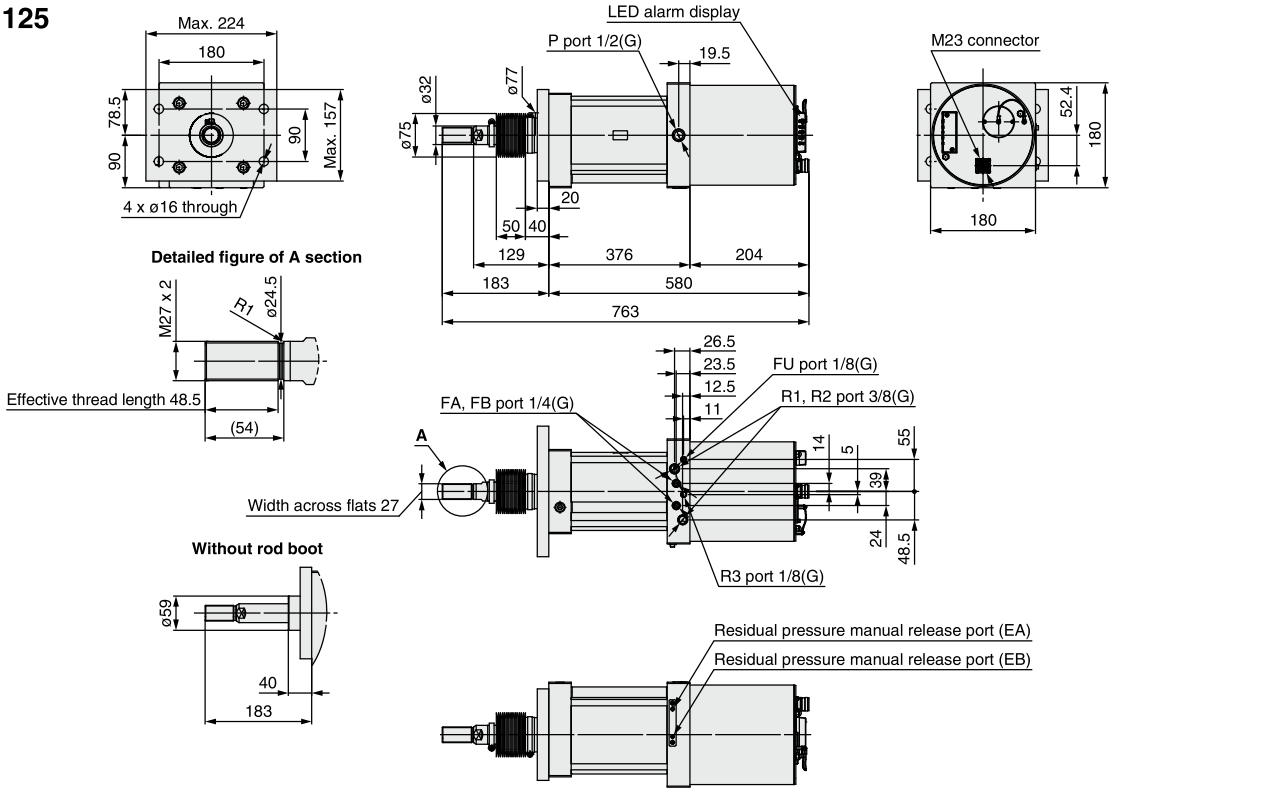
*1 When the signal is OFF, an emergency stop occurs. —: Cannot be connected

