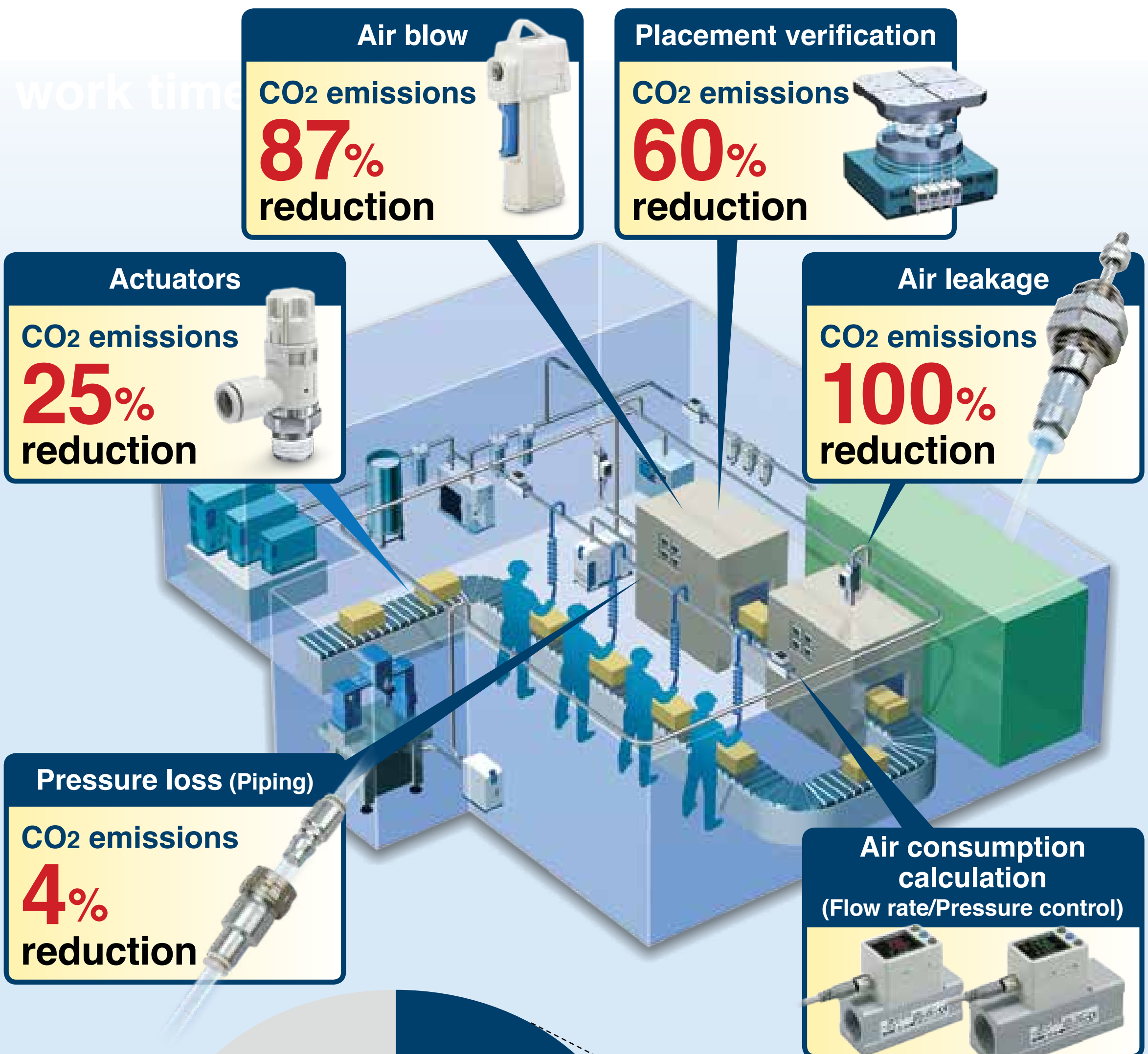
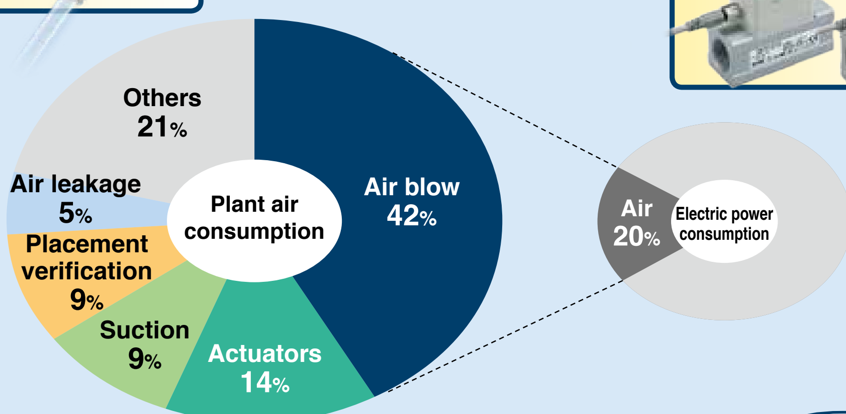
SMC®

Proposal for Energy Saving in Factories

Helping you optimize your air pressure





NC444-A
(P-E20-14)

Environment

Eco-Management

SMC Group Code of Conduct – Initiatives on Environmental Issues

We recognize that preservation of global environment is an essential condition for our company's existence and activities as well as a common issue for all humanity. We will work on preserving and improving the environment where people can live safely with rich nature.

1. We will strive to develop and supply environment-friendly products.
2. We will consider protection of environment throughout the whole process of business operation.
   - We will comply with regulations on banned substances.
   - We will ensure proper treatment of wastewater and air exhaustion, and disposal of waste, and will work on reducing waste.
   - We will be thorough in our effort to save natural resources and energy.

Environmental Policy

1. We will identify the environmental impacts of our business activities, products and services and strive to reduce environmental burden and prevent pollution, and to make continual improvement of our environmental management system.
2. We will comply with all environment-related laws, regulations and agreements, and enhance collaboration with our customers, neighbors and local communities.
3. We will minimize the environmental impacts from our design, development and production activities.
   (1) We will promote the development of environment-friendly products.
   (2) We will use energy efficiently to prevent global warming.
   (3) We will promote the reduction and recycling of waste.
4. We will ensure that the action plans are implemented properly to achieve the environmental objectives and goals.
5. We will make this policy known to all as well as release it to the general public.

This is a logo of SMC's environmental preservation activities. It is a heart-shaped design with a blue earth and a young leaf. The mark appears on our Environmental Policy as well as on documents and bulletins to enhance awareness among our employees.

CSR Promotion System

SMC has established a CSR Committee chaired by the President and has been taking initiatives in responding to customer requests and inquiries on CSR-related issues.

Main Tasks of the CSR Committee

1. To plan, develop and manage policies related to CSR and other matters.
2. To respond to questionnaires on CSR, etc., from users and corresponding to audits (site visits).
3. To conduct audits on the progress of implementation of policies related to CSR, etc.
4. To take necessary measures based on the progress of implementation of policies and audit results related to CSR, etc.

Environmental Training

SMC offers educational seminars and practical training on environmental issues for its employees, and also provides environmental training for environment-related partner companies. In addition, employees who hold their country's qualifications continuously attend follow-up training to enhance the quality of their knowledge and technical abilities.

Training conducted in FY2018

Environmental training for employees	7,219 attendees
Emergency response training	99 attendees
Training for front-line workers	458 attendees
Participation in external environment-related training sessions	19 attendees
Environmental training for environment-related partner companies	138 companies

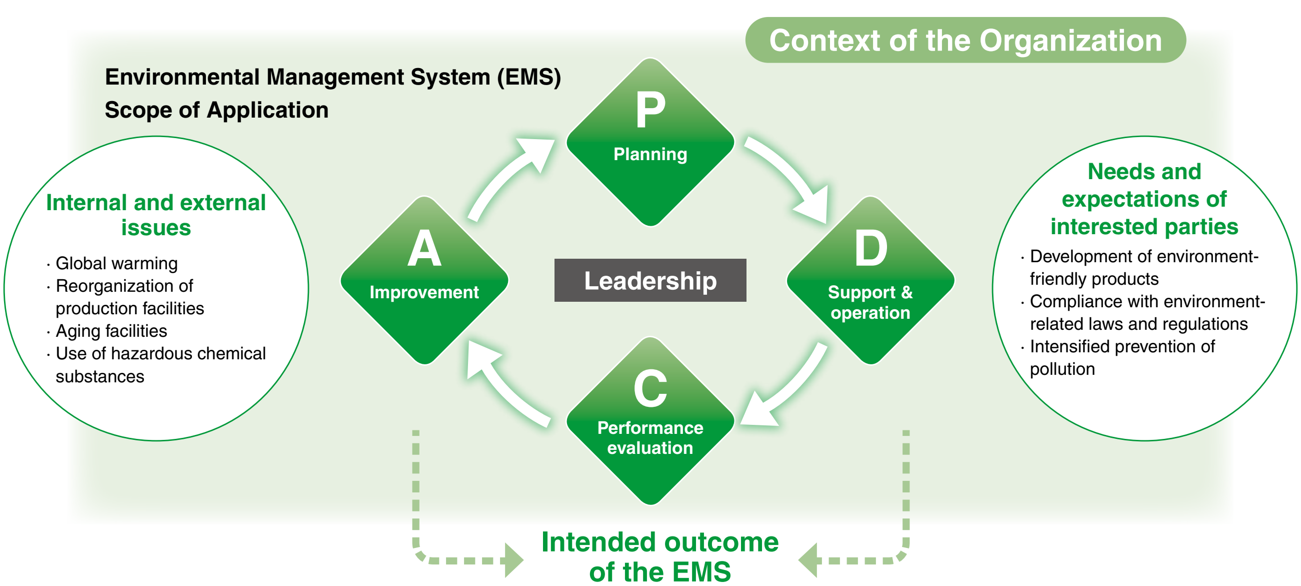
Environmental Objectives, FY2018 Results and Evaluation

As part of our initiatives under the Environmental Management System (EMS) which adheres to ISO 14001, SMC defines "Environmental Objectives" to be achieved over a period of three years and "Environmental Targets" for each fiscal year, and manages and evaluates the progress.
In FY2018, out of the "Environmental Targets" described below, we achieved all except for "Saving of resources". "Saving of resources" was not accomplished due to the effect of increased waste from packaging material (wooden crates and wooden pallets) accompanying overseas manufactured products.

1. SMC conducted product assessments to be utilized for the design and development of environmentally-friendly products.
2. As an initiative to prevent global warming, SMC achieved a 18.4% reduction of CO_2 emissions per unit of production compared to the Sixth Term (FY2014-2016) average. As an initiative to save resources, SMC achieved a 1.8% reduction of waste discharged per unit of production compared to the Sixth Term (FY2014-2016) average.
3. All regional groups consisting of our major production facilities participated in climate change actions organized by local governments and industry groups and community beautification activities, as well as conducted awareness building programs for employees.

	Environmental Objectives Goals to achieve in 3-year period of FY2017-2019	Environmental Targets for FY2018	Results	Evaluation
Product assessments (Environmental compatibility)	Design and development of environmentally-friendly products Conducted assessments using score evaluation of current status Total of 75 models or more in three years: 900 points or higher	Design and development of environmentally-friendly products Conducted assessments using score evaluation of current status 25 models or more: 300 points or higher	37 models: 345 points	Achieved
Business activities (Environmental conservation)	Promote energy-saving, resource-saving and reduction of environmental burden through beneficial environmental activities in our business activities			
	Prevention of global warming Reduction of CO_2 emission Sixth Term (FY2014-2016): Average of 10% or more reduction per unit of production	Reduction of CO_2 emission Reduce 8% or more compared to the Sixth Term (FY2014-2016) average per unit of production	18.4% reduction	Achieved
	Saving of resources Reduction of waste discharge Sixth Term (FY2014-2016): Average of 10% or more reduction per unit of production	Reduction of waste discharge Reduce 8% or more compared to the Sixth Term (FY2014-2016) average per unit of production	1.8% reduction	Not achieved
Communication (Coexistence with society)	Social contribution activities Community beautification activities	Social contribution activities Community beautification activities	All regional groups conducted as planned	Achieved
	Promotion of climate change actions	Promotion of climate change actions Participation in initiatives organized by local governments and industry groups Conduction of education and awareness building programs	All regional groups conducted as planned	Achieved

Framework of ISO 14001:2015



Proposal for Energy-saving, Compact, and

Air supply

Compressor

Air preparation equipment

- Aftercooler
- Tank

Main line filter

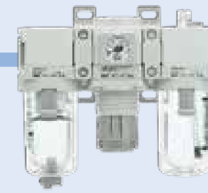
Air dryer

Fittings and Tubing

S Coupler
Tubing

Air combination Pressure control equipment

- Filter
- Regulator
- Lubricator



First, figure out how much air is currently being used. → **1**

Plan piping in a way that saves energy. → **3** **4** **5**

Don't let any pressure go to waste! A few minor revisions → energy savings! → **4**

Are you replacing your elements? → **4**

1 Air consumption calculation

p. 7 ▸ 10

- Flow rate measurement
- Air blow measurement
- Pressure measurement

2 Air blow efficiency

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Nozzles for blowing

Impact blow gun

Impact blow valve

3 Reduce air leakage

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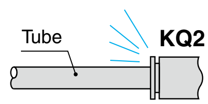
Air leakage from the One-touch fitting



Installation of a solenoid master valve

VXD

4 Reduce pressure loss

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Coupler

Air filter clogging

7 Energy-saving circuit

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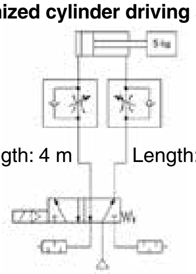
Optimized cylinder driving system



8 Compact and lightweight products

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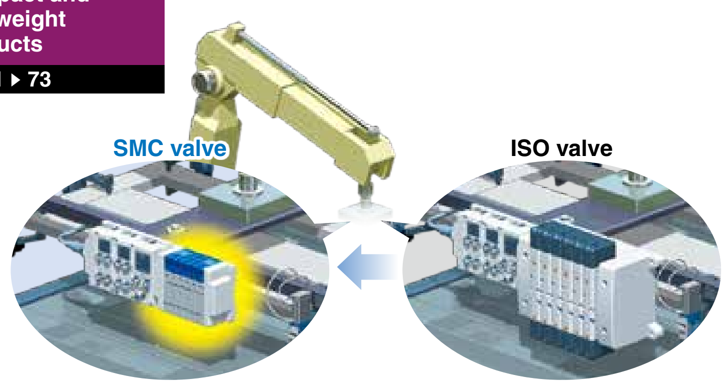
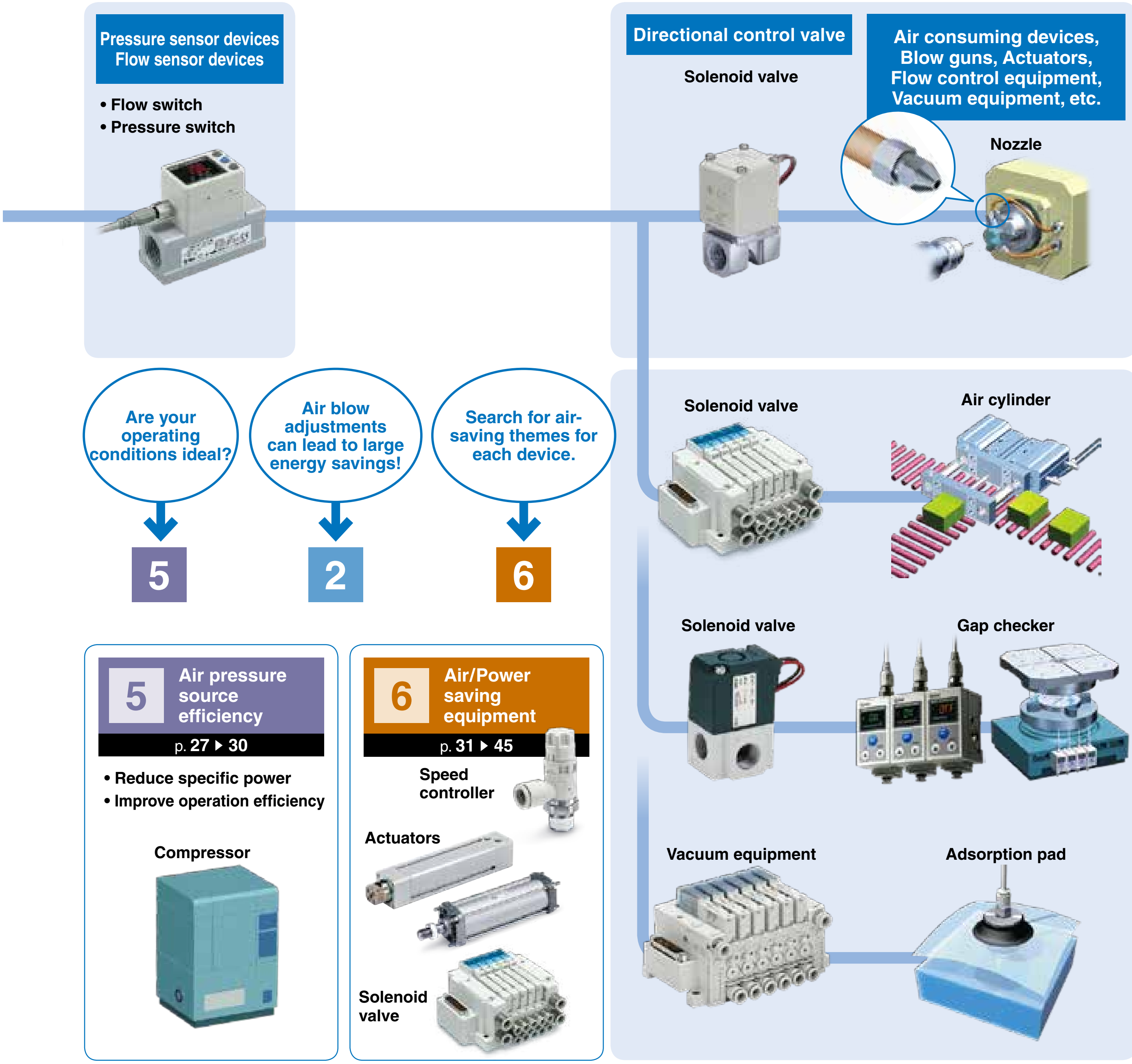


Lightweight Air Systems



9 Technical data

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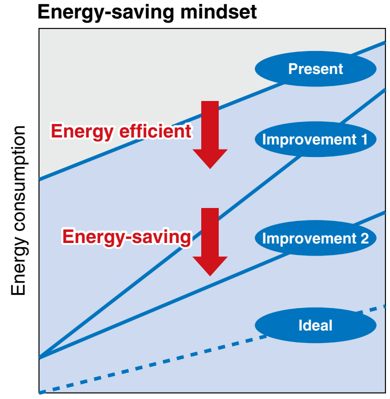
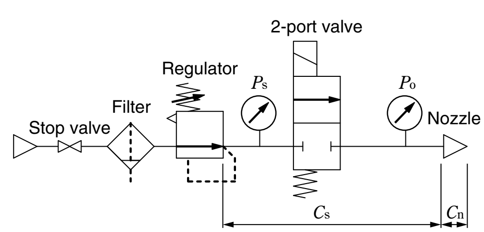
Energy-saving mindset



Changes in upstream conductance pressure loss



Recommended air blow system

We will help you save energy.

Successful cases of companies that implemented measures for energy saving

Company A performance	
Electricity	3000 kWh ➡ 1400 kWh
CO_2	0.9 t reduction/year
Cost	$743,348 reduction/year

Company B performance	
Electricity	10000 kWh ➡ 7000 kWh
CO_2	1.7 t reduction/year
Cost	$1,403,168 reduction/year

- **We will help you to improve and standardize your equipment and adopt new equipment.**
- **We also proactively promote activities through official organizations, such as holding seminars at the Energy Conservation Center.**

For energy saving in pneumatic systems, implement a PDCA cycle such as the one below. When following a PDCA cycle, the measuring of the usage amount before and after implementation is very important.

Phase	Step	Description	Reference
P Plan	Reduction goals	• Decide on a reduction goal.	
	Air consumption calculation	• Measure the usage amount of the factory as a whole and of the equipment as a whole. • Doing so will help you figure out the usage amount per application, per type of equipment, and per piece of equipment.	References for flow rate and pressure control p. 74
	Energy-saving theme selection	• In order to improve energy savings, select a theme according to the difficulty level and effectiveness of the measures, keeping horizontal development in mind. • Look for past examples and examples from books for reference.	References for how to approach energy saving p. 75
D Do	Implementation of energy-saving measures	• Implement the measures.	
C Check	Measuring the effectiveness of the measures	• Measure the usage amount after the measures have been implemented to measure their effectiveness.	References for flow rate and pressure control p. 74
A Action	Horizontal expansion/ Additional measures Monitoring of usage amounts	• Implement horizontal development measures. • If reduction goals aren't met, additional measures or a plan adjustment may be considered. • Monitor the usage amount, etc., to detect improvements obtained from the implemented measures.	

CONTENTS

1 Air consumption calculation

UNIT CONVERSIONS

	unit	conversion	result
length	m	x 3.28	ft
	mm	x 0.04	in
mass	g	x 0.04	oz
volume	cm^3	÷ 16.387	in^3
	L	x 61.024	in^3
speed	mm/s	÷ 25.4	in/s
pressure	MPa	x 145	psi
	kPa	÷ 6.895	psi
temperature	°C	x1.8 then add 32	°F
torque	N·m	x 0.738	ft-lb
force	N	÷ 4.448	lbf
flow	L/min	÷ 28.317	cfm
	JPY	x 0.0094	dollar

Figuring out the cost of compressed air

As compressed air cannot be seen by the naked eye and can be released to the atmosphere without causing any harm, it's easy to remain unaware of how much it's costing. By figuring out the cost of compressed air (per unit), it is possible to calculate the annual cost of the compressed air being used in your pneumatic system. The following equation is the standard calculation method for finding the cost of compressed air.

Cost of compressed air [JPY/m³ (ANR)]

$$= \frac{\text{Electric power consumption [JPY/year]} + \text{Operating costs [JPY/year]} + \text{Maintenance costs [JPY/year]} + \text{Cost of equipment [JPY/year]}}{\text{Amount of air used for compressed air [m}^3\text{ (ANR)]}}$$

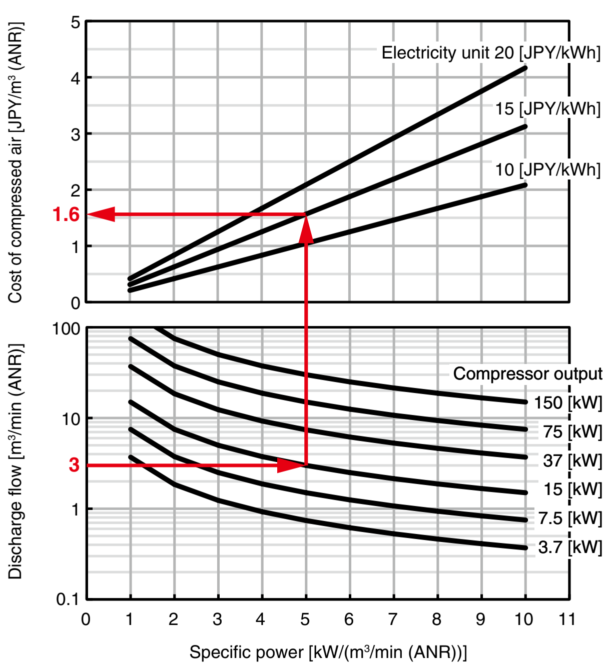
The cost of compressed air can be calculated using the actual values of combined total costs and the amount of compressed air used.

Calculation method

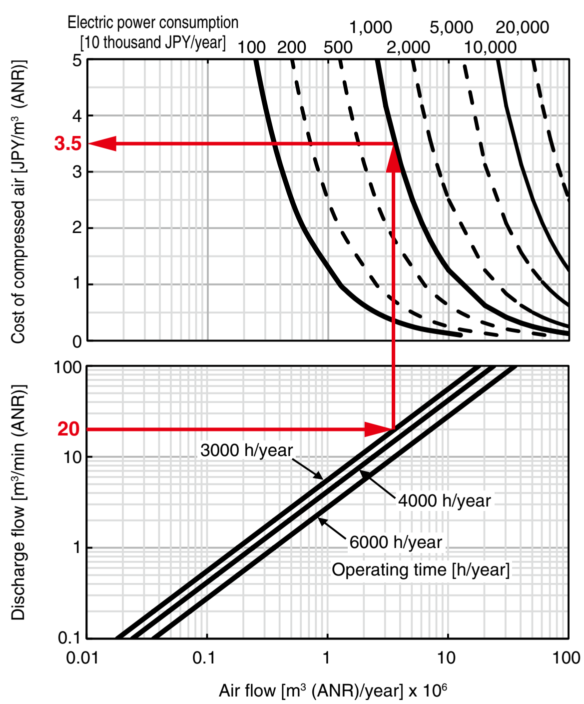
The following equation is a simple calculation method for figuring out the cost of compressed air.

Calculation method ①···Calculating from the specific power
- The specific power can be found using the compressor rated output and discharge amount.
- The combined total of operating costs, maintenance costs, and the cost of equipment can be estimated to make up 25% of the cost.

Calculation method ②···When the amount of air and costs other than the cost of electricity are unknown
- The amount of air being used can be estimated as follows: operating hours x rated air discharge amount
- The combined total of operating costs, maintenance costs, and the cost of equipment can be estimated to be 25% of the cost of electricity.



Graph 1 Calculation method 1



Graph 2 Calculation method 2

Calculation example

When the compressor has a 15 kW output, a 3 m³/min (ANR) discharge flow, and the cost of electricity is 15 JPY/kWh

① Go up in a vertical line from the point of intersection of 3 m³/min (ANR) discharge flow and 15 kW compressor output.

② If you look to the left of the point of intersection with 15 JPY/kWh as the cost of electricity, you'll see that the cost of compressed air is 1.6 JPY/m³ (ANR).

Calculation example

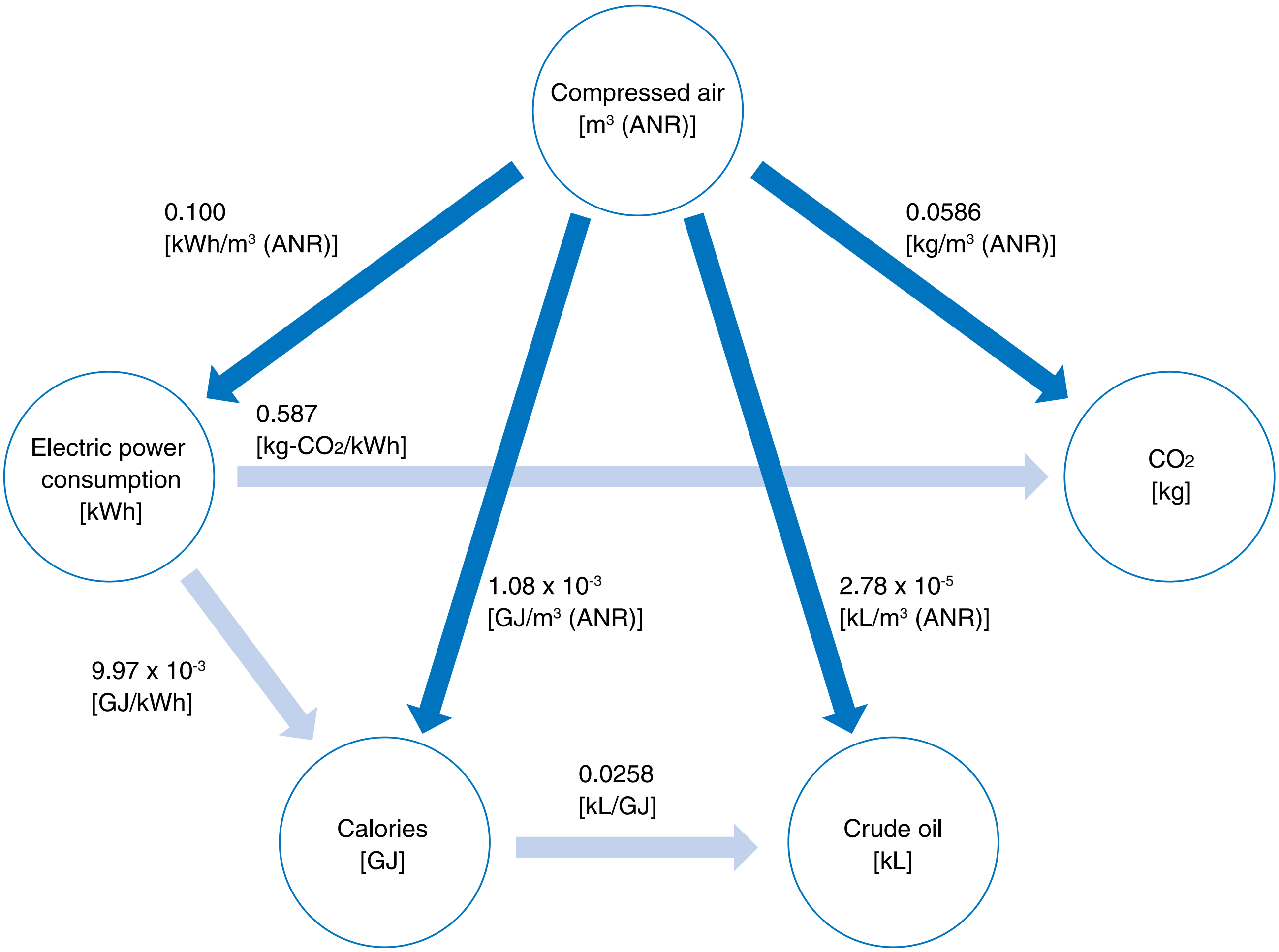
When the compressor is operated for 3,000 hours/year, has a 20 m³/min (ANR) discharge flow, and electricity costs 10 million JPY/year to operate it

① Go up in a vertical line from the point of intersection of 20 m³/min (ANR) discharge flow and 3,000 hours of operation/year.

② If you look to the left of the point of intersection with 10 million JPY/year as the cost of electricity, you'll see that the cost of compressed air is 3.5 JPY/m³ (ANR).

1 Air consumption calculation | Calculation of compressed air energy

To calculate the amount of compressed air per unit, the amount of electricity consumption, CO_2, calories, and crude oil are used.



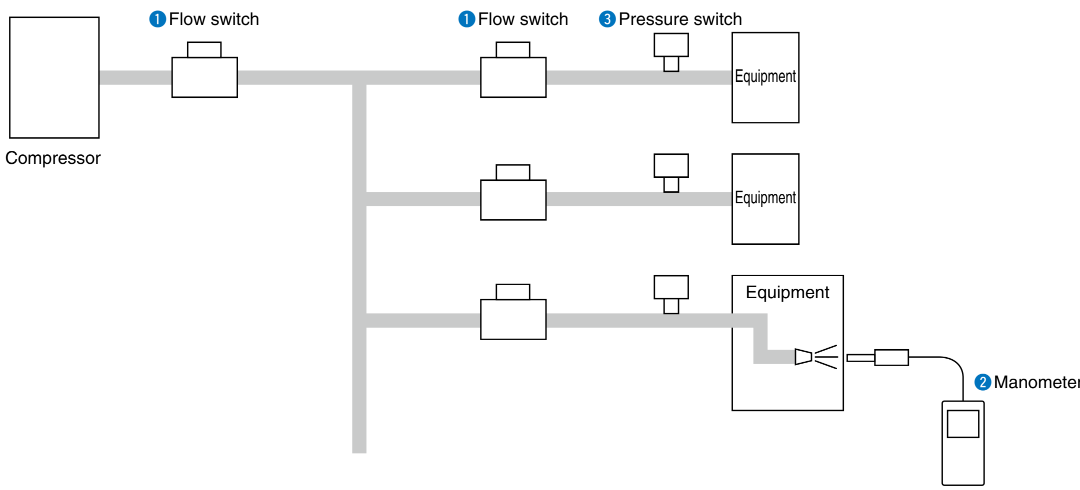
Conversion factor

- Calculated with the specific power = 6 [kW/(m³/min (ANR))]
- Amount of electricity consumption ➡ CO_2 conversion factor
  Quote: The Ministry of the Environment's website
  Emission factors of electricity business operators (For the calculation of greenhouse gas emission amounts of specified businesses) — 2015 fiscal year results — Officially announced on December 27, 2016: (Substitute values)
- Amount of electricity consumption ➡ Calorie conversion factor
  Quote: The Agency for Natural Resources and Energy's website
  Based on the annual reports of energy consumption in accordance with Article 15 and Article 19 (2) of the Act on Rationalizing Energy Use — February 7, 2017 revision: Use of daytime power purchase
- Calories ➡ Crude oil conversion factor
  Quote: Same as above

SMC

Pressure and flow rate control

In order to figure out how much air is currently being used in your pneumatic system and to measure the effectiveness of the implemented measures, it is necessary to measure the flow rate and pressure. In addition, measuring the flow rate and pressure is also necessary in order to monitor the effectiveness and further improve upon the measures.



Measure the flow rate of the main line and of each device.

Measure the flow rate of each device and of the factory as a whole in order to figure out how much air is currently being used as well as to measure the effectiveness of the implemented measures.

1 Flow switch

Measure the air blow impact pressure.

In order to improve air blow, measure the impact pressure.

2 Manometer

Measure the pressure at each device.

Monitor pressure drops between the compressor and the devices.

