

Air Servo Cylinder

Ø 125, Ø 160, Ø 200, Ø 250, Ø 320

Produced upon receipt of order



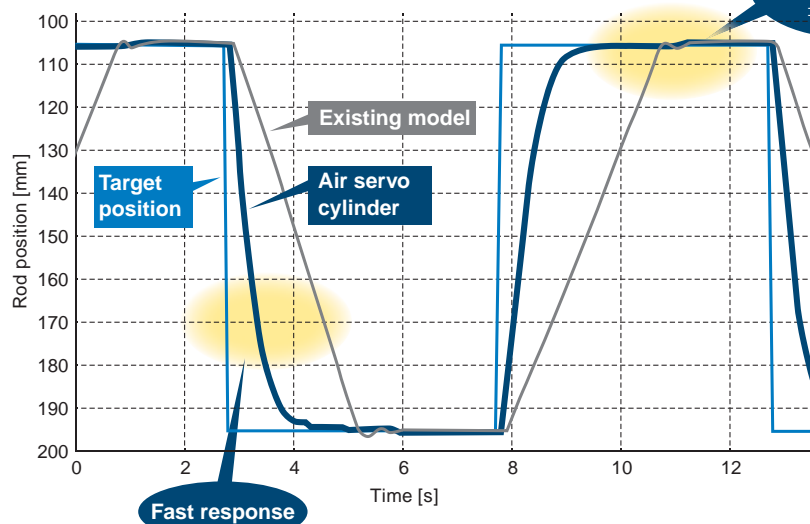
IP67



Capable of air cylinder multipoint positioning and control

Fast response and high positioning repeatability

Positioning repeatability: ± 0.5 mm



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

Easier maintenance due to unitisation

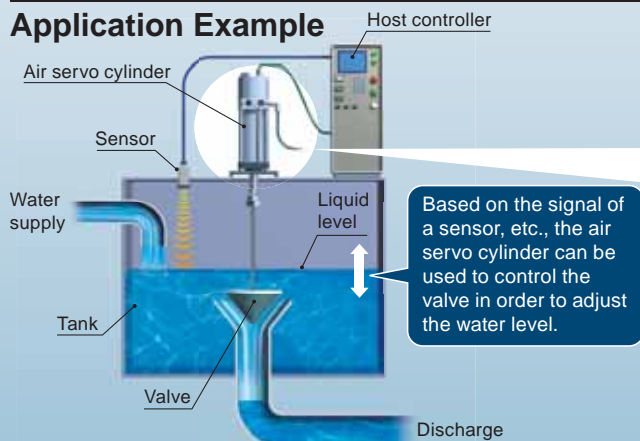
The valve unit, pilot valve, controller assembly, seal kit, etc., are replaceable.