# Wiring Diagram

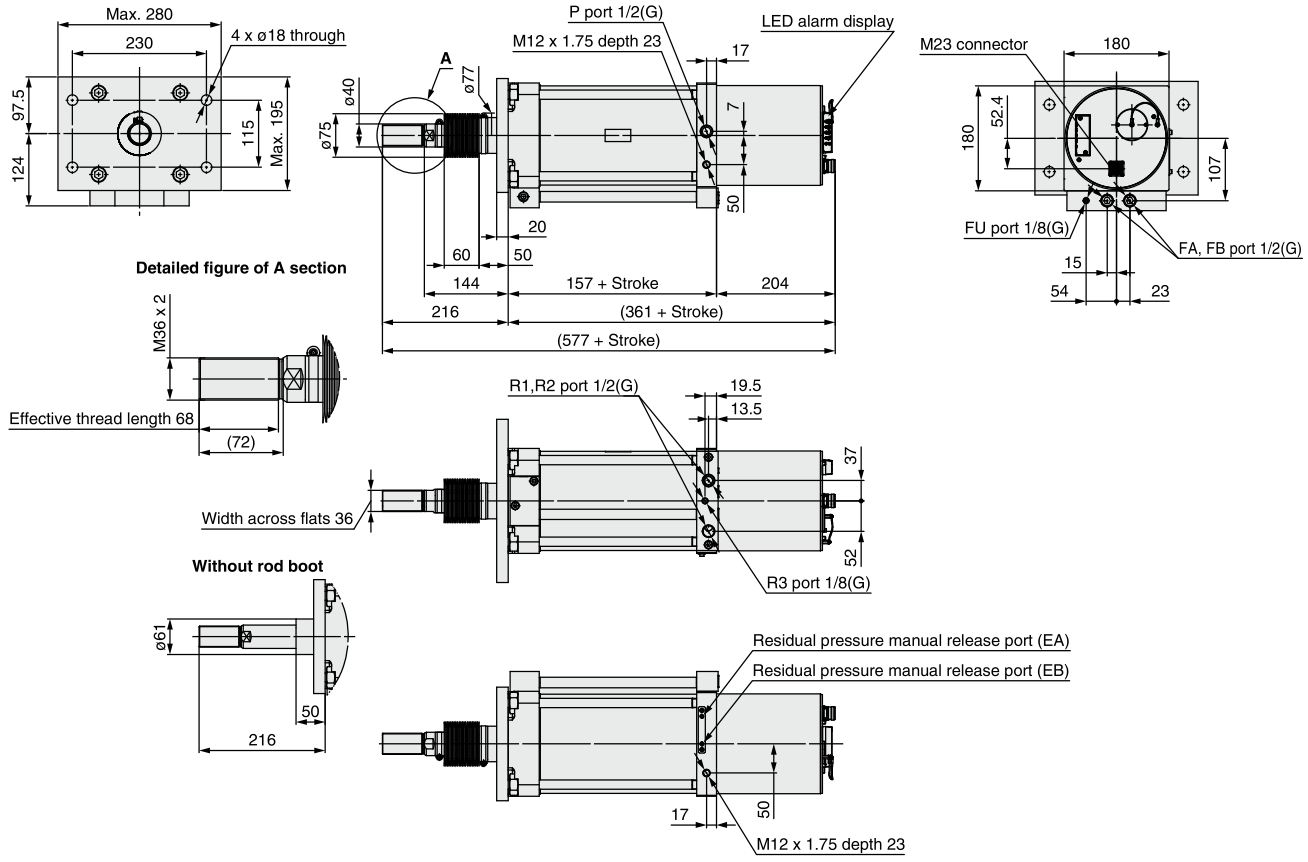


## Dimensions

### ø125

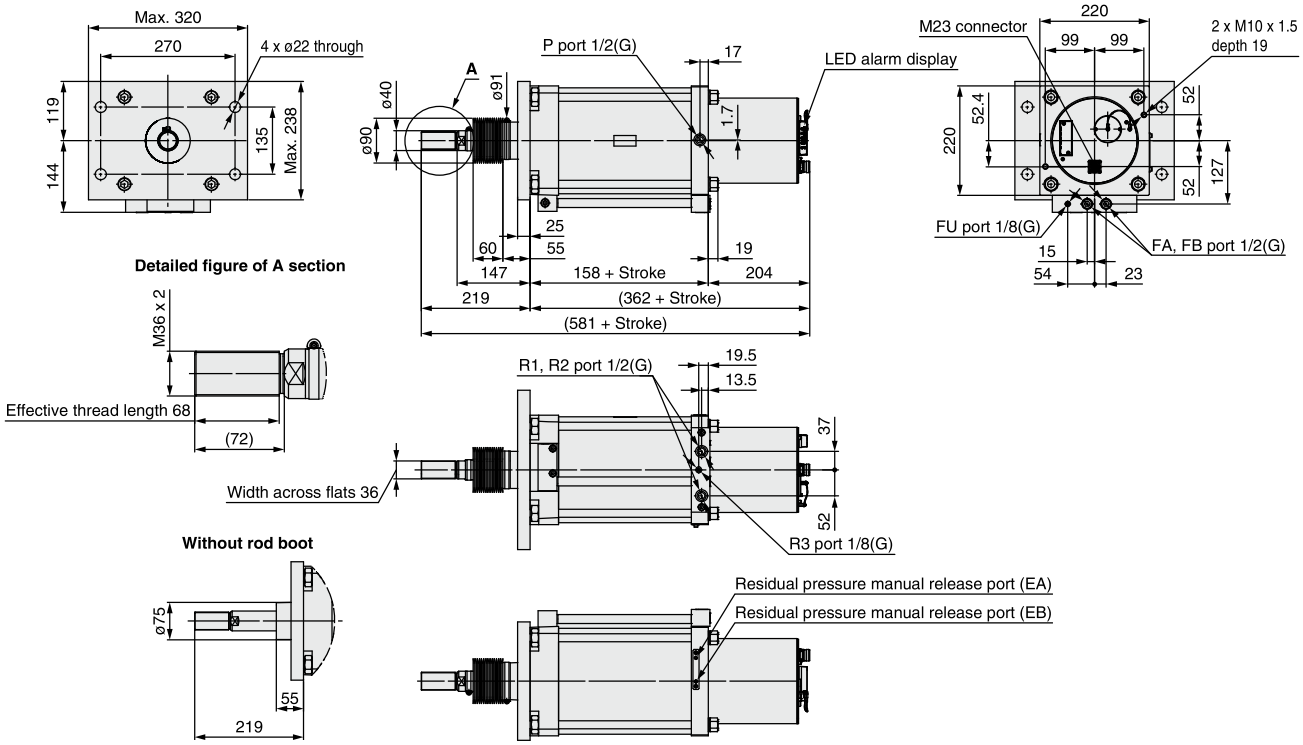



### ø160

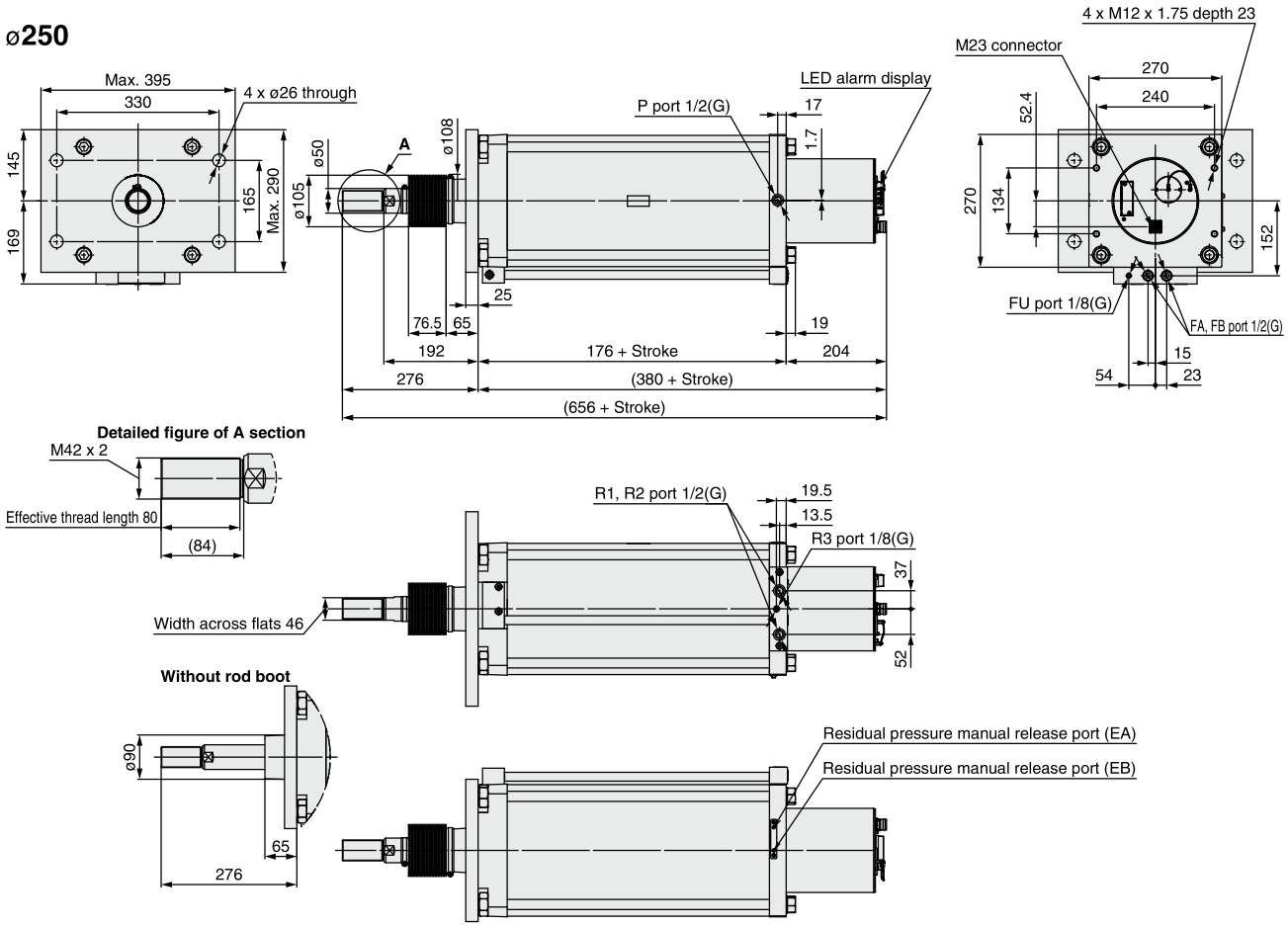


## Dimensions

### ø200

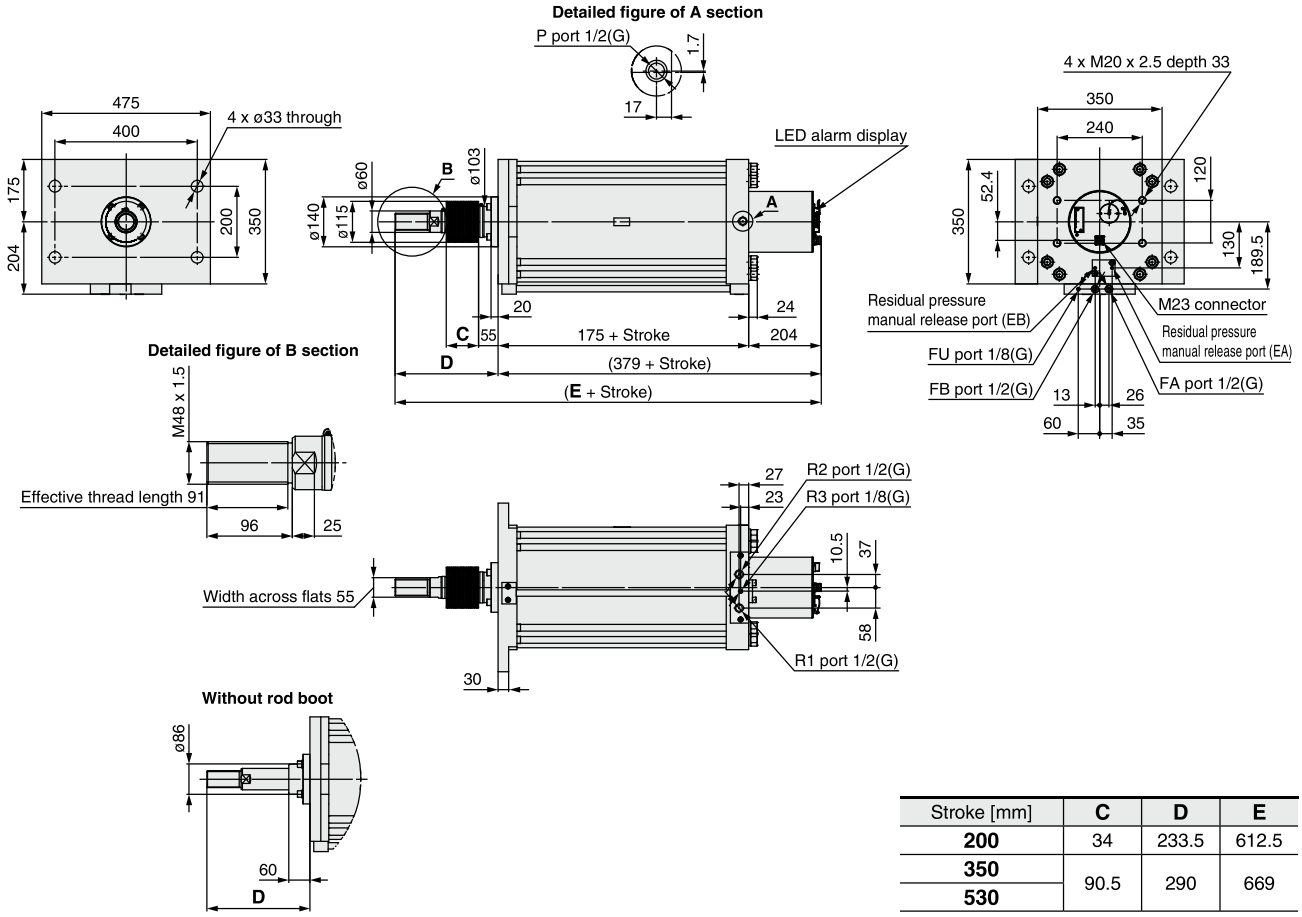



### ø250



## Dimensions

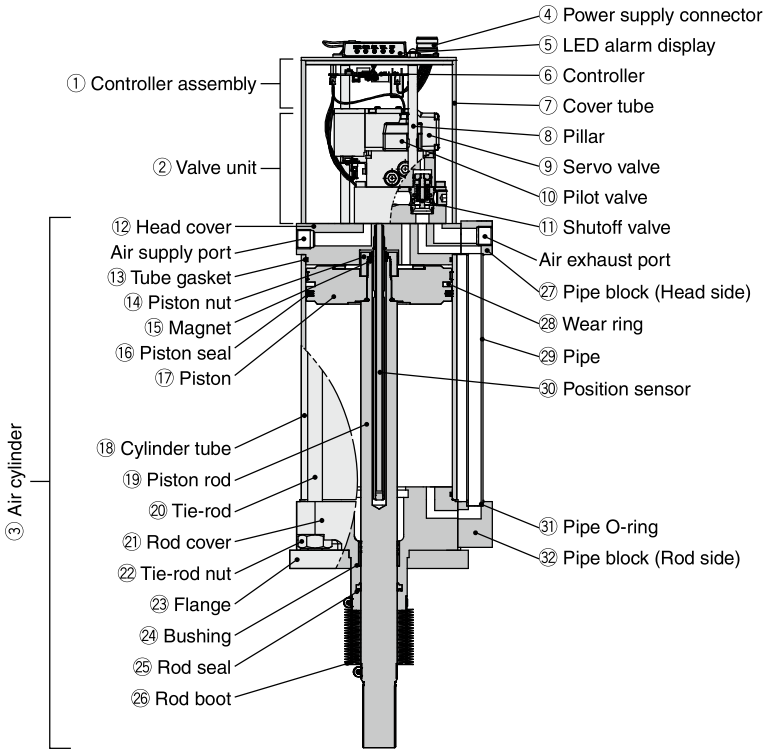
### ø320




| Stroke [mm] | C | D | E |
|---|---|---|---|
| **200** | 34 | 233.5 | 612.5 |
| **350** | 90.5 | 290 | 669 |
| **530** | | | |

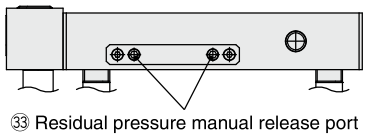
## Working Principle/Construction

The ㉚ position sensor built in to the ③ air cylinder outputs the current position of the ⑲ piston rod to the ⑥ controller.
Next, the ⑥ controller outputs a command signal to the 2 ⑨ servo valves according to the target position signal sent from the host controller.
Then, according to the command signal sent from the ⑥ controller, the ⑨ servo valves control the ③ air cylinder air supply or exhaust to move the piston rod forwards or backwards, or to stop it at the target position.