3 Pressure switch

2 Air blow efficiency

UNIT CONVERSIONS

	unit	conversion	result
length	m	x 3.28	ft
	mm	x 0.04	in
mass	g	x 0.04	oz
volume	cm^3	÷ 16.387	in^3
	L	x 61.024	in^3
speed	mm/s	÷ 25.4	in/s
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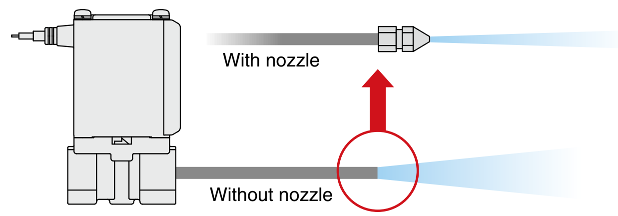
	kPa	÷ 6.895	psi
temperature	°C	x1.8 then add 32	°F
torque	N·m	x 0.738	ft-lb
force	N	÷ 4.448	lbf
flow	L/min	÷ 28.317	cfm
	JPY	x 0.0094	dollar

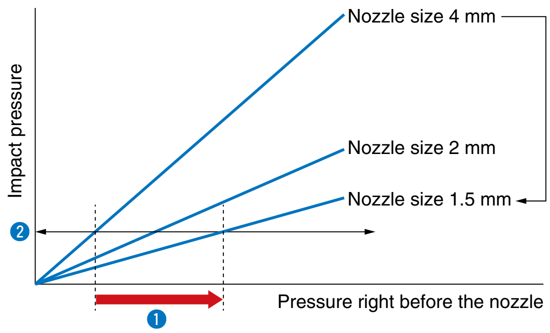
CO_2 emissions (Air consumption)

61% reduction

Install a suitable nozzle where soft copper piping, etc., is cut and used as is to conduct blow.



Comparison of Blow Effectiveness (Impact Pressure) Note: Fixed distance



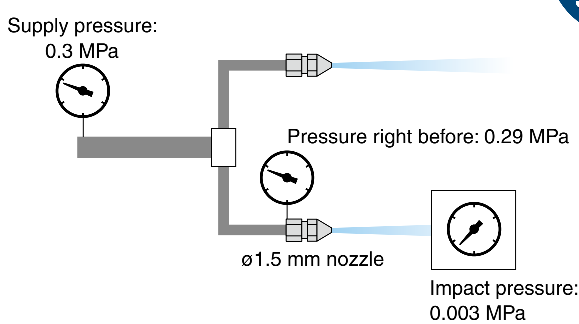
By installing a suitable nozzle, the pressure right before the nozzle will rise immediately (❶), resulting in improved blow efficiency. When the same operation is performed (❷), air consumption can be reduced.

Nozzle with self-align fitting/
KN

Nozzle with male thread/
KN

Effects of Energy Saving

Energy-saving Model



Collective piping: TU0805, 2 m
Intermediate and end piping:
TU0604, 0.5 m each
Distance: 100 mm

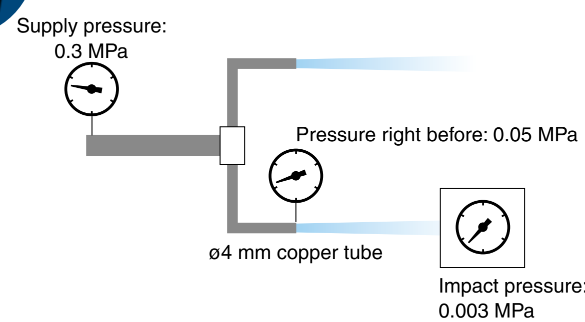
Air consumption per nozzle:
74 L/min (ANR)

Blow time: 2 sec.
Annual operating cycles:
900000

4464 m³/year (ANR)
CO_2 emissions: **261** kg/year
414 kg reduction in annual CO_2 emissions

(**$63**/year)
($99/year reduction)

Existing Model



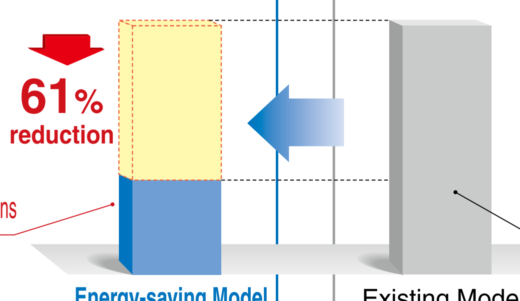
Collective piping: TU0805, 2 m
Intermediate and end piping:
TU0604, 0.5 m each
Distance: 100 mm

Air consumption per copper tube:
192 L/min (ANR)

Blow time: 2 sec.
Annual operating cycles:
900000

11520 m³/year (ANR)
CO_2 emissions: **675** kg/year

$162/year)



Corresponding value: Air unit $0.014/m³ (ANR), Air – CO_2 conversion factor 0.0586 kg/m³ (ANR)

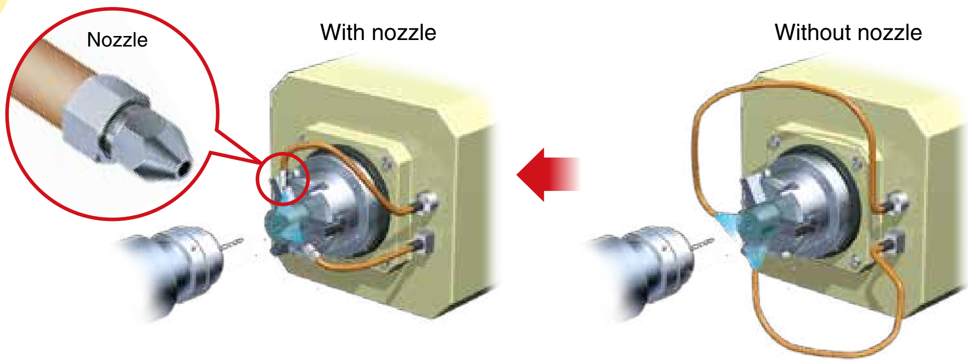
Nozzles for Blowing *KN Series* 2

CO_2 emissions
(Air consumption)

40% reduction

Overall improvements can be seen by installing nozzles and revising piping and blow positioning.

- Shorter copper pipes/Improved pipe branching
- Examination of blow position/Examination of number of blow operations
- Examination of hours of blow operation



Effects of Energy Saving

Energy-saving Model

Reduced length and number of bends in copper pipes
Attachment of a nozzle (ø2) at the end of copper pipes

Flow rate per nozzle:
171 L/min (ANR)

Blow time: 2 sec.
Annual operating cycles: 900000

5130 m^3/year (ANR)
CO_2 emissions: **301** kg/year
200 kg reduction in annual CO_2 emissions

(**$72**/year)
($48/year reduction)

Existing Model

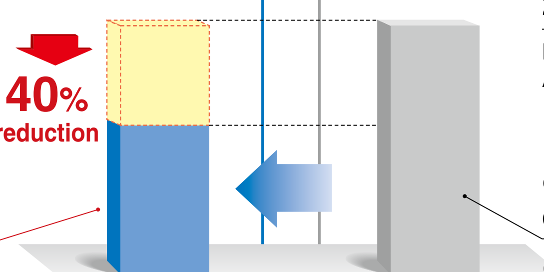
Copper pipes with a lot of bends
Air blow directly from copper pipes

Flow rate per copper tube:
285 L/min (ANR)

Blow time: 2 sec.
Annual operating cycles: 900000

8550 m^3/year (ANR)
CO_2 emissions: **501** kg/year

(**$120**/year)

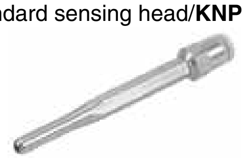


Corresponding value: Air unit $0.014/$m^3$ (ANR), Air – CO_2 conversion factor 0.0586 kg/m^3 (ANR) * Refer to the “Energy Saving Program” on the SMC website for further details.

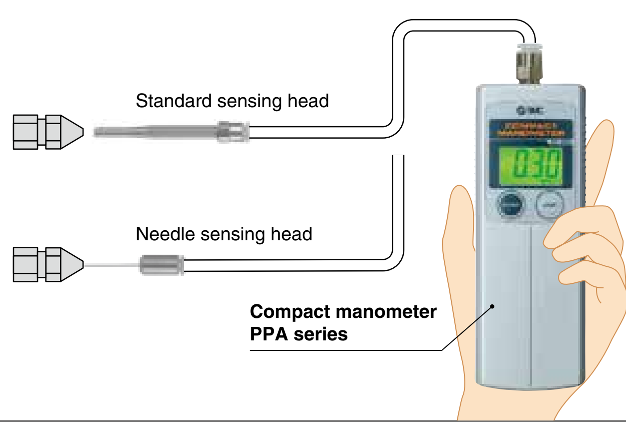
Related Products

Use to measure workpiece collision pressure.

Standard sensing head/**KNP**



Needle sensing head/**KNP**

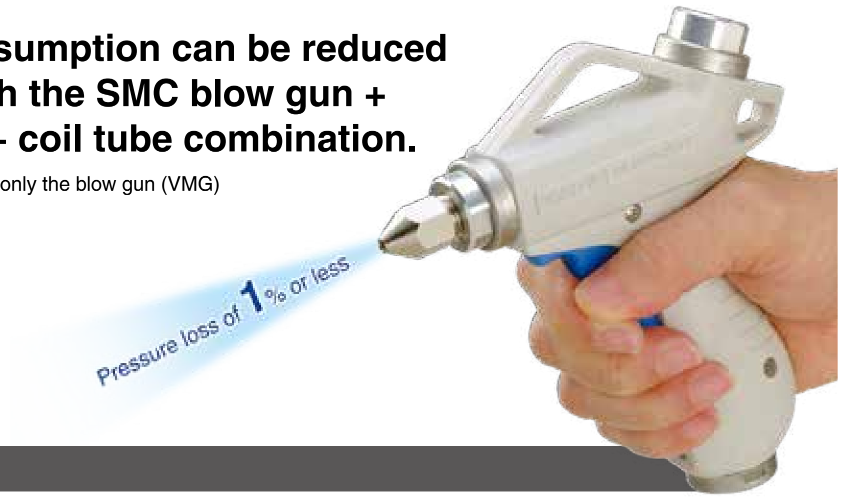


Blow Gun *VMG Series*

CO_2 emissions
(Power consumption)
20% reduction

Power consumption can be reduced by 20% with the SMC blow gun + S coupler + coil tube combination.

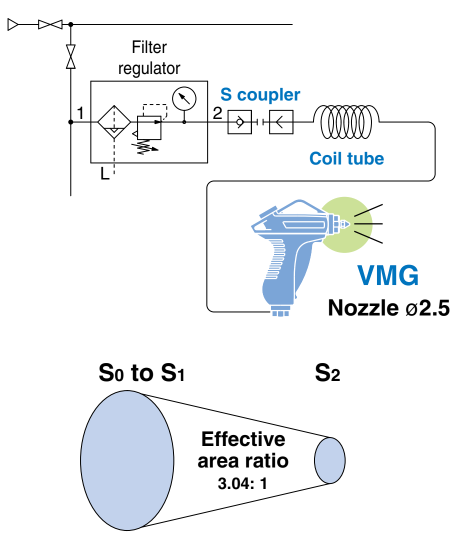
＊ 10% reduction with only the blow gun (VMG)



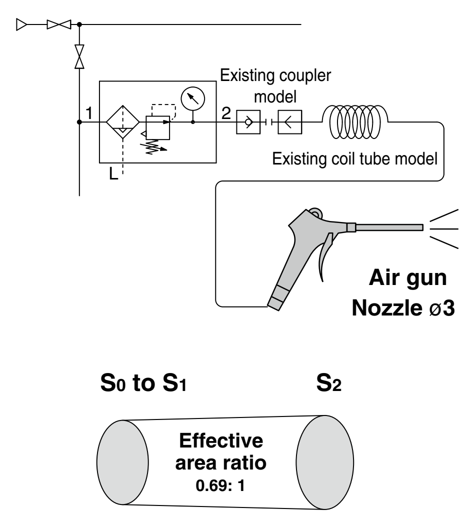
Example of Improvement

Review the blow work and change to the SMC blow gun, S coupler, and coil tube combination to create a larger effective area.

After improvement



Before improvement

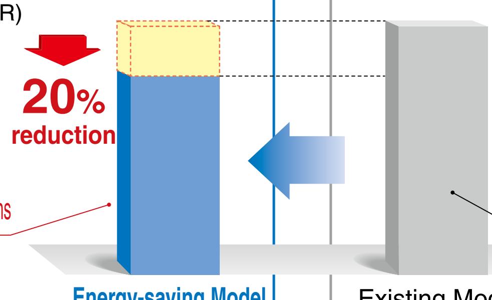


Effects of Energy Saving

Energy-saving Model

Impact pressure: 0.011 MPa (Distance: 100 mm)
Blow time: 10 s (Frequency: 12 times/h)
Working hours: 10 h/day (250 days/year)
Total working hours: 8300 h
Compressor pressure: **0.5 MPa**
Air consumption: **257 L/min** (ANR)

Power consumption by compressor:
1.25 kW
CO_2 emissions: **6090** kg/year
1511 kg reduction in annual CO_2 emissions
(**$1456**/year)
($361/year reduction)



Existing Model

Impact pressure: 0.011 MPa
(Distance: 100 mm)
Blow time: 10 s
(Frequency: 12 times/h)
Working hours: 10 h/day
(250 days/year)
Total working hours: 8300 h
Compressor pressure: 0.6 MPa
Air consumption: 287 L/min (ANR)

Power consumption by compressor:
1.56 kW
CO_2 emissions: **7601** kg/year
(**$1817**/year)

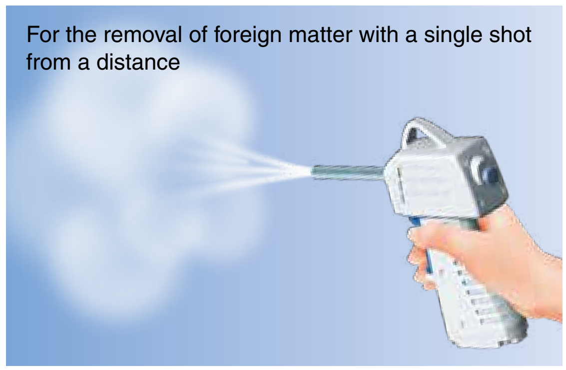
Corresponding value: Electricity unit $0.014/kWh, Power consumption – CO_2 conversion factor 0.587 kg - CO_2/kWh

Impact Blow Gun *IBG Series*

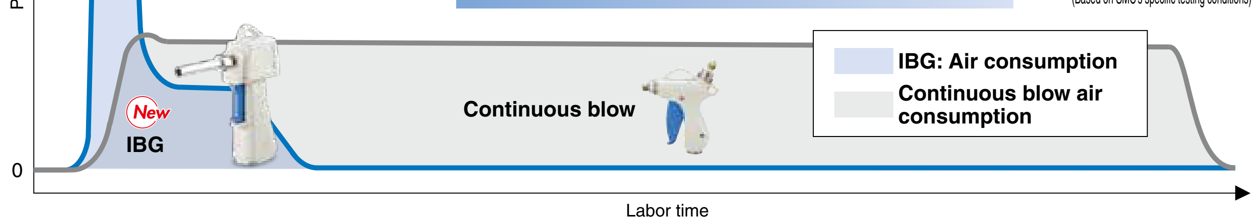
High peak pressure
3 times or more[*1]
(Compared with the existing model)

CO_2 emissions
(Air consumption)
87% reduction[*2]

Increased impact force due to higher peak pressure Drastic reduction in air consumption and labor time



*1 According to blow requirements
*2 Pressure: 0.5 MPa
(Based on SMC's specific testing conditions)



Effects of Energy Saving

Energy-saving Model

Application examples:
Cutting chip removal
Pressure: 0.5 MPa[*1]
Nozzle size: ø10
Removal time (1 operation):
0.1 s
Air consumption:
0.8 L (ANR)

*1 The removal of cutting chips adhered to the clamping unit

When operating for 2500 hours/year, 120 removal operations/hour

*240 m³/year (ANR)

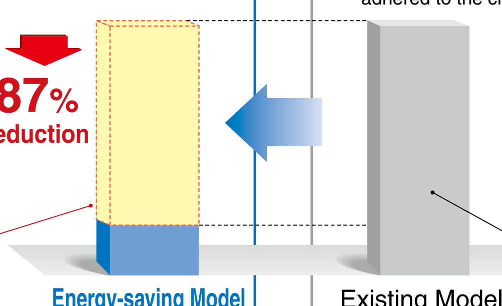
CO_2 emissions: 14 kg/year

*96 kg reduction in annual CO_2 emissions

($3/year)

($23/year reduction)

87% reduction



Existing Model

Application examples:
Cutting chip removal
Pressure: 0.5 MPa[*1]
Nozzle size: ø2
Removal time (1 operation):
3.1 s
Air consumption:
6.3 L (ANR)

*1 The removal of cutting chips adhered to the clamping unit

When operating for 2500 hours/year, 120 removal operations/hour

1890 m³/year (ANR)

CO_2 emissions: **110** kg/year

(**$27**/year)

Corresponding value: Air unit $0.014/m³ (ANR), Air – CO_2 conversion factor 0.0586 kg/m³ (ANR)

2 Air blow efficiency

Impact Blow Valve *IBV10-X5*

High peak pressure

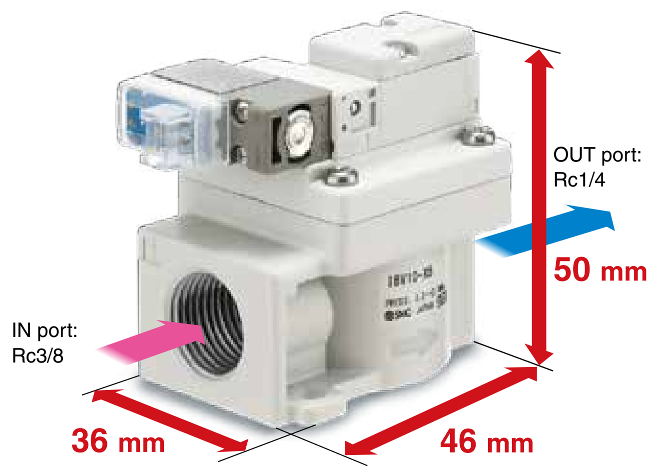
3 times or more[*1]
(Compared with the existing model)

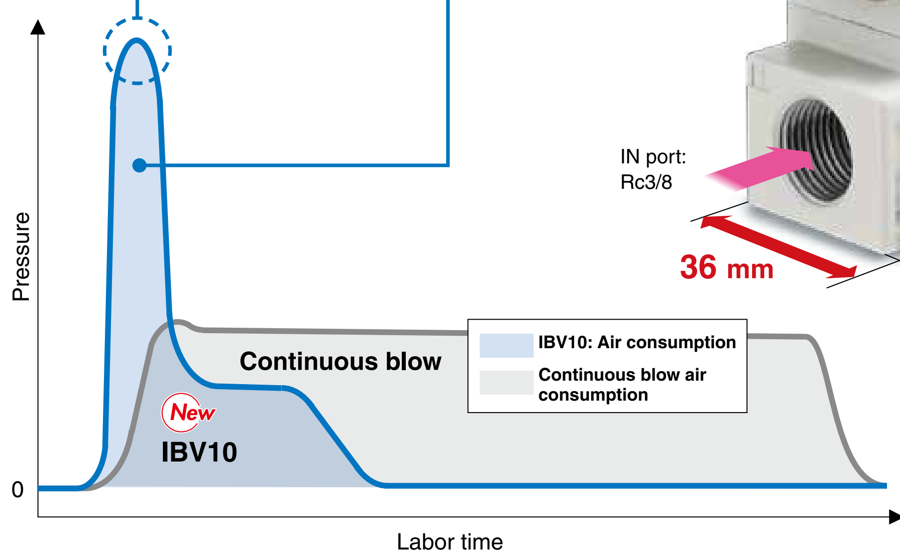
CO_2 emissions (Air consumption)

93% reduction[*2]

Increased impact force due to higher peak pressure Drastic reduction in air consumption and labor time

Solenoid Type/IBV10-X5





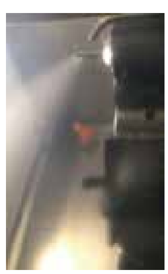
*1 According to blow requirements When the piping volume is 100 cc (Piping I.D. ø13, 800 mm)
*2 Pressure: 0.5 MPa (Based on SMC's specific testing conditions)

Effects of Energy Saving

Energy-saving Model

Application examples:
Cutting chip removal
Pressure: 0.5 MPa[*1]
Nozzle size: ø10
Removal time (1 operation): 0.1 s
Air consumption: 0.6 L (ANR)

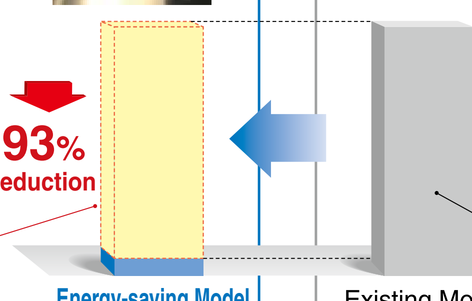
*1 The removal of cutting chips caught up in the blades



When operating for 2500 hours/year, 60 removal operations/hour

90 m³/year (ANR)
CO_2 emissions: **5** kg/year
65 kg reduction in annual CO_2 emissions

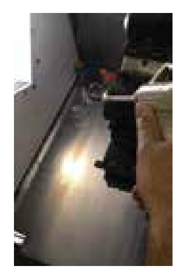
(**$1**/year)
($16/year reduction)



Existing Model

Application examples:
Cutting chip removal
Pressure: 0.5 MPa[*1]
Nozzle size: ø2
Removal time (1 operation): 4 s
Air consumption: 8 L (ANR)

*1 The removal of cutting chips caught up in the blades



When operating for 2500 hours/year, 60 removal operations/hour

1200 m³/year (ANR)
CO_2 emissions: **70** kg/year

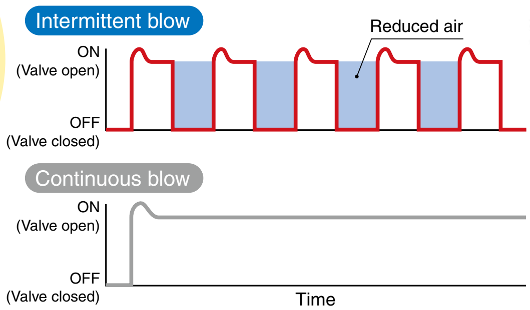
(**$17**/year)

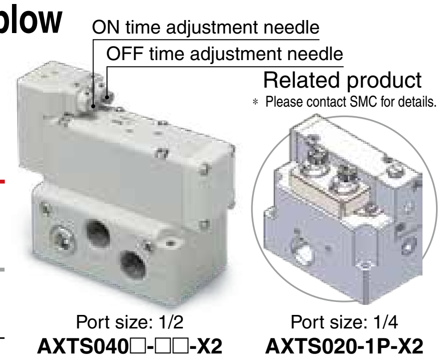
Corresponding value: Air unit $0.014/m³ (ANR), Air – CO_2 conversion factor 0.0586 kg/m³ (ANR)

Pulse Blowing Valve *AXTS* Series

CO_2 emissions
(Air consumption)
50% reduction

Proposal for air-saving air blow by changing from continuous blow to intermittent blow

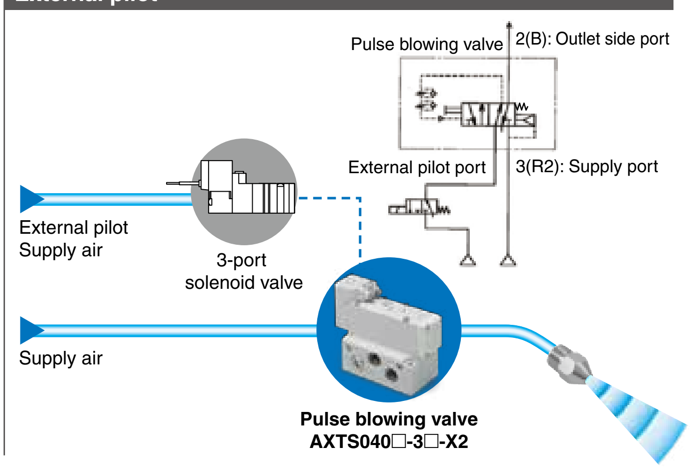




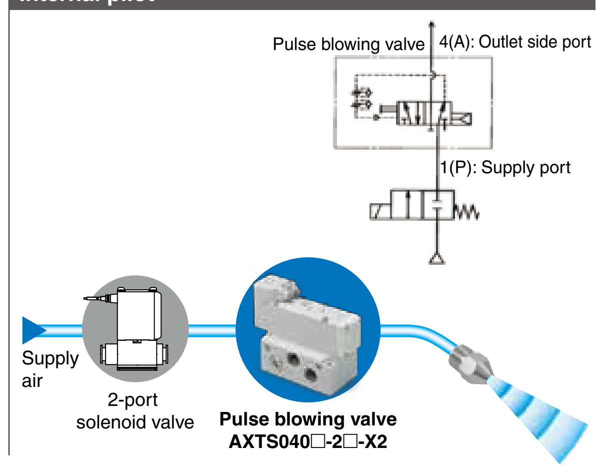
■ Control for pulse generation is not required.

Pulse blow can be used by simply supplying air.

External pilot



Internal pilot



■ Long service life (200 million cycles or more)

■ ON/OFF time adjustable individually

■ Operating pressure range: 0.2 to 1.0 MPa

■ Flow rate characteristics

Type of actuation	C [dm³/(s·bar)]	b	Cv
External pilot	14	0.18	3.4
Internal pilot	12	0.14	2.9

Effects of Energy Saving

Energy-saving Model

Changing to pulse air blow

Flow rate per nozzle:
142.5 L/min (ANR)

Blow time: 2 sec. (Duty 50%)
Annual operating cycles: 900000

4275 m³/year (ANR)
CO_2 emissions: **251** kg/year
250 kg reduction in annual CO_2 emissions

(**$60**/year)
($60/year reduction)

∗ Per nozzle

Existing Model

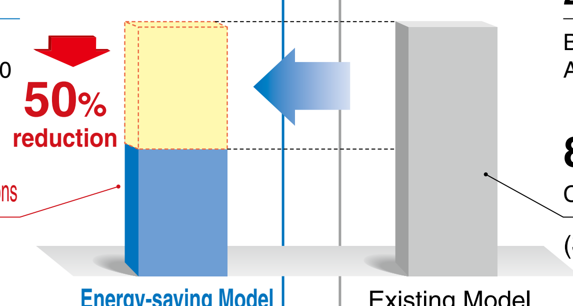
Air blow accounts for 50% of all air consumption

Flow rate per nozzle:
285 L/min (ANR)

Blow time: 2 sec
Annual operating cycles: 900000

8550 m³/year (ANR)
CO_2 emissions: **501** kg/year

(**$120**/year)



Corresponding value: Air unit $0.014/m³ (ANR), Air – CO_2 conversion factor 0.0586 kg/m³ (ANR)

3 Reduce air leakage

UNIT CONVERSIONS

	unit	conversion	result
length	m	x 3.28	ft
	mm	x 0.04	in
mass	g	x 0.04	oz
volume	cm^3	÷ 16.387	in^3
	L	x 61.024	in^3
speed	mm/s	÷ 25.4	in/s
pressure	MPa	x 145	psi
	kPa	÷ 6.895	psi
temperature	°C	x1.8 then add 32	°F
torque	N·m	x 0.738	ft-lb
force	N	÷ 4.448	lbf
flow	L/min	÷ 28.317	cfm
	JPY	x 0.0094	dollar

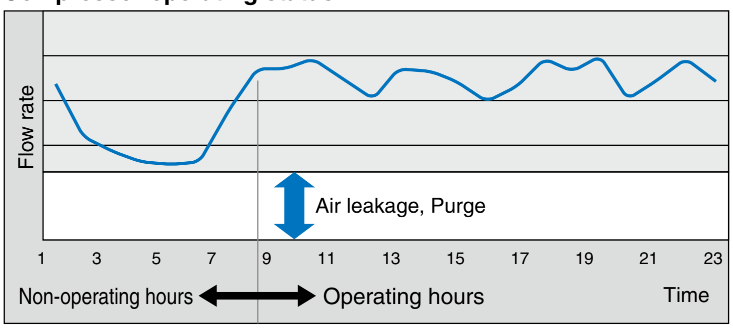
Air leakage

Stops leakage from piping equipment

Before improvement

Leaked air actually accounts for 20 to 50% of all consumed air.
Regardless of whether equipment is being operated or not, as the compressor is continually operated, a certain amount of air is consumed and leaked from piping equipment.

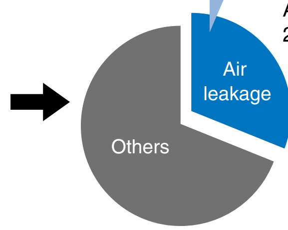
Compressor operating status



Air usage

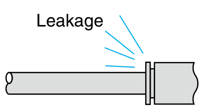
Tubing, Fittings	20%
Coupling fittings	25%
Rubber hose	30%
Others	25%

Air leakage accounts for 20 to 50%.

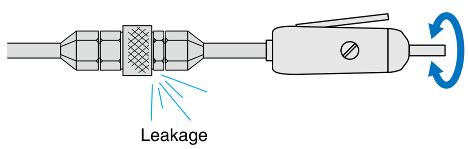


Air leakage examples

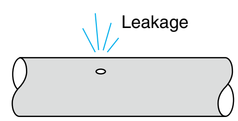
Air leakage from One-touch fittings due to poorly cut tubes



Air leakage from coupling fittings due to poor sealing



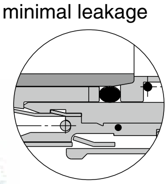
Air leakage from tubes due to cutting chips, wear, spatter, etc.



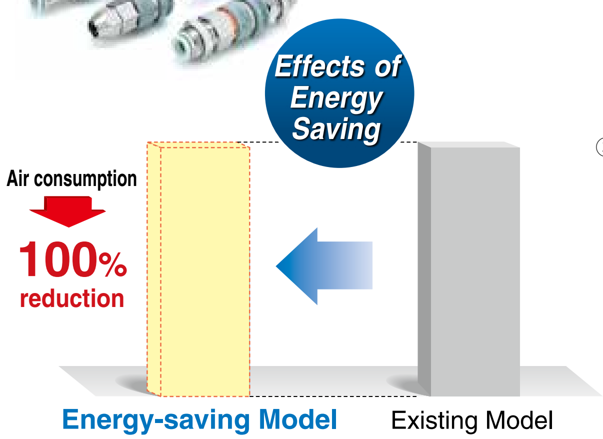
After improvement

① Selection of equipment with minimal leakage

S Coupler
KK Series



Minimal leakage seal construction



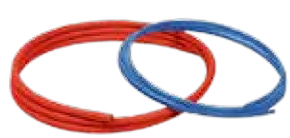
② Adjustment of tube cut surfaces with a dedicated tool

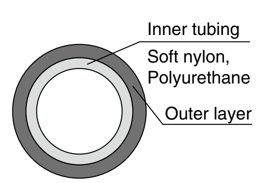
Tube Cutter
TK Series

Double Layer Tube Stripper
TKS Series

③ Adoption of double layer tubing to prevent tube damage due to cutting chips, spatter, and wear

Double Layer Tubing
TRB/TRBU Series





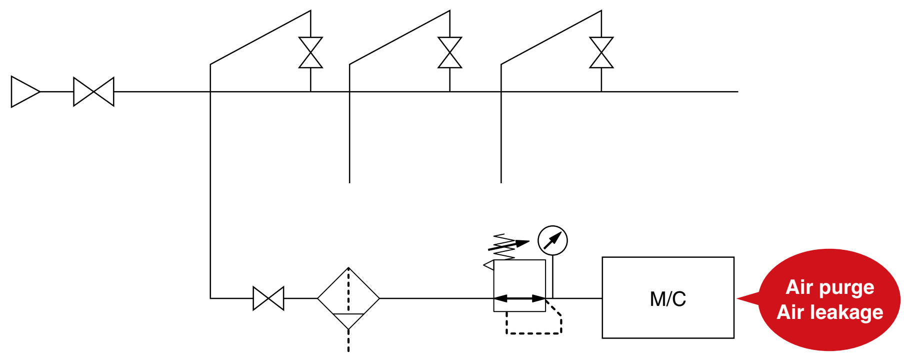
Sectional view of FR double layer tubing

Reducing leakage and purge during non-operating hours

Reducing air leakage and amount of air used for air purge during non-operating hours of equipment

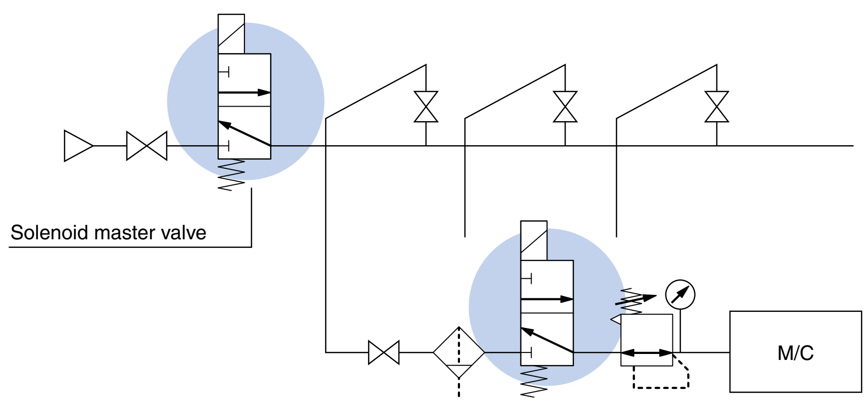
Before improvement

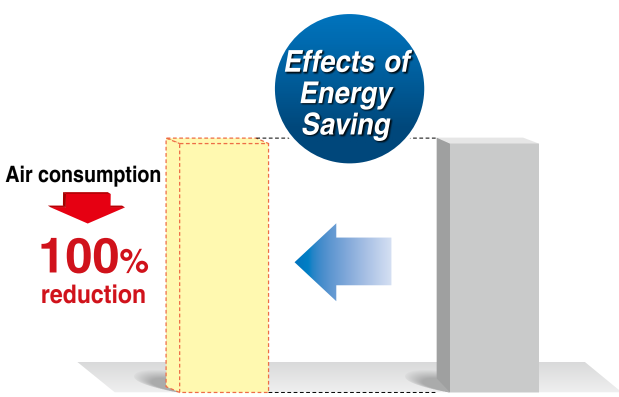
As the compressor is continually operated even during non-operating hours of equipment, it continues to consume air through air leakage, air purge, etc.