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

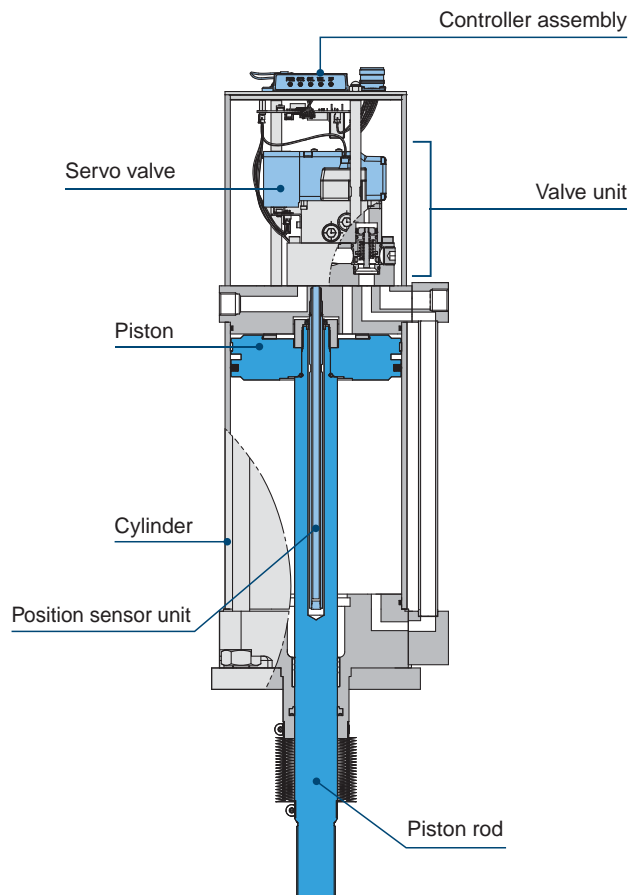


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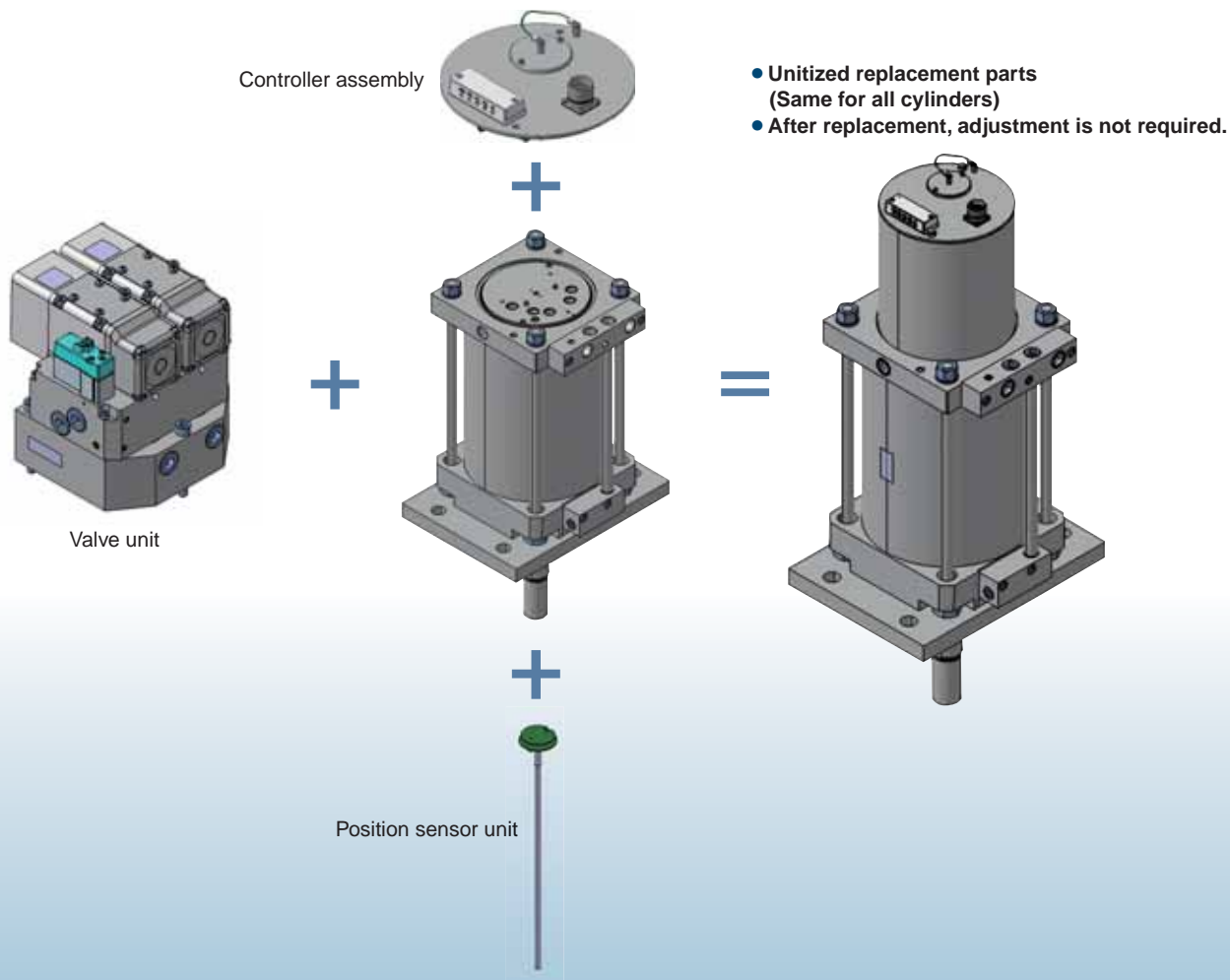
Capable of air cylinder multipoint positioning and control

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

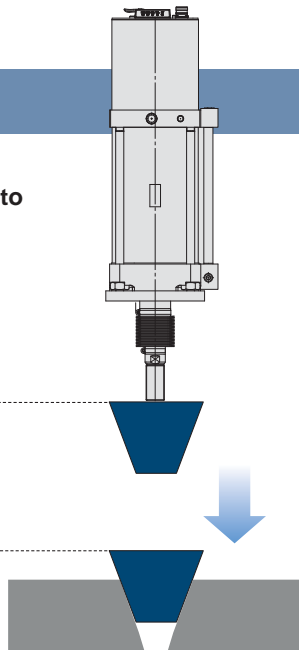


Easy initial setting

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

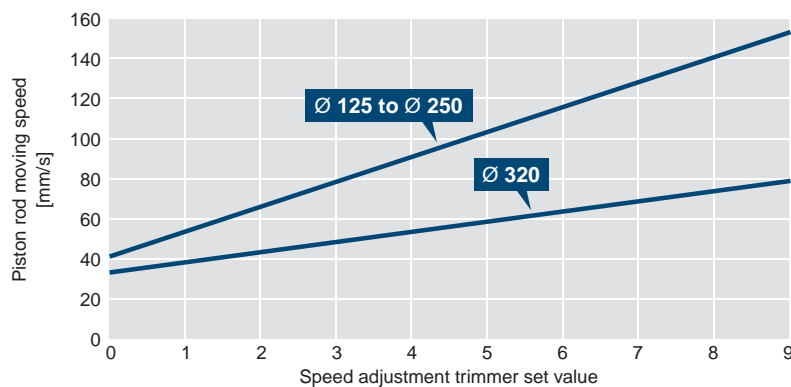
Rod retraction end: 4 mA (or 20 mA)

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



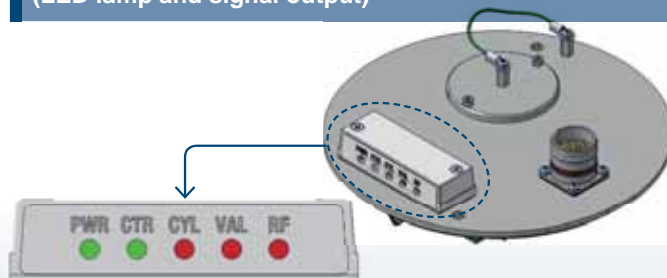
Speed adjustment function

Capable of 10-level speed setting



Built-in self-diagnosis function

(LED lamp and signal output)

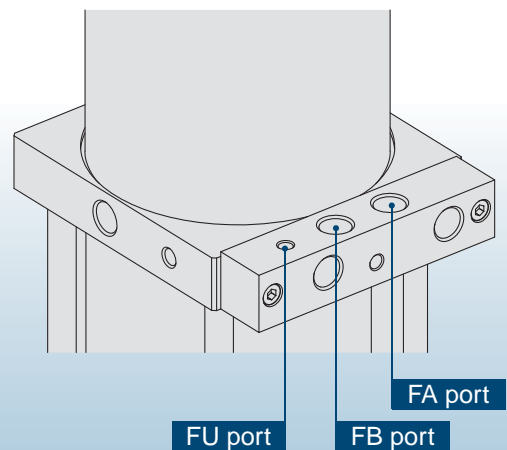


- LED display
- It is possible to output digital signals.

LED display	
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

Ø 125, Ø 160, Ø 200, Ø 250, Ø 320

Produced upon receipt of order



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
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Stroke [mm]

125	250
160	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

L	With LED alarm display
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Communication protocol

