



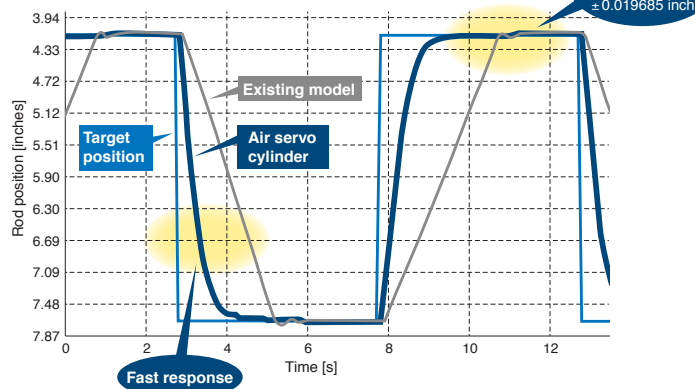
# Air Servo Cylinder

Ø125, Ø160, Ø200, Ø250, Ø320

## Capable of air cylinder multipoint positioning and control

Fast response and high positioning repeatability

Positioning repeatability:  $\pm 0.019685$  inch



Measuring conditions: Bore size:  $\phi 7.87402$  inches, Cylinder stroke: 7.87402 inches, Load mass: 154.324 lbs

### Easier maintenance due to unitization

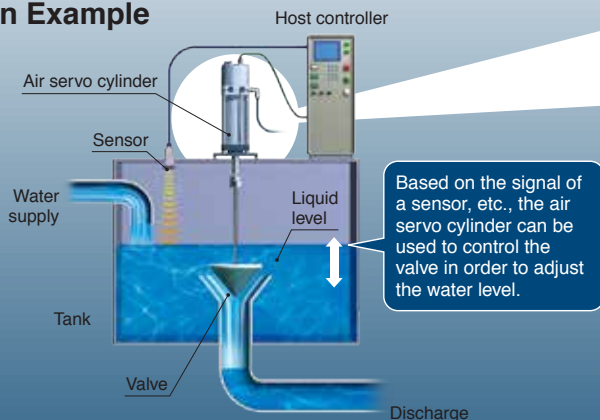
The valve unit, pilot valve, controller assembly, seal kit, etc., are replaceable.

### 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



RoHS

Produced upon receipt of order

IP67

**HART**  
COMMUNICATION PROTOCOL



# IN-777 Series

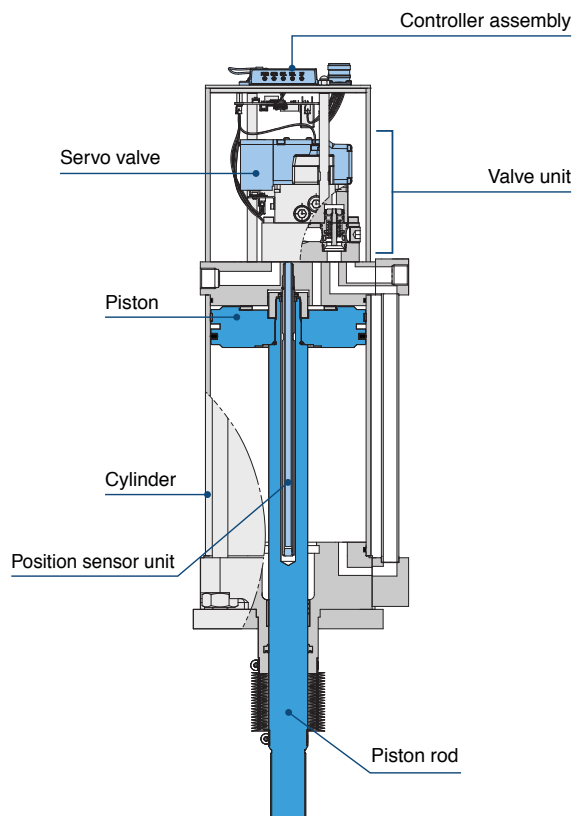
NC-E19-18A

## Air Servo Cylinder *IN-777 Series*

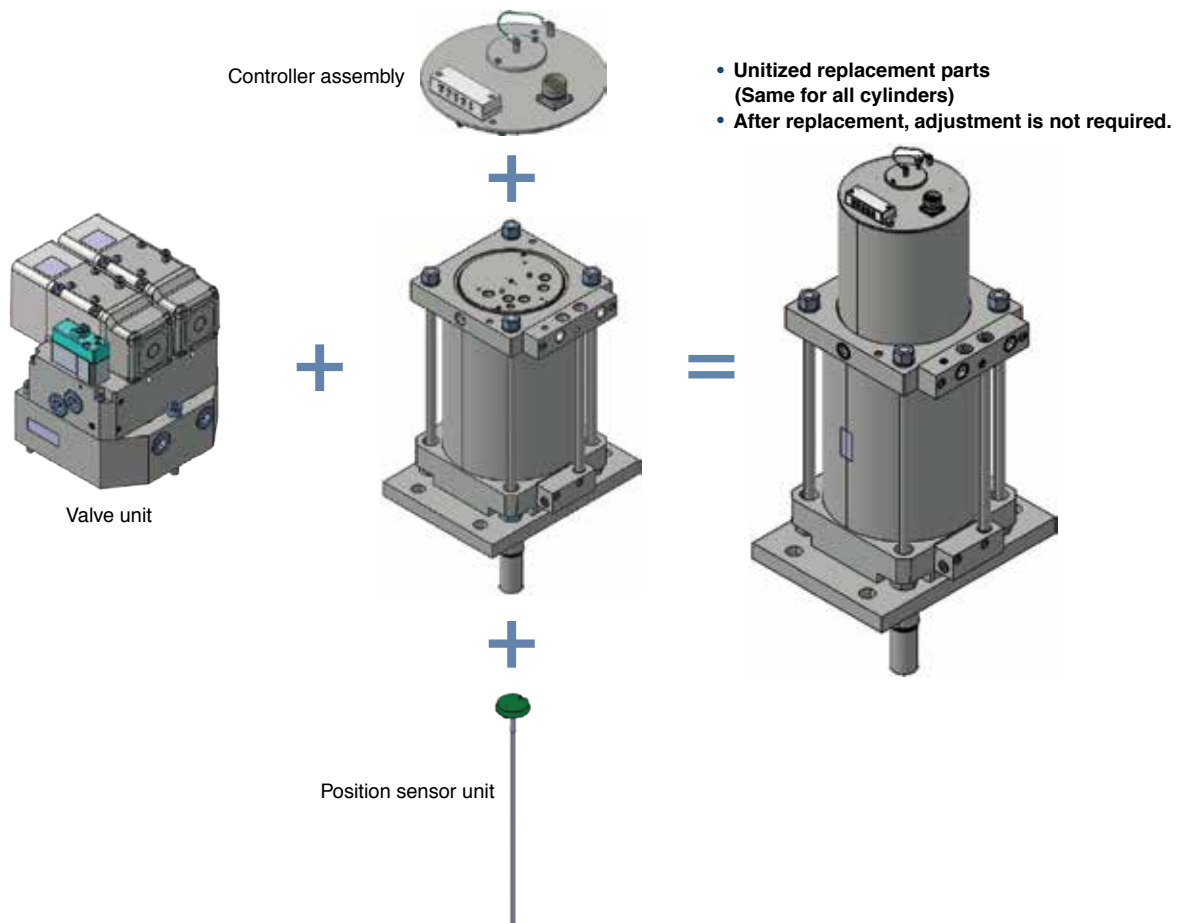
Capable of air cylinder multipoint positioning and control