The opening and closing of the ⑪ shutoff valve is controlled by the ⑩ pilot valve connected to the ⑥ controller.
Two air-operated ⑪ shutoff valves (head side and rod side) are mounted along the air passage between the ⑨ servo valves and the ③ air cylinder. During an emergency stop (air or power supply cutoff, emergency stop signal input, etc.), the 2 ⑪ shutoff valves will close and ③ air cylinder operation will be stopped.

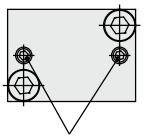



A 160 bore size, 200 mm stroke air cylinder is used in the drawings.

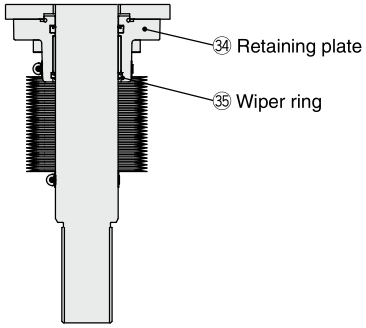
**Back portion of ø125 to ø250 head covers**




**Top portion of ø320 head covers**




**Cross-section portion of ø320 rod ends**




### Component Parts

| No. | Description | Material/Surface treatment |
|---|---|---|
| 1 | **Controller assembly**∗1 | Aluminum alloy/Anodized (Main parts) |