H	4-20 mA/HART communication
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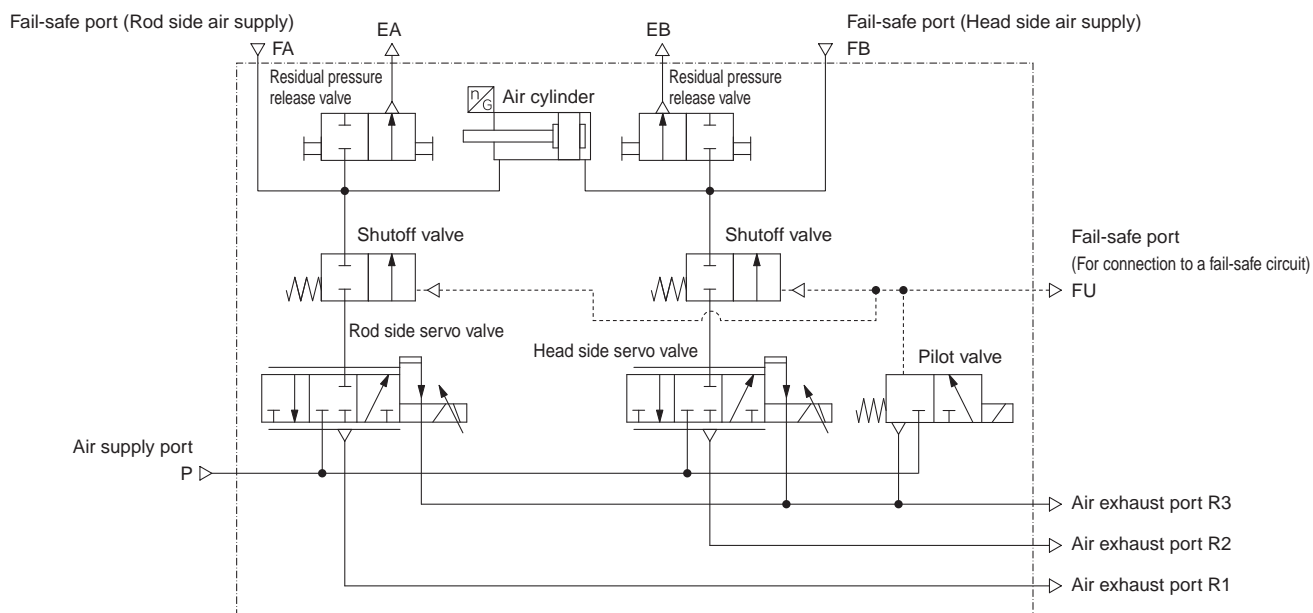
Rod boot

J	Silicone rubber material
—	Without rod boot

Mounting

F	With rod flange
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Pneumatic Circuit



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
Max. speed	Ø 125 to 250: 155 mm/s Ø 320: 80 mm/s
Ambient and fluid temperatures	-20 °C to 60 °C (No freezing)
Operating humidity	35 to 85 % (No condensation)
Enclosure	IP67
Standards	CE, RoHS
Weight	Refer to Table 1 .
Lubrication	Non-lube
Mounting orientation	Vertical downward/Vertical upward
Vibration resistance	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) Sweep time/cycle: 12 min/10 cycles
Impact resistance	Acceleration: 15 G
	Pulse applying time/waveform: 11 ms/Sine wave
	Pulse applying direction: 3 times in each direction (X, Y, and Z axes)
Allowable lateral load	Refer to Table 2 .
Theoretical output/Work load	Refer to Table 3 .
Power supply connector (body)	M23 19-pin connector (Male): Refer to Table 4 .

Electrical Specifications

Power supply	Supply voltage: 24 VDC ±10 %
Control system	Closed loop
Position sensor	Absolute
Analogue input signal	4 to 20 mA DC
Analogue input impedance	Approx. 250 Ω
Analogue output signal	4 to 20 mA DC
Analogue 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)

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

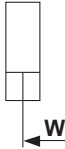


Table 3 Theoretical Output/Max. Work Load

Bore size [mm]	Operating direction	Theoretical output [N]		Max. work load [kg]*1
		Operating pressure [MPa]	Operating pressure [MPa]	
125	IN	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	

*1 Based on SMC's specific testing conditions

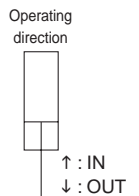
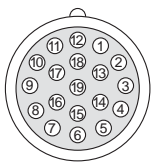


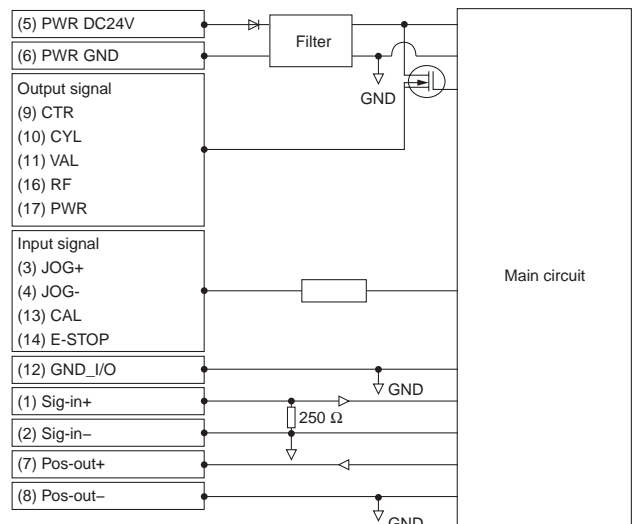
Table 4 Connector Pin Numbers (Body Side)



Pin no.	Signal name	IN/OUT	Description
1	Sig-in+	IN	Analogue signal (4-20 mA(+)), HART communication signal input
2	Sig-in-	IN	Analogue 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	Analogue position signal (+) output
8	Pos-out-	OUT	Analogue 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	—	—	—

