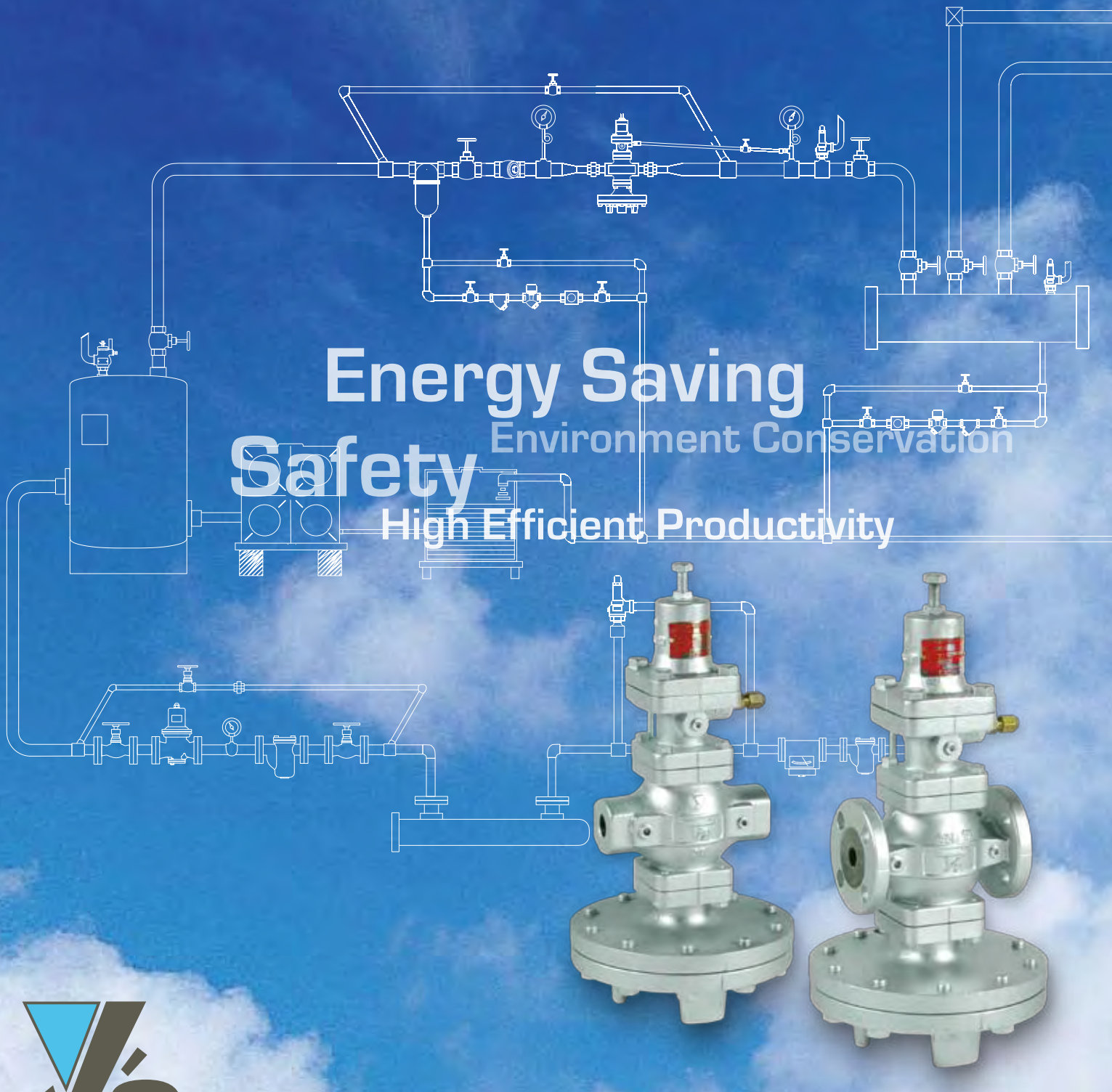
YOSHITAKE FULL MODEL CATALOGUE



Energy Saving

Environment Conservation

Safety

High Efficient Productivity

Born to save energy™

http://www.yoshitake.jp

Index

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Born to save energy™

As a leading company of fluid control

A valve is the main artery of our society. Yoshitake's valves are used in all fields including household use and industrial use, where they are hidden from view, but widely contributing to support our everyday life. What is the truly useful product for society? …that is the theme we pursue to fulfill our own raison d'etre as a leading valve manufacturer. What we are the most proud of is our reliable technology as a comprehensive valve manufacturer, which has enabled us to develop product lines, such as pressure reducing valves, safety valves, steam traps and etc.

