Booster Regulator

RoHS

VBA10A/11A Series

How to Order

VBA 10A – 02 □ – X3239

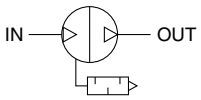
Body size

10A	1/4	Pressure increase ratio: Twice
11A	1/4	Pressure increase ratio: 4 times

Option

Symbol	Option
Nil	None
G	OUT side pressure gauge

Symbol



Standard Specifications

Model		VBA10A	VBA11A
Fluid		Compressed air	
Pressure increase ratio		2 times (Fixed)	4 times (Fixed)
Max. flow rate∗1	**L/min (ANR)**	250	90
Outlet pressure range	**MPa**	0.4 to 1.4	0.8 to 2.0
Inlet pressure range	**MPa**	0.2 to 0.7	0.2 to 0.5
Proof pressure	**MPa**	2.1	3.0
Port size (IN/OUT: 2 locations)	**Rc**	1/4	
OUT side gauge port	**Rc**	1/8	
Tank connection port (with plug)∗2		1/4	
Ambient and fluid temperatures	**°C**	2 to 50 (No freezing)	
Installation		Horizontal, Vertical	
Lubrication		Grease (Non-lube)	
Weight	**kg**	0.95	1.6

∗1 Flow rate at IN = OUT = 0.5 MPa. The pressure varies depending on the operating conditions. Refer to "Flow Rate Characteristics" on page 4.

∗2 The tank connection port cannot be used for applications other than the connection with VBAT.

Air Tank Compatibility Chart

Air tank \ Booster regulator	VBA10A/11A
VBAT05A(1)	●
VBAT05S(1)	
VBAT10A(1)	●
VBAT10S(1)	

Options/Part Nos.

Pressure Gauge/For details on pressure gauge, refer to the **Web Catalog**.

Model	VBA10A	VBA11A
Pressure gauge	G36-15-01	G46-20-01

Applicable Auto Switches/Refer to the **Web Catalog** for further information on auto switches.

Auto switch model	Electrical entry	Indicator light	Wiring (Output)	Load voltage		Applicable load	
In-line				DC			
D-M9N	Grommet	Yes	3-wire (NPN)	24 V	5 V, 12 V	IC circuit	Relay, PLC
D-M9P			3-wire (PNP)				
D-M9B			2-wire		12 V	—	

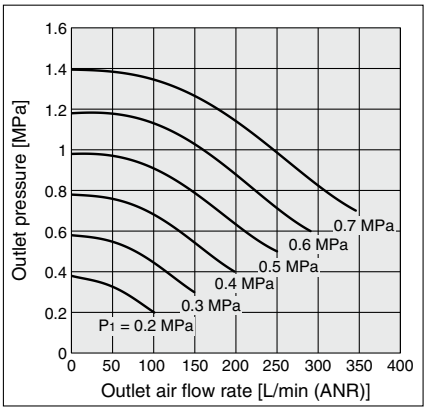
∗ Applicable auto switches can be ordered separately from the table shown above.

∗ Lead wire length symbols: 0.5 m ····· Nil (Example) D-M9N
1 m ····· M (Example) D-M9NM
3 m ····· L (Example) D-M9NL
5 m ····· Z (Example) D-M9NZ

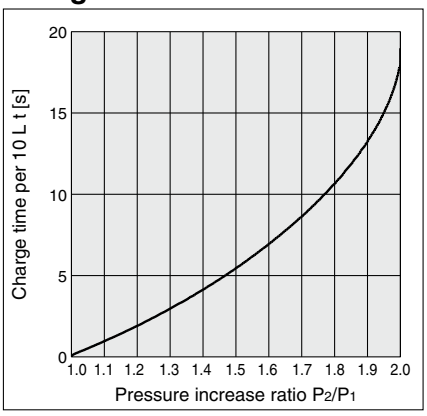
Operate so that the flow rate follows the solid line even when the outlet side air has been consumed.
Ex.) For the VBA10A: When the inlet pressure is 0.5 MPa and the set pressure is 0.8 MPa, operate at an outlet air flow rate of 140 L/min (ANR) or less.
P_1: Inlet pressure
P_2: Outlet pressure

VBA10A

Flow Rate Characteristics



Charge Characteristics



VBA10A

- The time required to charge pressure in the tank from 0.6 MPa to 0.8 MPa at 0.5 MPa supply pressure:

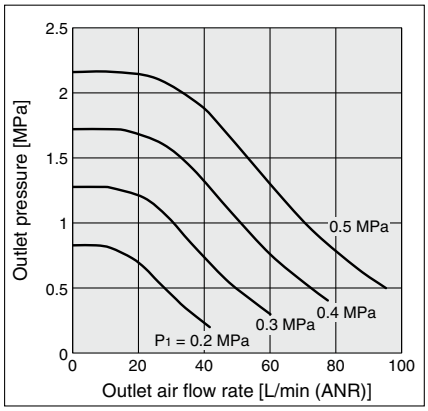
$\frac{P_2}{P_1} = \frac{0.6}{0.5} = 1.2$ $\frac{P_2}{P_1} = \frac{0.8}{0.5} = 1.6$

With the pressure increase ratio from 1.2 to 1.6, the charge time of 7 – 2 = 5 s (t) is given by the graph. Then, the charge time (T) for a 10 L tank:

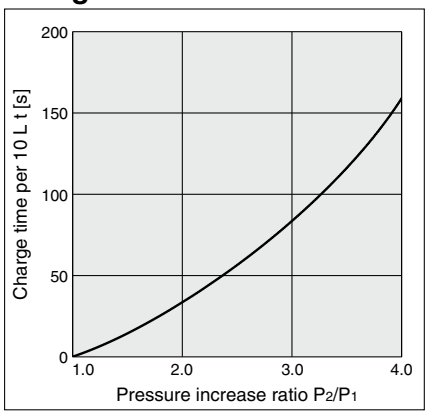
$T = t \times \frac{V}{10} = 5 \times \frac{10}{10} = 5$ (s)

VBA11A

Flow Rate Characteristics



Charge Characteristics



VBA11A

- The time required to charge pressure in the tank from 1.0 MPa to 1.5 MPa at 0.5 MPa supply pressure:

$\frac{P_2}{P_1} = \frac{1.0}{0.5} = 2.0$ $\frac{P_2}{P_1} = \frac{1.5}{0.5} = 3.0$

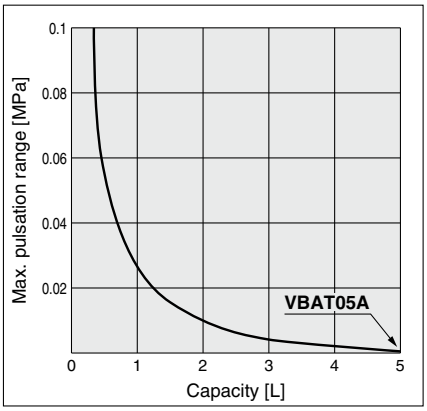
With the pressure increase ratio from 2 to 3, the charge time of 84 – 34 = 50 s (t) is given by the graph. Then, the charge time (T) for a 10 L tank:

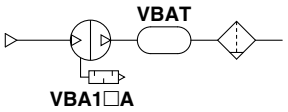
$T = t \times \frac{V}{10} = 50 \times \frac{10}{10} = 50$ (s)

Pulsation/Pulsation is decreased with a tank.

If the outlet capacity is undersized, pulsation may occur.

VBAT05A



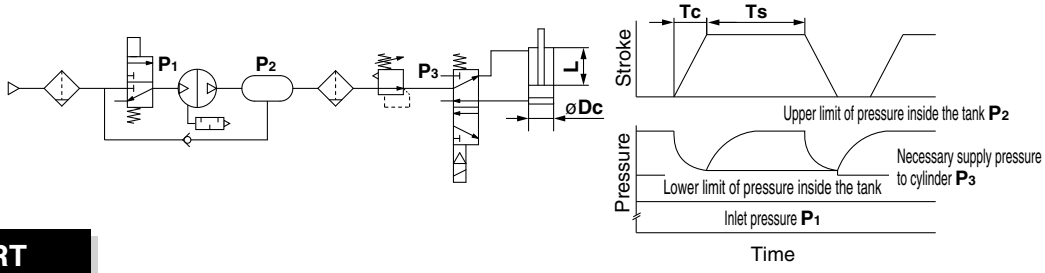


Conditions: Inlet pressure: 0.5 MPa
Outlet pressure: 1.0 MPa
Flow rate: Between 0 and max. flow rate

- Performance of air tank
  - Alleviates the pulsation generated on the outlet side.
  - When air consumption exceeds air supply during intermittent operation, required air will be accumulated in the tank for use. This does not apply for continuous operation.