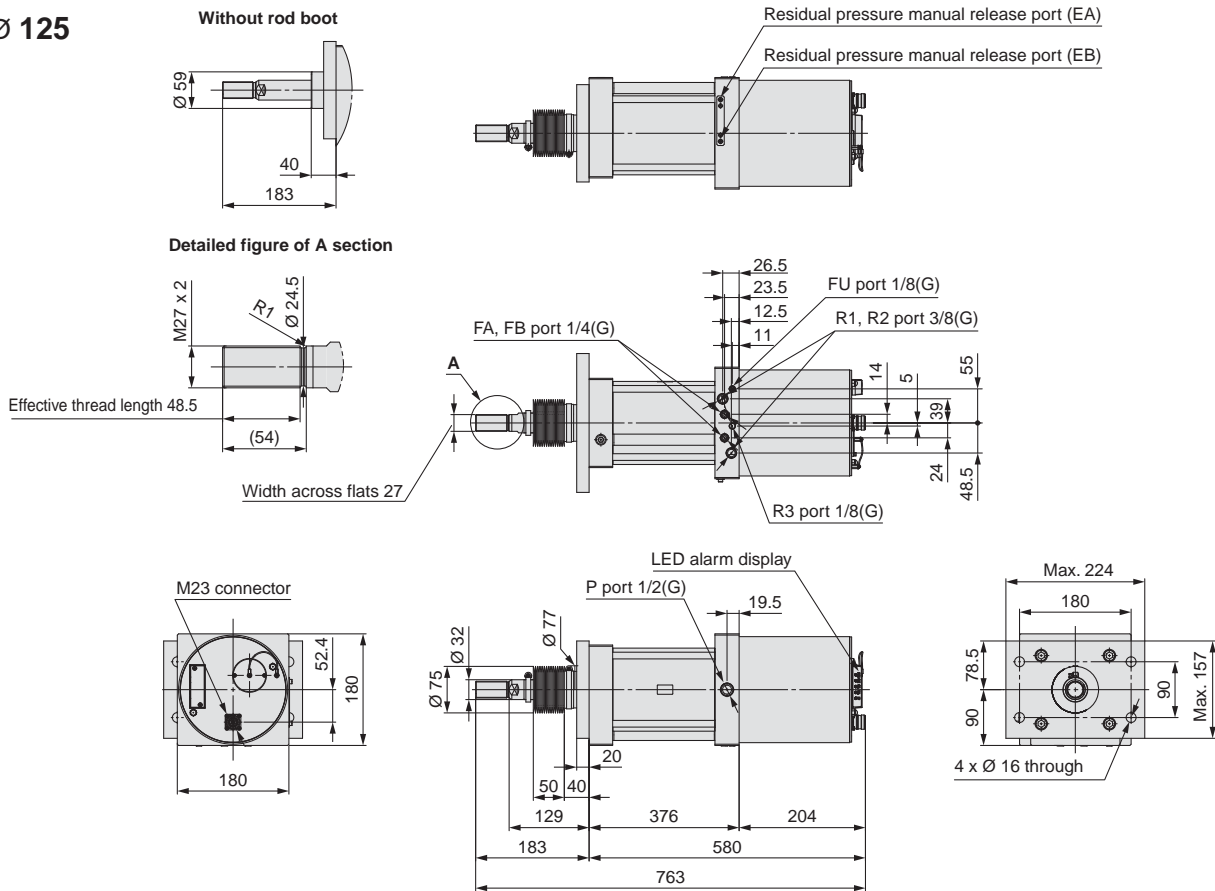
*1 When the signal is OFF, an emergency stop occurs. —: Cannot be connected