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**

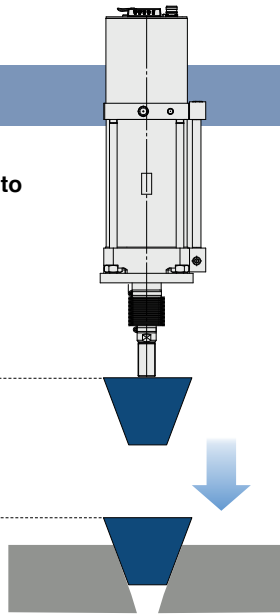


## Easy initial setting

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

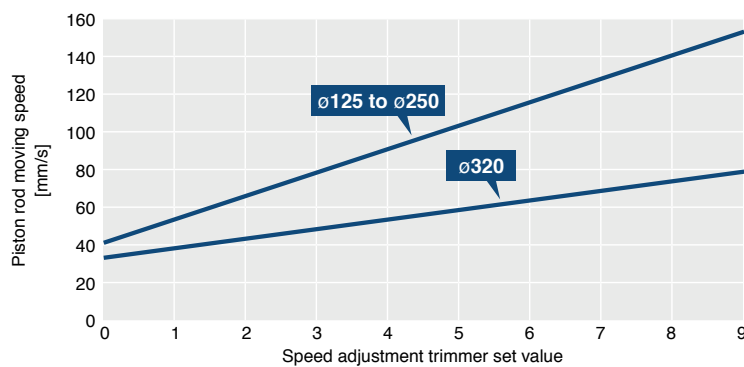
Rod retraction end: 4 mA (or 20 mA)

Rod stop position: Set to 20 mA (or 4 mA)



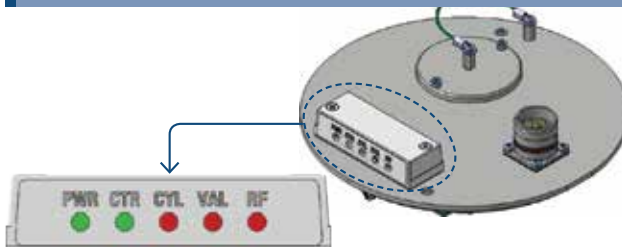
## Speed adjustment function

Capable of 10-level speed setting



## Built-in self-diagnosis function

(LED lamp and signal output)

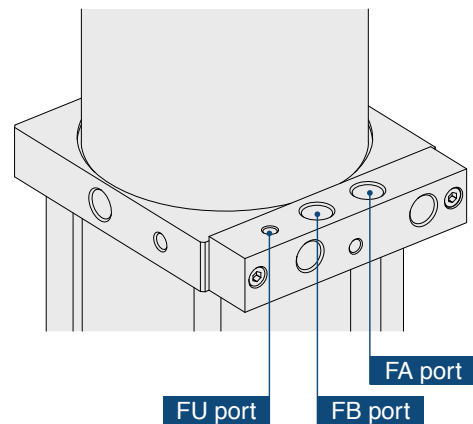


- LED display
- It is possible to output digital signals.

LED display	
<b>PWR</b>	Power supply status
<b>CTR</b>	Controller status
<b>CYL</b>	Cylinder position sensor error
<b>VAL</b>	Valve error
<b>RF</b>	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.



## How to Order

**IN-777-160TF-300FJ-HL**

**Bore size**

125	125 mm
<b>160</b>	160 mm
200	200 mm
250	250 mm
320	320 mm

**Port thread type**

<b>TF</b>	G
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**Stroke [mm]**

125	250
<b>160</b>	200, 300
200	200, 300
250	350, 450
320	200, 350, 530*1

\*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.

**LED alarm display**

<b>L</b>	With LED alarm display
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**Communication protocol**