After improvement

Stop the supply of air during non-operating hours of equipment.





Installation of a solenoid master valve in each line and for each piece of equipment

Pilot Operated 2-Port Solenoid Valve
VXD21/22/23 Series

Pilot Operated 3-Port Solenoid Valve
VG342 Series

Pilot Operated 3-Port Solenoid Valve
VP3145/3165/3185 Series

4 Reduce pressure loss

UNIT CONVERSIONS

	unit	conversion	result
length	m	x 3.28	ft
	mm	x 0.04	in
mass	g	x 0.04	oz
volume	cm^3	÷ 16.387	in^3
	L	x 61.024	in^3
speed	mm/s	÷ 25.4	in/s
pressure	MPa	x 145	psi
	kPa	÷ 6.895	psi
temperature	°C	x1.8 then add 32	°F
torque	N·m	x 0.738	ft-lb
force	N	÷ 4.448	lbf
flow	L/min	÷ 28.317	cfm
	JPY	x 0.0094	dollar

SMC

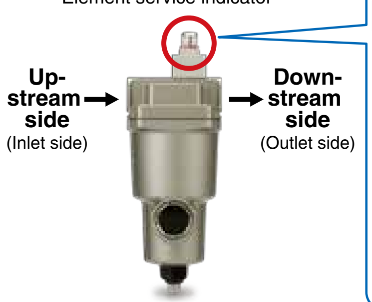
4 Reduce pressure loss | Monitoring of air filter clogging

As the air filter processes the compressed air, the element will gradually become clogged, resulting in a pressure drop. Failure to rectify the situation will result in energy loss and reduced actuator output. Therefore, be sure to periodically replace the air filter element before it becomes clogged.

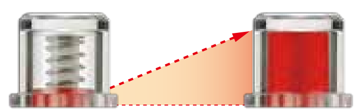
Clogging indicator

The air filter element needs to be replaced every 2 years or before the pressure drop reaches 0.1 MPa. Confirm the pressure drop due to clogging with the element service indicator, a differential pressure switch, or a differential pressure gauge.

Element service indicator

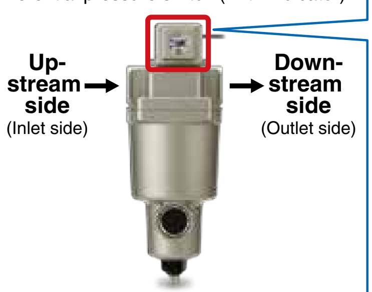


Replace the element
when **the red indicator reaches the top**.

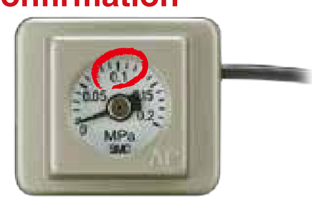


When the differential air is 0.05 MPa → When the differential air is **0.1 MPa**

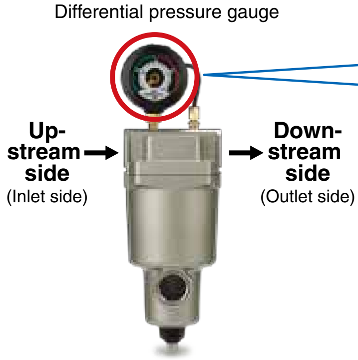
Differential pressure switch (With indicator)



- Confirm the differential pressure by **electrical signal**.
- With an indicator for easy **visual confirmation**



Differential pressure gauge

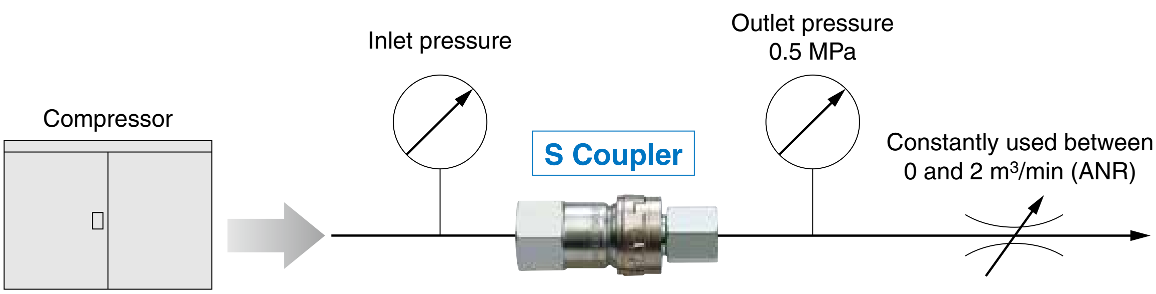


Replace the element
when **the needle enters the red zone**
(Differential pressure of **0.1 MPa** or more).

For reducing pressure loss in lines
S Couplers *KK130 Series*

CO_2 emissions
(Pressure loss)
4% reduction

The built-in valve is of a special shape, resulting in reduced pressure loss.



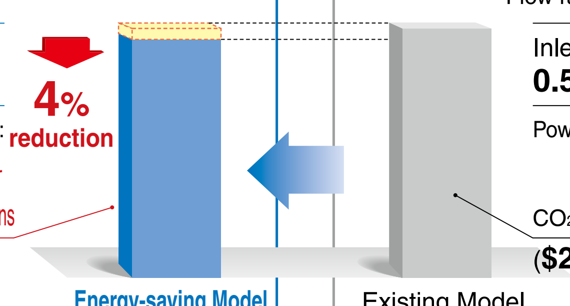
Effects of Energy Saving

Energy-saving Model

Operating pressure at the outlet: 0.5 MPa
Compressor efficiency: 0.7
Annual operating time: 2500 hours
Flow rate: 1.2 m^3/min (ANR)

Inlet pressure:
0.54 MPa

Power consumption by compressor:
CO_2 emissions: **10258** kg/year
425 kg reduction in annual CO_2 emissions
(**$2452**/year)
($103/year reduction)



Existing Model

Operating pressure at the outlet: 0.5 MPa
Compressor efficiency: 0.7
Annual operating time: 2500 hours
Flow rate: 1.2 m^3/min (ANR)

Inlet pressure:
0.58 MPa

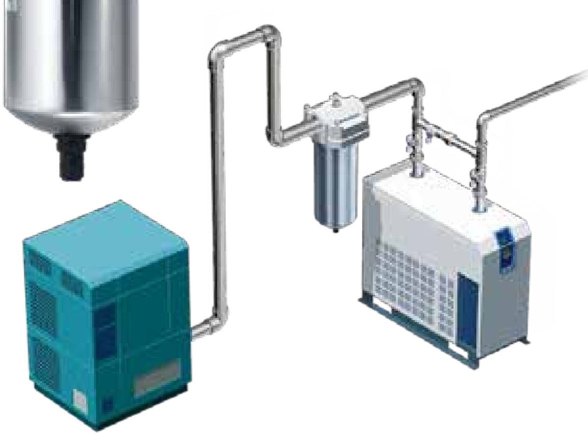
Power consumption by compressor:
CO_2 emissions: **10683** kg/year
(**$2555**/year)

Corresponding value: Electricity unit $0.014/kWh, Power consumption – CO_2 conversion factor 0.587 kg – CO_2/kWh

4 Reduce pressure loss

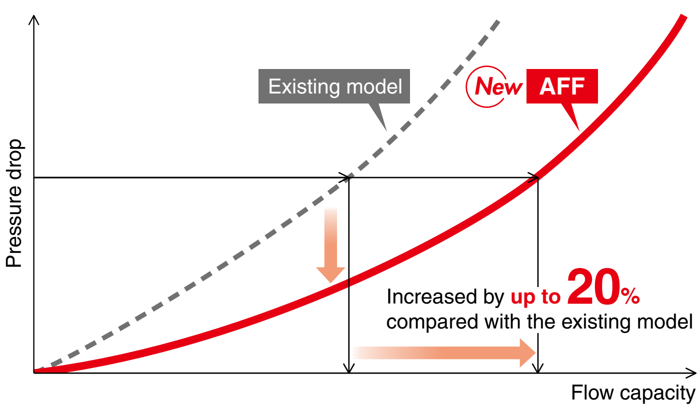
Main Line Filter *AFF Series*

Flow Capacity
20% increase



Flow capacity: 14.5 m³/min (ANR)
Pressure drop: 5 kPa or less

For **AFF90D**



Reduction in pressure drops! Increased air flow capacity!

Size	Filtration	Port size	Flow capacity m³/min (ANR)
AFF70D	1 μm*1	1, 1 1/2	7.0 / 6.0 AFF37B (Existing model)
AFF80D		1 1/2	11.0
AFF90D		1 1/2, 2	14.5 / 12.0 AFF75B (Existing model)

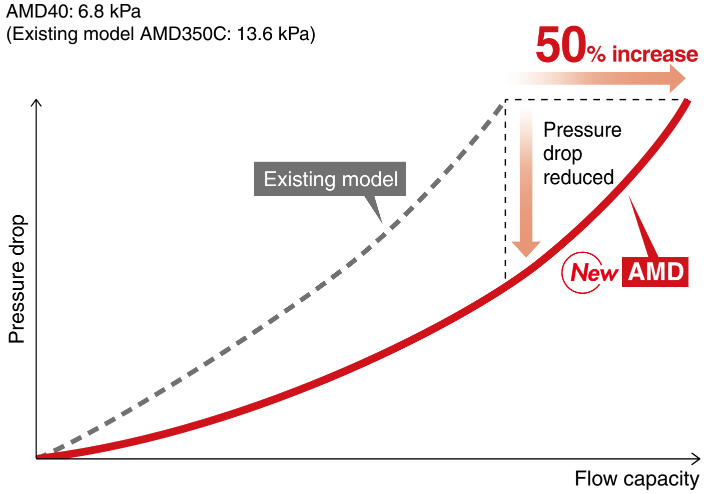
*1 ISO 8573-4: 2010 compliant

Modular Connection Type
Micro Mist Separator *AMD Series*

Flow Capacity
50% increase

Flow capacity: 1.5 m³/min (ANR)
Pressure drop: 6.8 kPa or less

AMD40: 6.8 kPa
(Existing model AMD350C: 13.6 kPa)



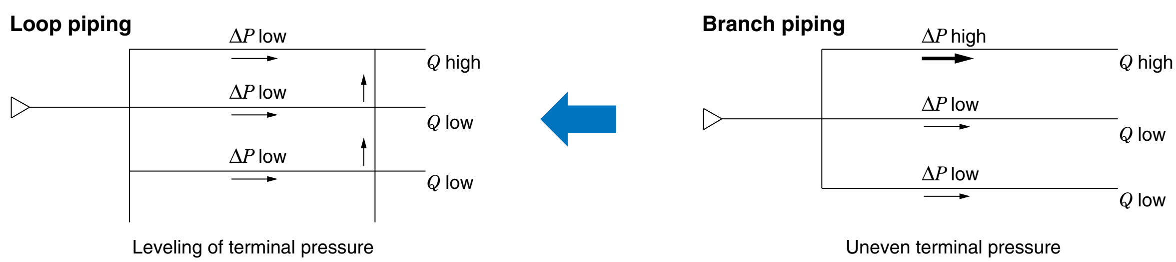
Reduction in pressure drops! Increased air flow capacity!

Size	Filtration	Port size	Flow capacity m³/min (ANR)
AMD20	0.01 μm*1	1/8, 1/4	0.3 0.2 AMD150C (Existing model)
AMD30		1/4, 3/8	0.75 0.5 AMD250C (Existing model)
AMD40		1/4, 3/8, 1/2	1.5 1.0 AMD350C (Existing model)

*1 ISO 8573-4: 2010 compliant

Leveling of the line pressure

Uneven terminal pressure in branch piping can be leveled by adopting loop piping, resulting in a reduction in pressure drops.



Air can be supplied from both sides with loop piping.

▼

Terminal pressure is leveled.

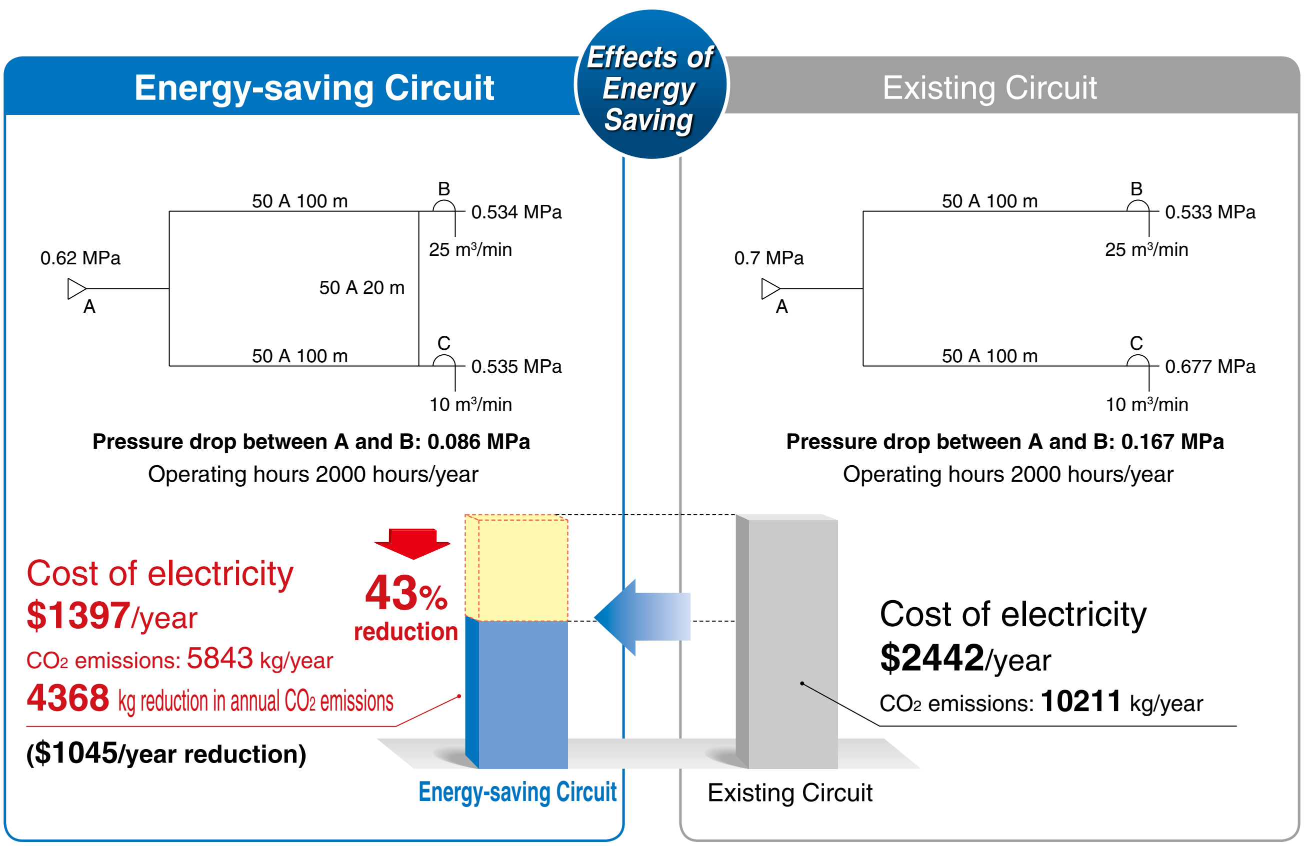
▼

The discharge pressure setting can be lowered.

An unbalanced consumption flow rate can lead to a large pressure drop in the line on one side.

▼

Set the discharge pressure high.



Corresponding value: Electricity unit $0.014/kWh, Power consumption – CO_2 conversion factor 0.587 kg - CO_2/kWh

5 Air pressure source efficiency

UNIT CONVERSIONS

	unit	conversion	result
length	m	x 3.28	ft
	mm	x 0.04	in
mass	g	x 0.04	oz
volume	cm^3	÷ 16.387	in^3
	L	x 61.024	in^3
speed	mm/s	÷ 25.4	in/s
pressure	MPa	x 145	psi
	kPa	÷ 6.895	psi
temperature	°C	x1.8 then add 32	°F
torque	N·m	x 0.738	ft-lb
force	N	÷ 4.448	lbf
flow	L/min	÷ 28.317	cfm
	JPY	x 0.0094	dollar

Reducing the specific power of the compressor

CO_2 emissions (Power consumption)

8% reduction

Power consumption can be reduced by reducing the discharge pressure, intake resistance, and intake temperature.

The discharge pressure, intake pressure, and intake temperature, as well as the number of compression stages, etc., all have an effect on the compressor's specific power. Therefore, in order to reduce the compressor's specific power, the discharge pressure, intake resistance, and intake temperature must all be reduced as well.

Calculating the specific power of the compressor

The specific power can be calculated from the theoretical shaft power as shown in the equation on the right.
For the specific power, the smaller the value, the greater the efficiency.

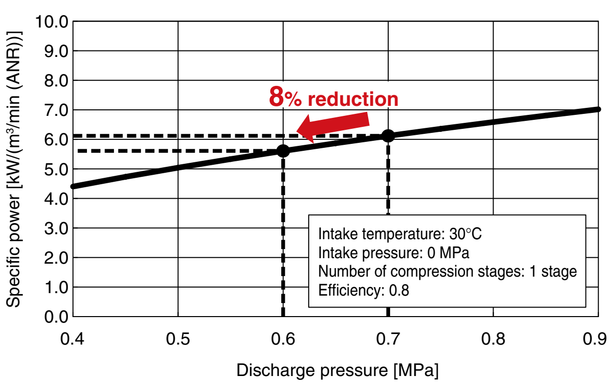
$$L = \frac{m\kappa}{\kappa - 1} \cdot \frac{0.1Q}{0.06\eta} \cdot \frac{273 + T}{293} \times \left\{ \left[\frac{p_d + 0.1}{p_s + 0.1} \right]^{\frac{\kappa - 1}{m\kappa}} - 1 \right\}$$

$$r = \frac{L}{Q}$$

L: theoretical shaft power [kW], r: specific power [kW/(m^3/min (ANR))], Q: discharge flow [m^3/min (ANR)], p_s: intake pressure [MPa], p_d: discharge pressure [MPa], T: intake temperature [°C], η: efficiency, m: number of compression stages, and κ: specific heat ratio (air = 1.4)

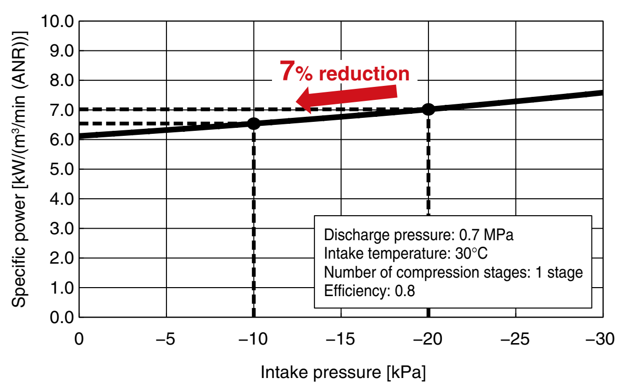
Effects of the discharge pressure on the specific power

By reducing the discharge pressure from 0.7 MPa to 0.6 MPa, the specific power can be reduced by 8%.



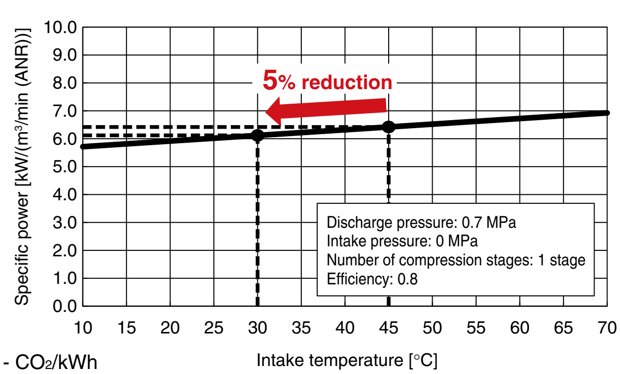
Effects of the intake pressure on the specific power

By increasing the intake pressure from –20 kPa to –10 kPa, the specific power can be reduced by 7%.



Effects of the intake temperature on the specific power

By reducing the intake temperature from 45°C to 30°C, the specific power can be reduced by 5%.



Corresponding value: Power consumption – CO_2 conversion factor 0.587 kg - CO_2/kWh

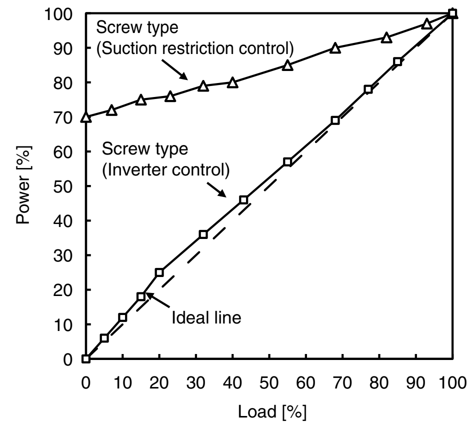
More efficient compressor operation

CO_2 emissions (Power consumption)

38% reduction

Power consumption can be reduced by selecting an optimal operation to deal with load fluctuations.

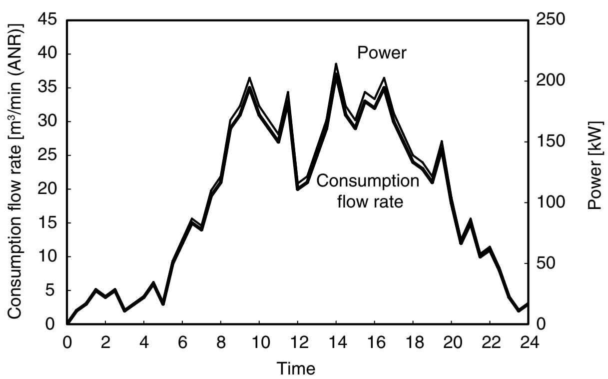
Increased energy efficiency can be realized when the operation selected to deal with and control compressor load (flow rate) fluctuations is optimal.



Fluctuations in factory air consumption flow rates

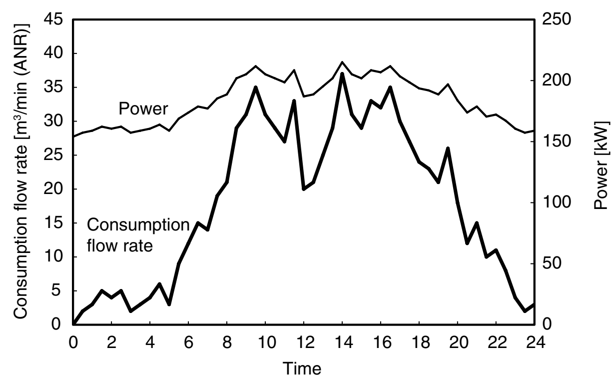
The factory air consumption flow rate (= load) changes depending on the operating state of the equipment. By using inverter control or control for multiple compressors to deal with consumption flow rate fluctuations, compressor energy efficiency can be increased.

Suitable operation



Inverter control for the control of consumption flow rate fluctuations when multiple compressors are operated

Before improvement



Open/close control for the control of consumption flow rate fluctuations when 1 compressor is operated

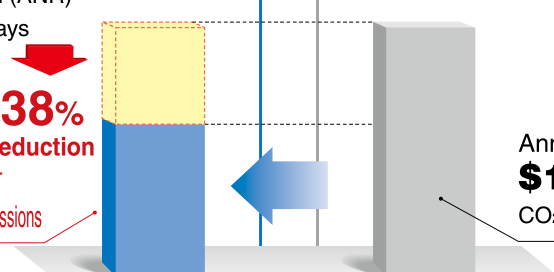
Effects of Energy Saving

Suitable Operation

Base compressor (Screw type)
110 kW, Discharge flow 19 m³/min (ANR)
+
Fluctuation-absorbing compressor (Screw type, Inverter control)
110 kW, Discharge flow 19 m³/min (ANR)
Days of operation per year: 250 days

Annual cost of electricity
$115,217year
CO_2 emissions: **482162** kg/year
292678 kg reduction in annual CO_2 emissions
($70,002/year reduction)

38% reduction



Suitable operation

Before Improvement

Compressor (Screw type, Suction restriction control)
220 kW, Discharge flow 40 m³/min (ANR)
Days of operation per year: 250 days

Annual cost of electricity
$185,173/year
CO_2 emissions: **774840** kg/year

Before improvement

Corresponding value: Electricity unit $0.014/kWh, Power consumption – CO_2 conversion factor 0.587 kg - CO_2/kWh

Booster circuit

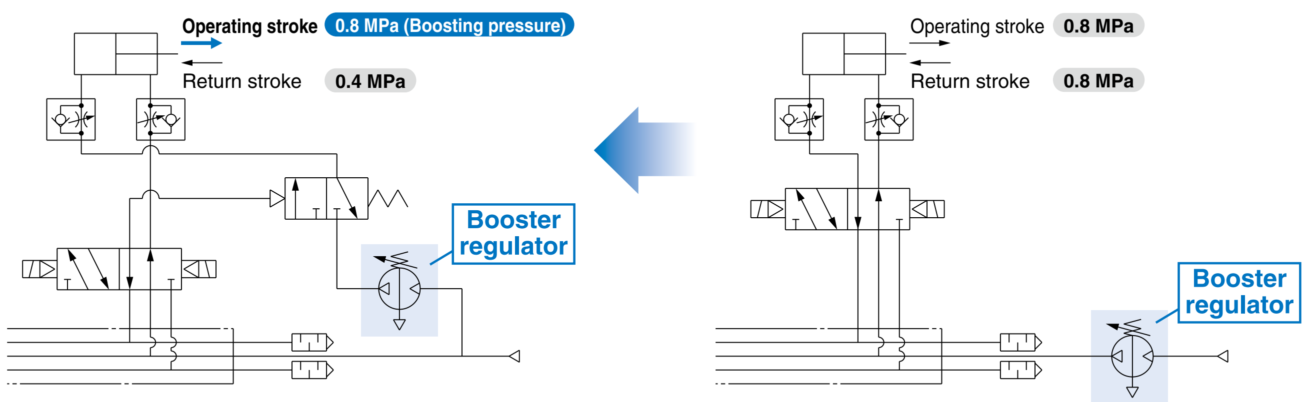
CO2 emissions (Air consumption)
33% reduction

Air consumption can be reduced by 33% due to the optimization of the booster circuit.

Boost an insufficiently powered portion with a booster regulator

- Optimized booster circuit: Now with a space-saving booster circuit

Example of a one-side booster circuit (Boosting pressure on the operating stroke only) / **Example of a two-side booster circuit**



Effects of Energy Saving

Energy-saving Circuit

When boosting pressure is on the extension side only
Retraction: 0.4 MPa
Extension: 0.8 MPa (Boosting pressure)

Air consumption:
8.7 L (ANR)/cycle

When it is operated
900000 times/year

7830 m³/year (ANR)
CO_2 emissions: **459** kg/year
227 kg reduction in annual CO_2 emissions

(**$110**/year)
($54/year reduction)

Existing Circuit

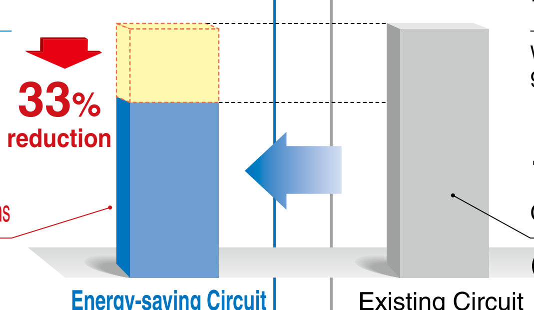
Bore size: ø50
Stroke: 200 mm
Pressure: 0.4 MPa
Boosting pressure: 0.8 MPa

Air consumption:
13 L (ANR)/cycle

When it is operated
900000 times/year

11700 m³/year (ANR)
CO_2 emissions: **686** kg/year

(**$164**/year)



Corresponding value: Air unit $0.014/m³ (ANR), Air – CO_2 conversion factor 0.0586 kg/m³ (ANR)

6 Air/Power saving equipment

UNIT CONVERSIONS

	unit	conversion	result
length	m	x 3.28	ft
	mm	x 0.04	in
mass	g	x 0.04	oz
volume	cm^3	÷ 16.387	in^3
	L	x 61.024	in^3
speed	mm/s	÷ 25.4	in/s
pressure	MPa	x 145	psi
	kPa	÷ 6.895	psi
temperature	°C	x1.8 then add 32	°F
torque	N·m	x 0.738	ft-lb
force	N	÷ 4.448	lbf
flow	L/min	÷ 28.317	cfm
	JPY	x 0.0094	dollar

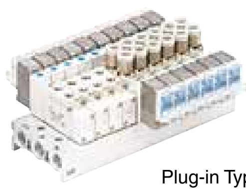
SMC

Low Wattage 3/4/5-Port Solenoid Valve

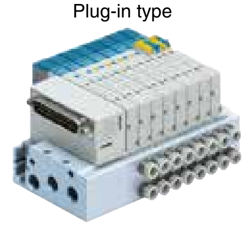
CO_2 emissions (Power consumption)
75% reduction

The power-saving circuit can reduce the consumption of electric power when the device is energized.

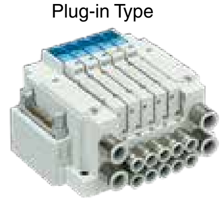
SY Series



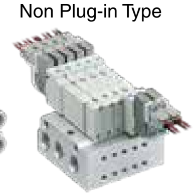
SY Series
Plug-in type



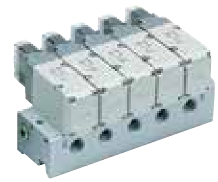
JSY Series
Plug-in Type



Non Plug-in Type



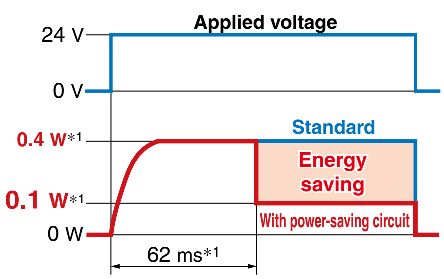
VP Series



• Reduces power consumption when energized

Power consumption can be reduced by approx. 1/4 by reducing the wattage required to hold the valve in an energized state. (Effective energizing time is over 62 ms*1 at 24 VDC.) Refer to the electrical power waveform as shown below.

Electrical power waveform with power-saving circuit



*1 SY/SYJ series

Low Wattage Valve

Energy-saving Product

Type	Model	Power consumption W*2	
		Standard	With power-saving circuit
4/5-port	SJ1000/2000	0.55	0.23
	SJ3000	0.4	0.15
	New SY3000/5000/7000	0.4	0.1
	SY3000/5000/7000	0.4	0.1
	JSY1000	—	0.2
	JSY3000/5000	0.4	0.1
	SYJ3000/5000/7000	0.4	0.1
3-port	V100	0.4	0.1
	SYJ300/500/700	0.4	0.1
	VP300/500	0.4	—
	VP700	0.55	0.55

*2 With DC light

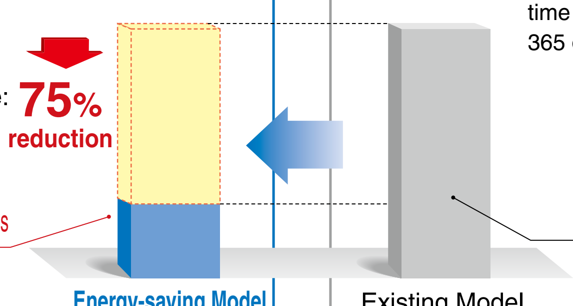
Effects of Energy Saving

Energy-saving Model

SY: 0.1 W
When the energizing time is 8 hours/day, 365 days/year

Power consumption per valve: **292 Wh/year**
CO_2 emissions: **0.2** kg/year
0.5 kg reduction in annual CO_2 emissions
(**$0.04**/year)
(**$0.12**/year reduction)

75% reduction



Existing Model

SY: 0.4 W
When the energizing time is 8 hours/day, 365 days/year

Power consumption per valve: **1168 Wh/year**
CO_2 emissions: **0.7** kg/year
(**$0.16**/year)

Corresponding value: Electricity unit $0.014/kWh, Power consumption – CO_2 conversion factor 0.587 kg - CO_2/kWh

Air Cylinder (Intermediary Bore Size) *JMB Series*

CO_2 emissions
(Air consumption)

29% reduction

Air consumption can be reduced by selecting an optimal size air cylinder.