Wiring Diagram

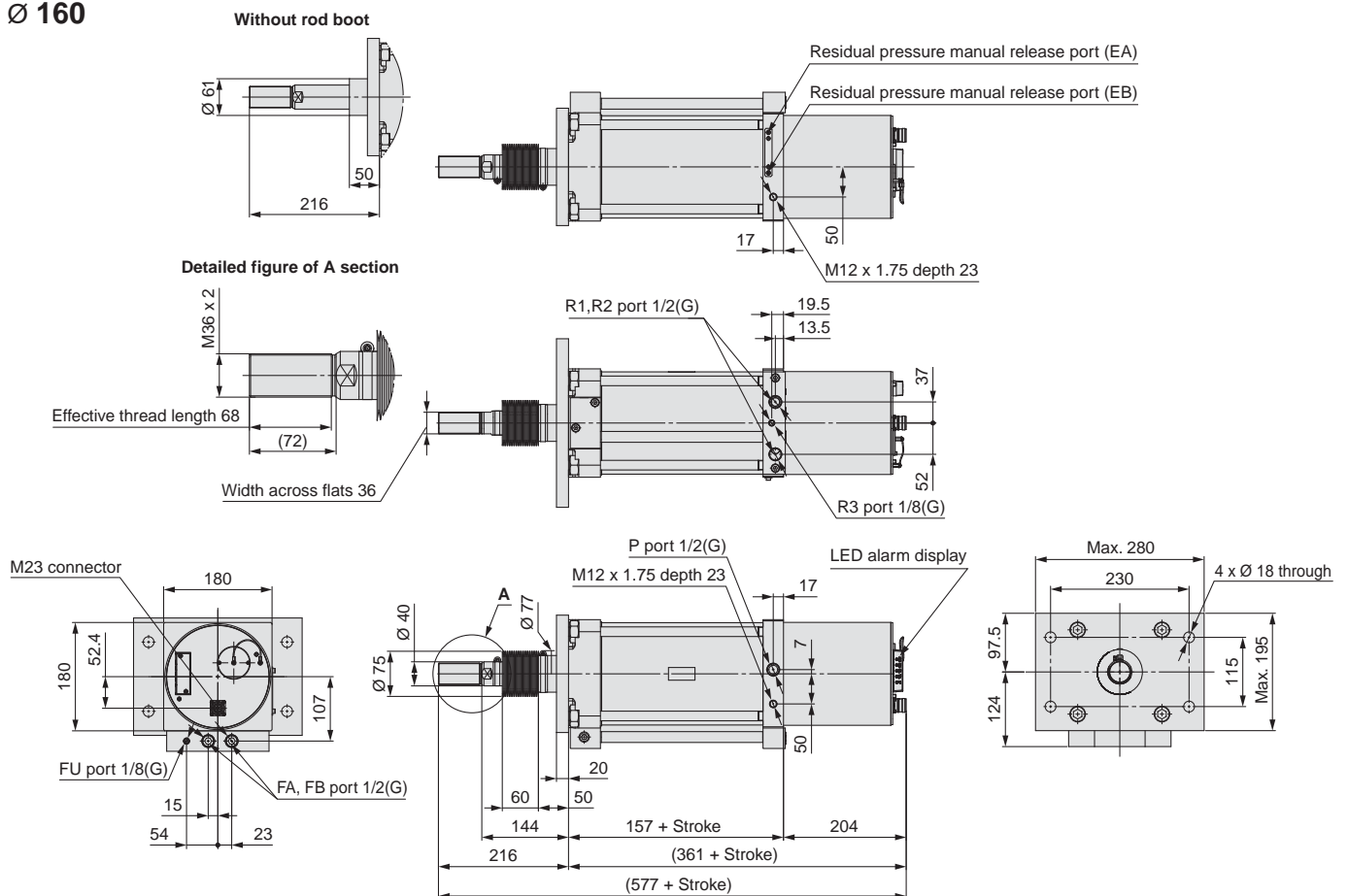


Dimensions

Ø 125

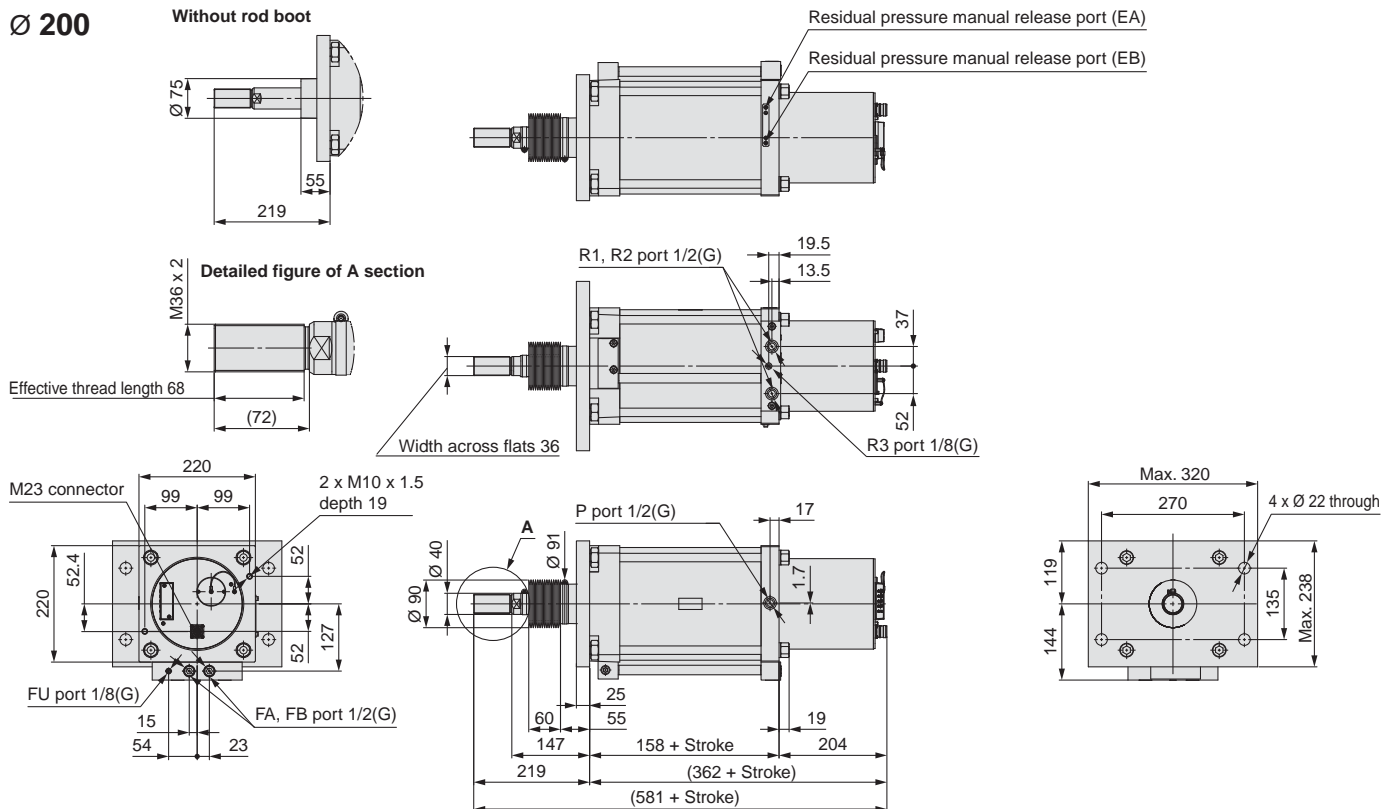


Ø 160

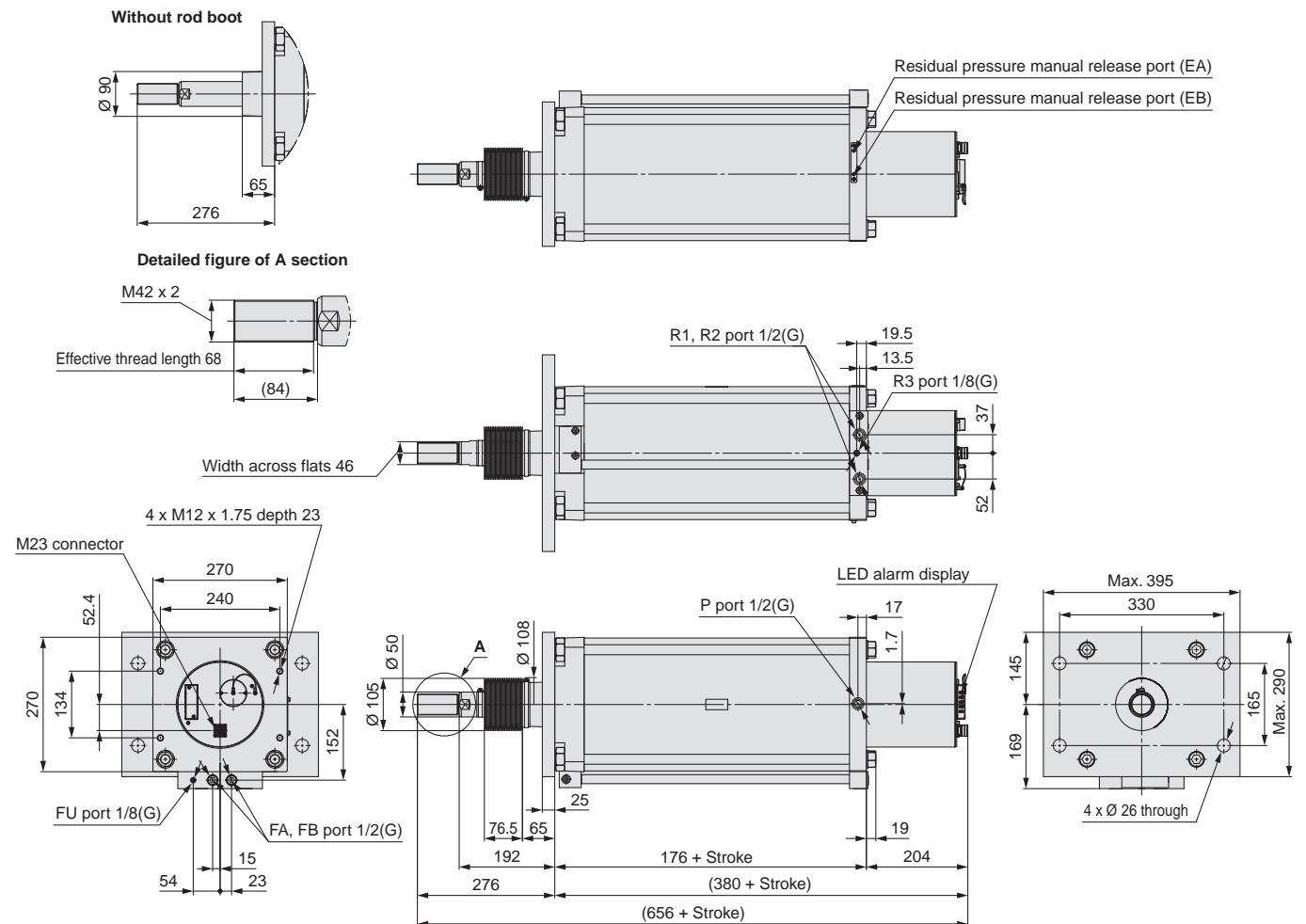


Dimensions

Ø 200

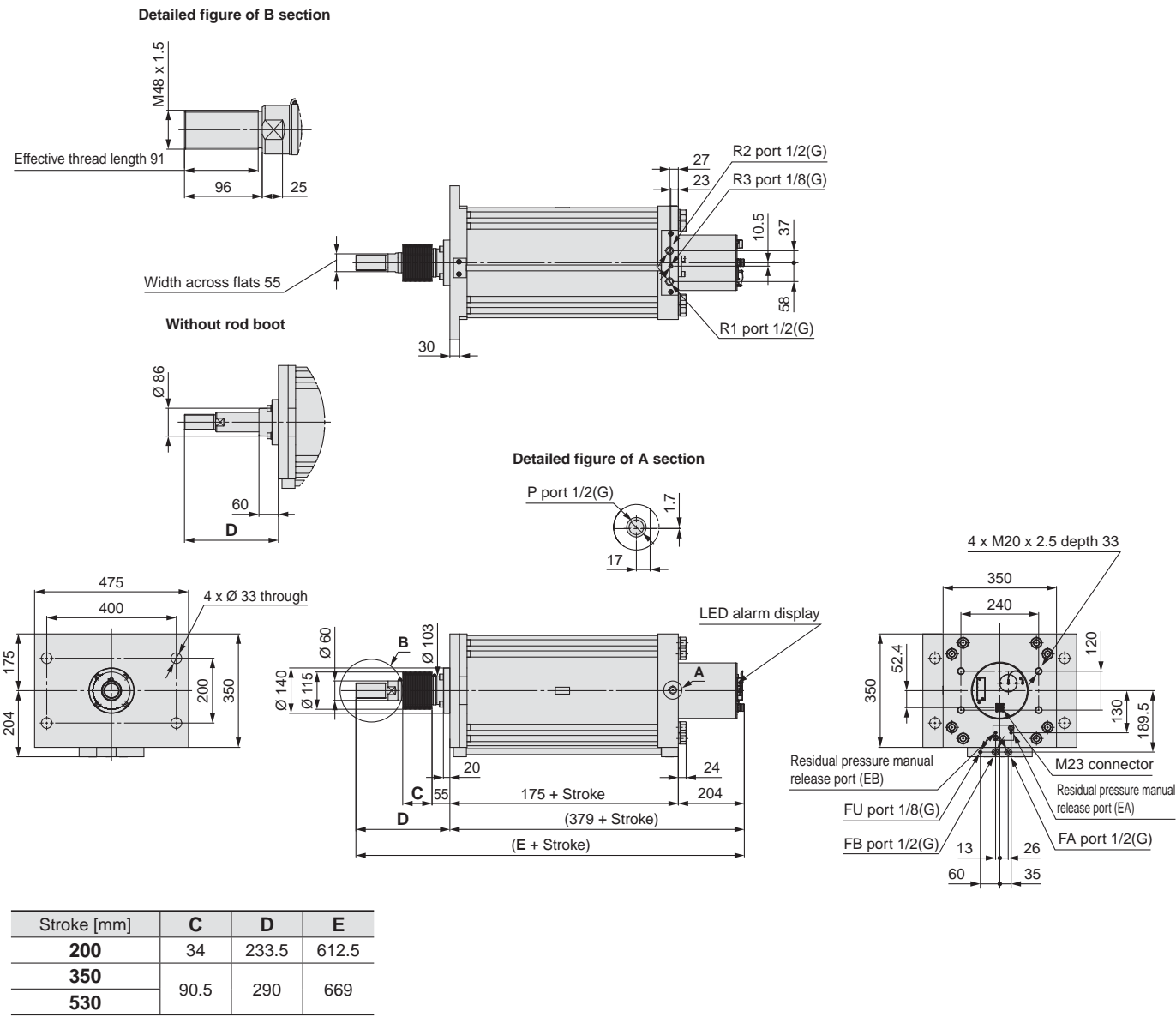