Sizing

Please use the Booster Regulator Model Selection Software on the SMC website: https://mssc.smcworld.com/brmss/



START

Provide requisite conditions for selection.

Necessary conditions:

Dc [mm]: Cylinder bore size
Lc [mm]: Cylinder stroke
N [pc.]: Number of cylinders
Tc [s]: Cylinder operating time
DT [mm]: Piping bore (Valve-Cylinder)
LT [mm]: Piping length (Valve-Cylinder)
C [cpm]: Operating frequency
P1 [MPa]: Booster regulator inlet pressure
P3 [MPa]: Necessary supply pressure to cylinder
P2 [MPa]: Booster regulator outlet pressure (Set pressure)

* **P3** is the necessary supply pressure to a cylinder, and set the pressure below the lower limit of pressure inside the tank with a regulator. Adjust the pressure taking the maximum operating pressure of equipment in use into consideration.
* **P2** is the output pressure of the booster regulator, which is also the upper limit of charge pressure to the tank.

Other conditions:

QAVE [L/min]: Average air flow rate
QMAX [L/min]: Maximum instantaneous air flow rate
K: Cylinder double-acting: 2, single-acting: 1
T1 [s]: Time to charge (Time to charge to **P3**)
T2 [s]: Time to charge (Time to charge to **P2**)
T [s]: Time to charge (Time to charge from **P3** to **P2**)

Selection example	
Dc [mm]: 50	**LT** [mm]: 500
Lc [mm]: 100	**C** [cpm]: 6
N [pc.]: 1	**P1** [MPa]: 0.5
Tc [s]: 0.5	**P3** [MPa]: 0.8
DT [mm]: 4	**P2** [MPa]: 1.0

Obtain the capacity (V).

Obtain the piping volume from the valve to the actuator and the volume of the actuator to obtain the air flow rate from the outlet side of the booster regulator.

Cylinder volume

$$V_{CYL}\ [L] = \frac{\pi \times D_C^2 \times L_C}{4 \times 10^6} \times \frac{P_3 + 0.101}{0.101} \times N$$

$$V_{CYL}\ [L] = \frac{\pi \times 50^2 \times 100}{4 \times 10^6} \times \frac{0.8 + 0.101}{0.101} \times 1 = 1.75\ [L]$$

Piping capacity

$$V_{TUBE}\ [L] = \frac{\pi \times D_T^2 \times L_T}{4 \times 10^6} \times \frac{P_3}{0.101} \times N$$

$$V_{TUBE}\ [L] = \frac{\pi \times 4^2 \times 500}{4 \times 10^6} \times \frac{0.8}{0.101} \times 1 = 0.05\ [L]$$

Calculate air flow rate (Q).

Obtain the average air flow rate **QAVE** to select the size of the booster regulator.

Average air flow rate

$$Q_{AVE}\ [L/min\ (ANR)] = (V_{CYL} + V_{TUBE}) \times \underline{2} \times C$$
(Reciprocation)

$$Q_{AVE}\ [L/min\ (ANR)] = (1.75 + 0.05) \times 2 \times 6 = 21.6\ [L/min\ (ANR)]$$

Obtain the maximum instantaneous air flow rate **QMAX** to check the necessity of an air tank.

Maximum instantaneous air flow rate

$$Q_{MAX}\ [L/min\ (ANR)] = \frac{(V_{CYL} + V_{TUBE})}{T_C} \times 60$$

$$Q_{MAX}\ [L/min\ (ANR)] = \frac{(1.75 + 0.05)}{0.5} \times 60 = 216\ [L/min\ (ANR)]$$

Select the booster regulator and check the necessity of an air tank.

Select the booster regulator from the average air flow rate **QAVE** and check the necessity of an air tank from the maximum instantaneous air flow rate **QMAX**.

It can be used when the outlet air flow rate of the intersecting point between the booster regulator inlet pressure (**P1**) and necessary supply pressure to cylinder (**P3**) on the catalog flow characteristic table (p. 4) is equal to the average air flow rate **QAVE** or higher.
An air tank is required when the outlet air flow rate is less than the maximum instantaneous air flow rate **QMAX**.
An air tank is not required when the outlet air flow rate is at the maximum instantaneous air flow rate **QMAX** or higher.