Intermediary Bore Sizes

Air consumption can be reduced by up to 29%

Bore size (mm)	ø40	ø45	ø50	ø56	ø63	ø67	ø80	ø85	ø100
Air consumption L/min (ANR)	1.4	1.8	2.2	2.8	3.6	4.1	5.8	6.6	9.1

Conditions/Supply pressure: 0.5 MPa
Load factor: 50%, At 100 mm stroke

18% reduction (ø50 → ø45) 22% reduction (ø63 → ø56) 29% reduction (ø80 → ø67) 27% reduction (ø100 → ø85)

Example Bore size for 85 kg workpieces

Conditions/Supply pressure: 0.5 MPa, Load factor: 50%

Bore size (mm)	Theoretical output (N)	Output for load factor of 50% (kg)	Judgment
ø63	1559	79.5	Not acceptable (Insufficient)
ø80	2513	128.2	Acceptable (Excessive)
When intermediary bore size ø67 is used			
ø67	**1763**	**89.9**	**OK**

Existing size: ø80
↓
Could be switched to intermediary bore size **ø67**

Effects of Energy Saving

Energy-saving Model

Bore size: ø67
Stroke: 100 mm
Pressure: 0.5 MPa
Load factor: 50%

Air consumption:
4.1 L (ANR)/cycle

When it is operated
1000000 times/year

4100 m^3/year (ANR)
CO_2 emissions: **240** kg/year
100 kg reduction in annual CO_2 emissions

(**$58**/year)
($24/year reduction)

Existing Model

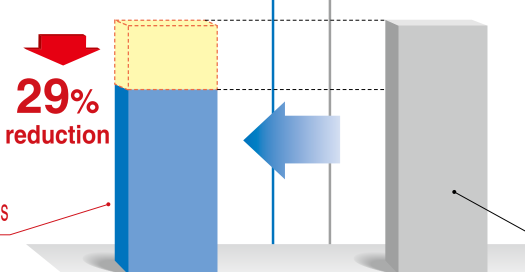
Bore size: ø80
Stroke: 100 mm
Pressure: 0.5 MPa
Load factor: 50%

Air consumption:
5.8 L (ANR)/cycle

When it is operated
1000000 times/year

5800 m^3/year (ANR)
CO_2 emissions: **340** kg/year

(**$81**/year)



Corresponding value: Air unit $0.014/$m^3$ (ANR), Air – CO_2 conversion factor 0.0586 kg/m^3 (ANR)

Air consumption can be reduced by 14% due to the reduced cylinder size.

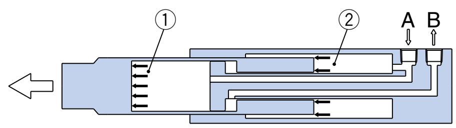
CO_2 emissions (Air consumption)
14% reduction

It is possible to reduce air consumption in the retracting direction, compared with a standard cylinder with equivalent output in the extending direction, due to the doubled piston area in the extending direction.

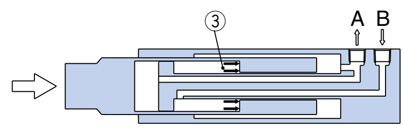
Double extension output power!

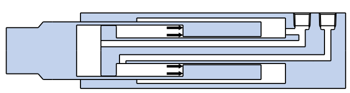
SMC's unique cylinder construction doubles the piston area in the extending direction. This is an ideal air cylinder for lifting and press applications.

Air pressure supplied from A operates on both surfaces ① and ②. (Extension)



Air pressure supplied from B operates on surface ③. (Retraction)



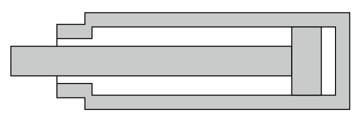


ø63

Piston area
Extension: 5945 mm²
Retraction: 2313 mm²

Increased energy saving and space saving
Reduced cylinder size

Size reduction
ø63 ← ø80



ø80

Piston area
Extension: 5030 mm²
Retraction: 4540 mm²

Effects of Energy Saving

Energy-saving Model

Bore size: ø63
Stroke: 200 mm
Pressure on the extension side: 0.5 MPa

Theoretical output (Extension side): 2973 N
Air consumption:
9.9 L (ANR)/cycle

When it is operated
900000 times/year

8910 m³/year (ANR)
CO_2 emissions: **522** kg/year
85 kg reduction in annual CO_2 emissions

(**$125**/year)
($20/year reduction)

Existing Model

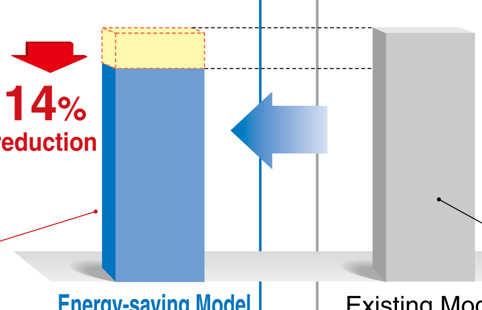
Bore size: ø80
Stroke: 200 mm
Pressure: 0.5 MPa

Theoretical output (Extension side): 2520 N
Air consumption:
11.5 L (ANR)/cycle

When it is operated
900000 times/year

10350 m³/year (ANR)
CO_2 emissions: **607** kg/year

(**$145**/year)



Corresponding value: Air unit $0.014/m³ (ANR), Air – CO_2 conversion factor 0.0586 kg/m³ (ANR)

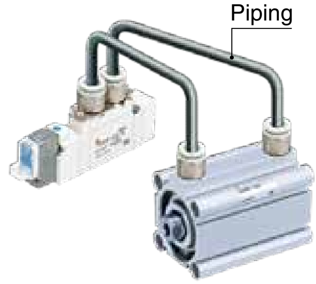
Compact Cylinder with Solenoid Valve *CVQ* Series

CO_2 emissions
(Air consumption)
50% reduction

Energy Saving

Air consumption between the valve and cylinder can be reduced by approximately **50%**.

Valve and compact cylinder integrated for compactness



Effects of Energy Saving

Energy-saving Model

Bore size: ø32
Stroke: 30 mm
No piping between the valve and the cylinder
Supply pressure: 0.5 MPa

Air consumption:
0.25 L (ANR)/cycle

When it is operated
900000 times/year

228 m³/year (ANR)
CO_2 emissions: **13** kg/year
13 kg reduction in annual CO_2 emissions

(**$3**/year)
($3/year reduction)

Existing Model

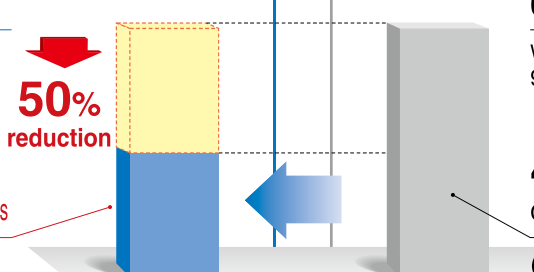
Bore size: ø32
Stroke: 30 mm
Piping bore: 4 mm
Piping length: 2 m
(Between the valve and the cylinder)
Supply pressure: 0.5 MPa

Air consumption:
0.51 L (ANR)/cycle

When it is operated
900000 times/year

455 m³/year (ANR)
CO_2 emissions: **26** kg/year

(**$6**/year)

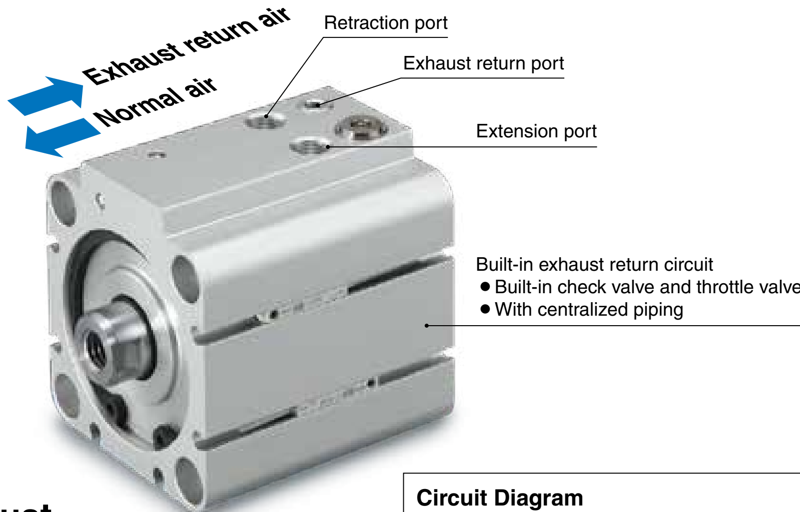


Corresponding value: Air unit $0.014/m³ (ANR), Air – CO_2 conversion factor 0.0586 kg/m³ (ANR)

Compact Cylinder/Air Saving Type *CDQ2B-X3150*

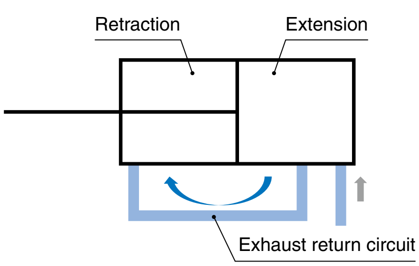
CO_2 emissions
(Air consumption)
Max. 46% reduction

Reduced air consumption due to the built-in exhaust return circuit

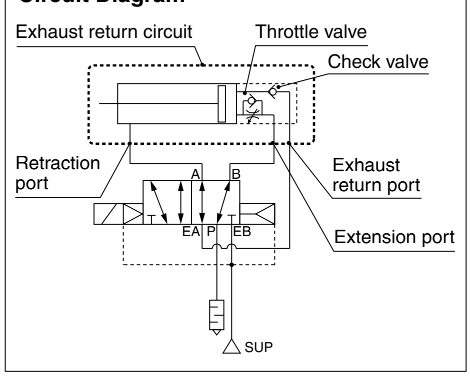


Uses the air exhausted from the working side to supply the non-working side, thus reusing the air

Reduce air consumption just by piping to the product



Circuit Diagram



Effects of Energy Saving

Energy-saving Model

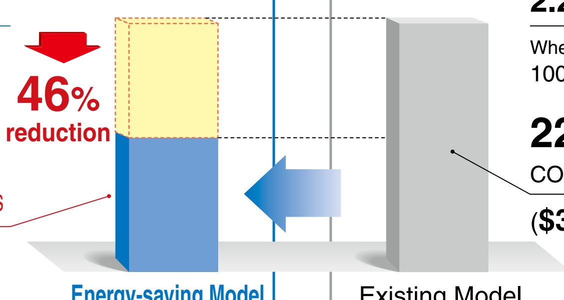
Bore size: ø50
Stroke: 100 mm
Pressure: 0.5 MPa

Air consumption per cycle
1.2 L (ANR)

When it is operated
1000000 times/year

1200 m³/year (ANR)
CO_2 emissions: **70** kg/year
59 kg reduction in annual CO_2 emissions

(**$17**/year)
($14/year reduction)



Existing Model

Bore size: ø50
Stroke: 100 mm
Pressure: 0.5 MPa

Air consumption per cycle
2.2 L (ANR)

When it is operated
1000000 times/year

2200 m³/year (ANR)
CO_2 emissions: **129** kg/year

(**$31**/year)

Corresponding value: Air unit $0.014/m³ (ANR), Air – CO_2 conversion factor 0.0586 kg/m³ (ANR)

Vacuum Ejector ZK2□A Series

A digital pressure switch for vacuum with an energy-saving function and a more efficient ejector

CO_2 emissions (Air consumption)

93% reduction*1

*1 Based on SMC's measuring conditions

Cuts off supply air when the pressure reaches the desired vacuum

Energy saving ejector

The digital pressure switch with energy-saving function can reduce

Air consumption 90% reduction*2

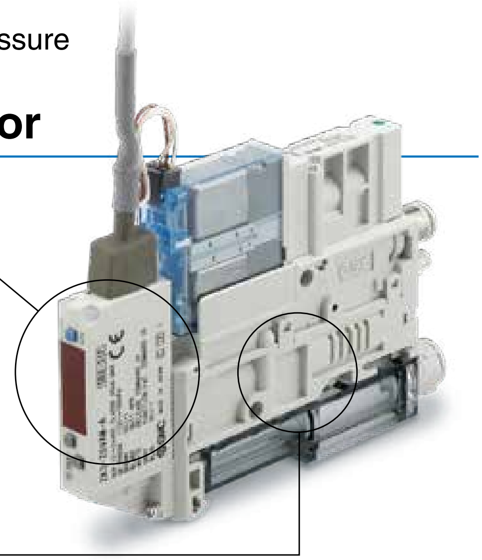
*2 Based on SMC's measuring conditions

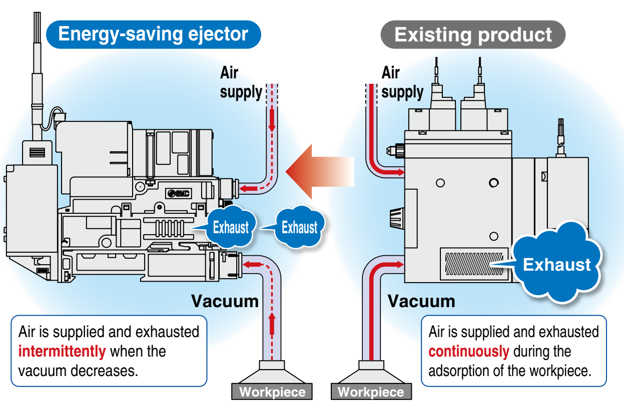
While the suction signal is ON, the ON/OFF operation of the supply valve is also performed automatically within the set value.

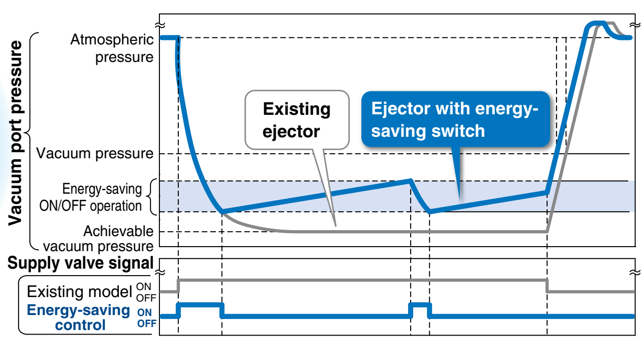
More efficient ejector

Air consumption 30% reduction

(Compared to other SMC single stage ejectors)

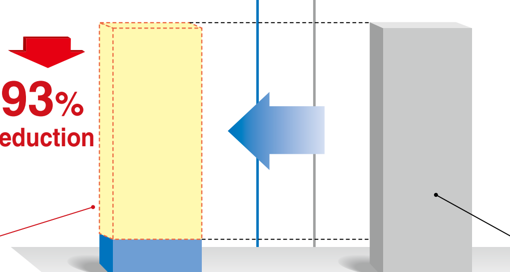






Effects of Energy Saving

Energy-saving Model	Existing Model
·Air consumption: 58 L/min (ANR) Vacuum suction flow rate: 61 L/min (ANR) ·Vacuum generation time: 0.6 s/cycle (Vacuum is continuously generated and air is consumed for 6 s (1 cycle)) ·Annual operating cycles: 1100000 (450 cycles/h, 10 h/day, 250 days/year)	·Air consumption: 85 L/min (ANR) Vacuum suction flow rate: 44 L/min (ANR) ·Vacuum generation time: 6 s/cycle (Vacuum is continuously generated and air is consumed for 6 s (1 cycle)) ·Annual operating cycles: 1100000 (450 cycles/h, 10 h/day, 250 days/year)
Air consumption (When placed): **58 L/min (ANR)** **638 m³/year** (ANR) CO_2 emissions: **37** kg/year **511** kg reduction in annual CO_2 emissions (**$9**/year) **($122/year reduction)**	Air consumption (When placed): **85 L/min (ANR)** **9350 m³/year** (ANR) CO_2 emissions: **548** kg/year **$131**/year)



Corresponding value: Air unit $0.014/m³ (ANR), Air – CO_2 conversion factor 0.0586 kg/m³ (ANR)

Multistage Ejector *ZL3* Series

CO2 emissions (Air consumption)

91% reduction[*1]

*1 Based on SMC's measurement conditions
When equipped with a pressure switch for vacuum with energy saving function (ZL3)

Pressure switch for vacuum with energy saving function

Air consumption

90% reduction

More efficient ejector

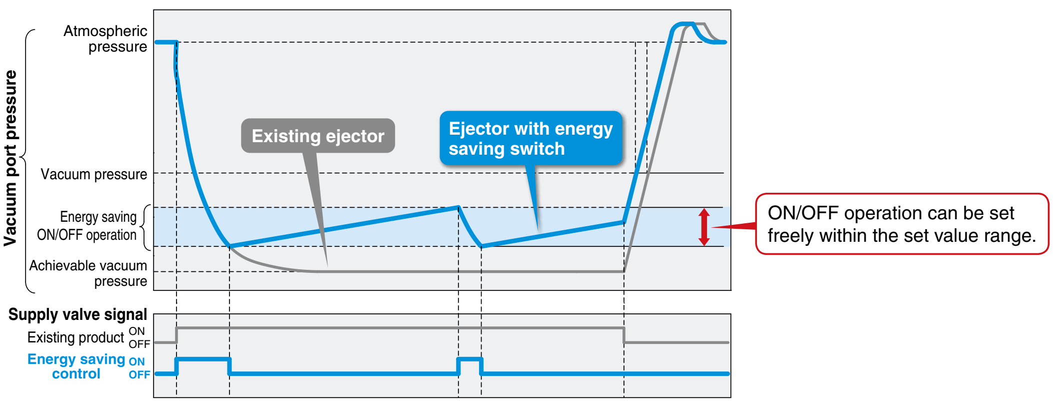
Air consumption

10% reduction

(Compared to ZL212)

Energy saving is possible due to the pressure switch for vacuum with energy saving function.

Even when the suction signal is ON, the ON/OFF operation of the supply valve is performed automatically within the set value.



Effects of Energy Saving

Energy-saving Model

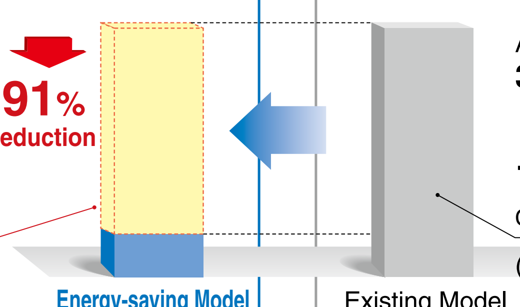
- Air consumption: 135 L/min (ANR)
  Vacuum suction flow rate: 300 L/min (ANR)
- Vacuum generation time: 1.5 s/cycle
  (Air is only consumed for 1.5 s per cycle (15 s) during workpiece adsorption.)
- Annual operating cycles: 300000
  (120 cycles/h, 10 h/day, 250 days/year)

Air consumption (When placed):
3.4 L/cycle (ANR)

1013 m³/year (ANR)
CO_2 emissions: **60** kg/year
606 kg reduction in annual CO_2 emissions

(**$14**/year)
($144/year reduction)

91% reduction



Existing Model

- Air consumption: 150 L/min (ANR)
  Vacuum suction flow rate: 250 L/min (ANR)
- Vacuum generation time: 15 s/cycle
  (Vacuum is continuously generated and air is consumed for 15 s (1 cycle))
- Annual operating cycles: 300000
  (120 cycles/h, 10 h/day, 250 days/year)

Air consumption (When placed):
37.5 L/cycle (ANR)

11250 m³/year (ANR)
CO_2 emissions: **666** kg/year

(**$158**/year)

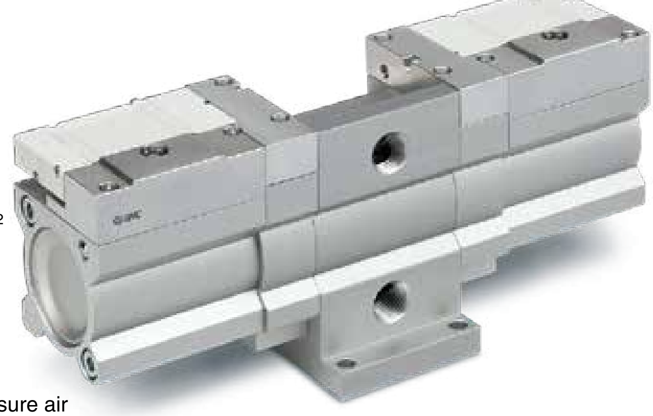
Corresponding value: Air unit $0.014/m³ (ANR), Air – CO_2 conversion factor 0.0586 kg/m³ (ANR)

Booster Regulator *VBA-X3145*

CO_2 emissions
(Air consumption)
40% reduction[*1]

- **3 piston construction**
- **The drive chamber on one side can be operated by the exhaust return circuit.**

*1 Based on SMC's measuring conditions

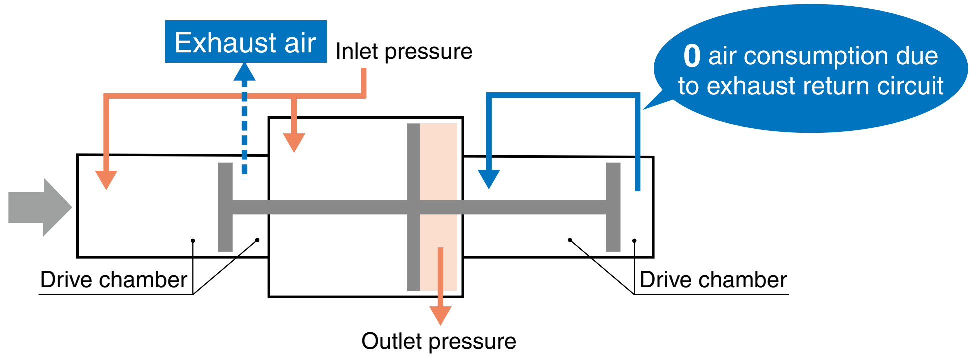


Operation noise: 65 dB(A)[*2]

*2 Based on SMC's measuring conditions

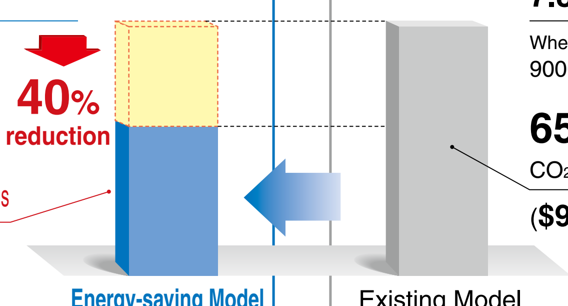
15 dB (A) reduction compared with the existing model (VBA series)

- Exhaust noise: Reduced noise due to exhaust of reused low-pressure air
- Metal noise: Reduced noise due to the adoption of a construction in which the internal switching part doesn't come into contact with any metal parts



Effects of Energy Saving

Energy-saving Model	Existing Model
Bore size: ø50 Stroke: 200 mm Pressure: 0.47 MPa Pressure increase: 0.8 MPa	Bore size: ø50 Stroke: 200 mm Pressure: 0.47 MPa Pressure increase: 0.8 MPa
Booster regulator air consumption per cycle[*3] **4.4 L (ANR)**	Booster regulator air consumption per cycle[*3] **7.3 L (ANR)**
When it is operated 900000 times/year **3960 m^3/year (ANR)** CO_2 emissions: **232** kg/year **153** kg reduction in annual CO_2 emissions (**$56**/year) **($37/year reduction)**	When it is operated 900000 times/year **6570 m^3/year (ANR)** CO_2 emissions: **385** kg/year (**$92**/year)



Corresponding value: Air unit $0.014/$m^3$ (ANR), Air – CO_2 conversion factor 0.0586 kg/m^3 (ANR)

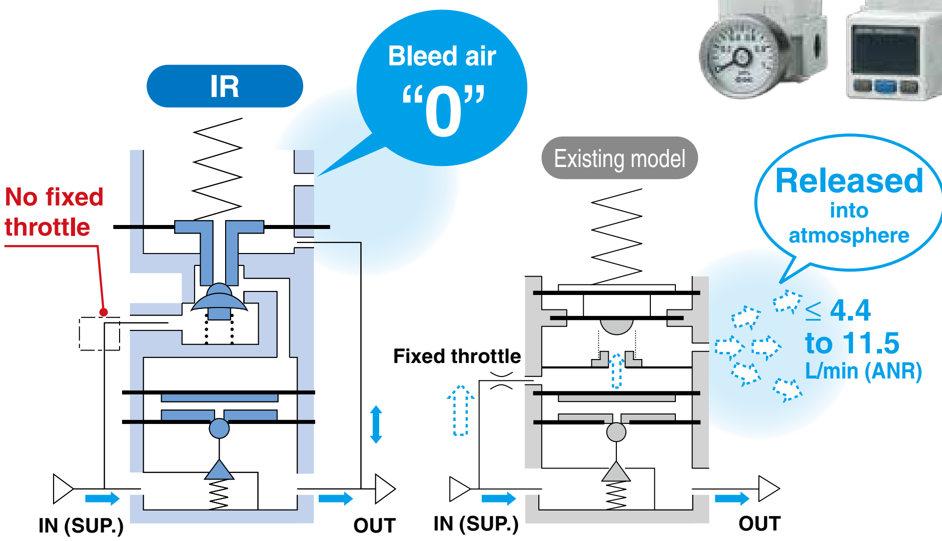
*3 Air consumption = Inlet flow rate – Outlet flow rate

Air consumption

Bleed air "0"

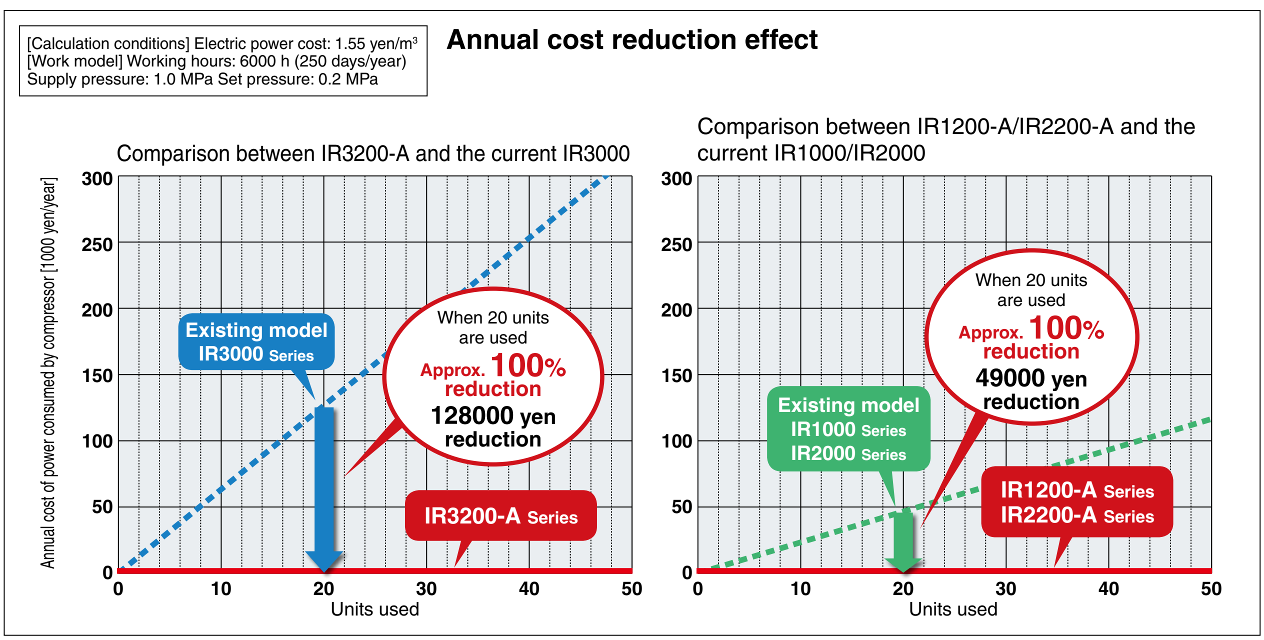
Air consumption is reduced with a new original structure.

With this new original structure,
running costs are reduced.



● No fixed throttle in the new design.

* Poor quality of air may cause operation failure. Select a model that is suitable for the desired air cleanliness by referring to "Air Preparation Equipment Model Selection Guide" for air quality.



Air Saving Speed Controller *AS-R Series*

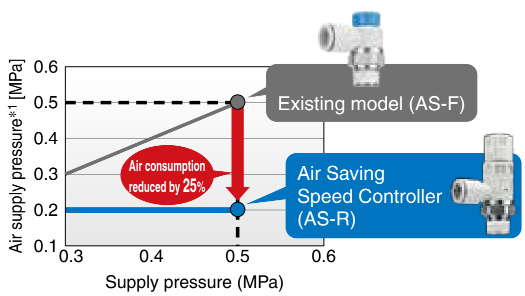
CO2 emissions
(Air consumption)
25% reduction

Reduce air consumption just by mounting to your current air cylinder!

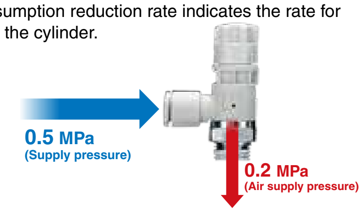
Mounting and operation are the same as a regular speed controller.

With pressure-reduction function
AS-R Series

By reducing the pressure on the return stroke to 0.2 MPa, air consumption can be reduced.



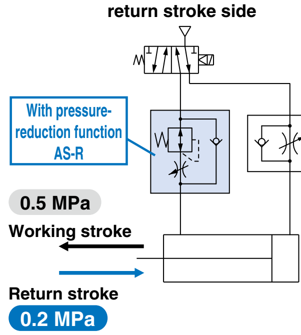
*1 Cylinder pressure on the return stroke side
* The air consumption reduction rate indicates the rate for one cycle of the cylinder.



When it is not necessary to apply force at the end of the working stroke, by using a lifter, pusher, etc.

Air-saving valve circuit

Pressure regulation on the return stroke side

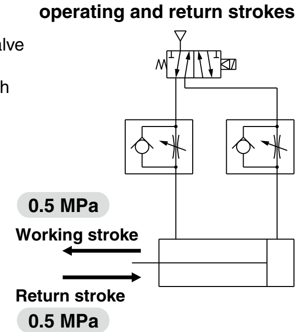


Pressure is regulated by replacing the speed control valve on the return stroke side with an AS-R

The working stroke side switches from meter-out to meter-in.

Existing circuit

Same pressure during operating and return strokes



Effects of Energy Saving

Energy-saving Model

Bore size: ø50
Stroke: 200 mm
Pressure on the extension side: 0.5 MPa
Pressure on the retraction side: 0.2 MPa

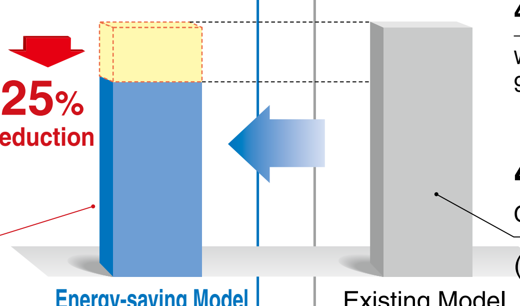
Air consumption:
3.5 L (ANR)/cycle

When it is operated
900000 times/year

3150 m³/year (ANR)
CO2 emissions: **185** kg/year
63 kg reduction in annual CO2 emissions

(**$44**/year)
($15/year reduction)

25% reduction



Existing Model

Bore size: ø50
Stroke: 200 mm
Pressure: 0.5 MPa

Air consumption:
4.7 L (ANR)/cycle

When it is operated
900000 times/year

4230 m³/year (ANR)
CO2 emissions: **248** kg/year

(**$59**/year)

Corresponding value: Air unit $0.014/m³ (ANR), Air – CO2 conversion factor 0.0586 kg/m³ (ANR)

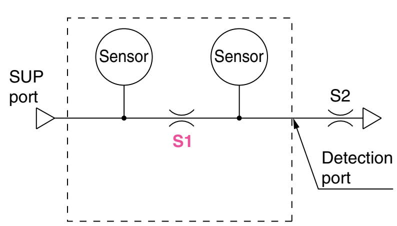
Digital Gap Checker *ISA3 Series*

CO2 emissions (Air consumption)
60% reduction

Air consumption when a workpiece is seated is now 0 L/min due to the new detection principle.

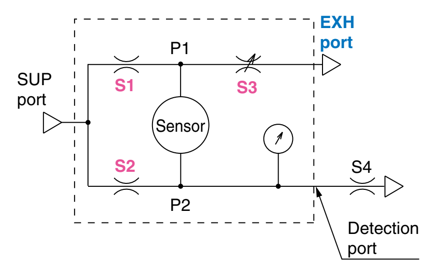
Comparison of detection circuit

New ISA3



S1: Fixed orifice
S2: Detection nozzle

Existing model (ISA2)



S1, S2: Fixed orifice
S3: Variable orifice (Adjusted by setting dial)
S4: Detection nozzle

Due to the new detection principle, the need for air to be exhausted from the product has been eliminated. This makes the flow consumption 0 L/min when a workpiece is seated.
The result is a great reduction in air consumption compared with the existing model.
⁎ Conditions: Unseated for 5 seconds and seated for 20 seconds (For the G type)

Effects of Energy Saving

Energy-saving Model

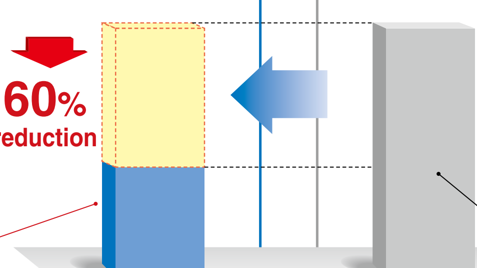
·Air consumption
When placed: 0 L/min (ANR)
When not placed: 10 L/min (ANR)
·Air consumption per cycle:
0.83 L/cycle (ANR)
·Annual operating cycles: 860000

Air consumption (When placed):
0 L/min (ANR)

717 m³/year (ANR)
CO_2 emissions: **42** kg/year
63 kg reduction in annual CO_2 emissions

(**$10**/year)
($15/year reduction)

60% reduction



Energy-saving Model   Existing Model

Existing Model

·Air consumption
When placed: 4 L/min (ANR)
When not placed: 10 L/min (ANR)
·Air consumption per cycle:
208 L/cycle (ANR)
·Annual operating cycles: 860000

Air consumption (When placed):
4 L/min (ANR)

1789 m³/year (ANR)
CO_2 emissions: **105** kg/year

(**$25**/year)

Corresponding value: Air unit \$0.014/m³ (ANR), Air – CO_2 conversion factor 0.0586 kg/m³ (ANR)

Intermittent Blow Circuit *IZE110-X238*

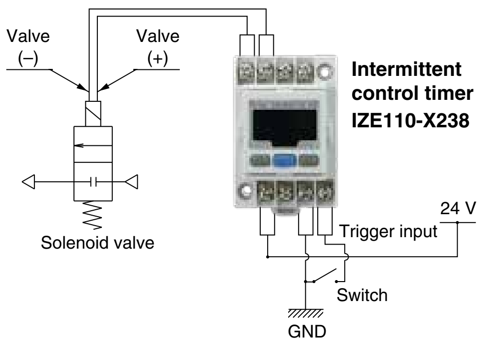
CO2 emissions (Air consumption) 50% reduction

By using intermittent blow based on an intermittent control timer, air consumption can be reduced by 50%.