Yoshitake develops leading-edge products with its experience for over a half century and information network formed in every different field, and is sure to lead you to the more comfortable future.

Technology, Experience, Information – Only Yohistake, a leading company of fluid control, can have all the three treasures. Our product will absolutely meet the expectations of society.

Yoshitake's

1 Energy Saving

Many of Yoshitake's regulating valves are mechanically self-operated valves requiring no electric power or energy. Using the force of the spring contained in the body and the differential pressure of the fluid passing through piping, these valves ensure reliable fluid control for many years to come. What is surprising is that they are also capable of automatically adapting themselves to the pressure variation of the fluid once they are set. We are proud to say that the functionality of our products contributes directly to energy saving. Additionally, they can greatly help customers reduce energy costs through the optimum control of the fluid inside piping.

Melting in an electric furnace

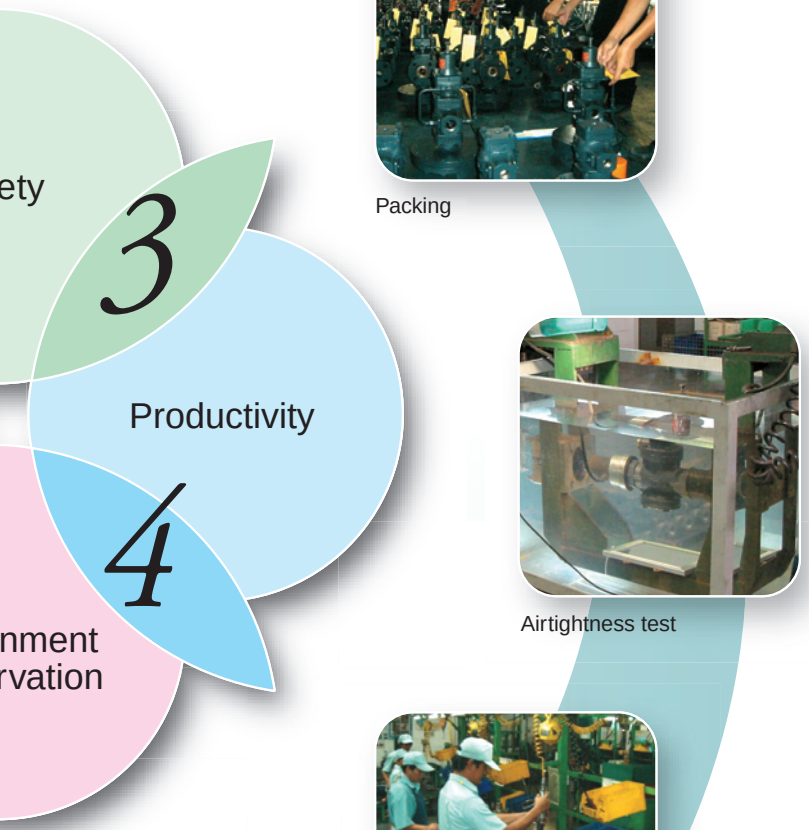
Teeming

Machining by CNC

2 Environment Conservation

As a manufacturer of products, Yoshitake is aware that consideration for the global environment is the foundation of the presence of a manufacturer, and acquired an ISO 14001 certificate in 2000. All of us at Yoshitake are grappling with environmental problems.
We are endeavoring to comply with the RoHS (Restriction on Hazardous Substances) Directive and participate in the "Eco-Design Promotion Project" encouraged by the Japan Environmental Management Association For Industry. We are determined to concentrate more energies on compliance with design for environment and life cycle assessment.

four key concepts



Packing

Airtightness test

Assembly

system from
finishing of products

Machining large workpieces
on a lathe

3 Safety

Most of Yoshitake's products fall under pressure-proof products. In order for customers to safely use our products, we give the utmost consideration to quality. We promote integrated production, from casting, machining, assembly, inspection to packing, to achieve a high standard of quality. We select materials for valve bodies, the core of pressure-proof valves, with great care. Although FC200, an inexpensive gray cast iron with high castability and machinability, is generally used for valve bodies, we adopt ductile cast iron (FCD450) as standard material, minimizing the breakage of bodies, which is the most important requirement of pressure-proof products.

4 High Efficient Productivity

Yoshitake's products are integral parts of piping. The optimum combination of these products is sure to help our customers reduce energy costs and improve productivity by making the most of their air conditioning equipment, plumbing equipment, or process line. Our service system gives priority to the offering to our customers of the construction of the optimum piping systems matching their environments and use of our products, in addition to the sale of products.