| 2 | **Valve unit**∗1 | — |
| 3 | **Air cylinder** | — |
| 4 | **Power supply connector** | — |
| 5 | **LED alarm display** | Aluminum alloy/Painted (Main parts) |
| 6 | **Controller** | — |
| 7 | **Cover tube** | Aluminum alloy/Anodized |
| 8 | **Pillar** | Aluminum alloy |
| 9 | **Servo valve**∗1 | — |
| 10 | **Pilot valve**∗1 | — |
| 11 | **Shutoff valve** | — |
| 12 | **Head cover** | Aluminum alloy/Anodized |
| 13 | **Tube gasket**∗1 | Low-temperature NBR |
| 14 | **Piston nut** | Stainless steel |
| 15 | **Magnet** | — |
| 16 | **Piston seal**∗1 | Low-temperature NBR |
| 17 | **Piston** | Aluminum alloy/Chromated |
| 18 | **Cylinder tube** | ø125 to ø250: Aluminum alloy/Anodized<br>ø320: Carbon steel tube/Painted |
| 19 | **Piston rod** | Stainless steel/Hard chrome plating |
| 20 | **Tie-rod** | Stainless steel |

| No. | Description | Material/Surface treatment |
|---|---|---|
| 21 | **Rod cover** | ø160 to ø250: Aluminum die-cast/Chromated<br>ø125 and ø320: Aluminum alloy/Anodized |
| 22 | **Tie-rod nut** | Stainless steel |
| 23 | **Flange**∗2 | Steel/Zinc plating |
| 24 | **Bushing** | Bearing alloy |
| 25 | **Rod seal**∗1 | Low-temperature NBR |
| 26 | **Rod boot (Option)**∗1 | Silicone rubber material<br>Nylon tarpaulin (selectable) |
| 27 | **Pipe block (Head side)**∗3 | Aluminum alloy/Anodized |
| 28 | **Wear ring**∗1 | Resin |
| 29 | **Pipe** | Aluminum alloy/Anodized |
| 30 | **Position sensor**∗1 | — |
| 31 | **Pipe O-ring**∗1 | Low-temperature NBR |
| 32 | **Pipe block (Rod side)**∗4 | Aluminum alloy/Anodized |
| 33 | **Residual pressure manual release port** | — |
| 34 | **Retaining plate** | Stainless steel |
| 35 | **Wiper ring**∗1 | Low-temperature NBR |

∗1 Refer to page 9 for maintenance parts and seal kit accessories.
∗2 The rod cover is integrated for size ø320.
∗3 The head cover is integrated for size ø125.
∗4 The rod cover is integrated for size ø125.