⚠ Caution

- Since the booster regulator is a compressor powered by the air, it consumes the air. The air consumption is approximately 0.9 times (VBA10A) or 3 times (VBA11A) larger than the outlet side volume. Therefore, the booster regulator requires a supply capacity of the inlet side volume that is approximately 1.9 times (VBA10A) or 4 times (VBA11A) larger than the outlet side volume.

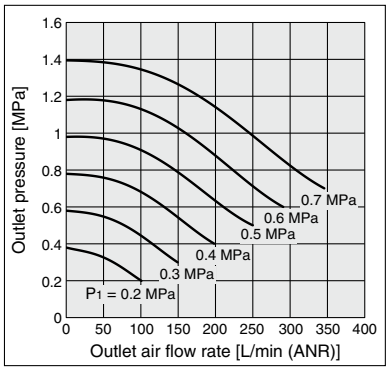
Selection example

P1: 0.5 [MPa], **P2**: 0.8 [MPa] → Outlet air flow rate **VBA10A**: 140 [L/min]

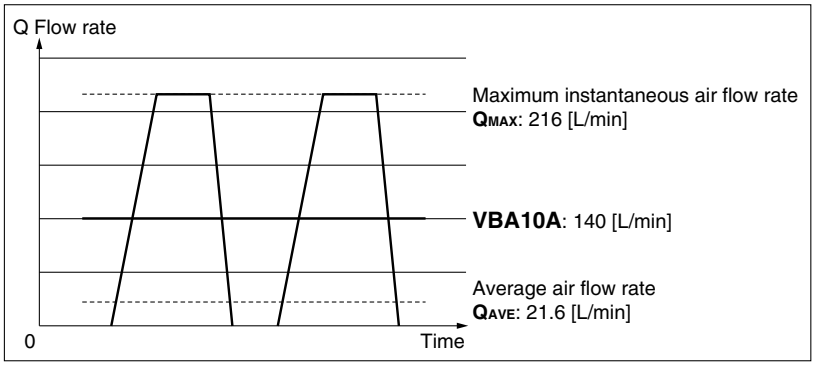
Average air flow rate **QAVE**: 21.6 [L/min]
Maximum instantaneous air flow rate **QMAX**: 216 [L/min]

VBA10A

Flow Rate Characteristics



Results
The outlet air flow rate of **VBA10A** is equal to the average air flow rate **QAVE** or higher but it is less than the maximum instantaneous air flow rate **QMAX**. Therefore, it can be used but an air tank is required.



Booster regulator selection and air tank necessity confirmation results

Obtain the air tank capacity.

Obtain the air tank capacity.

$$\mathbf{V}\ [L] = \frac{\mathbf{Q_{MAX}}}{(\mathbf{P_2} - \mathbf{P_3}) \times 9.9} \times \frac{\mathbf{T_C}}{60} \times \mathbf{K}$$

Application example

Required air tank volume for **VBA10A**

$$\mathbf{V}\ [L] = \frac{216}{(1 - 0.8) \times 9.9} \times \frac{0.5}{60} \times 2 = 1.8\ [L]$$

∗ Air tank of 1.8 L or more is required.

Check the air tank charge characteristics.

Obtain the time **T** from the catalog charge characteristics table (p. 4) and check that it satisfies the operating frequency.

$$\mathbf{T} = (\frac{\mathbf{V}}{10}) \times (\mathbf{T_2} - \mathbf{T_1}) \leq \frac{60}{\mathbf{C}}$$

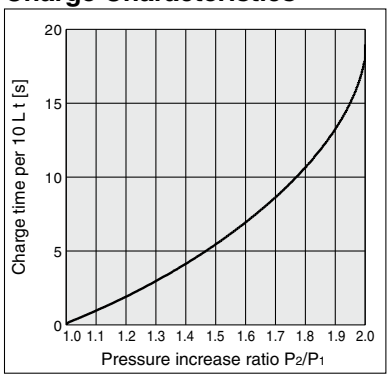
Application example

$$\mathbf{T} = (\frac{1.8}{10}) \times (18 - 7) = 2 \leq \frac{60}{6}$$

A tank smaller than the calculation results may satisfy the requirement since this size selection calculation provides calculation which is on the safe side. This does not consider air flowing from the booster regulator.
Please use the booster regulator model selection software on the SMC website.