Energy-saving Circuit

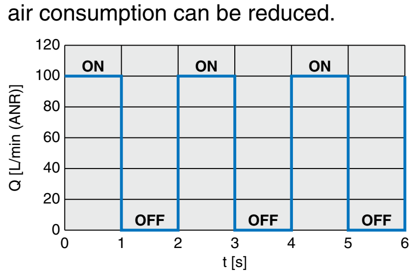
Intermittent Blow Circuit

[Output under timer control]



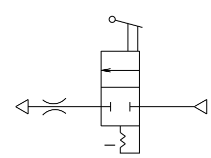
The duty ratio can be freely adjusted.
By setting the duty ratio to one that has the same blow effectiveness, air consumption can be reduced.

Example:

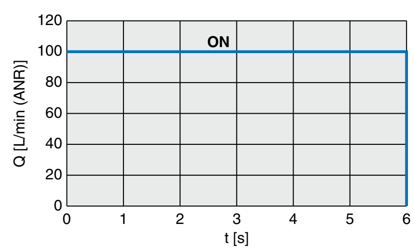


Existing Circuit

Continuous Blow Circuit



The duty ratio is equivalent to 100%.



Effects of Energy Saving

Energy-saving Circuit

Pressure right before: 0.2 MPa
Blow time: 10 s
(Frequency: 12 times/h)
One blow operation:
ON for 1 s, OFF for 1 s;
Repeated a total of 5 times
Working hours: 10 h/day
(250 days/year)
Nozzle diameter: 1 mm

318.2 m³/year (ANR)
CO_2 emissions: **19** kg/year
19 kg reduction in annual CO_2 emissions

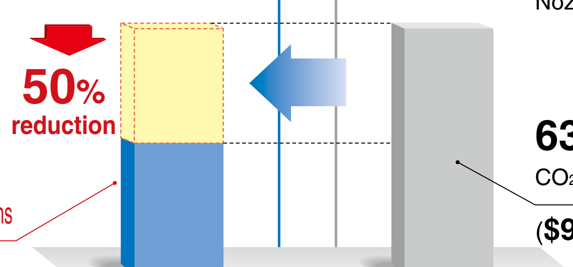
(**$5**/year)
($5/year reduction)

Existing Circuit

Pressure right before: 0.2 MPa
Blow time: 10 s
(Frequency: 12 times/h)
Working hours:
10 h/day (250 days/year)
Nozzle diameter: 1 mm

636.3 m³/year (ANR)
CO_2 emissions: **38** kg/year

(**$9**/year)

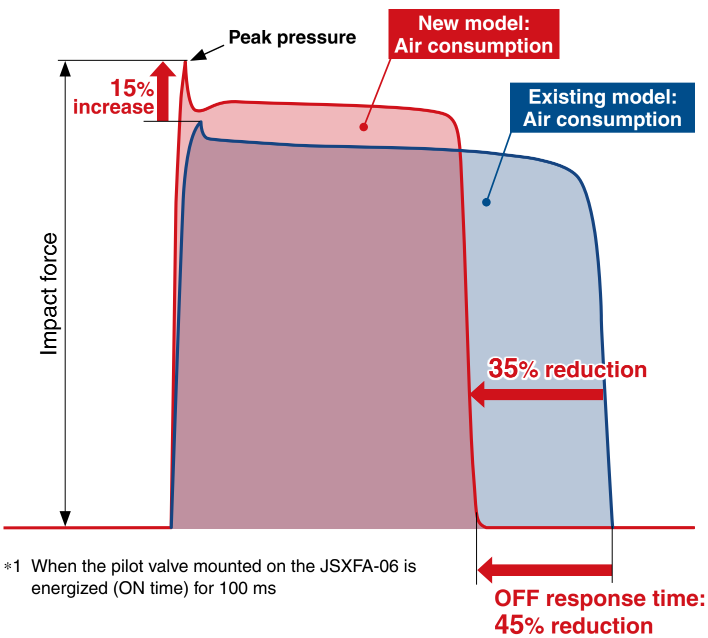


Corresponding value: Air unit $0.014/m³ (ANR), Air – CO_2 conversion factor 0.0586 kg/m³ (ANR)

High peak pressure and low air consumption

Peak pressure
15%*1
increase

CO_2 emissions
(Air consumption)
35%*1
reduction



*1 When the pilot valve mounted on the JSXFA-06 is energized (ON time) for 100 ms

Effects of Energy Saving

Energy-saving Model

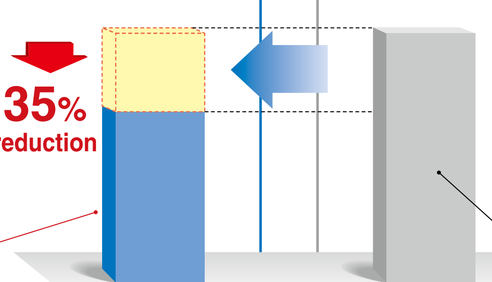
·Optimized internal geometry
·Improved response

Injection quantity per cycle:
57 L/cycle (ANR)

Pressure: 0.9 MPa
Energizing time: 100 ms
Annual operating cycles: 240000

13680 m³/year (ANR)
CO_2 emissions: **802** kg/year
436 kg reduction in annual CO_2 emissions

(**$192**/year)
($104/year reduction)



Existing Model

·Flow path construction with a large pressure loss
·Long response time

Injection quantity per cycle:
88 L/cycle (ANR)

Pressure: 0.9 MPa
Energizing time: 100 ms
Annual operating cycles: 240000

21120 m³/year (ANR)
CO_2 emissions: **1238** kg/year

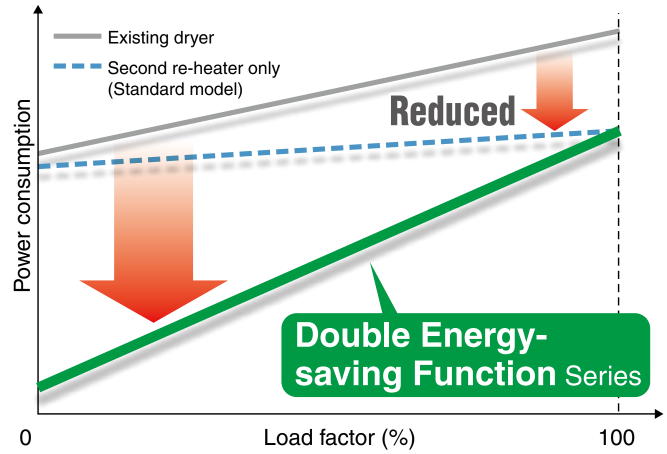
(**$296**/year)

Corresponding value: Air unit $0.014/m³ (ANR), Air – CO_2 conversion factor 0.0586 kg/m³ (ANR)

Refrigerated Air Dryer *IDF□FS Series*

Double Energy-saving Function Series

CO2 emissions
(Power consumption)
76% reduction



The addition of a second re-heater + digital scroll results in high energy savings.

Energy-saving design

Up to a 76% (1 kW)*1 reduction

*1 Operating conditions: The IDF125FS in energy-saving operation mode
- Ambient temperature 32°C
- Inlet air temperature 40°C
- Inlet air pressure 0.7 MPa
- Air flow rate = Rated flow x 0.4
- Power supply frequency 60 Hz
- Power supply voltage 200 V
- Set dew point = 30°C

Example 1 year (Spring to Winter) power consumption

Reduced

Compared with the standard model (constant compressor operation), the **Double Energy-saving Function Series** per year **can reduce power consumption by 43%!*1**

*1 The IDF125FS was used for this example.

* **[Trial calculation conditions]** Days of operation per year = 240 days (60 days each in spring, summer, autumn, and winter), Operating hours per day = 12 hours
For details about the dryer operating conditions for each season, refer to the **Web Catalog** (IDF□FS series.).

Corresponding value: Power consumption – CO_2 conversion factor 0.587 kg - CO_2/kWh

7 Energy-saving circuit

UNIT CONVERSIONS

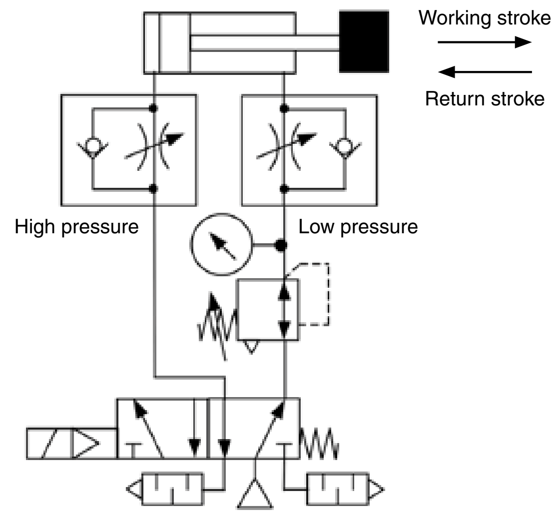
	unit	conversion	result
length	m	x 3.28	ft
	mm	x 0.04	in
mass	g	x 0.04	oz
volume	cm^3	÷ 16.387	in^3
	L	x 61.024	in^3
speed	mm/s	÷ 25.4	in/s
pressure	MPa	x 145	psi
	kPa	÷ 6.895	psi
temperature	°C	x1.8 then add 32	°F
torque	N·m	x 0.738	ft-lb
force	N	÷ 4.448	lbf
flow	L/min	÷ 28.317	cfm
	JPY	x 0.0094	dollar

Two-pressure drive circuit

CO_2 emissions
(Air consumption)
24% reduction

Low pressure is supplied during the non-working return stroke.

In general usage, a cylinder is used to clamp, press fit, or transfer workpieces during the working stroke, with no work taking place during the return stroke. Therefore, it is sufficient to only supply low pressure during the return stroke. In this way, by using a two-pressure drive circuit as the driving circuit, it is possible to reduce the amount of compressed air used to supply pressure on the return side.



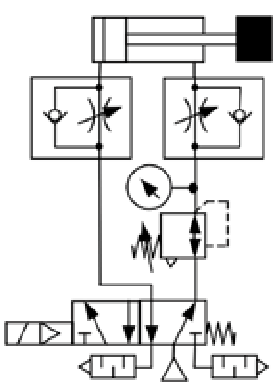
Two-pressure Drive Circuit

By installing a regulator with backflow function in the piping between the rod side cylinder port and the solenoid valve port, it is possible to set the set pressure to low pressure, resulting in a reduction in the amount of compressed air consumed on the return stroke. For the two-pressure drive circuit, sudden extension may occur at the beginning of the working stroke, which may result in a delayed start of the return stroke. In order to resolve this phenomenon, we recommend incorporating an SMC air-saving speed controller.

Effects of Energy Saving

Energy-saving Circuit

Cylinder
I.O.: ø100
Rod size: ø30
Stroke: 400 mm
Piping I.O.: 8 mm
Length: 4 m
Rod side supply pressure:
0.5 MPa
Head side supply pressure:
0.2 MPa
Operating frequency:
5 cycles/min
Operating hours:
2000 hours/year



Air consumption
28.8 L (ANR)/cycle

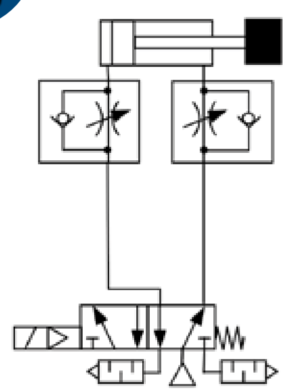
Air consumption
17280 m³/year (ANR)
CO_2 emissions: **1013** kg/year
323 kg reduction
in annual CO_2 emissions

24% reduction

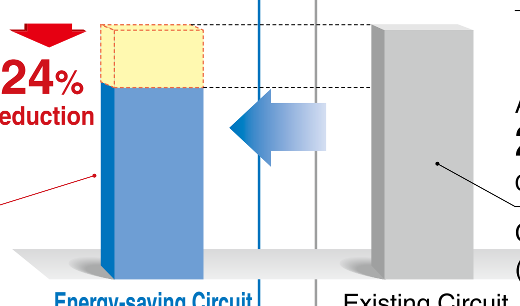
Cost of compressed air
(**$241**/year)
($77/year reduction)

Existing Circuit

Cylinder
I.O.: ø100
Rod size: ø30
Stroke: 400 mm
Piping I.O.: 8 mm
Length: 4 m
Supply pressure: 0.5 MPa
Operating frequency:
5 cycles/min
Operating hours:
2000 hours/year



Air consumption
38 L (ANR)/cycle



Air consumption
22800 m³/year (ANR)
CO_2 emissions: **1336** kg/year

Cost of compressed air
(**$319**/year)

Corresponding value: Air unit $0.014/m³ (ANR), Air – CO_2 conversion factor 0.0586 kg/m³ (ANR)

7 Energy-saving circuit

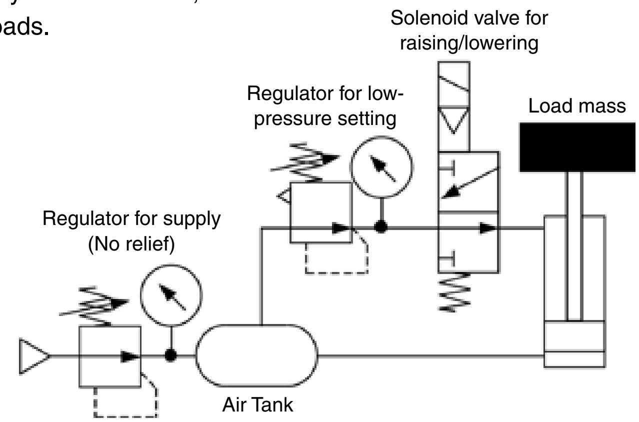
Energy-saving lifter circuit

CO2 emissions (Air consumption)

71% reduction

By using an air tank, a substantial reduction in air consumption is possible.

An air tank can be used to substantially reduce the amount of air consumed by the lifter circuit, which is used to raise and lower loads.

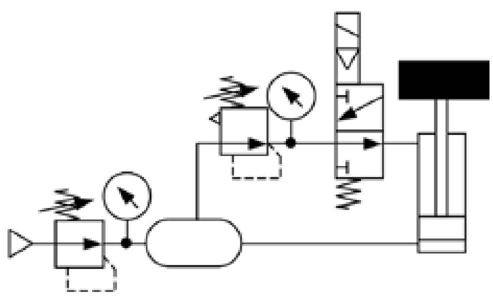


Energy-saving Lifter Circuit

When the cylinder rises, the compressed air in the upper cylinder chamber is exhausted, and the compressed air accumulated in the air tank is supplied to the lower cylinder chamber. Then, when the cylinder lowers, low-pressure compressed air is supplied to the upper cylinder chamber, and the compressed air from the lower cylinder chamber is accumulated in the air tank. The only compressed air consumed during a cycle operation is the low-pressure compressed air supplied to the upper cylinder chamber. Compared with a regular circuit, air consumption can be reduced by 70 to 80%.

Effects of Energy Saving

Energy-saving Circuit

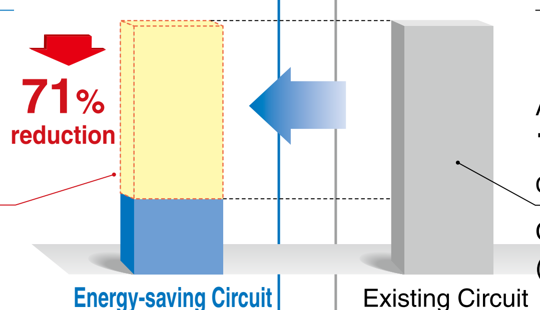


Cylinder
I.O.: ø180
Rod size: ø45
Stroke: 500 mm
Tank capacity: 100 L
Head pressure: 0.36 to 0.42 MPa
Rod side supply pressure: 0.2 MPa
Operating frequency: 1 cycle/min
Operating hours: 2000 hours/year

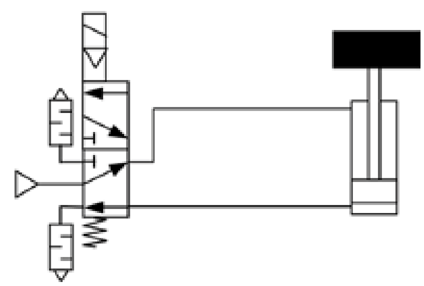
Air consumption
35.8 L (ANR)/cycle

Air consumption
4286 m³/year (ANR)
CO_2 emissions: **251** kg/year
614 kg reduction in annual CO_2 emissions

Cost of compressed air
(**$60**/year)
$146/year reduction)



Existing Circuit



Cylinder
I.O.: ø180
Rod size: ø45
Stroke: 500 mm
Supply pressure: 0.5 MPa
Operating frequency: 1 cycle/min
Operating hours: 2000 hours/year

Air consumption
123 L (ANR)/cycle

Air consumption
14760 m³/year (ANR)
CO_2 emissions: **865** kg/year

Cost of compressed air
(**$206**/year)

Corresponding value: Air unit $0.014/m³ (ANR), Air – CO_2 conversion factor 0.0586 kg/m³ (ANR)

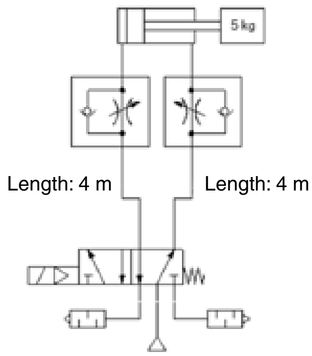
Optimized cylinder driving system

CO_2 emissions
(Air consumption)
42% reduction

Our model selection software can be used to find the smallest possible model which meets your requirements, helping you reduce your air consumption.

Example

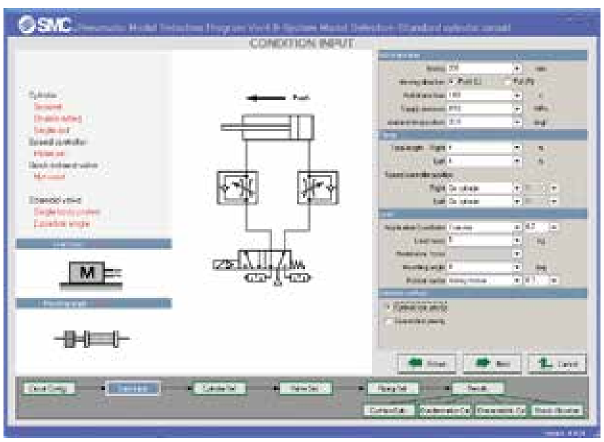
Stroke: 200 mm
Stroke time: 1 second



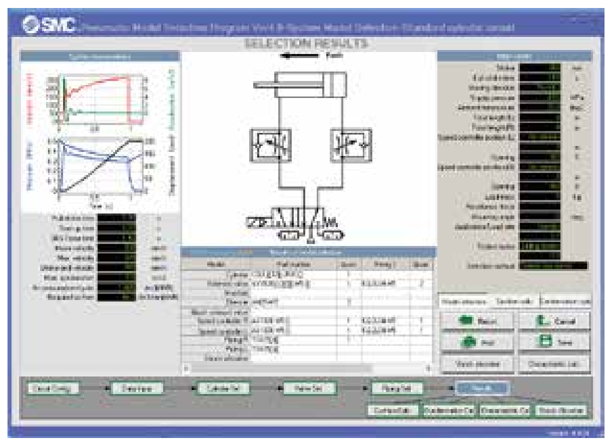
Selection of the optimal size via the selection software

1. Input operating conditions.
2. Conduct a simulation.
3. The optimal size model will be displayed.

Operating condition input screen



Results screen



Effects of Energy Saving

Energy-saving Circuit

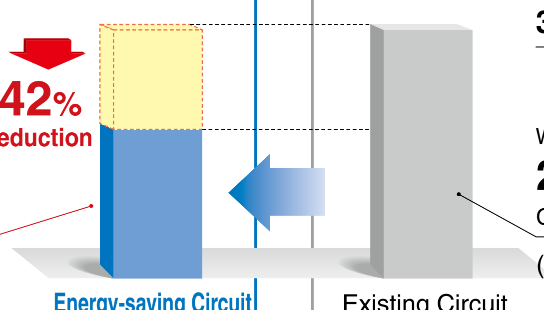
Bore size: ø32 CQ2☐32-200
Piping I.O.: ø4 T0425

Air consumption
1.885 L (ANR)/cycle

When it is operated 900000 times/year
1696.5 m³/year (ANR)
CO_2 emissions: **100** kg/year
73 kg reduction in annual CO_2 emissions

(**$24**/year)
($18/year reduction)

42% reduction



Existing Circuit

Bore size: ø40 CQ2☐40-200
Piping I.O.: ø6 T0604

Air consumption
3.277 L (ANR)/cycle

When it is operated 900000 times/year
2,949 m³/year (ANR)
CO_2 emissions: **173** kg/year

(**$41**/year)

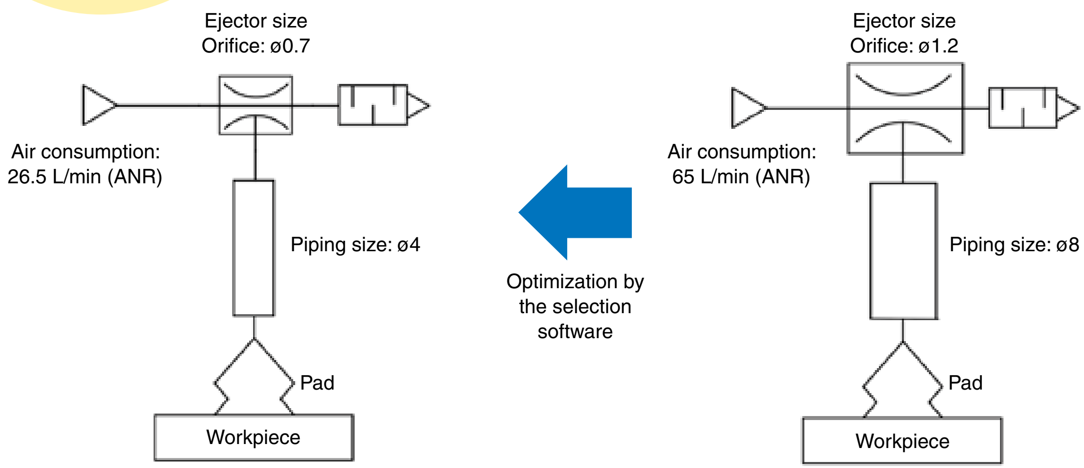
Corresponding value: Air unit \$0.014/m³ (ANR), Air – CO_2 conversion factor 0.0586 kg/m³ (ANR)

Optimized vacuum adsorption transfer system

CO_2 emissions (Air consumption)

59% reduction

By using our model selection software to find an optimal size model which meets your requirements, you can reduce your air consumption.



By selecting optimal size piping, a smaller ejector can also be used, resulting in reduced air consumption.

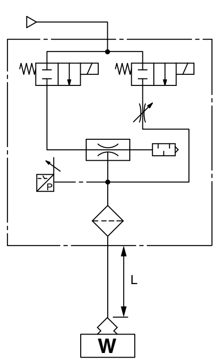
The larger the piping is, the larger the ejector must be, and the greater the amount of air that is consumed.

Effects of Energy Saving

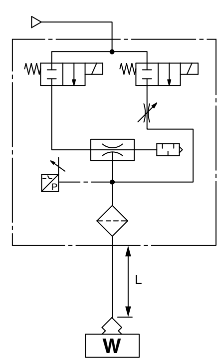
Energy-saving Circuit

Ejector: ZK2A07K-06
(Orifice: ø0.7)
Tubing: TU0425
Pad: ZP2-TB30MTN-H5

Suction time: 0.042 seconds
Safety factor: 4.2
Air consumption: 26.5 L/min (ANR)
Operating frequency: 10 times/h
Operating time: 5 s/time
Operating hours: 2000 hours/year
Number of circuits: 30



Existing Circuit

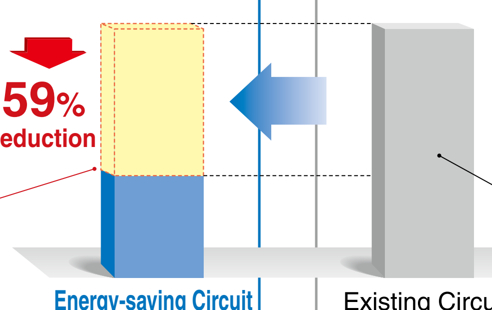


Ejector: ZK2A12K-06
(Orifice: ø1.2)
Tubing: TU0805
Pad: ZP2-TB30MTN-H5

Suction time: 0.079 seconds
Safety factor: 4.3
Air consumption: 65 L/min (ANR)
Operating frequency: 10 times/h
Operating time: 5 s/time
Operating hours: 2000 hours/year
Number of circuits: 30

CO_2 emissions: **78** kg/year
113 kg reduction
in annual CO_2 emissions

59% reduction



Cost of compressed air
(**$19**/year)
($27/year reduction)

CO_2 emissions: **191** kg/year

Cost of compressed air
(**$45**/year)

Corresponding value: Air unit $0.014/m³ (ANR), Air – CO_2 conversion factor 0.0586 kg/m³ (ANR)

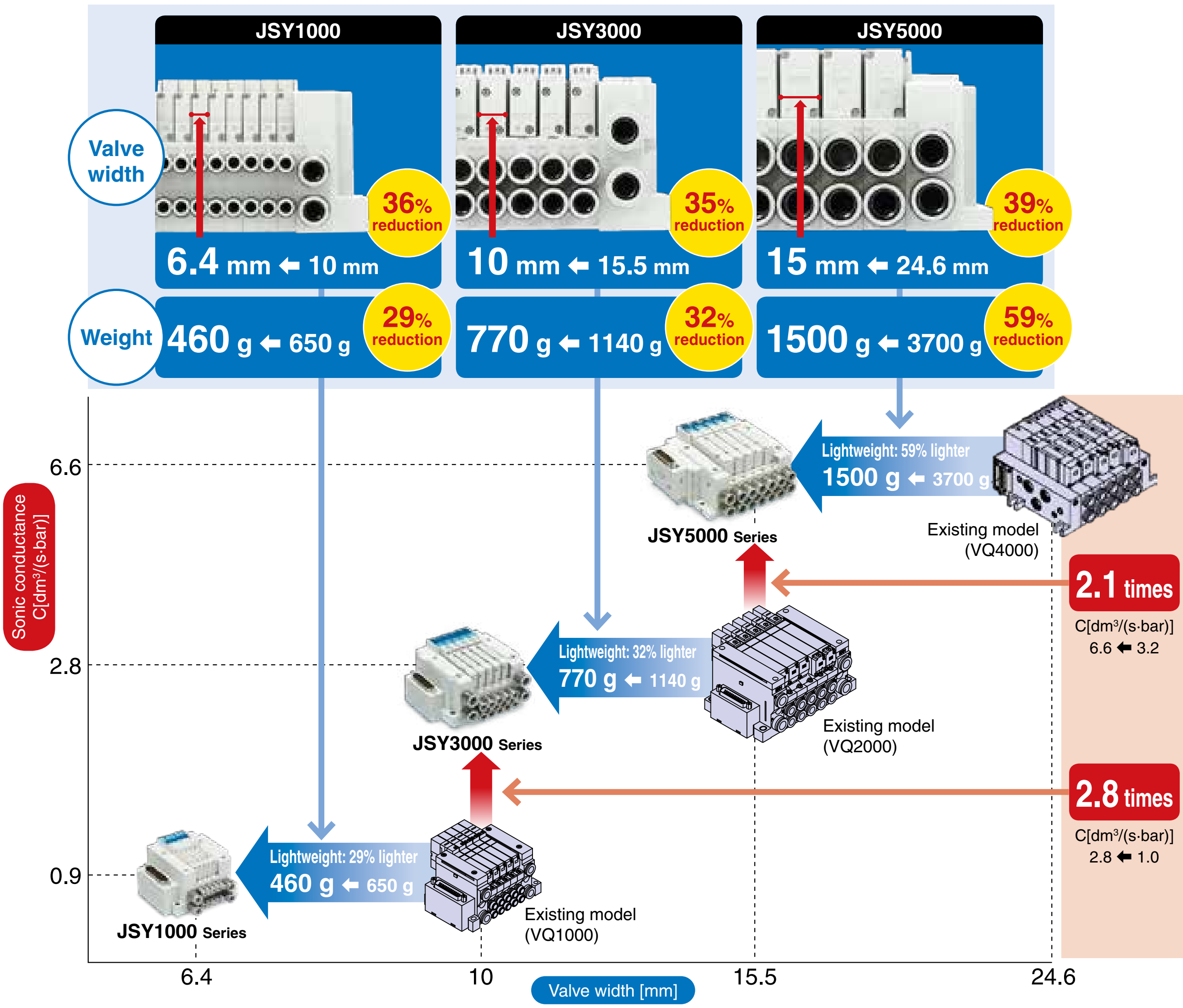
8 Compact and lightweight products

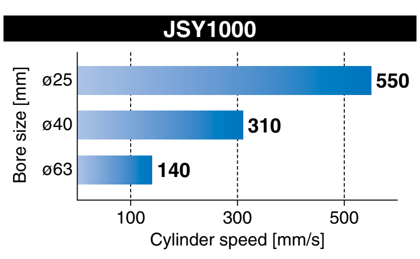
Plug-in Type Compact 5-Port Solenoid Valve *JSY* Series

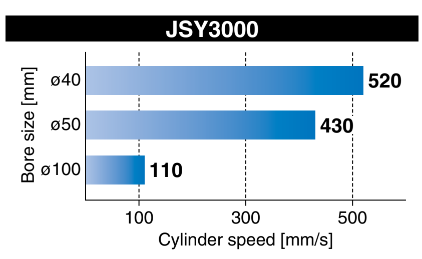
Weight
Max. 59%*1 reduction
3700 g ➡ 1500 g

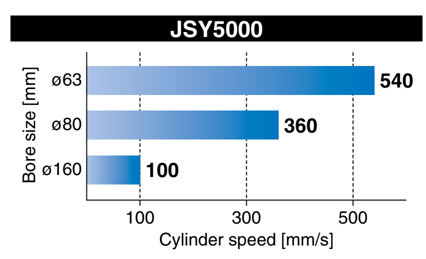
Valve width
Max. 39%*1 reduction
24.6 mm ➡ 15 mm

*1 Compared with the existing VQ4000 series







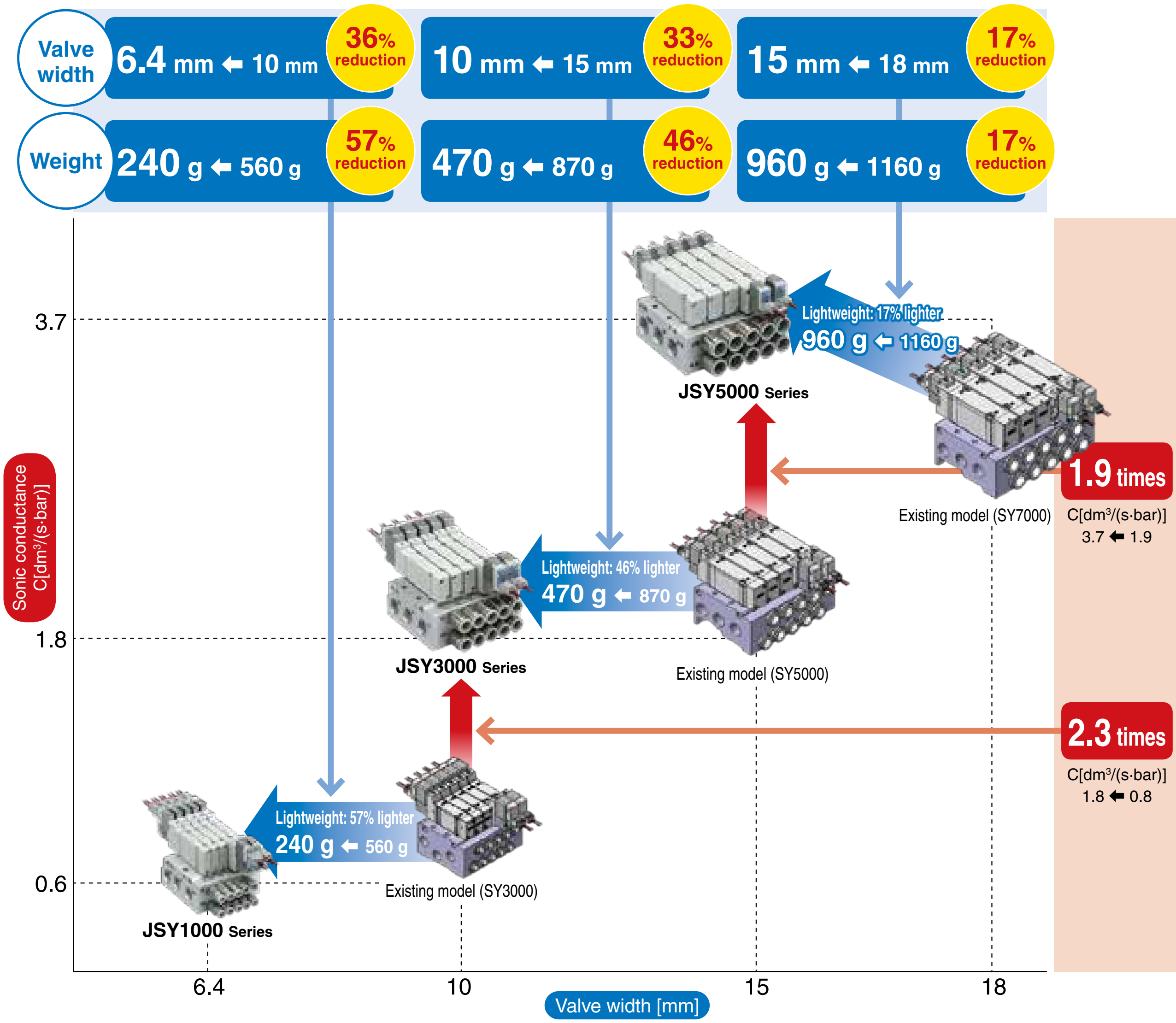


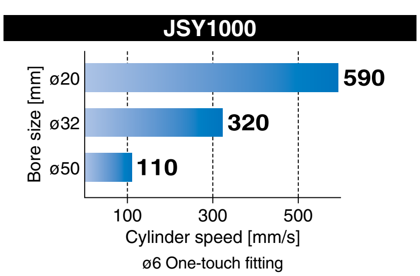
Non Plug-in Type Compact 5-Port Solenoid Valve *JSY* Series

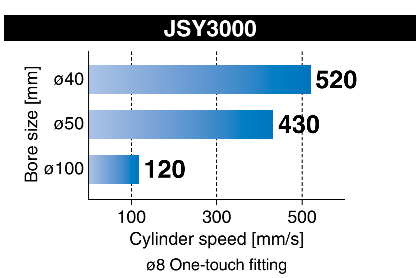
Weight
Max. 57%*1 reduction
560 g ➡ 240 g

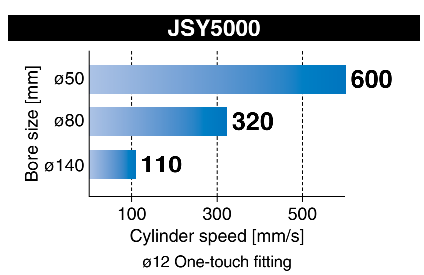
Valve width
Max. 36%*1 reduction
10 mm ➡ 6.4 mm

*1 Compared with the existing SY3000 series









Air Cylinder *JCM* Series
ø20, ø25, ø32, ø40

Weight
Max. **54%**[*1] reduction
0.69 kg ➡ 0.32 kg

Overall length
Approx. **1/3**[*1]
154 mm ➡ 57 mm

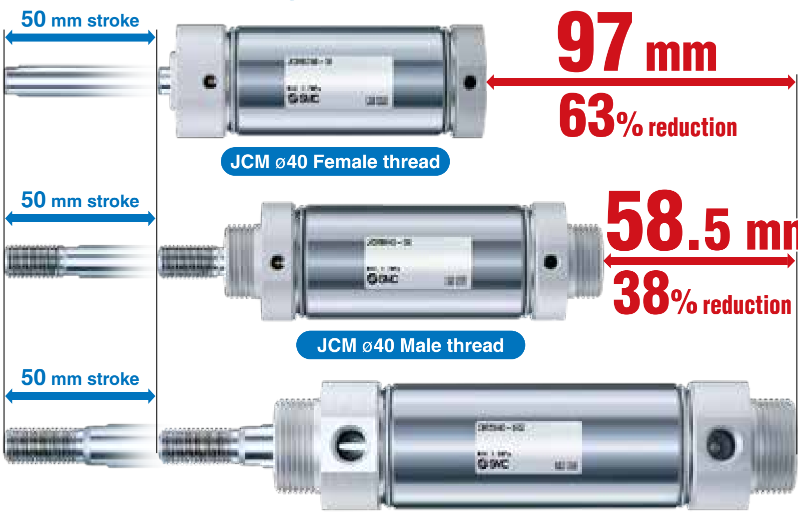
*1 Compared with the existing CM2B series, ø40, 50 mm stroke

Shortened height

New mounting band for auto switch

Mounting height
Approx. 8 mm shorter

Overall length shortened

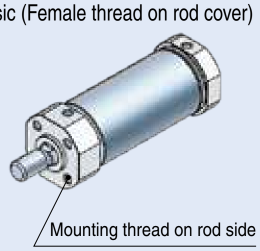


Existing model ø40 (CM2 series)

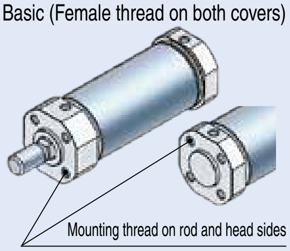
Various cover types available

Direct mounting is possible.