## Maintenance Parts

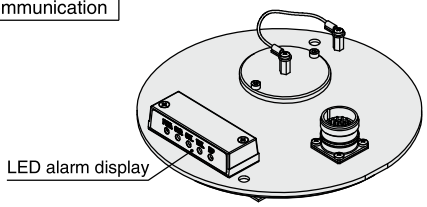
① **Controller assembly**

**IN – 777P – H L – 410AS**

Communication protocol ● ● LED alarm display

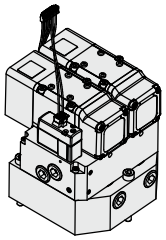
| | |
|---|---|
| H | 4-20 mA/HART communication |

| | |
|---|---|
| L | With LED alarm display |



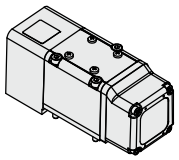

② **Valve unit**

**IN – 777P – 010AS**



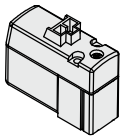
⑨ **Servo valve**

**XT581 – V – C – X001**

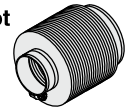


⑩ **Pilot valve**

**V211KT – 5LOZ – X48**



㉖ **Rod boot**



| Bore size [mm] | Stroke [mm] | Part number | |
|---|---|---|---|
| | | Silicone rubber material | Nylon tarpaulin |
| 125 | 250 | C96A2G-1461V-R | C96A2G-0294Y-R |
| 160 | 200 | C95A6G-471AQ-R | CS1-J16-300 |
| | 300 | | |
| 200 | 200 | C95B0G-472AQ-R | C95B0G-0304Y-R |
| | 300 | | |
| 250 | 350 | C95B5G-533AQ-R | C95B5G-574EQ-R |
| | 450 | | |
| 320 | 200 | C1SC2G-1468V-R | CS1-J25-200 |
| | 350 | C1SC2G-1470V-R | CS1-J25-530 |
| | 530 | | |

Ambient temperature specifications
Silicone rubber material: –20°C to 60°C (No freezing)
Nylon tarpaulin: –10°C to 60°C (No freezing)

㉚ **Position sensor unit**

**IN – 777P – 200 – 830AS**

● **Cylinder stroke**

| | |
|---|---|
| 200 | 200 mm |
| 250 | 250 mm |
| 300 | 300 mm |
| 350 | 350 mm |
| 450 | 450 mm |
| 530 | 530 mm |

∗ For the position sensor unit, the cylinder stroke is the same for all tube sizes.

**Seal kit**

**IN – 777P – 125 – 910AS**

**Bore size** ●

| | |
|---|---|
| 125<br>160<br>200<br>250 | This set includes the following: ⑬Tube gasket (2 pcs.)<br>⑯Piston seal (1 pc.)<br>㉕Rod seal (1 pc.)<br>㉘Wear ring (1 pc.)<br>㉛Pipe O-ring (2 pcs.) |
| 320 | This set includes the following: ⑬Tube gasket (2 pcs.)<br>⑯Piston seal (1 pc.)<br>㉕Rod seal (1 pc.)<br>㉘Wear ring (1 pc.)<br>㉛Pipe O-ring (2 pcs.)<br>㉟Wiper ring (1 pc.) |

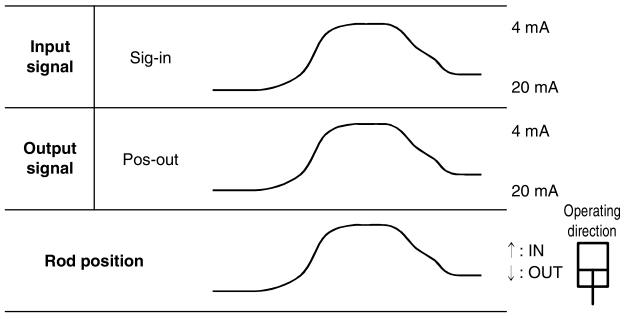
∗ The seal kit includes a grease pack.
∗ The circled numbers correspond to the component numbers in the cross-section construction drawing on page 8.

## Operation Modes

### ■ Target position operation

The rod position is decided according to the Sig-in signal input by the master controller.
The rod position is then output as a Pos-out signal.