VBA10A

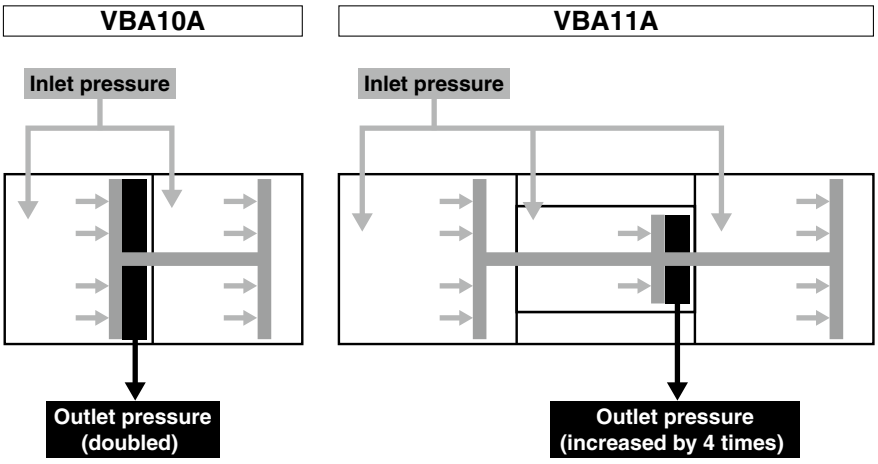
Charge Characteristics



END

When running continuously for longer periods of time, confirm the life expectancy.
When the life expectancy is shorter than required, select a larger sized booster regulator.

Working Principle

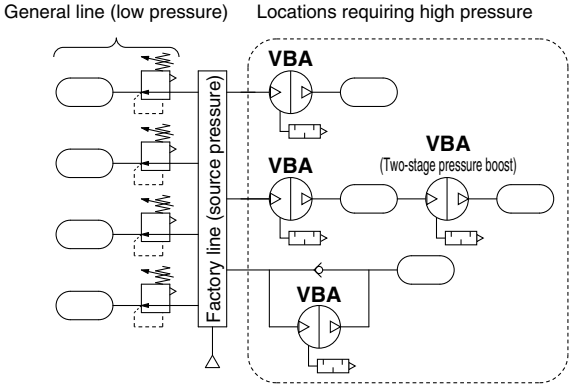


The VBA10A has two pistons and four chambers.
The inlet pressure enters two chambers as shown in the figure and pushes the pistons in the arrow direction and outputs compressed air as outlet pressure.

The VBA11A has three pistons and six chambers.
The inlet pressure enters three chambers as shown in the figure and pushes the pistons in the arrow direction and outputs compressed air as outlet pressure.

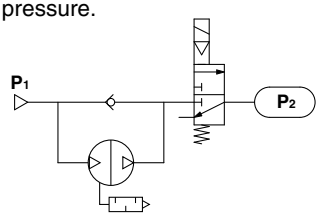
Circuit Example

- When only some of the machines in the factory require high-pressure air, booster regulators can be installed for only the equipment that requires it. This allows the overall system to use low-pressure air while accommodating machines requiring high-pressure air.

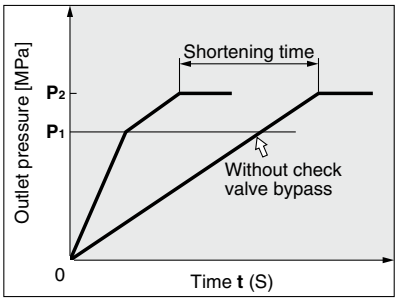


∗ When using two booster regulators for 2-stage pressure boost, be sure to supply sufficient flow to each booster regulator in order to stabilize the booster regulator inlet pressure. Refer to Selection 2. on page 10 for the inlet side supply amount.

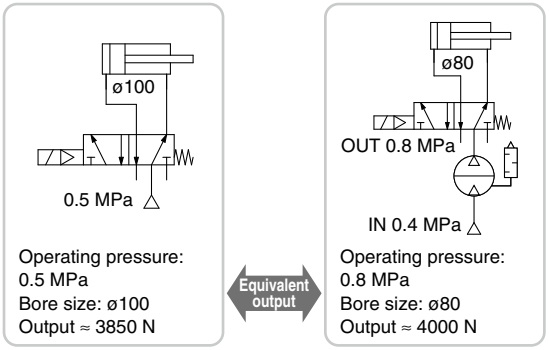
- When charging a tank or the like from a source at atmospheric pressure, a circuit with a check valve can be used to reduce the charge time by allowing air to pass through the check valve up to the inlet pressure.