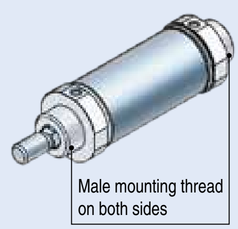
Basic (Female thread on rod cover)



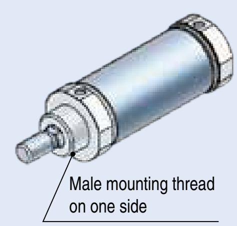
Basic (Female thread on both covers)



Male thread on both covers

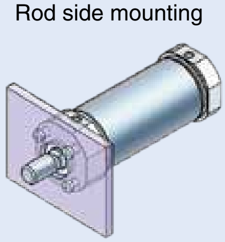


Male thread on rod cover

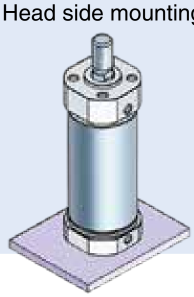


Examples

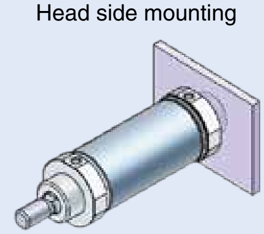
Rod side mounting



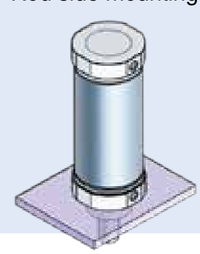
Head side mounting



Head side mounting



Rod side mounting



Air Cylinder *JMB* Series
ø32, ø40, ø45, ø50, ø56, ø63, ø67, ø80, ø85, ø100

Weight
Max. 36%*1 reduction
1.56 kg ➡ 1.00 kg

Overall length
Max. 11%*1 reduction
256 mm ➡ 229 mm

*1 Compared with the existing MB series, ø50, 100 mm stroke

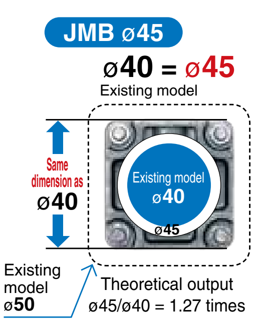
Overall length shortened

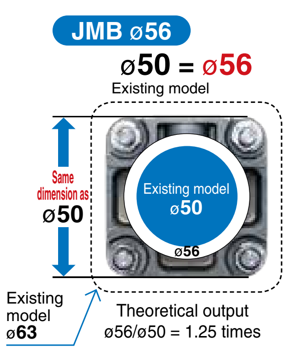
Intermediary bore sizes ◎Air saving ◎Space saving

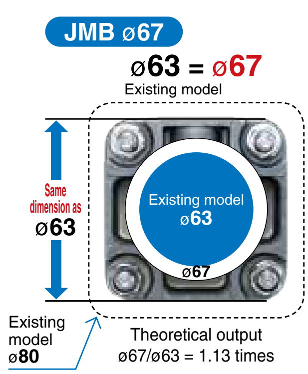
ø40*1 — ø45 — ø50*1 — ø56 — ø63*1 — ø67 — ø80*1 — ø85 — ø100*1

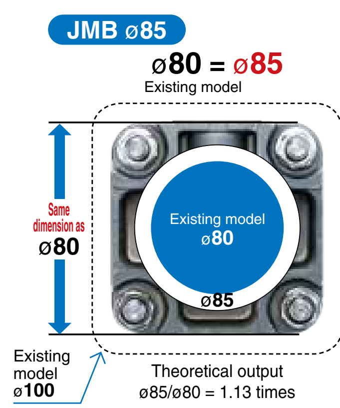
ø40 / ø45: Same external dimensions
ø50 / ø56: Same external dimensions
ø63 / ø67: Same external dimensions
ø80 / ø85: Same external dimensions

*1 Existing model









8 Compact and lightweight products

Air Cylinder *CS2 Series*
ø125, ø140, ø160

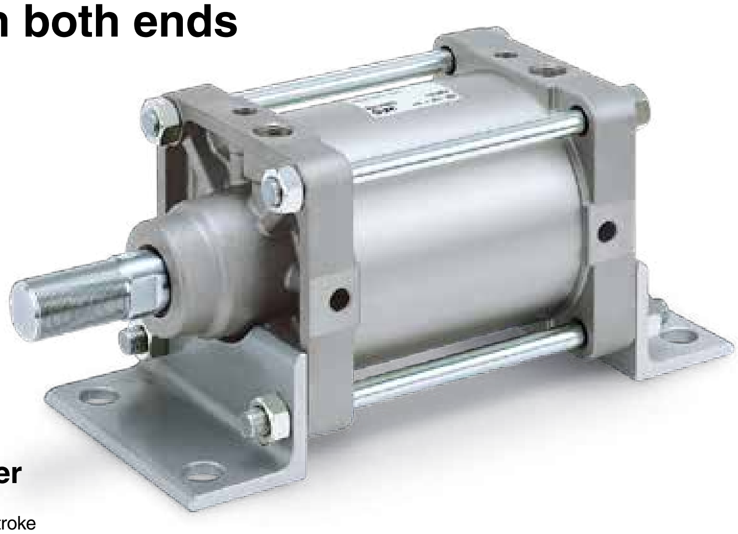
Weight

62% reduction

21.4 kg ➡ **8.2 kg**

Compared with a ø140, 100 mm stroke CS1 (steel tube) series model

More lightweight due to the aluminum covers on both ends



Weight reduced by a change in the cover material

∗ Compared at a 100 mm stroke

Bore size [mm]	CS2 (Aluminum tube) [kg]	CS1 (Steel tube) [kg]	Reduction rate [%]
125	**7.0**	17.9	61
140	**8.2**	21.4	62
160	**11.3**	28.8	61

Mini Free Mount Cylinder *CUJ Series*

ø4, ø6, ø8, ø10, ø12, ø16, ø20

Miniature body

Overall length
Max. 20%*1 reduction
29.5 mm ➡ 23.5 mm

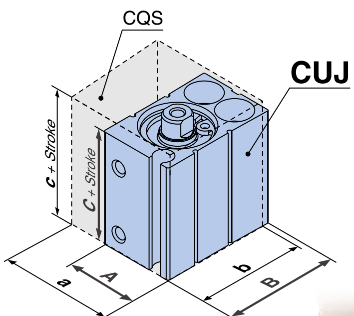
Volume
Max. 45%*1 reduction
382 cm³ ➡ 211 cm³

*1 Compared with the CQS series cylinders, ø20

Dimensions (With Magnet) [mm]

Bore size	A(a)	B(b)	C(c)
12	17(25)	26.5(25)	19.5(22)
16	21(29)	29.5(29)	21(22)
20	25(36)	36(36)	23.5(29.5)

( ): Dimensions of the CQS series cylinders



Overall length
Max. 64%*2 reduction
36 mm ➡ 13 mm

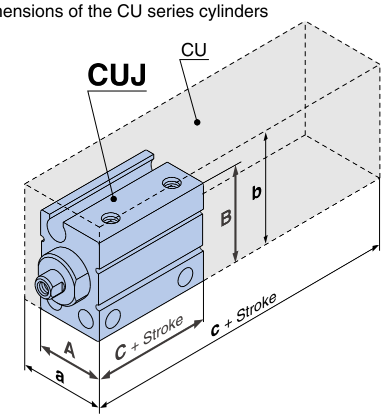
Volume
Max. 70%*2 reduction
129 cm³ ➡ 38.6 cm³

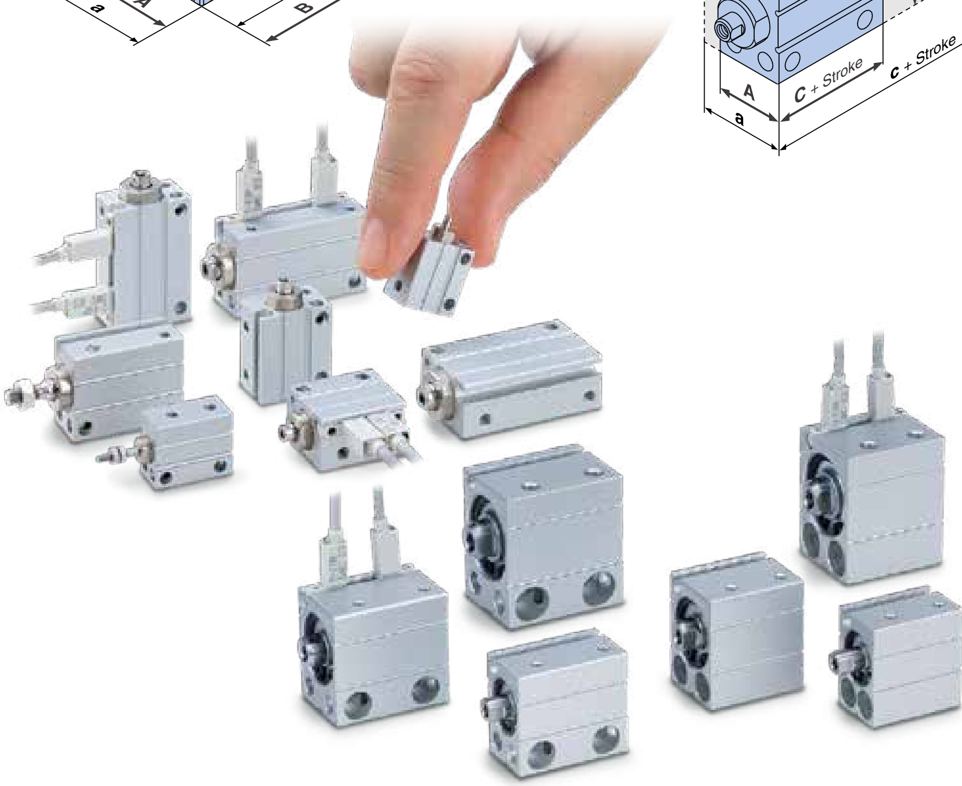
*2 Compared with the CU series cylinders, ø10

Dimensions (Without Magnet) [mm]

Bore size	A(a)	B(b)	C(c)
4	10(—)	15(—)	13(—)
6	13(13)	19(22)	13(33)
8	13(—)	21(—)	13(—)
10	13.5(15)	22(24)	13(36)
12	17(—)	26.5(—)	15.5(—)
16	21(20)	29.5(32)	16.5(30)
20	25(26)	36(40)	19.5(36)

( ): Dimensions of the CU series cylinders





Compact Air Cylinder *JCQ Series*

ø12, ø16, ø20, ø25, ø32, ø40, ø50, ø63, ø80, ø100

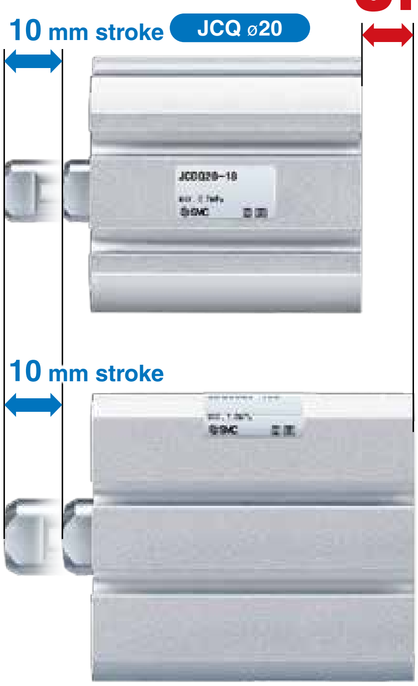
Weight
Max. **45%** *1 reduction
150 g ➡ **82 g**

Volume
Max. **37%** *1 reduction
76 cm³ ➡ **48 cm³**

*1 Compared with the existing CDQS series, ø25, 10 mm stroke

Overall length shortened

6.5 mm



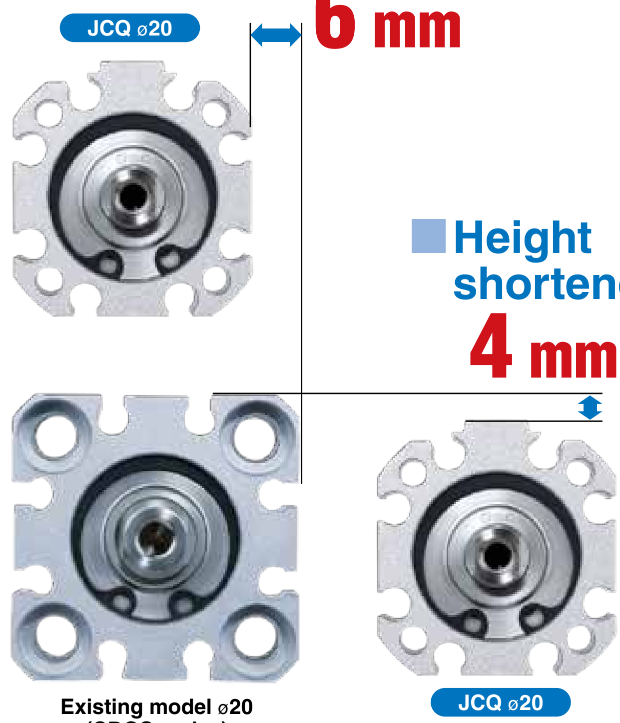
Existing model ø20
(CDQS series)

Width shortened

6 mm

Height shortened

4 mm

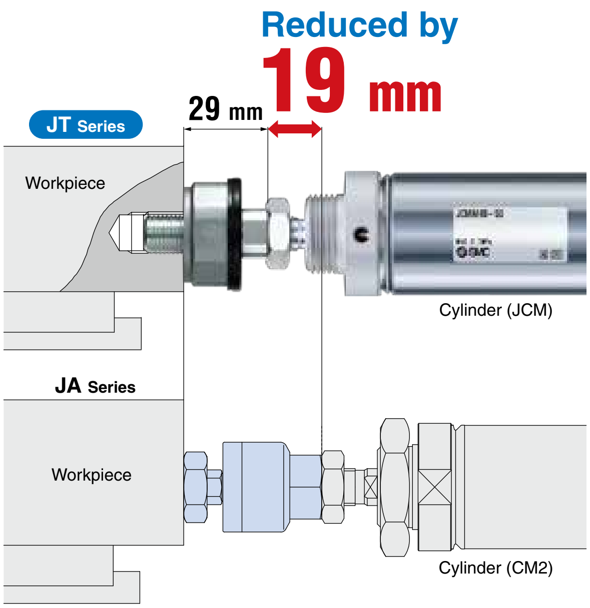


Existing model ø20
(CDQS series)

Floating Joint *JT* Series
20, 32, 40

Weight
Max. 56% reduction
50 g ➡ 22 g

Compared with the existing JA20

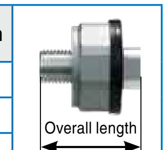


Weight Comparison

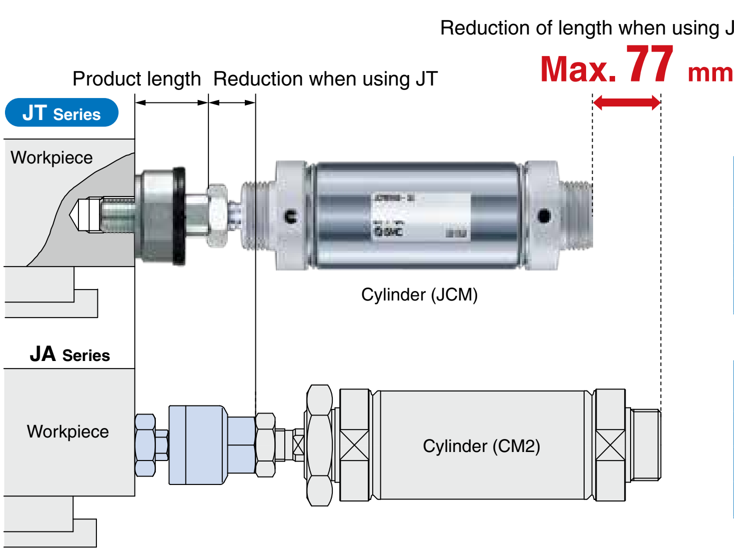
Model	JA Series		JT Series	Reduction rate
JT20	50 g	➡	22 g	56%
JT32	70 g	➡	38 g	46%
JT40	160 g	➡	98 g	39%

Overall Length Comparison

Model	Connection thread	Shortened dimensions	Overall length
JT20	M8 x 1.25	12.3 mm	27.2 mm
JT32	M10 x 1.25	13.0 mm	33.0 mm
JT40	M14 x 1.5	19 mm	43.0 mm



More compact and lightweight combination are available by using the JT series with a JCM series cylinder.



Overall Length Comparison

Model	JA + CM2 Series		JT + JCM Series	Reduction rate
JT20	139.5 mm	➡	90.2 mm	35%
JT32	149.0 mm	➡	96.0 mm	36%
JT40	189.0 mm	➡	112.0 mm	41%

Weight Comparison

Model	JA + CM2 Series		JT + JCM Series	Reduction rate
JT20	190 g	➡	102 g	46%
JT32	350 g	➡	188 g	46%
JT40	720 g	➡	378 g	48%

Compact Slide *MXH Series*

ø6, ø10, ø16, ø20

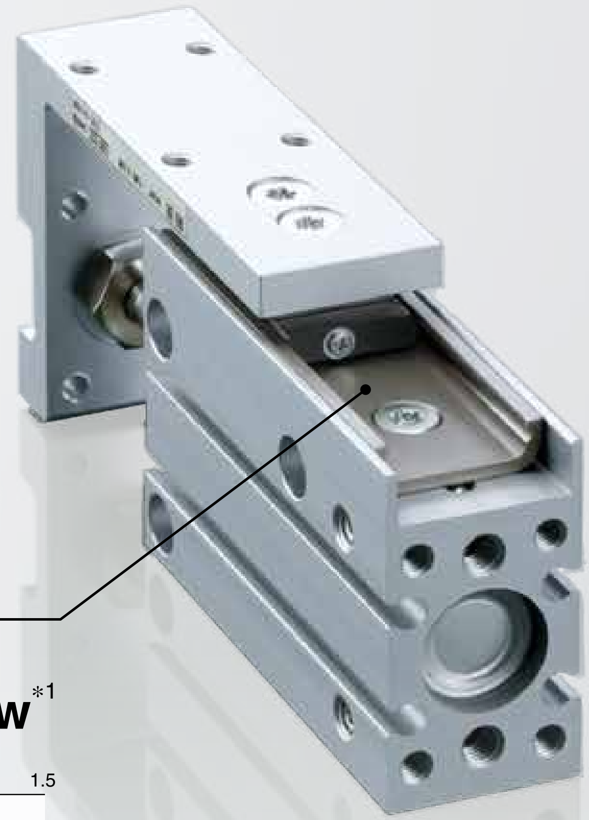
Weight

Max. 19% reduction

455 g ➡ 369 g

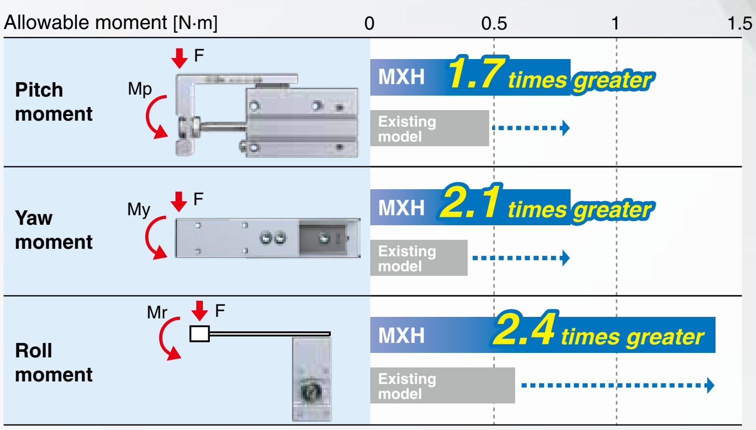
(Existing MXH series, ø20-10 mm stroke)

Allowable moment Improved by up to 240%

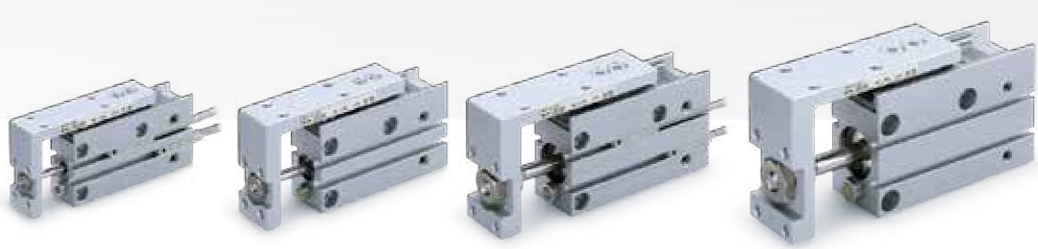


With new high rigidity linear guide

Allowable moment improvement illustrated below*1



*1 Allowable moment caused by static load
(The above graph is a comparison between the new MXH and the existing MXH6.)



SMC

Air Slide Table *MXQ* Series
ø6, ø8, ø12, ø16, ø20, ø25

Reduced in height and weight with thinner table

Height
Max. 10%*1 reduction
30 mm ➡ 27 mm

Weight
Max. 22%*1 reduction
380 g ➡ 298 g

Allowable kinetic energy
Max. 64%*1 increase
0.055 J ➡ 0.09 J

*1 Compared between the double-ported type and the existing MXQ12-30

Double-ported type MXQ□A
- Height reduced by 10% of the existing model
  30 mm → 27 mm
- Weight reduced by 22%
  380 g → 298 g
  For MXQ12A-30ZN
  Improved visibility
  Pilot port
  For ø16
  Two auto switch mounting grooves
- A piping port and auto switch mounting groove are provided on both sides.

Low thrust with high rigidity type MXQ□B

Guide rigidity according to thrust improved
- Guide rigidity improved by 50%
  (For MXQ8B and MXQ8A)
- Cylinder can be downsized when load is light!
  - Reduced in height
  - Reduced in air consumption
  - Lightweight

Single side-ported type MXQ□C
- Compact body with good switch visibility
  Applicable to ø8 and ø12 only
- Compact design, Two auto switch mounting grooves on one side

Height interchangeable type MXQ□
- Same height as the existing model
- Visibility of auto switches improved
- Interchangeable in mounting with the existing model

Guide Size and Cylinder Bore Size Combination Chart

Small guide → Large guide

Guide size	Max. load mass	MXQ□A Bore size	MXQ□A height	MXQ□B Bore size	MXQ□B height	MXQ□C Bore size	MXQ□C height	MXQ□ Bore size	MXQ□ height
32 mm	0.6 kg	ø6	23 mm	—	—	ø6	Not available Use the MXQ□, height interchangeable type.	ø6	20 mm Standard/Symmetric type (Figure shows standard model)
32 mm	1 kg	ø8	23 mm	ø6	20 mm Standard/Symmetric type (Figure shows standard model)	ø8	21 mm Standard/Symmetric type (Figure shows standard model)	ø8	23 mm Standard/Symmetric type (Figure shows standard model)
40 mm	2 kg	ø12	27 mm	ø8	23 mm Standard/Symmetric type (Figure shows standard model)	ø12	27 mm Standard/Symmetric type (Figure shows standard model)	ø12	30 mm Standard/Symmetric type (Figure shows standard model)
50 mm	4 kg	ø16	35 mm	ø12	30 mm Standard/Symmetric type (Figure shows standard model)	ø16		ø16	37 mm
60 mm	6 kg	ø20	43 mm	ø16	37 mm	ø20	Not available Use the MXQ□A, double-ported type.	ø20	46 mm
70 mm	9 kg	ø25	52 mm	ø20	46 mm	ø25		ø25	55 mm

When the height needs to be the same as the existing model, choose the MXQ□, height interchangeable type.

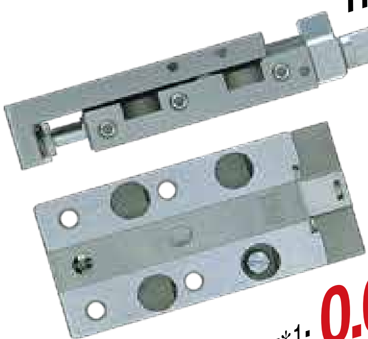
Purpose of usage ❶ (MXQ□A ø8 → MXQ□B ø6)
Guide rigidity and a large table surface are necessary but thrust is not needed.
Application examples
- Horizontal transfer of workpieces, transfer of tools, low thrust clamping

Purpose of usage ② (MXQ□A ø8 → MXQ□B ø8)
A guide with higher rigidity is necessary without changing the thrust from the existing model.
Application examples
- Transfer of workpieces with increased overhang
- High-accuracy and high-thrust clamping

MXQ□A: Size ø16, ø20, and ø25 have two auto switch mounting grooves on both sides.
MXQ□B: Size ø16 and ø20 have two auto switch mounting grooves on both sides.
MXQ□: Size ø16, ø20, and ø25 have two auto switch mounting grooves on both sides.

Compact

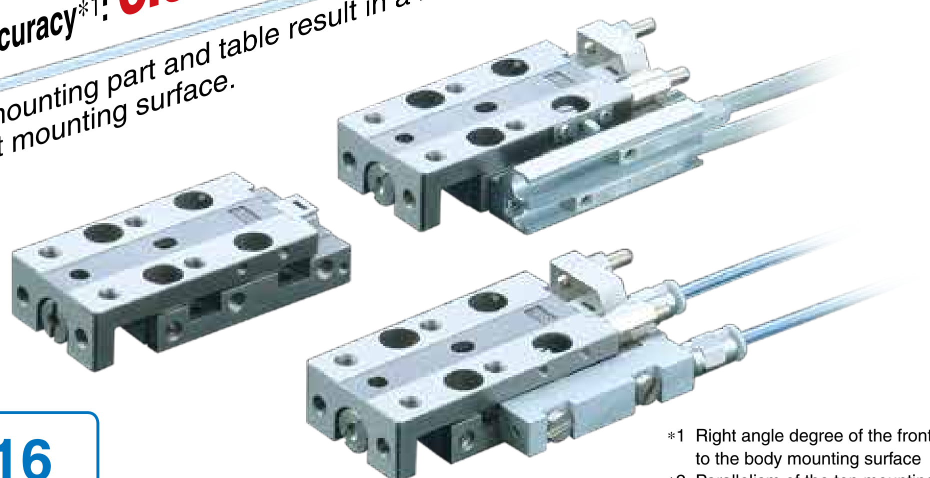
Height: 10 mm/Width: 20 mm/Length: 43 mm (MXJ4)



Traveling parallelism: 0.005 mm

Front mounting accuracy*1: 0.01 mm/Top mounting accuracy*2: 0.03 mm

Integrated front mounting part and table result in a highly accurate and rigid top and front mounting surface.

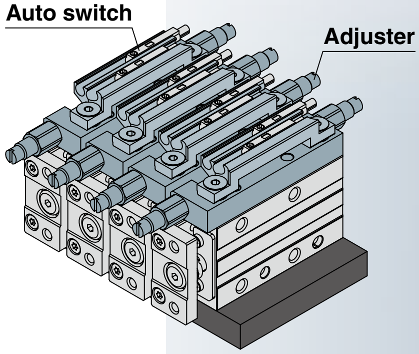


*1 Right angle degree of the front mounting surface to the body mounting surface
*2 Parallelism of the top mounting surface to the body mounting surface

ø12, ø16

Auto switch and adjuster **can be mounted on the same side.**

Short pitch mounting is possible.