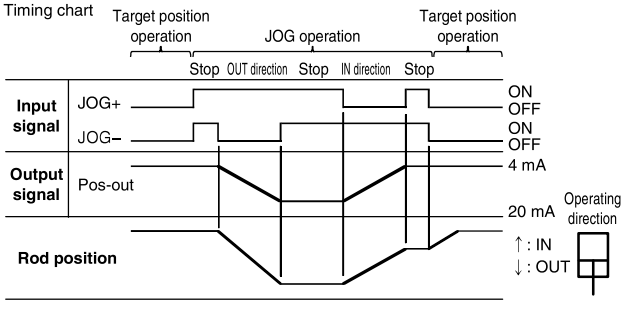
∗ Be sure to calibrate the product before use. If the set point has not yet been set, the rod will not move even during a target position operation. Refer to page 10 for calibration instructions.




∗ The operating direction can be changed.

### ■ JOG operation

The rod moves according to the JOG signal input by the master controller.




| | | JOG+ | |
|---|---|---|---|
| | | OFF | ON |
| JOG- | OFF | Target position operation | JOG operation (Moves in the OUT direction) |
| | ON | JOG operation (Moves in the IN direction) | JOG operation (Stops) |

∗ The device will move to the target position input as the Sig-in and stop when changing from JOG operation to target position operation.

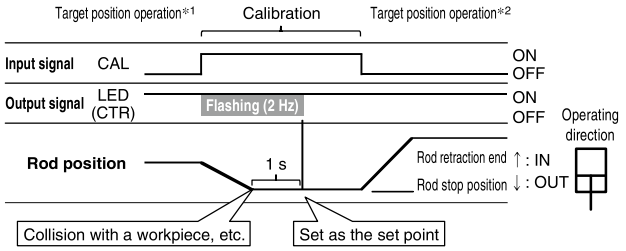
## Operation Modes

### ■Calibration

Set the rod position (set point) by inputting a CAL signal into the master controller and setting the Sig-in signal to 20 mA (default).
When changing the operation direction, the 4 mA rod position becomes the set point.
It is possible to change the operation mode from automatic to manual.

#### Automatic (Default)

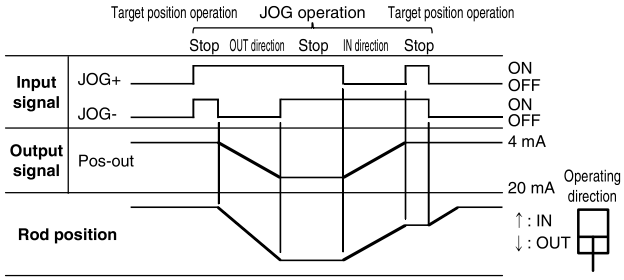
When the CAL signal is turned ON, the rod will move in the OUT direction, and the position where the rod stops for 1 s will become the set point.
When the CAL signal is turned OFF, the rod will move in the IN direction, and the rod will stop at the retraction end.




*1 If the set point has not yet been set, the rod will not move even during a target position operation.
*2 The target position may vary slightly before and after the set point has been set, even if the Sig-in signal is the same.

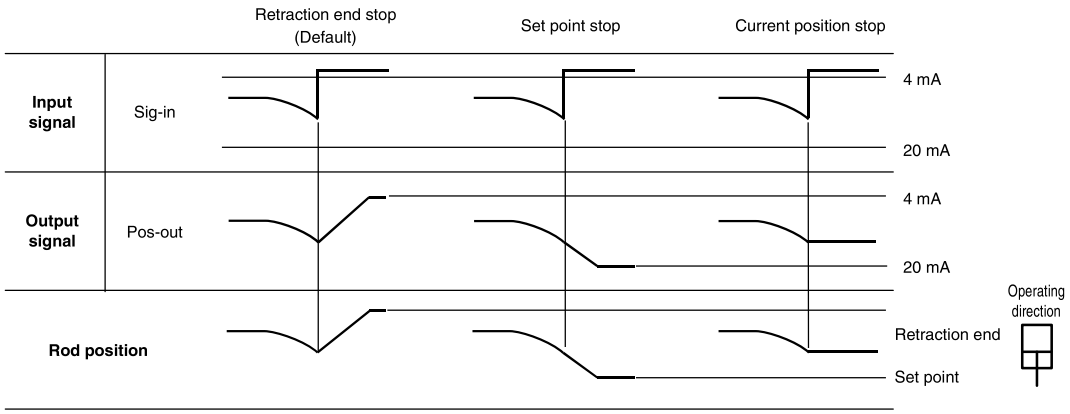
#### Manual

The rod will be moved by the JOG signal, and the position of the rod when the CAL signal is input will become the set point.



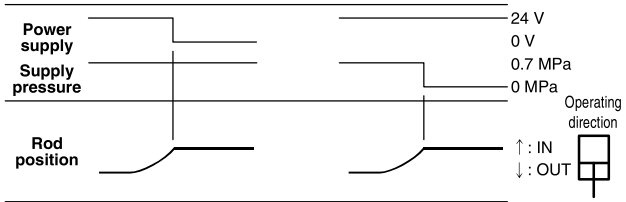

### ■No signal operation

This is the operation mode used when the Sig-in signal input into the master controller is 4 mA or less.
The rod will move to the predetermined position and then stop.