<b>H</b>	4-20 mA/HART communication
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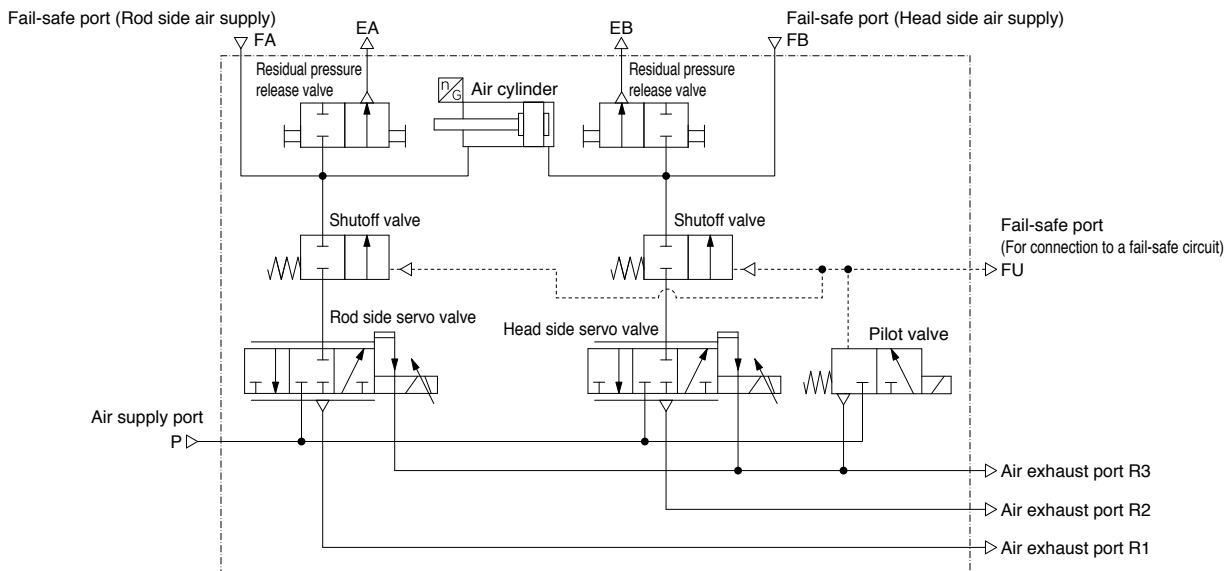
**Rod boot**

<b>J</b>	Silicone rubber material
<b>Nil</b>	Without rod boot

**Mounting**

<b>F</b>	With rod flange
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## Pneumatic Circuit





## Specifications

### Mechanical Specifications

<b>Action</b>	Double acting, Single rod
<b>Fluid</b>	Air
<b>Compressed air filtration</b>	0.3 μm or less
<b>Proof pressure</b>	1.2 MPa
<b>Operating pressure range</b>	0.55 to 0.8 MPa
<b>Positioning repeatability</b>	±0.5 mm or less
<b>Max. speed</b>	ø125 to 250: 155 mm/s ø320: 80 mm/s
<b>Ambient and fluid temperatures</b>	−20°C to 60°C (No freezing)
<b>Operating humidity</b>	35 to 85% (No condensation)
<b>Enclosure</b>	IP67
<b>Standards</b>	CE, RoHS
<b>Weight</b>	Refer to <b>Table 1</b> .
<b>Lubrication</b>	Non-lube
<b>Mounting orientation</b>	Vertical downward/Vertical upward
<b>Vibration resistance</b>	Total amplitude or acceleration: 1.5 mm or 3 G
	Vibration frequency: 5 to 100 Hz
	Vibration applying direction: 3 directions (X, Y, and Z)
<b>Impact resistance</b>	Sweep time/cycle: 12 min/10 cycles
	Acceleration: 15 G
	Pulse applying time/waveform: 11 ms/Sine wave
<b>Allowable lateral load</b>	Refer to <b>Table 2</b> .
	Theoretical output/Work load
<b>Theoretical output/Work load</b>	Refer to <b>Table 3</b> .
<b>Power supply connector (body)</b>	M23 19-pin connector (Male): Refer to <b>Table 4</b> .

### Electrical Specifications

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

**Table 1 Weight**

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

**Table 2 Allowable Lateral Load**

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

**Table 3 Theoretical Output/Max. Work Load**

Bore size [mm]	Operating direction	Theoretical output [N]		Max. work load [kg]*1
		Operating pressure [MPa]	Operating pressure [MPa]	
125	IN	0.55	0.8	160
	OUT	6,400	9,200	
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	

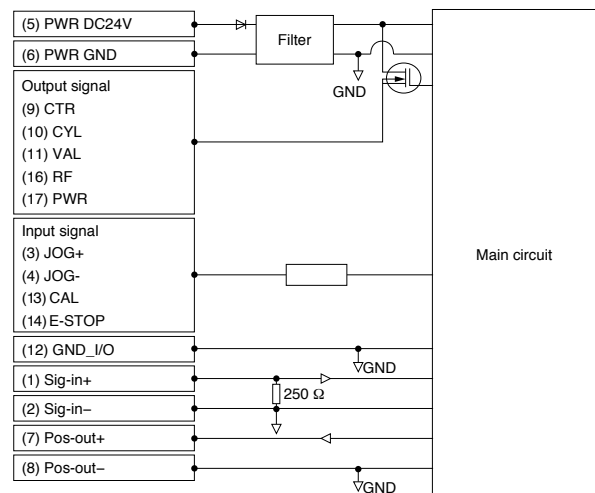
\*1 Based on SMC's specific testing conditions