Ø 250



Dimensions

Ø 320



Working Principle/Construction

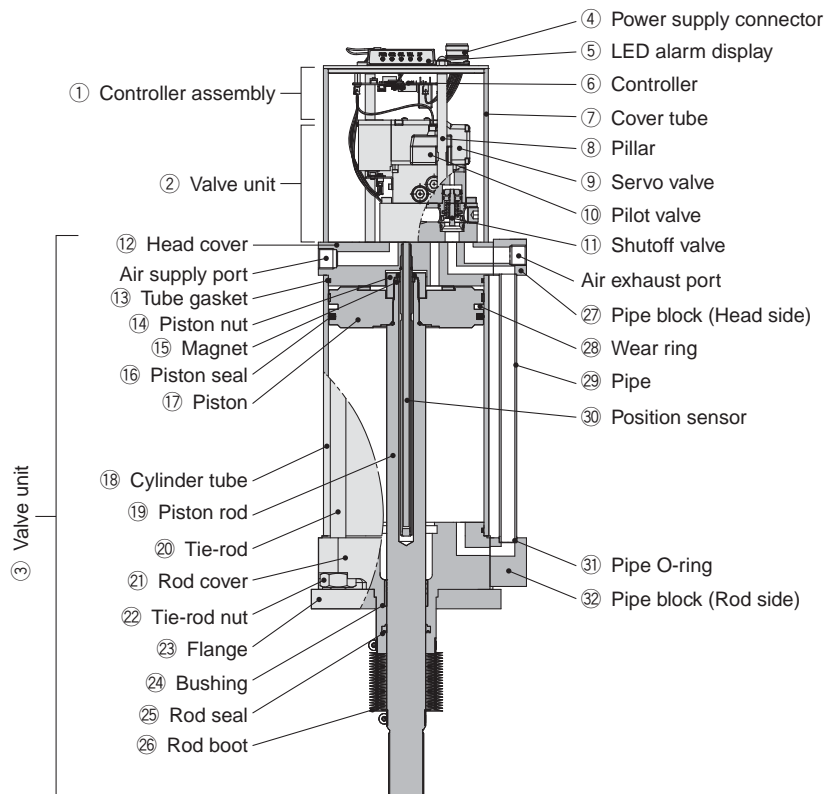
The ③ position sensor built in to the ③ air cylinder outputs the current position of the ⑱ piston rod to the ⑥ controller.