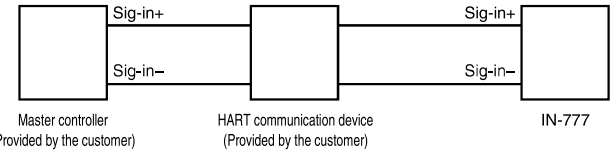

### ■Emergency stop

When the air servo cylinder air or power supply is cut during use, the built-in shutoff valves will close, stopping the rod.
Air from the emergency tank can be supplied via the fail-safe port (FA/FB) in order to allow for the operation of the air cylinder rod.




### ■HART (Highway Addressable Remote Transducer) communication

With this communication type, a digital signal is superimposed on the 4-20 mA Sig-in signal and then transmitted. Connect a HART communication device (provided by the customer) between the Sig-in + and the Sig-in -.




| Main transmission contents |
|---|
| 1. IN-777 information – confirmation and revision |
| 2. HART communication settings – confirmation and revision |
| 3. Cylinder operating conditions - setting and confirmation |
| 4. Calibration - execution |
| 5. Operating mode - setting and revision |
| 6. JOG operation - execution |
| 7. Operation status/Alarm confirmation |

# *IN-777*
# Air Servo Cylinder
# Specific Product Precautions

**Be sure to read this before handling the products.**

## Mounting

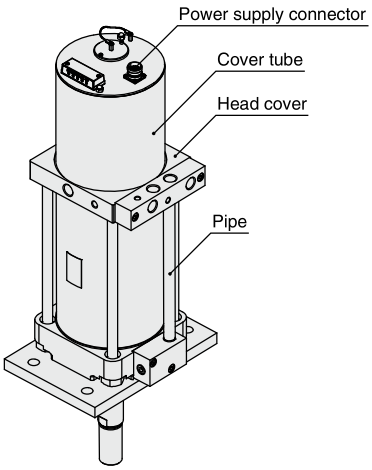
### ⚠ Caution

**1. Vibration may occur due to positioning control depending on the operating environment, load, conditions, etc.**
Be sure to inspect the actual machine for sufficient strength retention in regard to the amount of cylinder vibration that occurs.

**2. Mount so that a lateral load which exceeds the allowable lateral load is not applied to the piston rod.**
If a lateral load which exceeds the allowable lateral load is applied, the positioning repeatability during the target position operation will decline, which may lead to piston rod malfunction.
In addition, if the seals, cylinder tubing, etc., come into direct contact with the metal parts of the piston, air leakage due to uneven wear or reduced service life due to accelerated wear of the bearing may result. Refer to **Table 2** on page 4 for the allowable lateral load.

**3. When a workpiece is mounted on the piston rod end, connect them by aligning the axial center of the piston rod and that of the workpiece.**
If they are off-center, a lateral load will be generated and the phenomena mentioned in item 2 may occur.

**4. When mounting the body, be sure to avoid force being applied to the piping between the air cylinder head cover and the rod cover, cover tube, power supply connector, etc.**
Applying excessive external force to the piping may result in damage to the piping or a malfunction.
As screw holes for installing eye bolts are provided on the head covers of sizes ø160 and larger, insert the eye bolts into the screw holes and hang the product to mount it.




## Operating Precautions

### ⚠ Caution

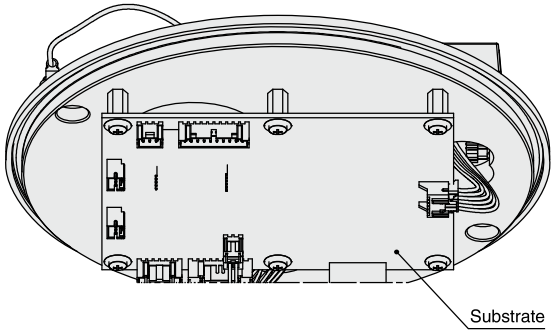
**1. When powering-up the product, restarting after an emergency stop, or switching the operating mode, be careful as the piston rod may suddenly extend or retract according to the settings.**

**2. Avoid use in environments where condensation is generated.**
When moving the product to a location at room temperature after operating it in low-temperature conditions, the temperature will rise suddenly and condensation will be generated. If water droplets from the generated condensation adhere to the internal substrate, an electric short-circuit may occur, resulting in a malfunction.

## Maintenance

### ⚠ Caution

**1. When disassembling the product for controller assembly replacement, etc., be sure not to touch the substrate with your bare hands.**




| ⚠ Safety Instructions | Be sure to read the “Handling Precautions for SMC Products” (M-E03-3) and “Operation Manual” before use. |
|---|---|