**Table 4 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

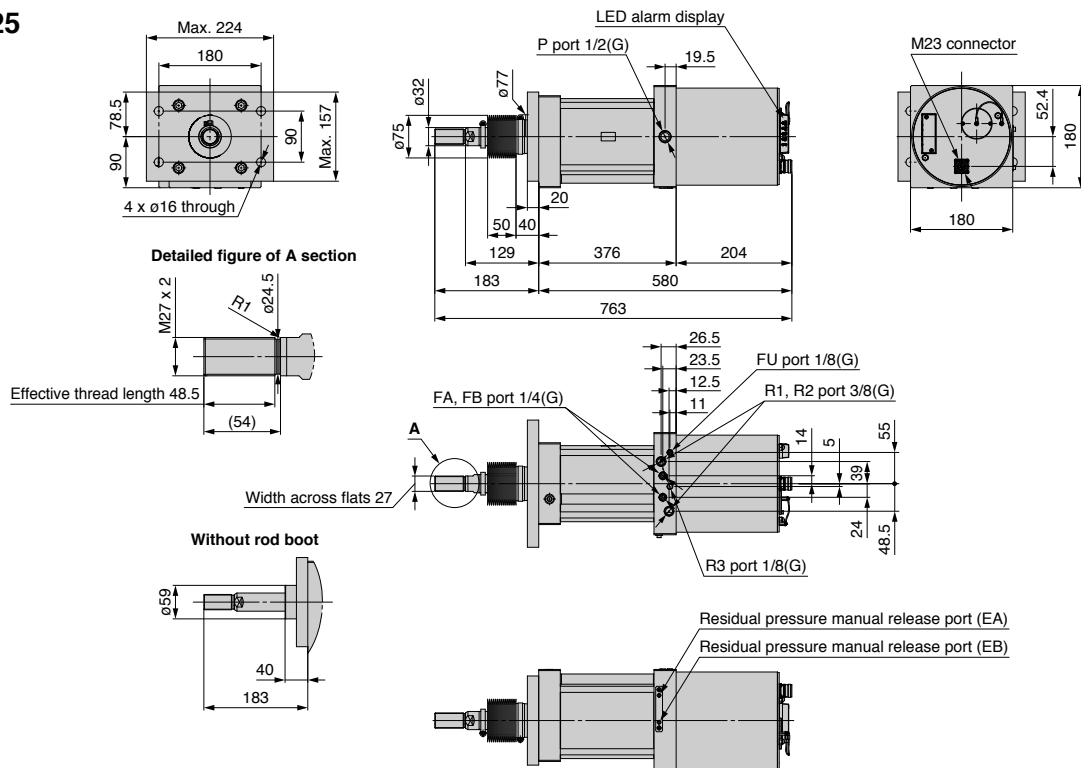
### Wiring Diagram



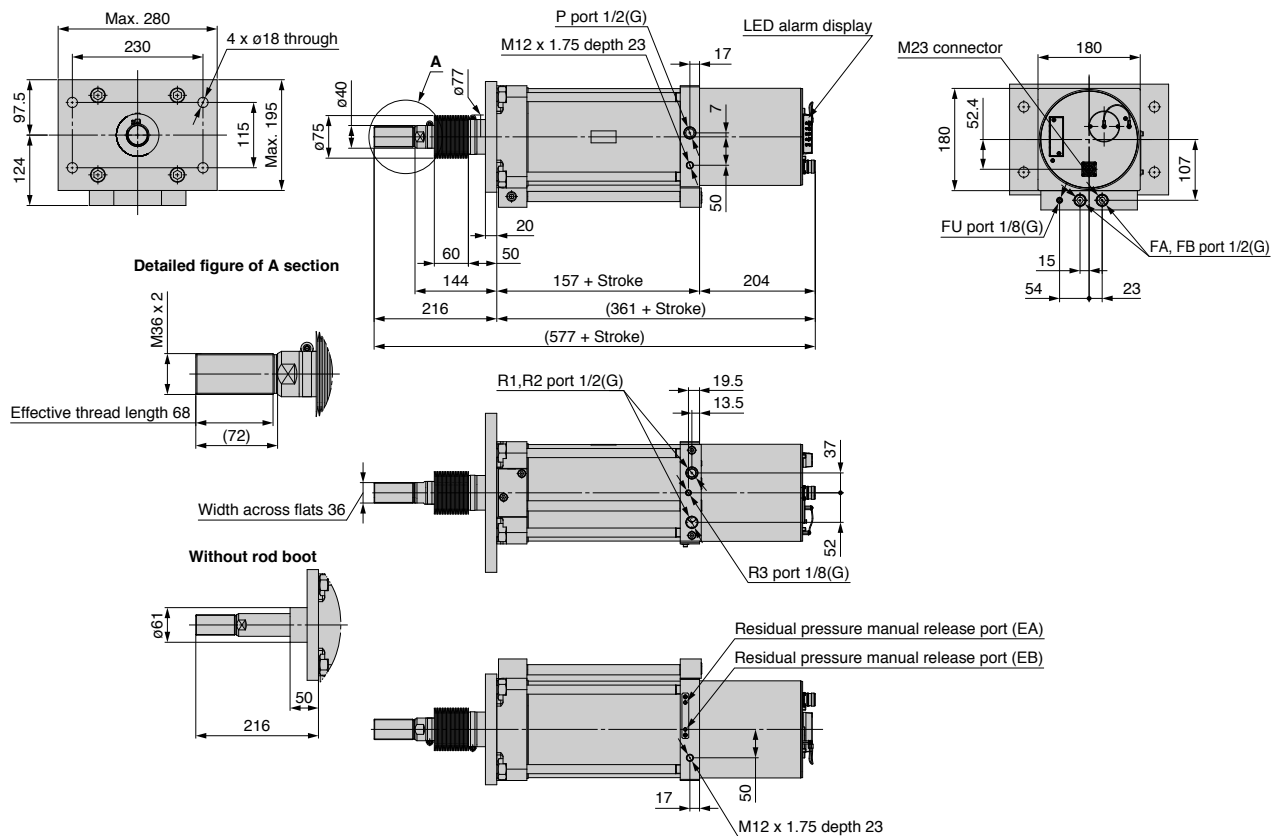
# Air Servo Cylinder *IN-777 Series*

## Dimensions

ø125

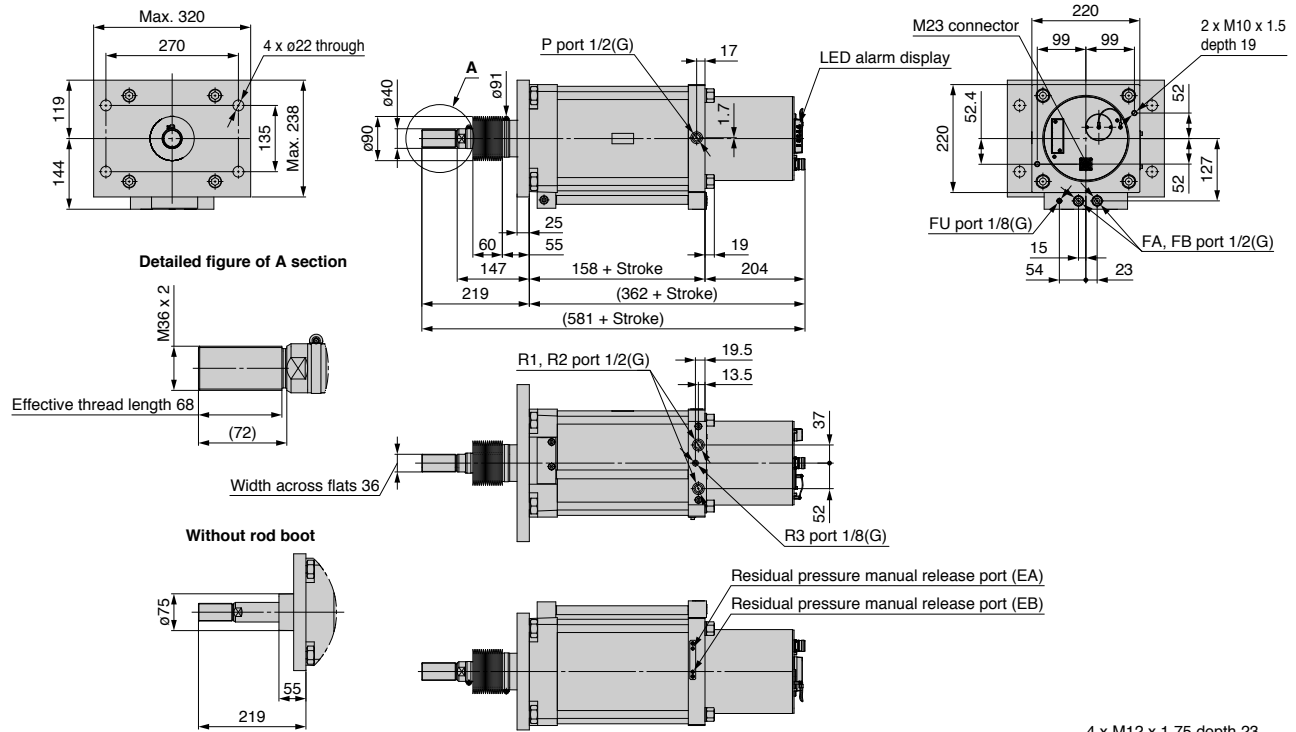


ø160