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.

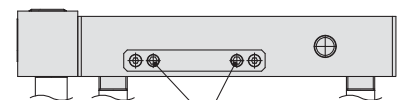
The opening and closing of the ⑪ shutoff valve is controlled by the ⑩ pilot valve connected to the ⑥ controller.

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.

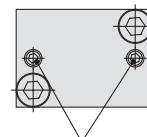


A 160 bore size, 200 mm stroke air cylinder is used in the drawings.

Back portion of Ø 125 to Ø 250 head covers

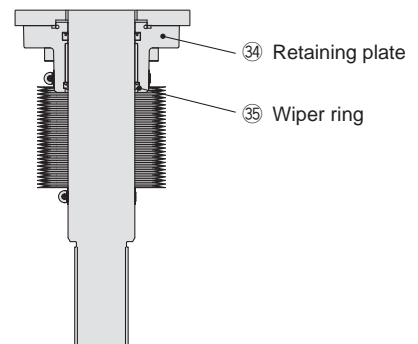


Top portion of Ø 320 head covers



Residual pressure manual release port

Cross-section portion of Ø 320 rod ends



Component Parts

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

*3 The head cover is integrated for size Ø 125.

*4 The rod cover is integrated for size Ø 125.

Maintenance Parts

① Controller assembly

IN-777P-HL-410AS

Communication protocol

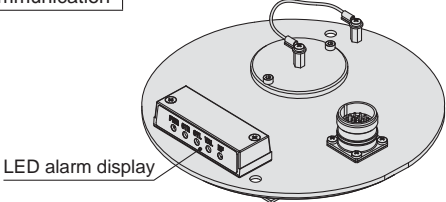
H

4-20 mA/HART communication

LED alarm display

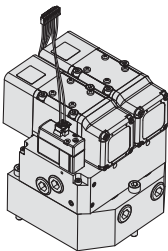
L

With LED alarm display



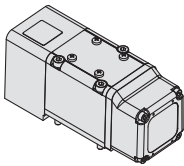
② Valve unit

IN-777P-010AS



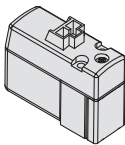
⑨ Servo valve

XT581-V-C-X001



⑩ Pilot valve

V211KT-5LOZ-X48



②⑥ Rod boot



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

③⑩ 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

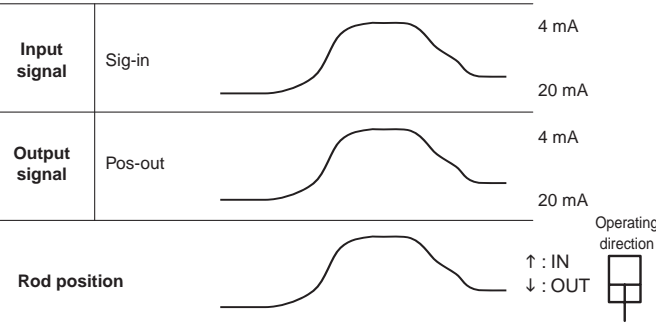
Bore size	
125	This set includes the following: ⑬Tube gasket (2 pcs.)
160	⑯Piston seal (1 pc.)
200	⑳Rod seal (1 pc.)
250	㉔Wear ring (1 pc.)
320	㉑Pipe O-ring (2 pcs.)
320	This set includes the following: ⑬Tube gasket (2 pcs.)
	⑯Piston seal (1 pc.)
	⑳Rod seal (1 pc.)
	㉔Wear ring (1 pc.)
	㉑Pipe O-ring (2 pcs.)
	㉕Wiper 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

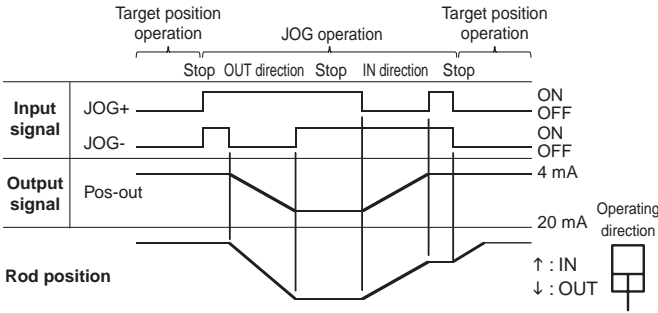
The rod position is decided according to the Sig-in signal input by the master controller.
The rod position is then output as a Pos-out signal.
* Be sure to calibrate the product before use. If the set point has not yet been set, the rod will not move even during a target position operation. Refer to page 10 for calibration instructions.



*1 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.

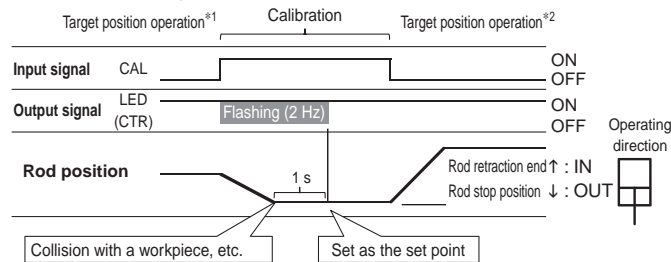
Operation Modes

■ 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.

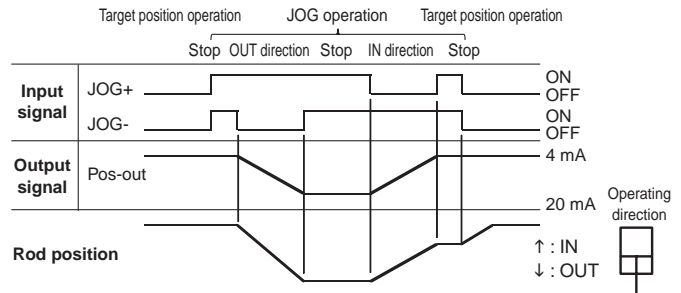


*1 If the set point has not yet been set, the rod will not move even during a target position operation.