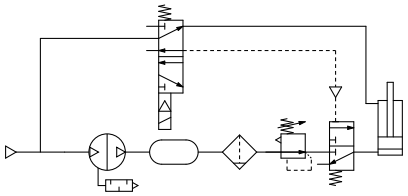
Initially, inlet pressure (**P1**) passes through the check valve, fills **P2**, and results in **P1** = **P2**.



- When the actuator output is insufficient but space limitations prohibit switching to a larger cylinder diameter, a booster regulator can be used to increase the pressure. This makes it possible to boost the output without replacing the actuator.
- When a certain level of output is required but the cylinder size must be kept small so that the driver remains compact.

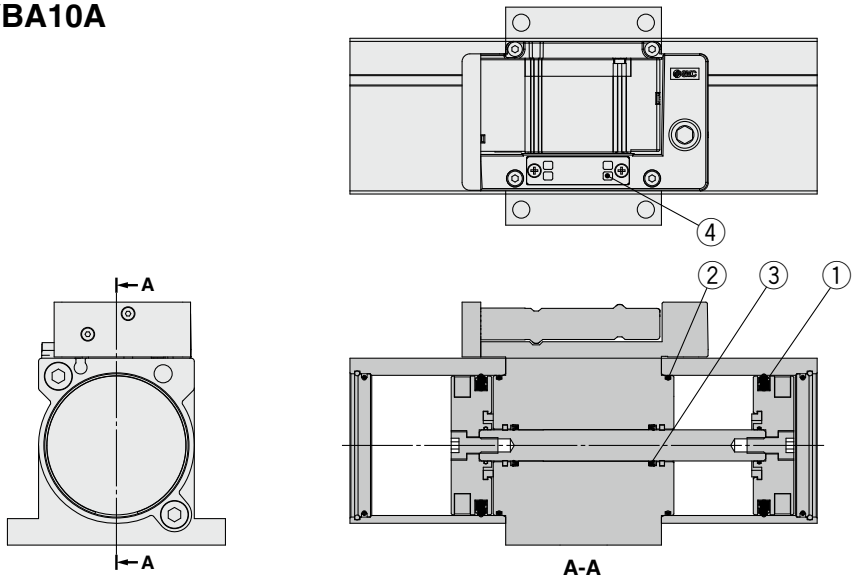


- When only one side of the cylinder is used for work, booster regulators can be installed only on the lines that require them to reduce the overall air consumption volume.