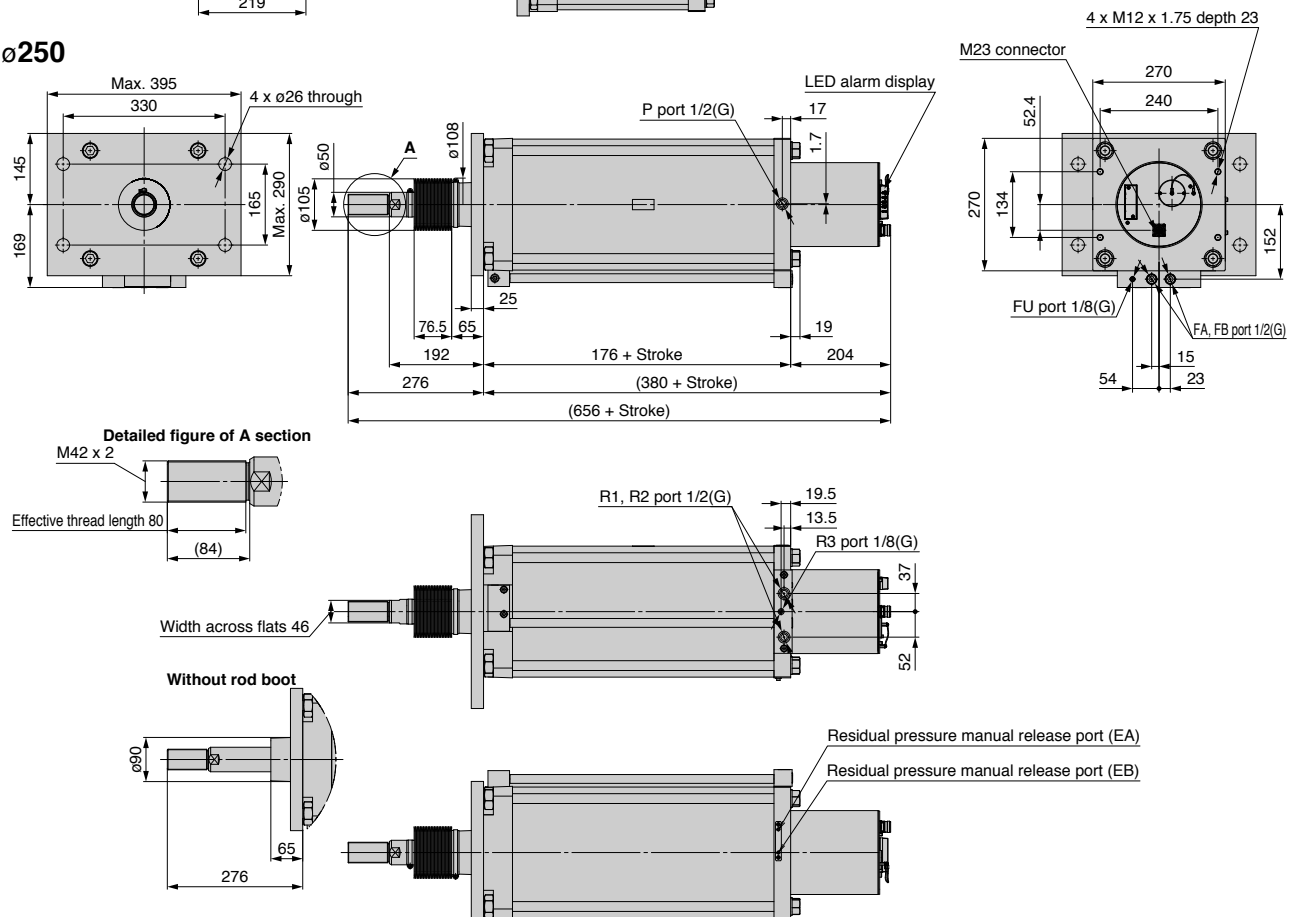


## Dimensions

**Ø200**



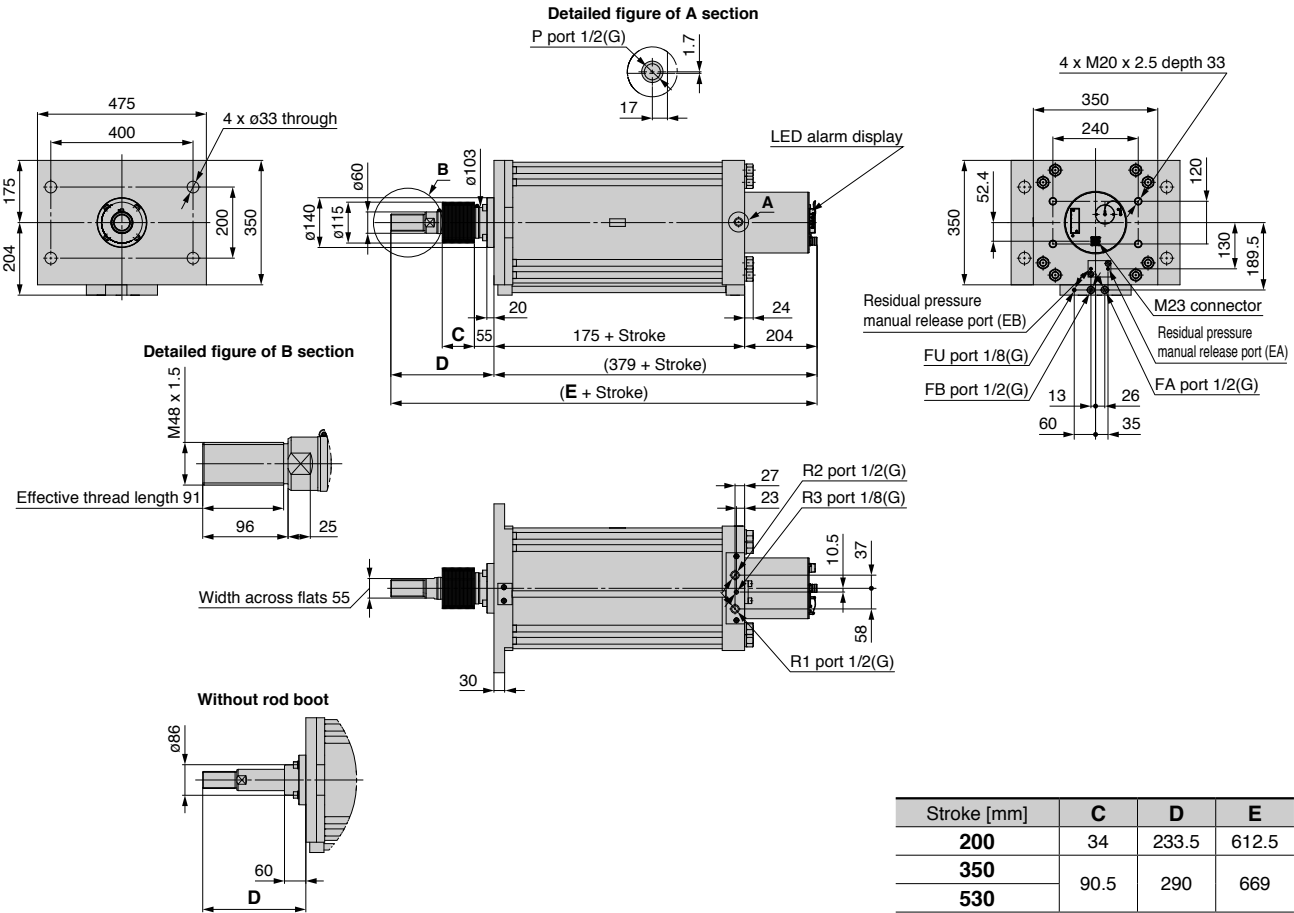
**Ø250**



Air Servo Cylinder *IN-777 Series*

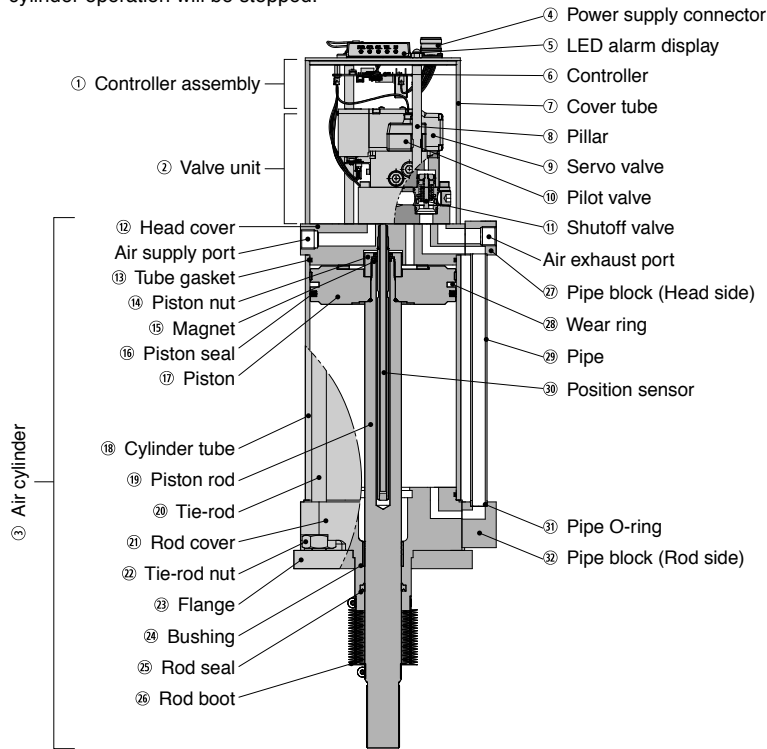
Dimensions

ø320



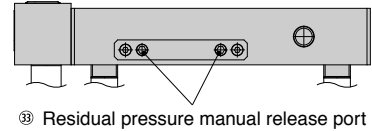
## Working Principle/Construction

The ⑩ position sensor built in to the ③ air cylinder outputs the current position of the ⑨ 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.

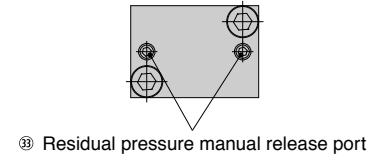


A 160 bore size, 200 mm stroke air cylinder is used in the drawings.