*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.

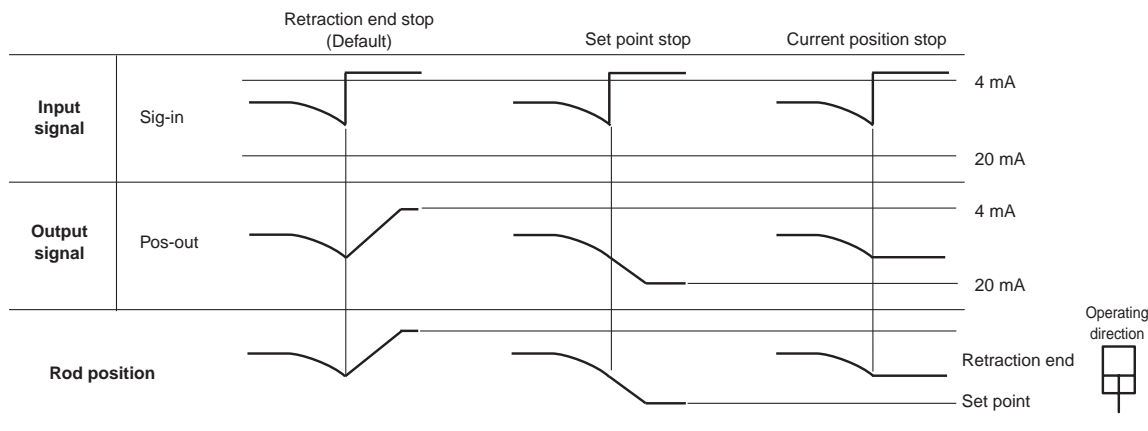
Manual

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.



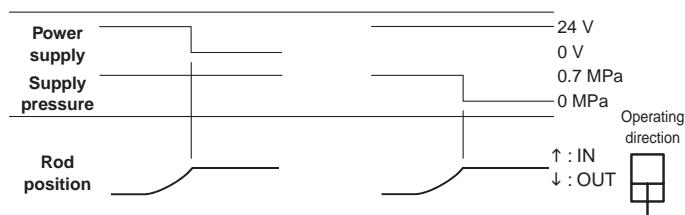
■ No signal operation

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.



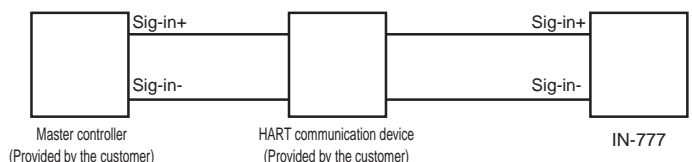
■ Emergency stop

When the 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.

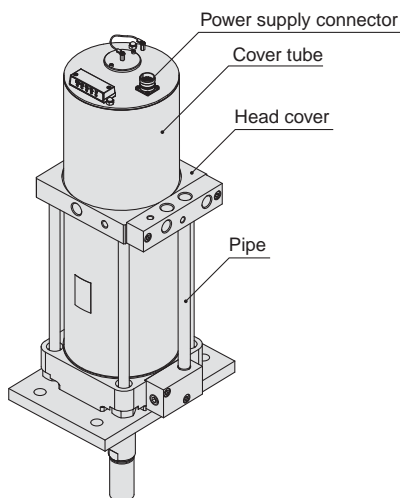
3. When a workpiece is mounted on the piston rod end, connect them by aligning the axial centre of the piston rod and that of the workpiece.

If they are off-centre, 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 Ø 160 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.

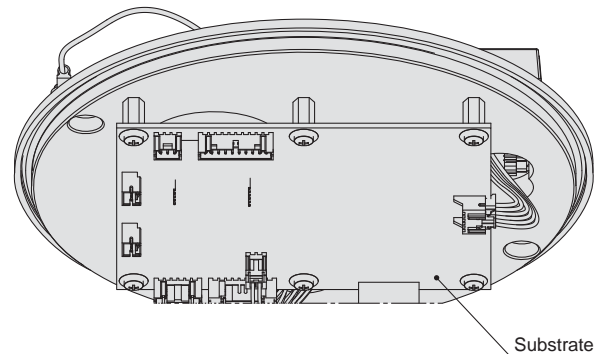
2. Avoid use in environments where condensation is generated.

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

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of “Caution,” “Warning” or “Danger.” They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC)¹⁾, and other safety regulations.

-  **Caution:** **Caution** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
-  **Warning:** **Warning** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
-  **Danger:** **Danger** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

- 1) ISO 4414: Pneumatic fluid power – General rules relating to systems.
ISO 4413: Hydraulic fluid power – General rules relating to systems.
IEC 60204-1: Safety of machinery – Electrical equipment of machines.
(Part 1: General requirements)
ISO 10218-1: Manipulating industrial robots - Safety.
etc.

Warning

1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results. The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product. This person should also continuously review all specifications of the product referring to its latest catalogue information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly. The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.

1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.
2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.
3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.

1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
2. Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalogue.
3. An application which could have negative effects on people, property, or animals requiring special safety analysis.
4. Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.

Caution

1. The product is provided for use in manufacturing industries.

The product herein described is basically provided for peaceful use in manufacturing industries.
If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary.
If anything is unclear, contact your nearest sales branch.

Limited warranty and Disclaimer/Compliance Requirements

The product used is subject to the following “Limited warranty and Disclaimer” and “Compliance Requirements”. Read and accept them before using the product.

Limited warranty and Disclaimer

1. The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.²⁾ Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.
2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided. This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.
3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalogue for the particular products.
- 2) Vacuum pads are excluded from this 1 year warranty.
A vacuum pad is a consumable part, so it is warranted for a year after it is delivered. Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

Compliance Requirements

1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction (WMD) or any other weapon is strictly prohibited.
2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulations of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.

Caution

SMC products are not intended for use as instruments for legal metrology.

Measurement instruments that SMC manufactures or sells have not been qualified by type approval tests relevant to the metrology (measurement) laws of each country. Therefore, SMC products cannot be used for business or certification ordained by the metrology (measurement) laws of each country.

Safety Instructions

Be sure to read “Handling Precautions for SMC Products” (M-E03-3) before using.

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