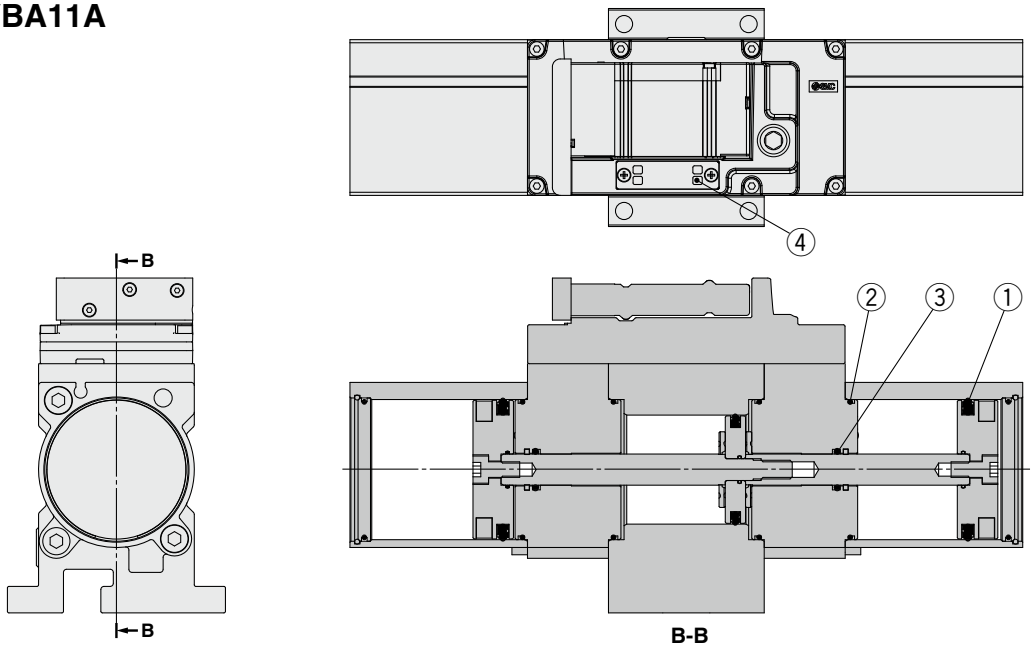


Construction/Replacement Parts

VBA10A



VBA11A



Replacement Parts/Kit No.

Place an order with the following applicable kit number.

Model	VBA10A	VBA11A
Kit no.	KT-VBA10A-X3239-1	KT-VBA11A-X3239-1

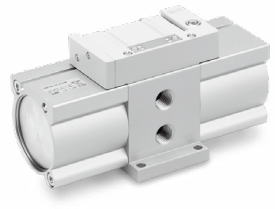
The kit includes the following parts and a grease pack.

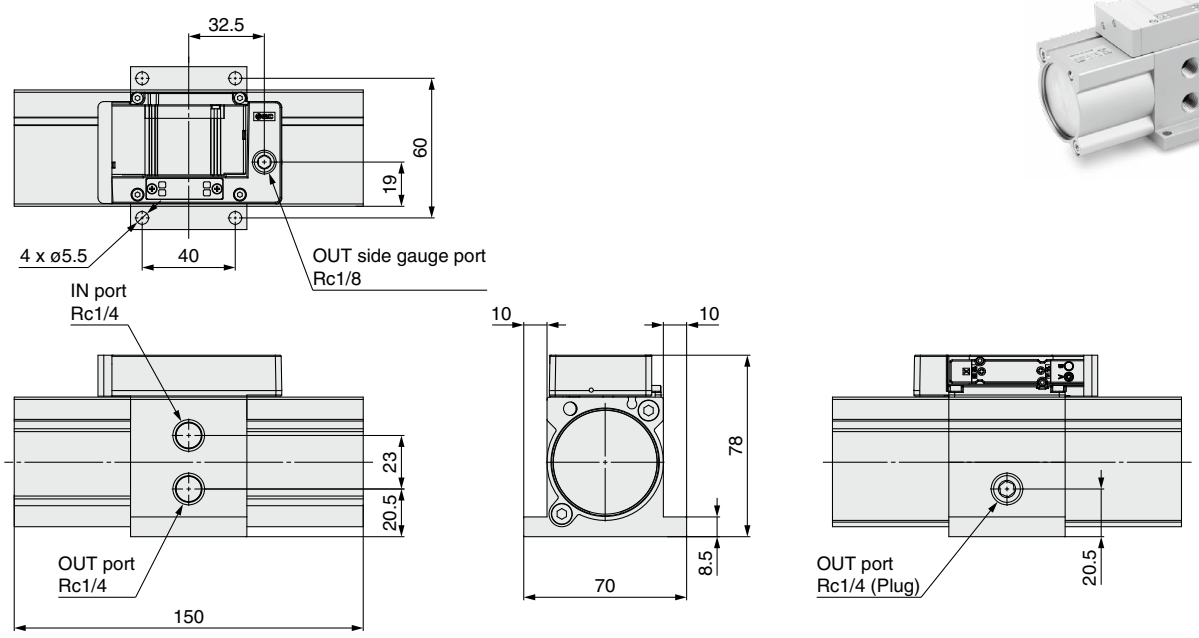
No.	Description \ Model	VBA10A	VBA11A
		Quantity	
1	**Piston seal**	2	2 large 1 small
2	**Tube gasket**	2	4
3	**Rod seal**	2	
4	**Silencer**	2	
—	**Check valve assembly**	4	
—	**Pilot valve assembly**	2	
—	**O-ring**	2	6
—	**Grease pack**	1	

∗ The grease pack has 10 g of grease.
∗ Make sure to refer to the procedure for maintenance.
∗ For details on the replacement parts kit, refer to the procedure for maintenance.

Dimensions

VBA10A





VBA11A