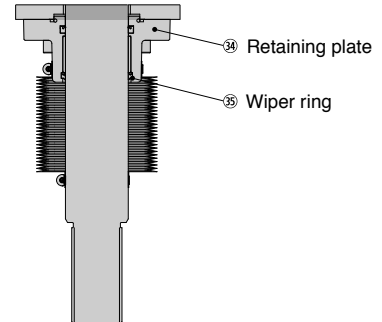
### Back portion of $\phi 125$ to $\phi 250$ head covers



### Top portion of $\phi 320$ head covers



### Cross-section portion of $\phi 320$ rod ends



## Component Parts

No.	Description	Material/Surface treatment	No.	Description	Material/Surface treatment
1	Controller assembly* <sup>1</sup>	Aluminum alloy/Anodized (Main parts)	20	Tie-rod	Stainless steel
2	Valve unit* <sup>1</sup>	—	21	Rod cover	$\phi 160$ to $\phi 250$ : Aluminum die-cast/Chromated $\phi 125$ and $\phi 320$ : Aluminum alloy/Anodized
3	Air cylinder	—	22	Tie-rod nut	Stainless steel
4	Power supply connector	—	23	Flange* <sup>2</sup>	Steel/Zinc plating
5	LED alarm display	Aluminum alloy/Painted (Main parts)	24	Bushing	Bearing alloy
6	Controller	—	25	Rod seal* <sup>1</sup>	Low-temperature NBR
7	Cover tube	Aluminum alloy/Anodized	26	Rod boot (Option)* <sup>1</sup>	Silicone rubber material
8	Pillar	Aluminum alloy	27	Pipe block (Head side)* <sup>3</sup>	Aluminum alloy/Anodized
9	Servo valve* <sup>1</sup>	—	28	Wear ring* <sup>1</sup>	Resin
10	Pilot valve* <sup>1</sup>	—	29	Pipe	Aluminum alloy/Anodized
11	Shutoff valve	—	30	Position sensor* <sup>1</sup>	—
12	Head cover	Aluminum alloy/Anodized	31	Pipe O-ring* <sup>1</sup>	Low-temperature NBR
13	Tube gasket* <sup>1</sup>	Low-temperature NBR	32	Pipe block (Rod side)* <sup>4</sup>	Aluminum alloy/Anodized
14	Piston nut	Stainless steel	33	Residual pressure manual release port	—
15	Magnet	—	34	Retaining plate	Stainless steel
16	Piston seal* <sup>1</sup>	Low-temperature NBR	35	Wiper ring* <sup>1</sup>	Low-temperature NBR
17	Piston	Aluminum alloy/Chromated			
18	Cylinder tube	$\phi 125$ to $\phi 250$ : Aluminum alloy/Anodized $\phi 320$ : Carbon steel tube/Painted			
19	Piston rod	Stainless steel/Hard chrome plating			

\*1 Refer to page 9 for maintenance parts and seal kit accessories.

\*2 The rod cover is integrated for size  $\phi 320$ .

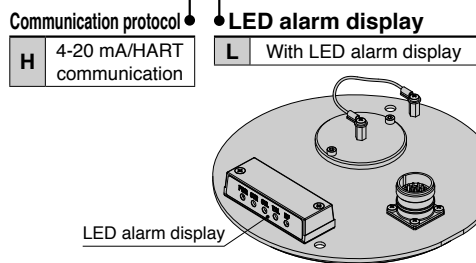
\*3 The head cover is integrated for size  $\phi 125$ .

\*4 The rod cover is integrated for size  $\phi 125$ .

## Maintenance Parts

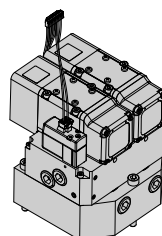
### ① Controller assembly

#### IN-777P-HL-410AS



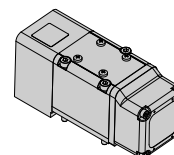
### ② Valve unit

#### IN-777P-010AS



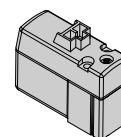
### ⑨ Servo valve

#### XT581-V-C-X001

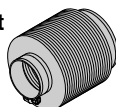


### ⑩ Pilot valve

#### V211KT-5LOZ-X48



### ⑪ Rod boot



Bore size [mm]	Stroke [mm]	Part number
125	250	C96A2G-1461V-R
160	200	C95A6G-471AQ-R
	300	
200	200	C95B0G-472AQ-R
	300	
250	350	C95B5G-533AQ-R
	450	
320	200	C1SC2G-1468V-R
	350	
	530	C1SC2G-1470V-R

### ⑫ 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	This set includes the following: ⑬ Tube gasket (2 pcs.)
160	⑭ Piston seal (1 pc.)
200	⑮ Rod seal (1 pc.)
250	⑯ Wear ring (1 pc.)
320	⑰ Pipe O-ring (2 pcs.)
	This set includes the following: ⑬ Tube gasket (2 pcs.)
	⑭ Piston seal (1 pc.)
	⑮ Rod seal (1 pc.)
	⑯ Wear ring (1 pc.)
	⑰ Pipe O-ring (2 pcs.)
	⑱ Wiper 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.

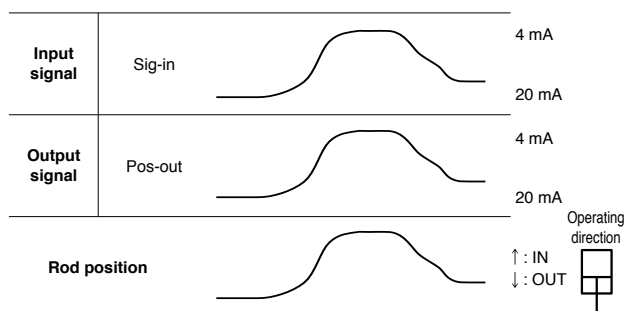
## Operation Modes

### ■ 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.

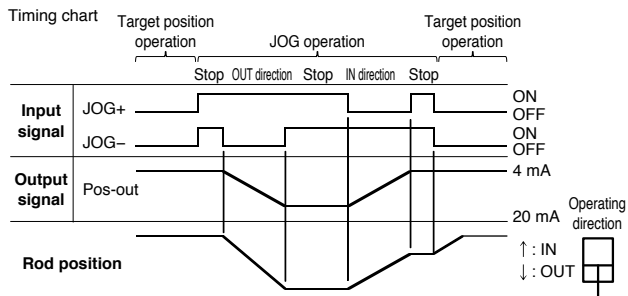
\* Be sure to calibrate the product before use. If the set point has not yet been set, the rod will not move even during a target position operation. Refer to page 10 for calibration instructions.