Compact Guide Cylinder *JMGP* Series

ø12, ø16, ø20, ø25, ø32, ø40, ø50, ø63, ø80, ø100

Weight
Max. 69%*1 reduction
0.32 kg ➡ **0.1 kg**

Overall length
Max. 31%*2 reduction
100 mm ➡ **69.5 mm**

Height
33%*2 reduction
48 mm ➡ **32 mm**

*1 Compared with the existing MGP-Z series, ø16, 10 mm stroke *2 Compared with the existing MGP-Z series, ø32, 25 mm stroke

Overall length shortened

Existing model ø32

Height shortened

Existing model ø32

Suitable for pushing, lifting, or clamping in a transport line

Micro Clamp Cylinder *CKZM16* *-X2800* (Base Type) *-X2900* (Tandem Type)

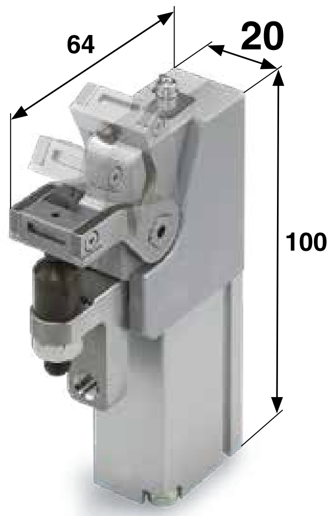
Compact | **Lightweight** | **High clamping force** | **High holding force**

Width
20 mm
Base type, Tandem type

Weight
250 g
Base type

Max. clamping force: 200 N
(Tandem type)
＊ Operating pressure: 0.6 MPa

Max. holding force: 300 N
(Base type, Tandem type)
＊ When operating pressure of 0.2 to 0.6 MPa is applied

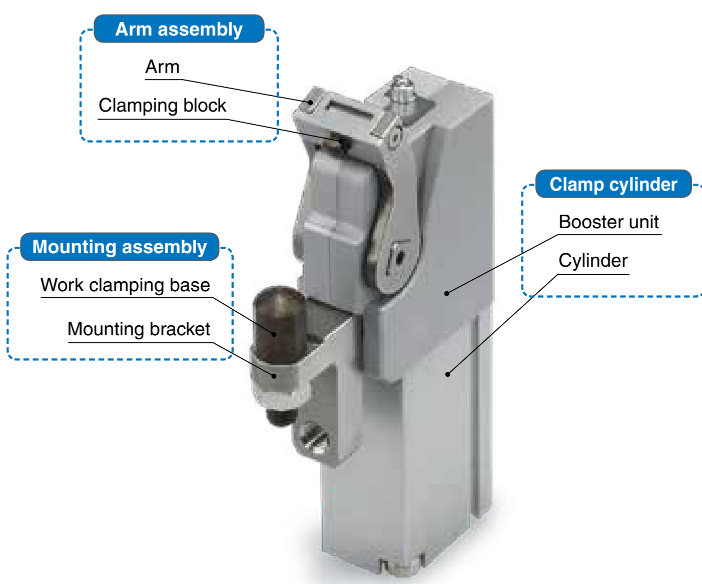


Base type: X2800

Tandem type: X2900

Reduction of design assembly labor by unitization

Arm assembly **Mounting assembly**
added to clamp cylinder



Rotary Actuator/Vane Type *CRB Series*
Size: 10, 15, 20, 30, 40

Overall length
Max. 44%*1 reduction
100 mm ➡ 55.6 mm

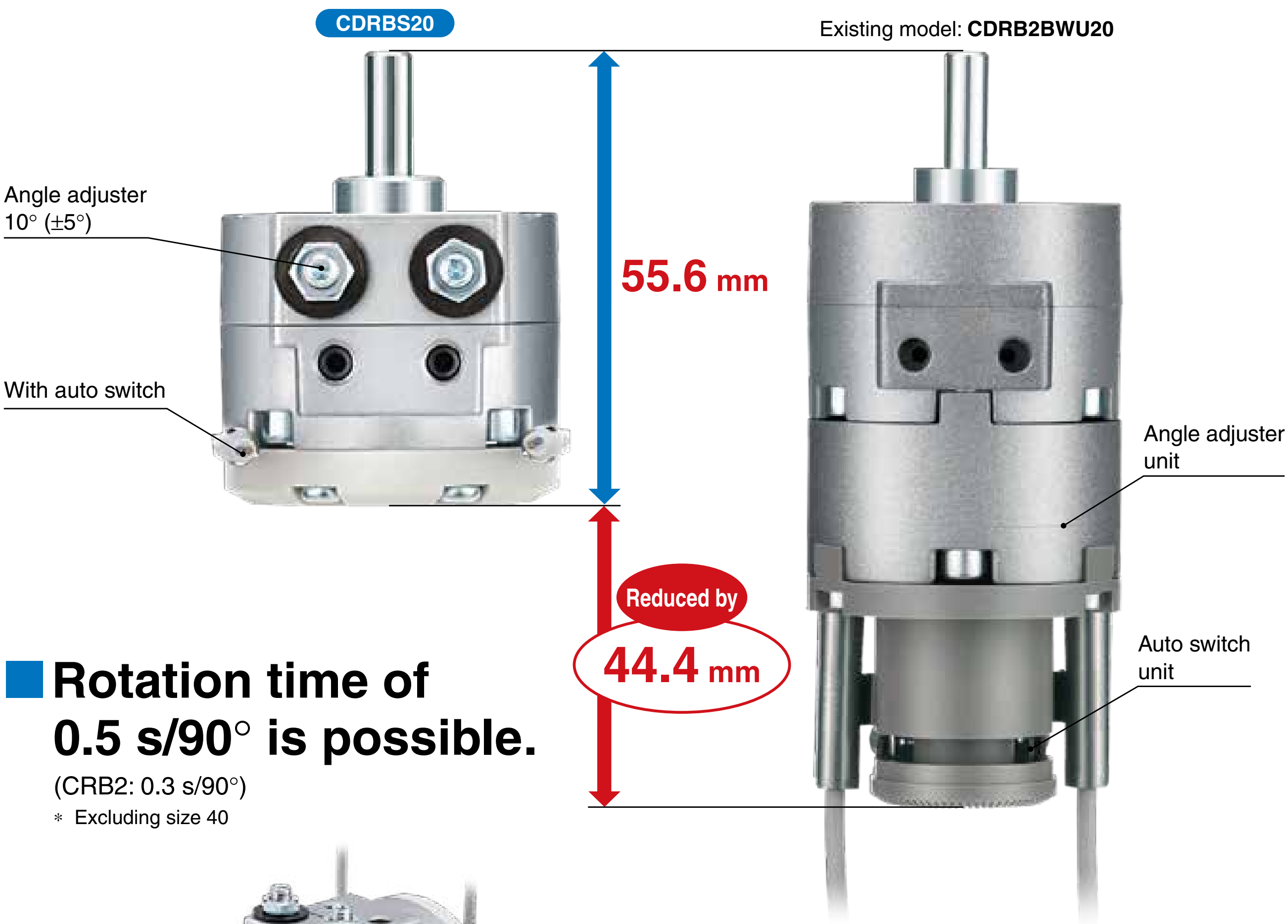
Weight
Max. 48%*2 reduction
222 g ➡ 115 g

*1 Compared with the existing CDRB2□WU, Size 20

*2 Compared with the existing CDRB2□WU, Size 20, Rotating angle 90°

Features a compact body with a built-in angle adjuster unit and auto switch unit

(Size: 20, 30, 40)



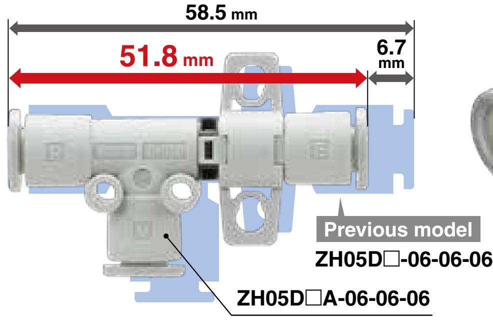
■ Rotation time of 0.5 s/90° is possible.

(CRB2: 0.3 s/90°)

* Excluding size 40

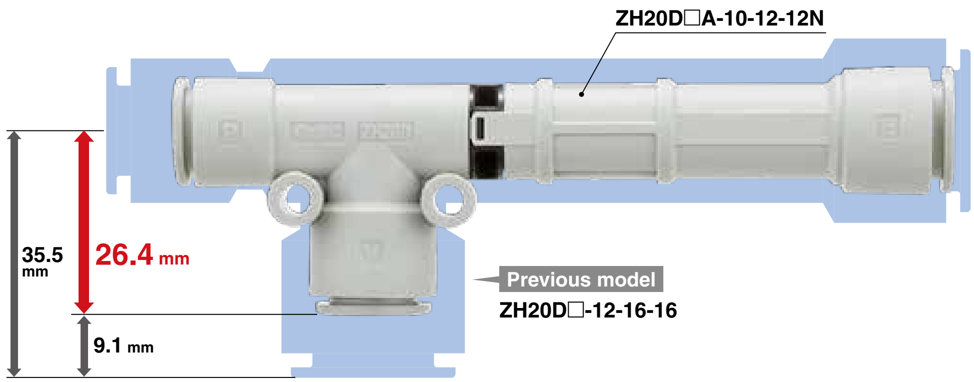
Compact and lightweight

Overall length
Max. 11% reduction
58.5 mm ➡ 51.8 mm



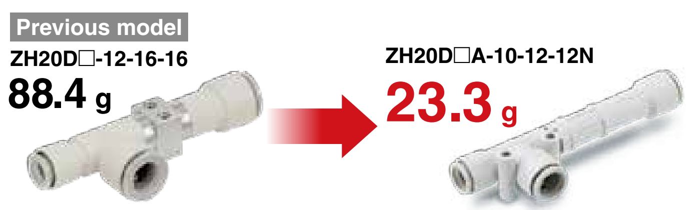
Compared with the previous ZH05D□

Port height
Max. 25% reduction
35.5 mm ➡ 26.4 mm



Compared with the previous ZH20D□

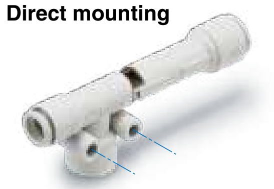
Weight
Max. 74% reduction
88.4 g ➡ 23.3 g



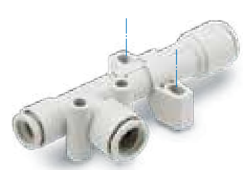
Compared with the previous ZH20D□

4 mounting types

Direct mounting



Standard bracket mounting



L-bracket mounting

DIN rail mounting

Variations

Model	Nozzle nominal size [mm]	Ultimate vacuum pressure*1 [kPa]		Max. suction flow rate [L/min (ANR)]		Air consumption [L/min (ANR)]
		Type S	Type L	Type S	Type L	
ZH05D□A	0.5	–90	–48	6	13	13
ZH07D□A	0.7	–90	–48	12	28	27
ZH10D□A	1.0	–90	–48	26	52	52
ZH13D□A	1.3	–90	–48	40	78	84
ZH15D□A	1.5	–90	–66	58	78	113
ZH18D□A	1.8	–90	–66	76	128	162
ZH20D□A	2.0	–90	–66	90	155	196

*1 Supply pressure: 0.45 MPa

In-line Type Vacuum Ejector
ZU□A Series

Compact and lightweight

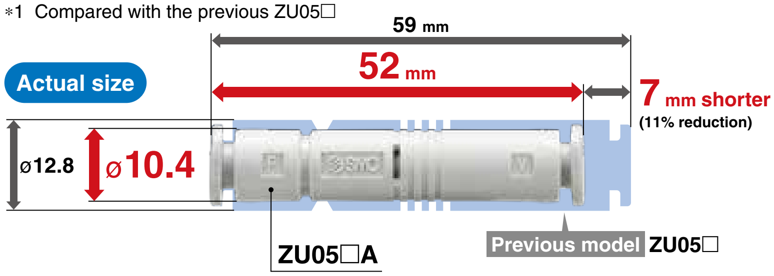
O.D.
ø10.4 mm *1
Previous model: ø12.8 mm

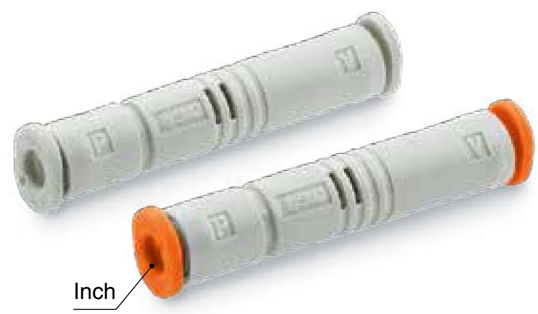
Weight
3.9 g *1
Previous model: 6.5 g

Overall length
52 mm *1
Previous model: 59 mm

*1 Compared with the previous ZU05□

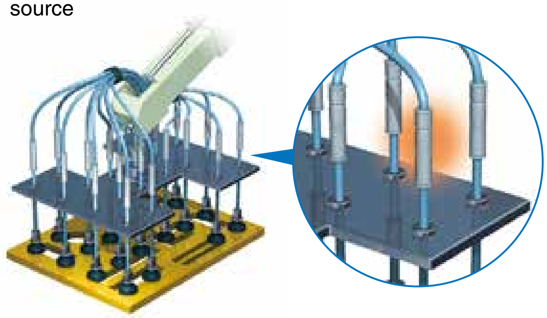
Actual size





Application Examples

For preventing pad adsorption failures from the vacuum source



Numerous pads can be used to adsorb workpieces with holes.

For improving responsiveness by installing on flexible parts

Can be used to open and close plastic bags

For mounting on the end of a Z-axis air cylinder

Variations

Model	Nozzle size [mm]	Standard supply pressure [MPa]	Ultimate vacuum pressure [kPa]		Max. suction flow rate [L/min (ANR)]		Air consumption [L/min (ANR)]	Port size
			Type S	Type L	Type S	Type L		
ZU03SA	0.3	0.35	–85	—	1.8	—	3.7	ø4 One-touch fitting ø5/32"
ZU04SA	0.4		–87		3.2		7.4	
ZU05□A	0.5	0.45	–90	–48	7	13	14	ø6 One-touch fitting Rc1/8
ZU07□A	0.7				11	16	28	

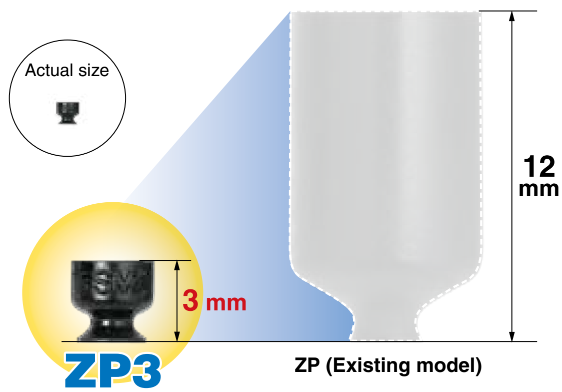
Vacuum Pad *ZP3* Series
ø1.5, ø2, ø3.5, ø4, ø6, ø8, ø10, ø13, ø16

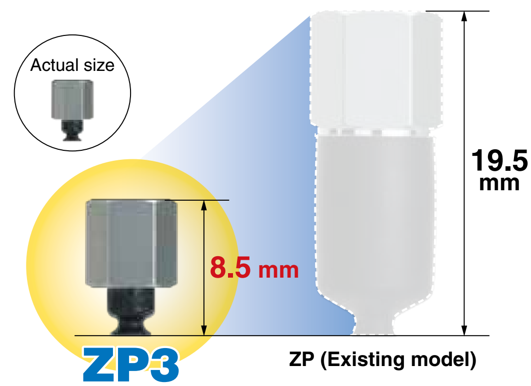
Overall length shortened

Overall length
Max. 9 mm*1 shorter
12 mm ➡ 3 mm
* Pad unit

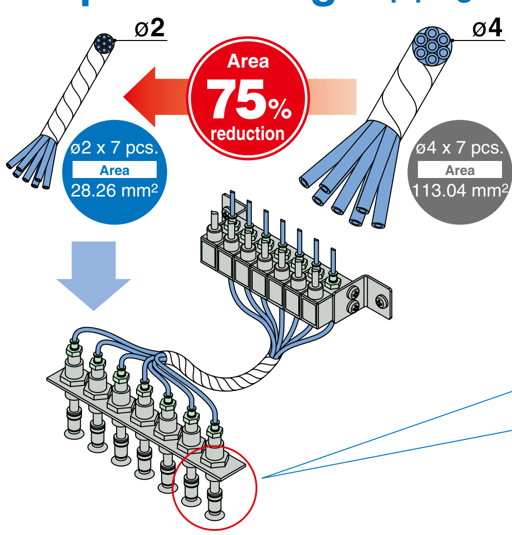
Overall length
Max. 11 mm*1 shorter
19.5 mm ➡ 8.5 mm
* With adapter

*1 For the flat type (Pad diameter: ø2)



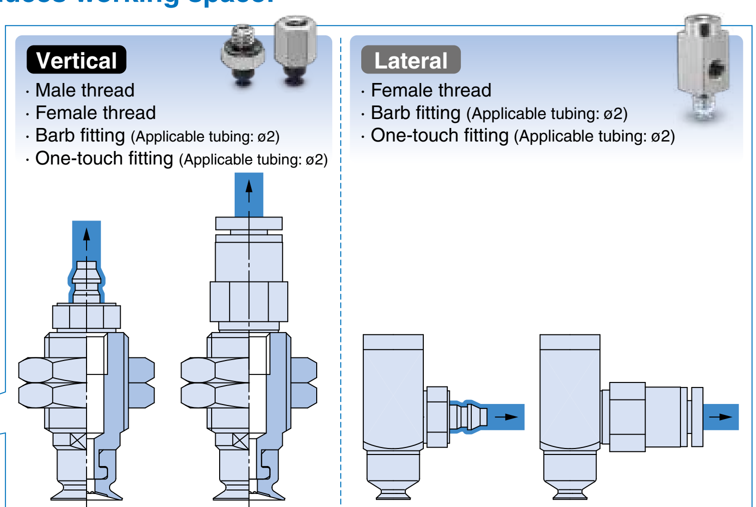


Space saving ø2 piping reduces working space!



Vertical
- Male thread
- Female thread
- Barb fitting (Applicable tubing: ø2)
- One-touch fitting (Applicable tubing: ø2)

Lateral
- Female thread
- Barb fitting (Applicable tubing: ø2)
- One-touch fitting (Applicable tubing: ø2)



Variations

Form	Pad diameter ø1.5	ø2	ø3.5	ø4	ø6	ø8	ø10	ø13	ø16
Flat type	●	●	●						
Flat type with groove				●	●	●	●	●	●
Bellows type				●	●	●	●	●	●

One-touch Fittings *KQ2 Series*

Weight Max. 57%[*1] reduction
12 g ➡ 5.2 g

Height Max. 24%[*1] reduction
25.5 mm ➡ 19.4 mm

Length Max. 23%[*1] reduction
20 mm ➡ 15.5 mm

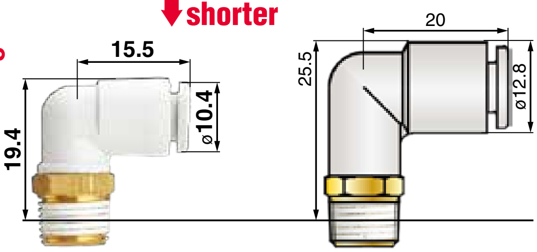
*1 Compared with the previous KQ2 series model: Male elbow, applicable tubing O.D. ø6, connection thread R1/8

Compact and lightweight

Dimensions Height: **24%**[*1] **shorter**

Dimensions Length: **23%**[*1] **shorter**

Weight: **57%**[*1] **lighter**



*1 Compared with the previous KQ2 series model:
Male elbow, applicable tubing O.D. ø6, connection thread R1/8

Improved tube insertion/removal

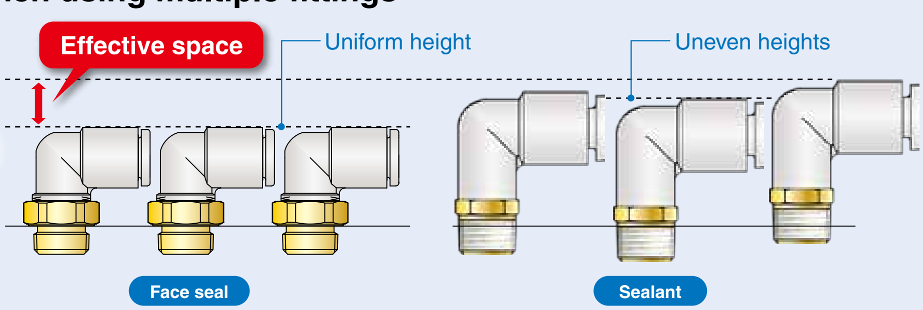
*1 Tube removal strength is ensured to be equivalent to previous model.

◎ Face seal adopted for threading

Improved installability (Reduction in amount of tool-tightening required after hand-tightening)

◎ Uniform height when using multiple fittings

Provides effective space above fittings



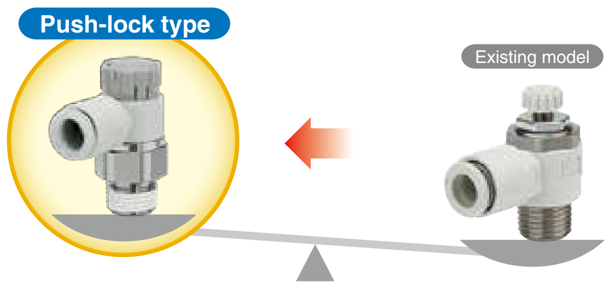
Speed Controller with One-touch Fitting (Push-lock Type) AS Series

Reduced labor time and weight!

Weight

Reduced by up to approx. **50%***1

*1 Compared with the existing AS22□1F, ø12



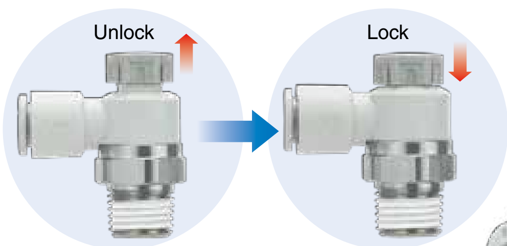
Tubing O.D.	Thread	Part no.	Weight
ø6	1/4	AS22□1F-02-06A	18 g
ø12	1/2	AS42□1F-04-12A	56 g

Tubing O.D.	Thread	Part no.	Weight
ø6	1/4	AS22□1F-02-06	32 g
ø12	1/2	AS42□1F-04-12	101 g

Easy to use

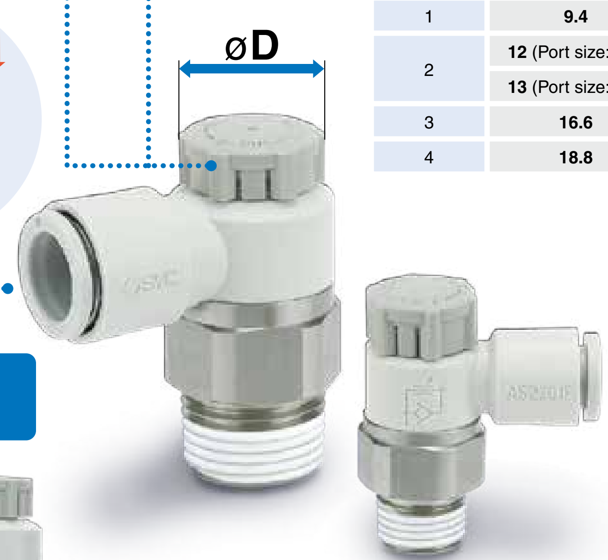
Push-lock type

- Easy to lock

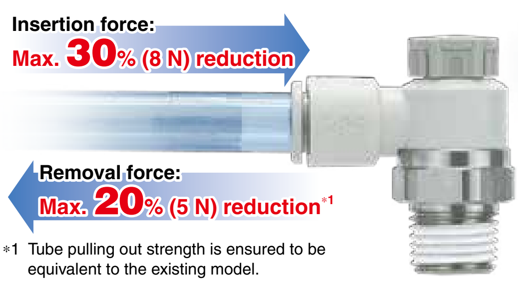


Larger knob

Body size	øD [mm]
1	9.4
2	12 (Port size: 1/8)
	13 (Port size: 1/4)
3	16.6
4	18.8

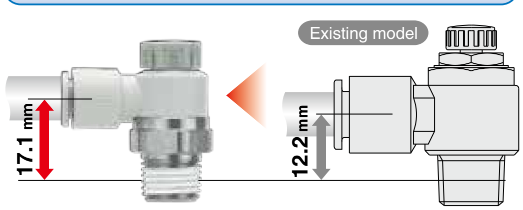


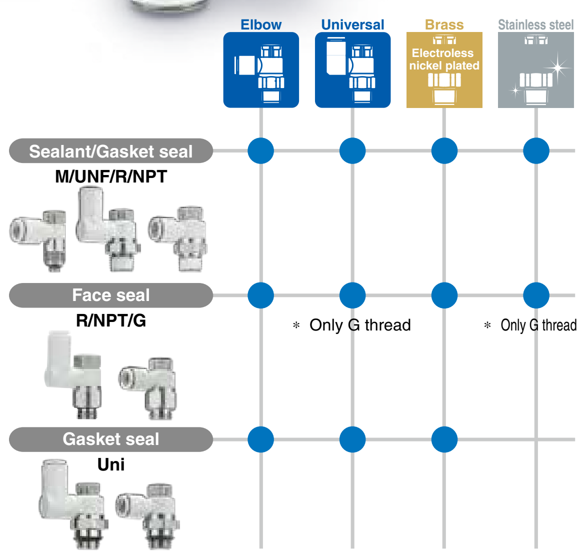
Improved tube insertion/removal



*1 Tube pulling out strength is ensured to be equivalent to the existing model.

More space beneath the tube. Easier installation/removal of the tube.



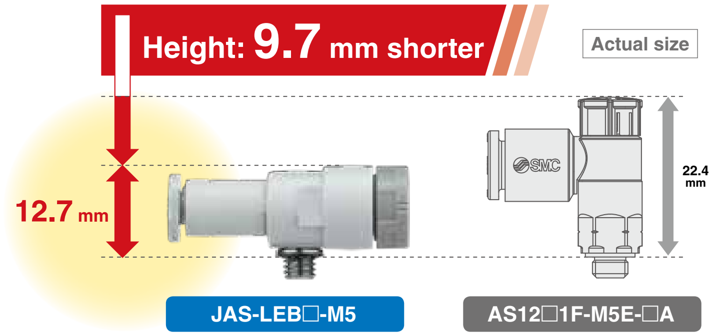


8 Compact and lightweight products

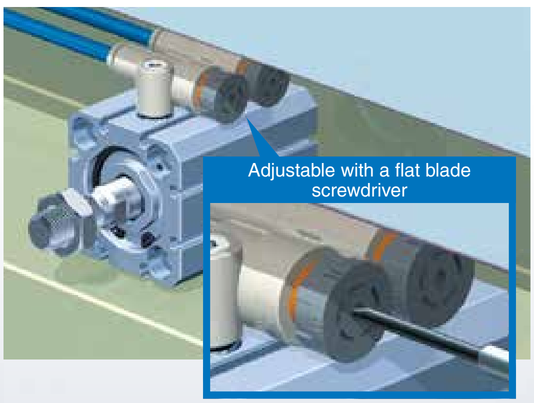
Speed Controller with One-touch Fitting (Push-lock/Compact Type) *JAS Series*

Height
9.7[*1] **mm shorter**
22.4 mm ➡ 12.7 mm

*1 Compared with the existing AS12□1F, M5

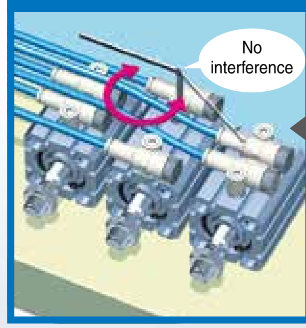


Possible to adjust flow rate even in a narrow space

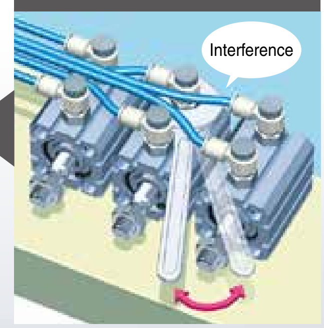


Easily mounted using a hexagon wrench

<Compact type>
Mounting using a hexagon wrench



<Existing model>
Mounting using a wrench



Minimum operating pressure: 0.05 MPa

8 Compact and lightweight products

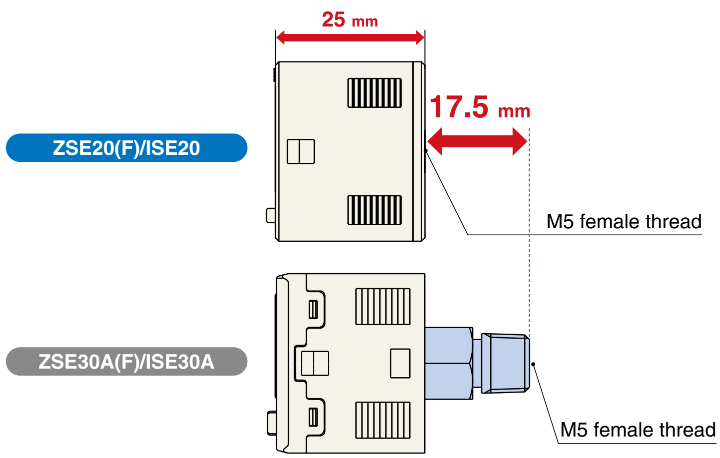
3-Screen Display High-Precision Digital Pressure Switch *ZSE20(F)/ISE20 Series*

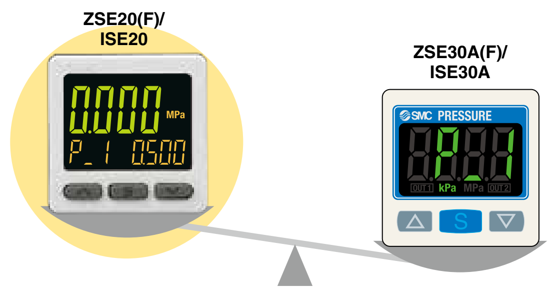
Now more compact and lightweight due to the M5 pressure port being located on the inside of the product

Depth
Max. 17.5 mm*1 shorter
42.5 mm ➡ 25 mm

Weight
Max. 21 g*1 reduction
43 g ➡ 22 g

*1 When an M5 female thread is used.



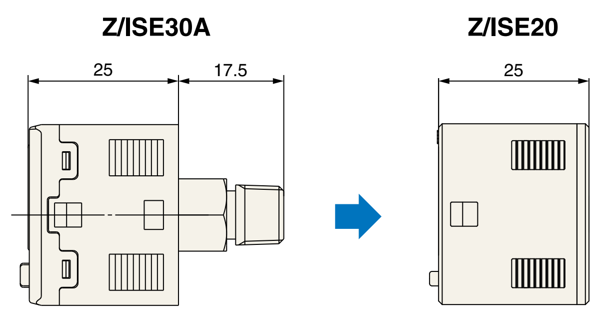


Piping: M5 female thread type

	Z/ISE20	Z/ISE30A	Reduction rate
Weight (g)	22	43	49%
Depth (mm)	25	42.5	41%
Height (mm)	30	30	—
Width (mm)	30	30	—

Piping: R1/8 type

	Z/ISE20	Z/ISE30A	Reduction rate
Weight (g)	32	43	26%
Depth (mm)	40.2	42.5	5%
Height (mm)	30	30	—
Width (mm)	30	30	—



Digital Flow Switch *PFM□ Series*

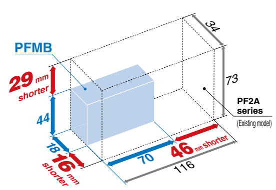
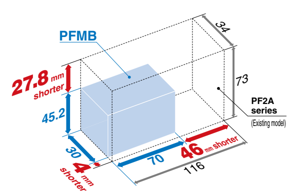
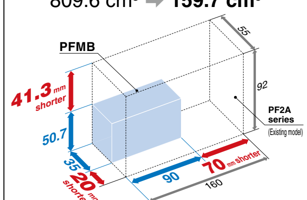
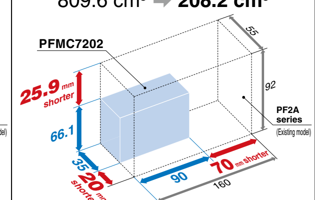
Volume
Max. 81%*1 reduction
287.9 cm³ ➡ **55.4 cm³**

Weight
Max. 86%*2 reduction
1100 g ➡ **155 g**

*1 Compared with the existing PF2A series, 200 L type

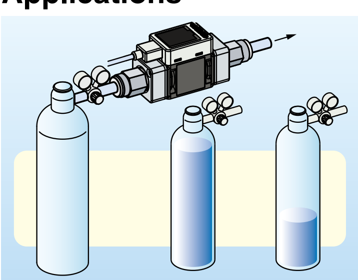
*2 Compared with the existing PF2A series, 2000 L type

Compared with the Existing PF2A

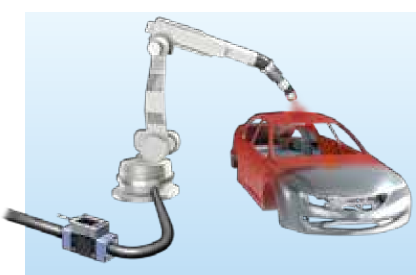
	PFMB			PFMC
	200 L type	500 L type	2000 L type	2000 L type
Series				
Weight	**76%** reduction 290 g ➡ **70 g**	**66%** reduction 290 g ➡ **100 g**	**86%** reduction*1 1100 g ➡ **155 g**	**78%** reduction 1100 g ➡ **240 g**
Volume	**81%** reduction 287.9 cm³ ➡ **55.4 cm³** 	**67%** reduction 287.9 cm³ ➡ **94.9 cm³** 	**80%** reduction 809.6 cm³ ➡ **159.7 cm³** 	**74%** reduction 809.6 cm³ ➡ **208.2 cm³** 

*1 Compared with the rated flow rate of 3000 L

Applications

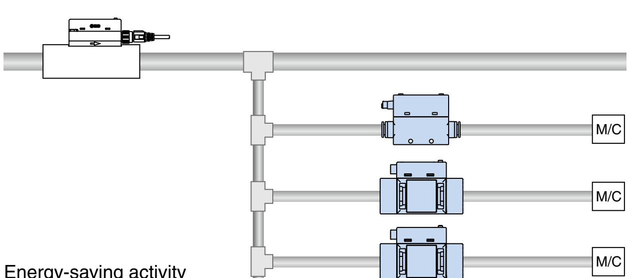


Accumulated indication shows the operating flow rate or residual amount (of N_2, etc.) in a gas cylinder.



Flow control of the air for spray painting
* The product is not designed to be explosion proof.