NEW RELEASED AND IMPROVED PRODUCTS

Pressure Reducing Valve


GP-2000CS

Carbon steel made pressure reducing valve for steam → P.30


GP-1000EN

Pressure reducing valve for steam, complying with EN standard → P.38


GD-41G・43G

Direct acting type pressure reducing valve, applicable to air and gas → P.67

Strainer


SY-40EN・40H

Y-strainer, made of FCD, max. pressure of 2.0 MPa, complying with EN and ASME standards → P.153

Solenoid Valve


DP-100・100F

Solenoid valve made of stainless steel, applicable to various fluids → P.175


DD-2・3

Stainless steel made direct acting type solenoid valve, compact and lightweight → P.187

Trap


TSD-42

Disc trap, made of stainless steel, compact size, high pressure type → P.226


TSD-7・7F

Disc trap with bypass function → P.228


TFA-2000

Assist trap equipped with float type steam trap and pump function by driven pressure → P.232

Others

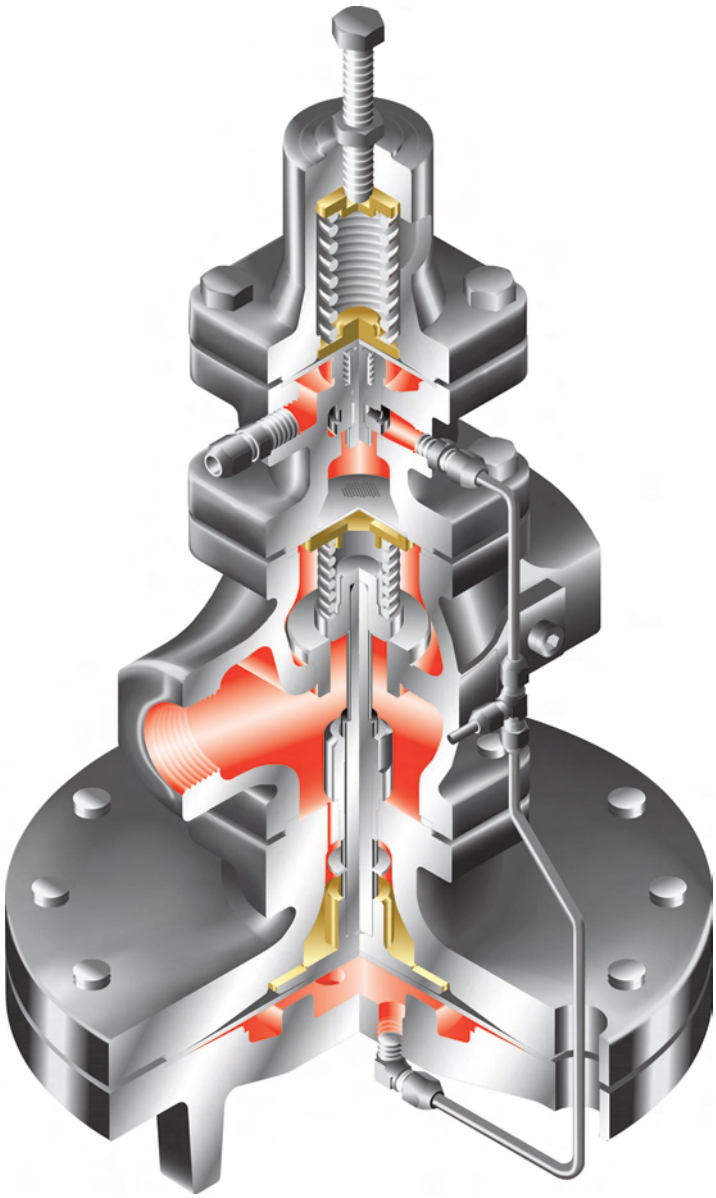

TAV-3A

Air vent valve with vacuum breaker, with large and quick intake and smooth exhaust → P.299


Y's Jacket

For energy saving and CO_2 reduction effect → P.318

GP-2000CS CARBON STEEL MADE pressure reducing valve up to 3.0 MPa and 260°C can be in ...



- Steam Loop Facilities
- Plant Facilities
- Steam Main Line
- Lines Requires Large Capacity and Accuracy
- Superheated Steam Lines

The **GP-2000CS** quickly responses to even a slight fluctuation in the reduced pressure because it has main diaphragms, and thus it can control lower pressure range, keeping efficient flow rate, far better than conventional pressure reducing valves.