\* 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.

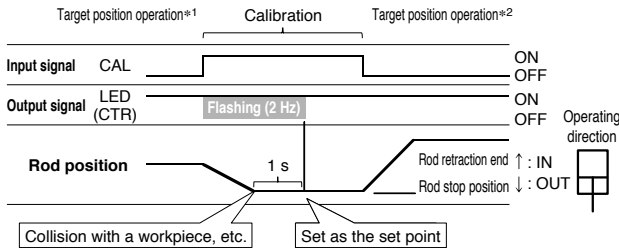
## Operation Modes

### ■ 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.

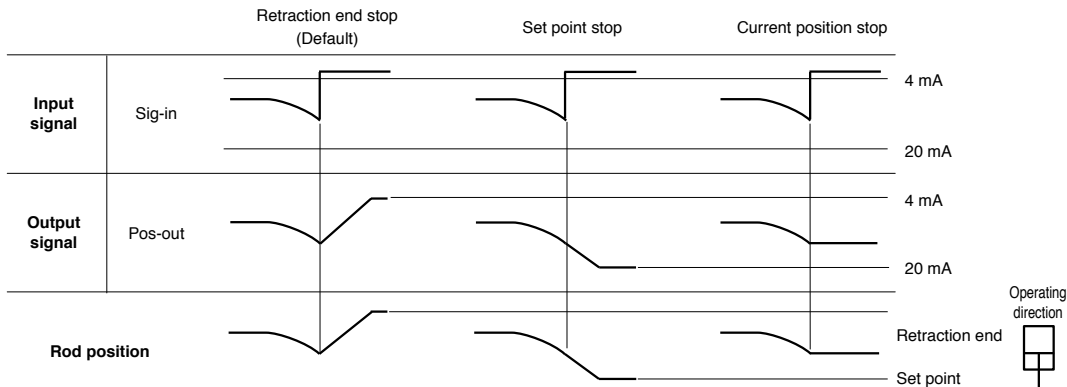


\*1 If the set point has not yet been set, the rod will not move even during a target position operation.

\*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.

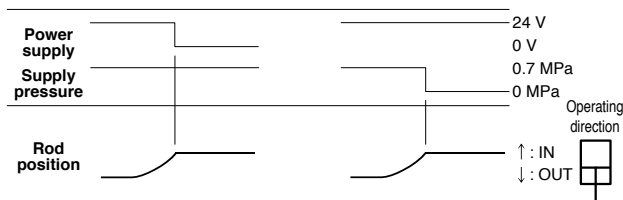
### ■ No signal operation

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.



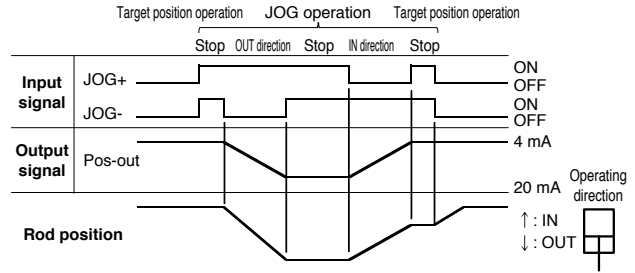
### ■ Emergency stop

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.



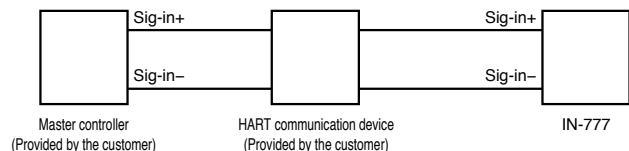
### Manual

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.



### ■ 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



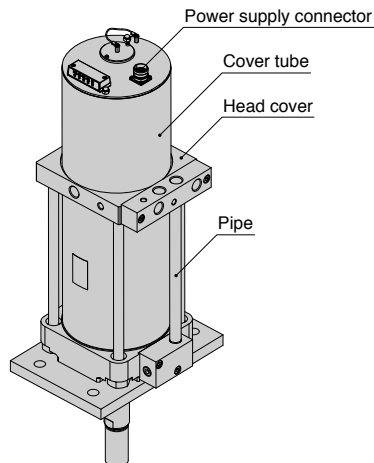
# IN-777 Series Air Servo Cylinder Specific Product Precautions

Be sure to read this before handling the products.

## Mounting

### ⚠ Caution

- 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.
- 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.
- 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.
- 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  $\phi 160$  and larger, insert the eye bolts into the screw holes and hang the product to mount it.



## Operating Precautions

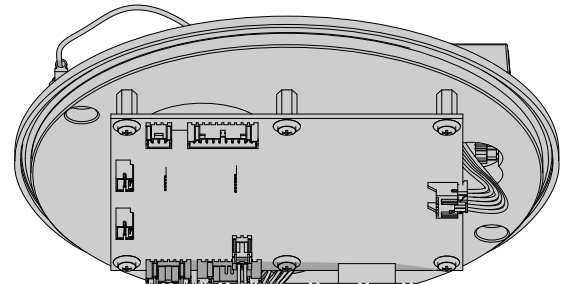
### ⚠ Caution

- 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.**
- 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

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



Substrate

## UNIT CONVERSIONS

	unit	conversion	result		unit	conversion	result
length	m	x 3.28	psi	pressure	MPa	x 145	psi
	mm	x 0.04	psi		kPa	÷ 6.895	psi
mass	g	x 0.04	°F	temperature	°C	x 1.8 then add 32	°F
volume	cm³	÷ 16.387	ft-lb	torque	N-m	x 0.738	ft-lb
	L	x 61.024	lbf	force	N	÷ 4.448	lbf
speed	mm/s	÷ 25.4	cfm	flow	L/min	÷ 28.317	cfm



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



**SMC Corporation of America**  
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