Control of purge air flow of ionizer



Energy-saving activity
(Flow consumption control)

Flow control for each branch line

9 Technical data

UNIT CONVERSIONS

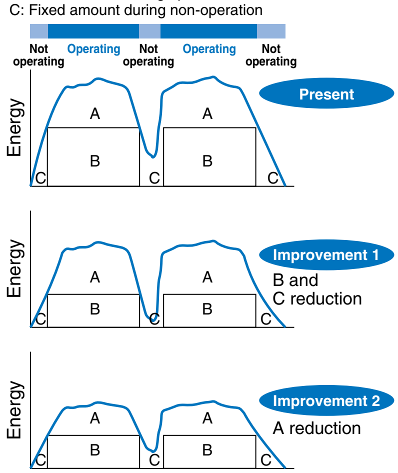
	unit	conversion	result
length	m	x 3.28	ft
	mm	x 0.04	in
mass	g	x 0.04	oz
volume	cm^3	÷ 16.387	in^3
	L	x 61.024	in^3
speed	mm/s	÷ 25.4	in/s
pressure	MPa	x 145	psi
	kPa	÷ 6.895	psi
temperature	°C	x1.8 then add 32	°F
torque	N·m	x 0.738	ft-lb
force	N	÷ 4.448	lbf
flow	L/min	÷ 28.317	cfm
	JPY	x 0.0094	dollar

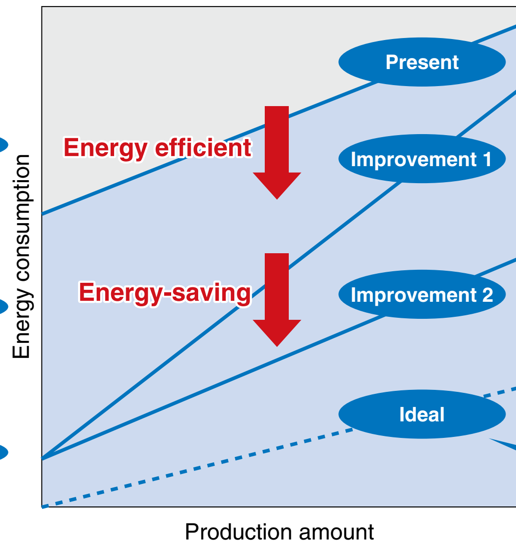
Energy-saving mindset

Energy-saving measures can be divided into two main categories. They are either energy efficient or energy saving.
Easy-to-implement, effective measures with a priority on energy efficiency can help you take your energy savings to the next level!

Factory production examples

A: Fluctuation amount in proportion to production
B: Fixed amount during operation
C: Fixed amount during non-operation





Energy efficient

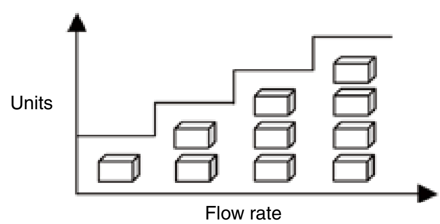
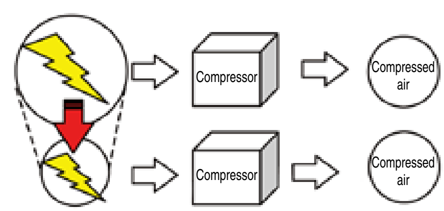
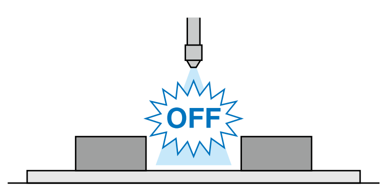
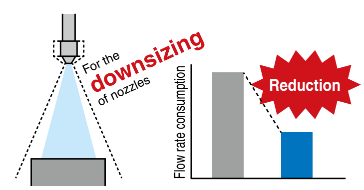
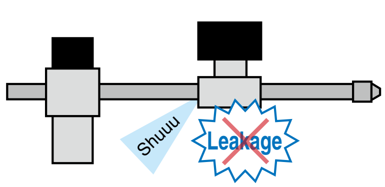
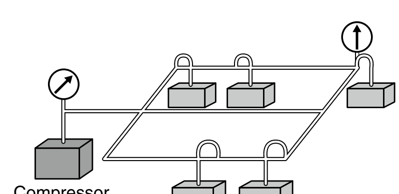
Energy is only used when and where it is required.
Eliminates wasted energy!

Energy-saving

Only the required amount of energy is used.
Improves energy usage efficiency!

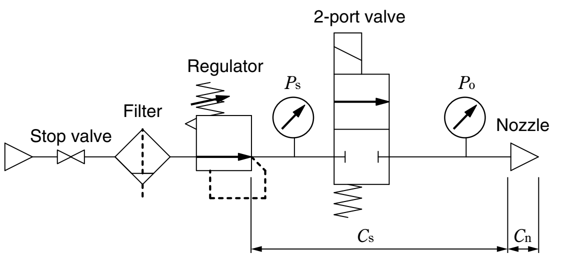
· Consumption in proportion to the min. production ratio
· No air is consumed during non-operation!

Energy-efficient and energy-saving examples

	Energy efficient	Energy-saving
Air pressure source	For the control of multiple units 	For reducing the specific power 
Blow system	For intermittent blow 	For adopting smaller nozzles with higher pressure 
Piping system	For reducing air leakage to 0 	For the leveling of pressure with loop piping 

Changes in upstream conductance pressure loss

Since the amount of pressure loss changes depending on the blow nozzle conductance ratio and the upstream (piping, valves, etc.) conductance ratio, the pressure right before the nozzle will also change.

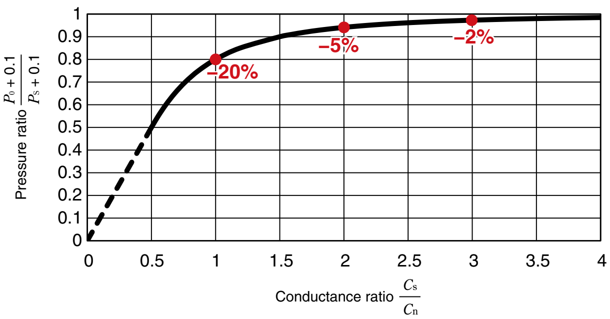


Recommended air blow system

P_s : Supply pressure
P_o : Pressure right before the nozzle
C_s : Upstream conductance
C_n : Nozzle conductance

Pressure ratio $\frac{P_o + 0.1}{P_s + 0.1}$

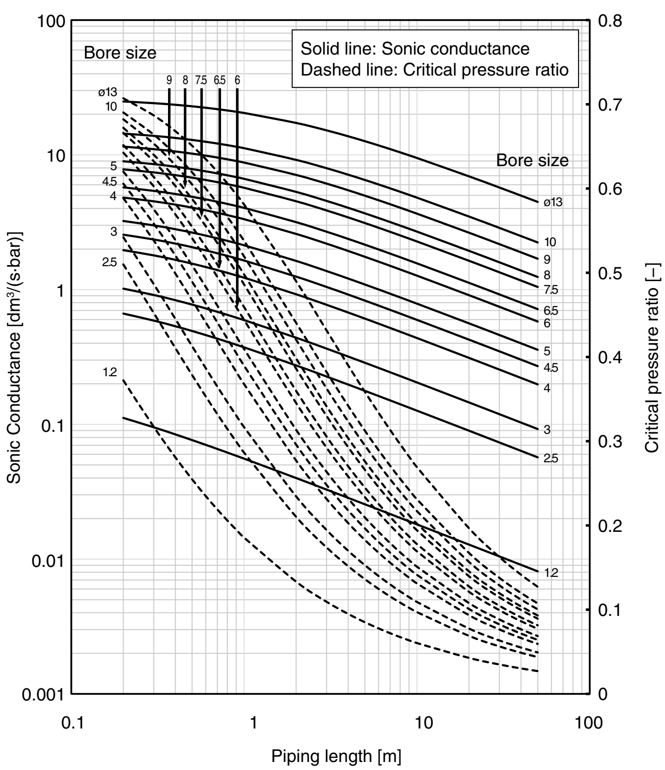
Conductance ratio $\frac{C_s}{C_n}$



Conductance ratio	Pressure drop [%]
1	20
2	5
3	2

When selecting the size of upstream piping, we recommend staying within 2 to 3 of the conductance ratio.

Tube conductance example



Nozzle conductance example

Nozzle size [mm]	C_n	Nozzle size [mm]	C_n
1	0.14	3	1.27
1.5	0.32	3.5	1.73
2	0.57	4	2.26
2.5	0.88	6	5.09
		8	9.05

Valve conductance example

Body material	Port size	Orifice diameter mmø	Model	Flow rate characteristics C	Flow rate characteristics b
Al	1/4 (8A)	10	VXD230	8.5	0.35
	3/8 (10A)			9.2	
	1/2 (15A)			9.2	
Resin	ø10			5.6	0.33
	ø3/8"			4.8	0.33
	ø12			7.2	0.33
Stainless steel C37	3/8 (10A)	15	VXD240	18.0	0.35
	1/2 (15A)			20.0	
	3/4 (20A)	20	VXD250	38.0	0.30

Flow rate calculation

By using the flow rate calculation graph, it is possible to easily calculate the flow rate of a nozzle, tube, or valve.

Formula for flow rate

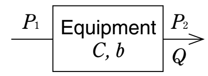
Choked flow

$$Q = 600 \times C\,(P_1 + 0.1)\sqrt{\frac{293}{273 + T}}$$

Subsonic flow

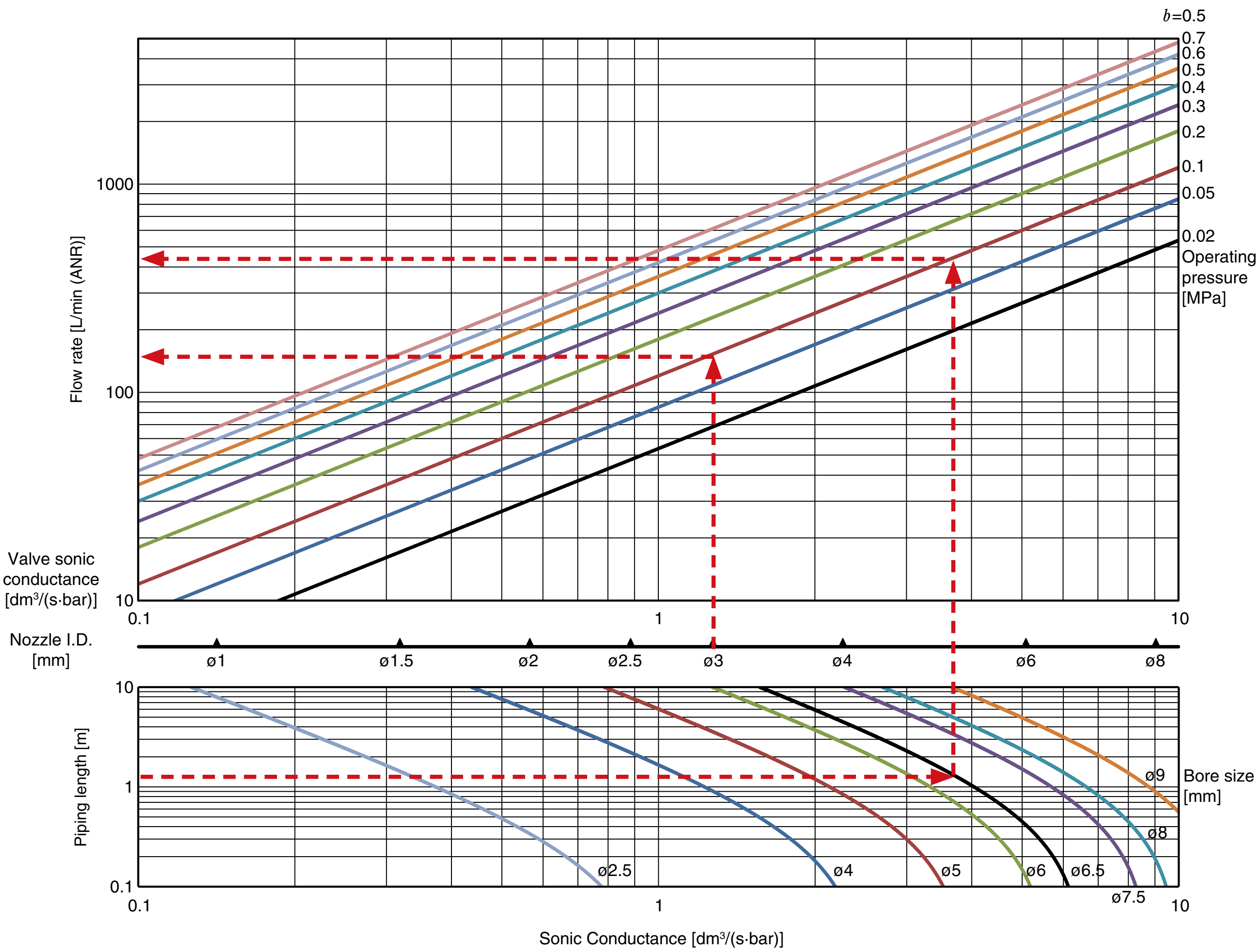
$$Q = 600 \times C\,(P_1 + 0.1)\sqrt{1 - \left[\frac{\frac{P_2 + 0.1}{P_1 + 0.1} - b}{1 - b}\right]^2}\sqrt{\frac{293}{273 + T}}$$

When the critical pressure ratio is 0.5



Q : Air flow rate [L/min (ANR)]
C : Sonic conductance [L/(s·bar)]
b : Critical pressure ratio [–]
P_1: Upstream pressure [MPa]
P_2: Downstream pressure [MPa]
T : Temperature [°C]

Flow rate calculation graph



Calculation example

For nozzles

① Go up in a vertical line from the nozzle I.D.
② From the point of intersection with the operating pressure (diagonal line), go horizontally to the left to find the flow rate.

For tubes

① Find the point of intersection of the tube I.D. (diagonal line) and the piping length, and go up in a vertical line.
② From the point of intersection with the operating pressure (diagonal line), go horizontally to the left to find the flow rate.

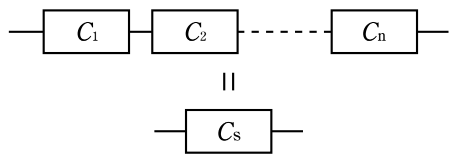
Conductances combined

Calculation method for combining the conductance of each device and finding the equivalent conductance of each device in order to figure out the flow capacity of a pneumatic system

Formula for finding the combined total

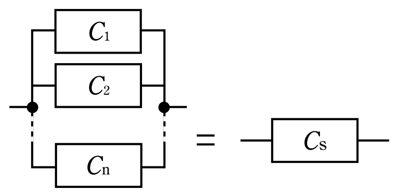
Connected in series

$$C_s = \frac{1}{\sqrt[3]{\frac{1}{C_1^3} + \frac{1}{C_2^3} + \dots + \frac{1}{C_n^3}}}$$



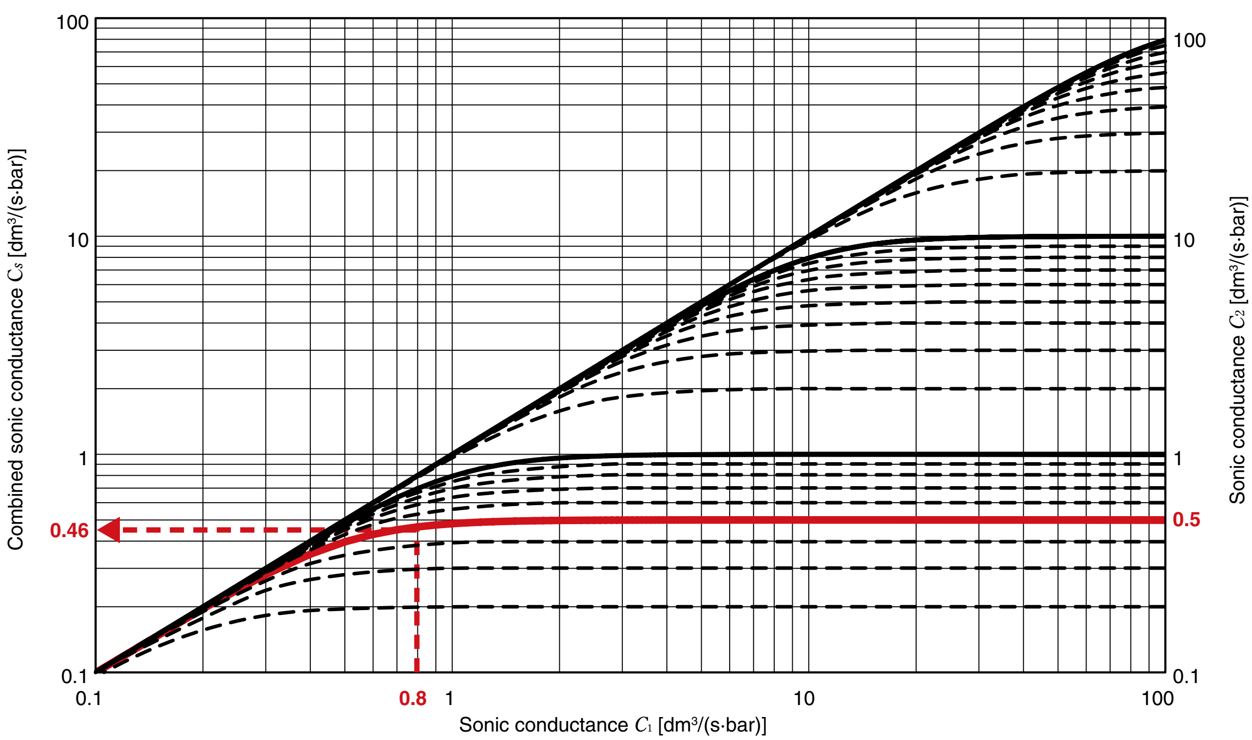
Connected in parallel

$$C_s = C_1 + C_1 + \dots + C_n$$



There is also a formula for finding the critical pressure ratio (b), but it's easier to just use the smallest device possible.

Graph for when connected in series



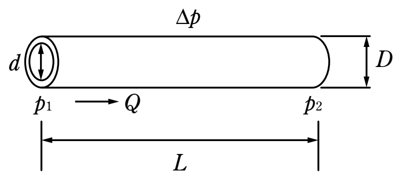
Ex.) When connecting a device (sonic conductance: $C_1 = 0.8$) to another device (sonic conductance: $C_2 = 0.5$), 0.46 is required.

Main piping pressure loss calculation

Pressure loss formula

Pressure loss Δp

$$\Delta p = \frac{2.466 \times 10^3 L}{d^{5.31} (p_1 + 0.1)} Q^2$$



Δp : Pressure loss [MPa] (= $p_1 - p_2$)

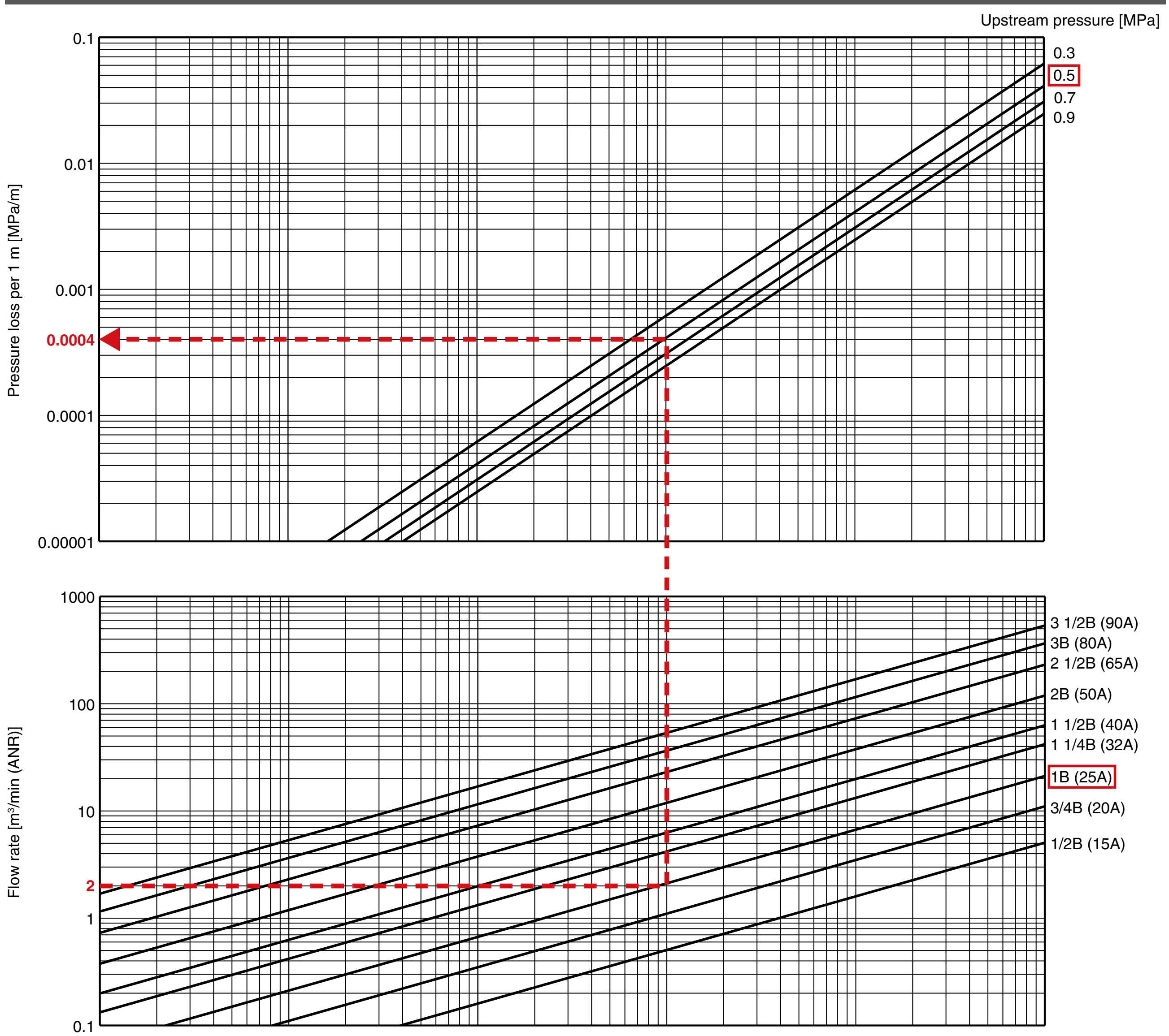
Q : Standard volume flow [m³/min (ANR)]

p_1 : Upstream pressure [MPa] (= Gauge pressure)

d: Pipe bore [mm]

L: Piping length [m]

Pressure loss calculation graph



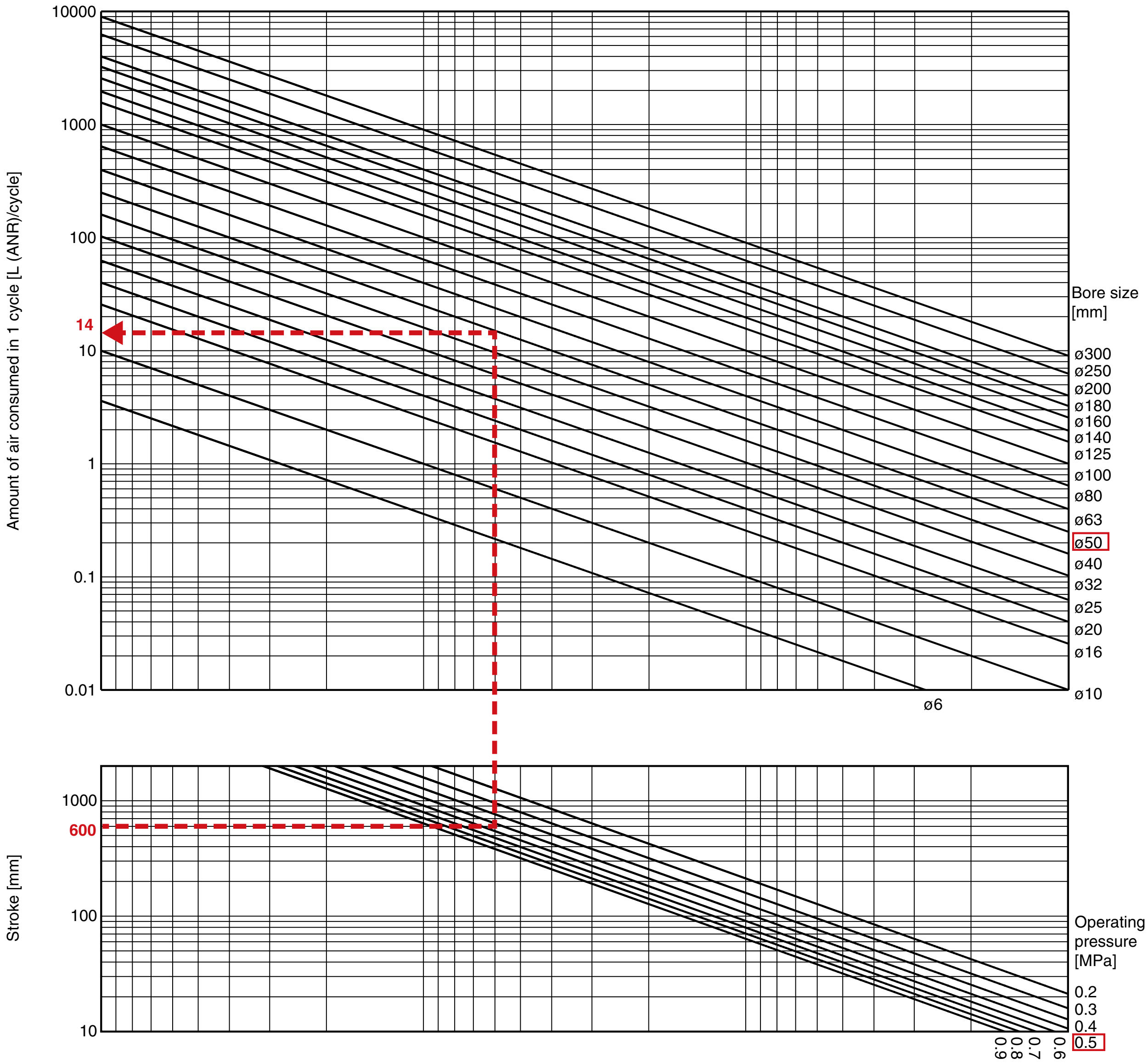
Calculation example

For 1B (25A), L = 10 m, p_1 = 0.5 MPa, and Q = 2 m³/min (ANR), the pressure loss per 1 m can be found to be 0.0004 [MPa/m] and, therefore, for 10 m, it is Δp = 0.0004 x 10 = 0.004 [MPa].

Amount of air consumed by the cylinder and tubing 1

By using the graph, it is possible to easily calculate the amount of air consumed by a cylinder and the tubing in 1 cylinder cycle.

Graph for finding the amount of air consumed by the cylinder in 1 cycle



How to find the amount of air consumed by the cylinder

How much air is consumed in 1 cycle when 10 cylinders (Bore size: 50 mm, Stroke: 600 mm) are operated at a pressure of 0.5 MPa?

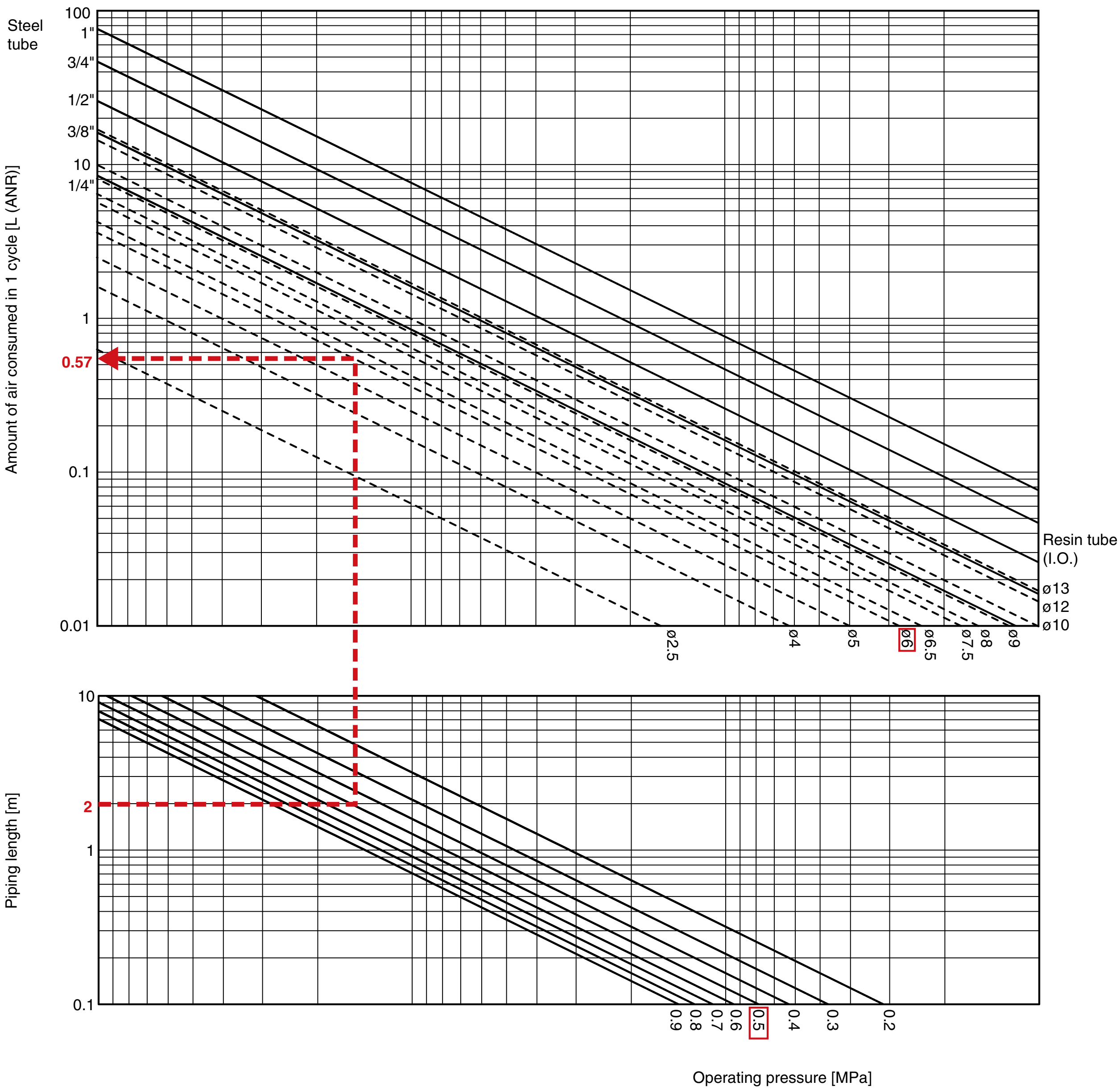
① Find the point of intersection of the operating pressure (diagonal line) and the stroke length, and go up in a vertical line.

② From the point of intersection with the tube I.D. (diagonal line), go horizontally to the left to find the amount of air required for 1 cylinder cycle.

③ Furthermore, by multiplying this number by 10, the amount of air required for 1 cycle of 10 cylinders can be found.

Amount of air consumed by the cylinder and tubing 2

Graph for finding the amount of air consumed by the tubing in 1 cylinder cycle



How to find the amount of air consumed by the tubing

How much air is consumed in 1 cycle of a cylinder operating at a pressure of 0.5 MPa when 2 tubes (I.D.: 6 mm, Piping length: 2 m) are used?

① Find the point of intersection of the operating pressure (diagonal line) and the piping length, and go up in a vertical line.

② From the point of intersection with the tube I.D. (diagonal line), go horizontally to the left to find the amount of air consumed by the tubing in 1 cylinder cycle.

How to find the total amount of air consumed

The amount air consumed by the cylinder and tubing can be found using the formula below.

Total air consumption = (the amount of air consumed by the cylinder in 1 cycle + the amount of air consumed by the piping in 1 cylinder cycle) x the number of operations

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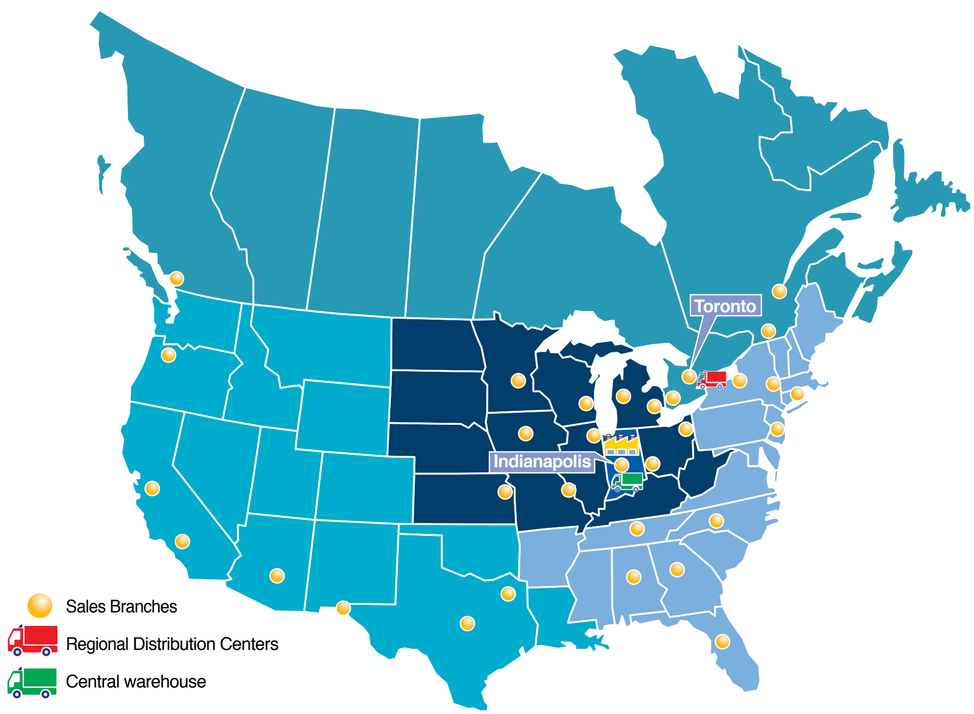

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