Superior Durability
Unique patented diaphragms enable superior durability.

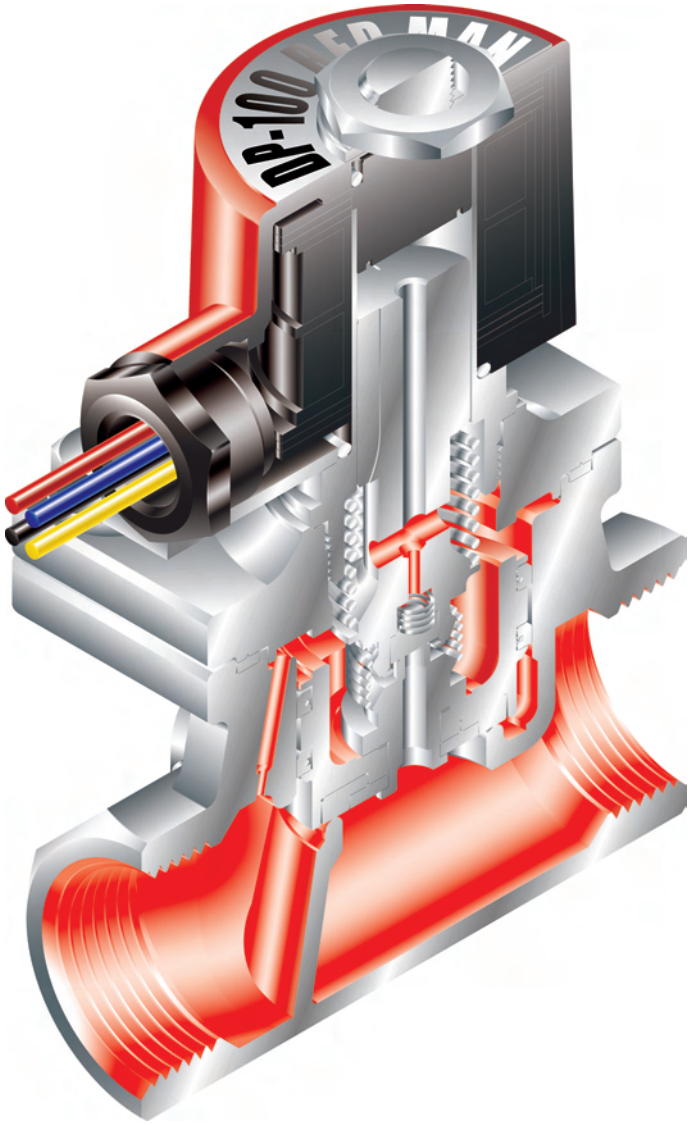
Integral Strainer
200 mesh integral strainer prevents most scale problem on the pilot valve.

Reliable Pilot Valve
The GP-2000 Series, Yoshitake's original pilot-operated valve, has proven its contribution to various systems.

Tight Shut-off
Spherical valve provides a tight seal meeting ANSI Class Ⅳ.

See page 30 for details.

RED MAN™



1: Three Times more Durability

for more than 600,000 opening/closing.

2: Three Times Higher Scale Resistance

*Above features are from our comparison test.

3: Stainless steel made Body <SCS14A>

Body and main parts made of stainless steel give higher corrosion resistance, making usable for clean fluid.

4: Easy Maintenance

A combined internal component enables easy cartridge replacement with this product installed.

Screwed type

DP-100 <10A-25A>

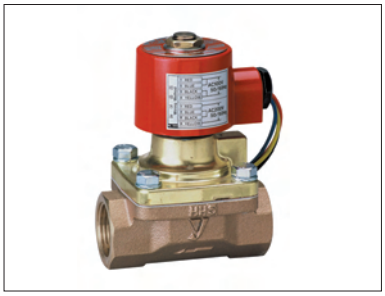
DP-100 <32A-50A>

Flanged type

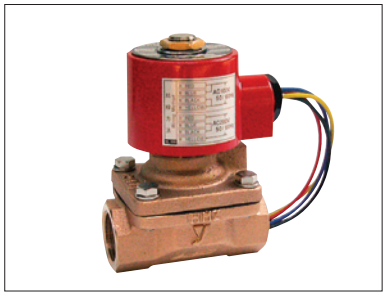
DP-100F <10A-25A>

DP-100F <32A-65A>

5: Other Models



DP-10



DP-12

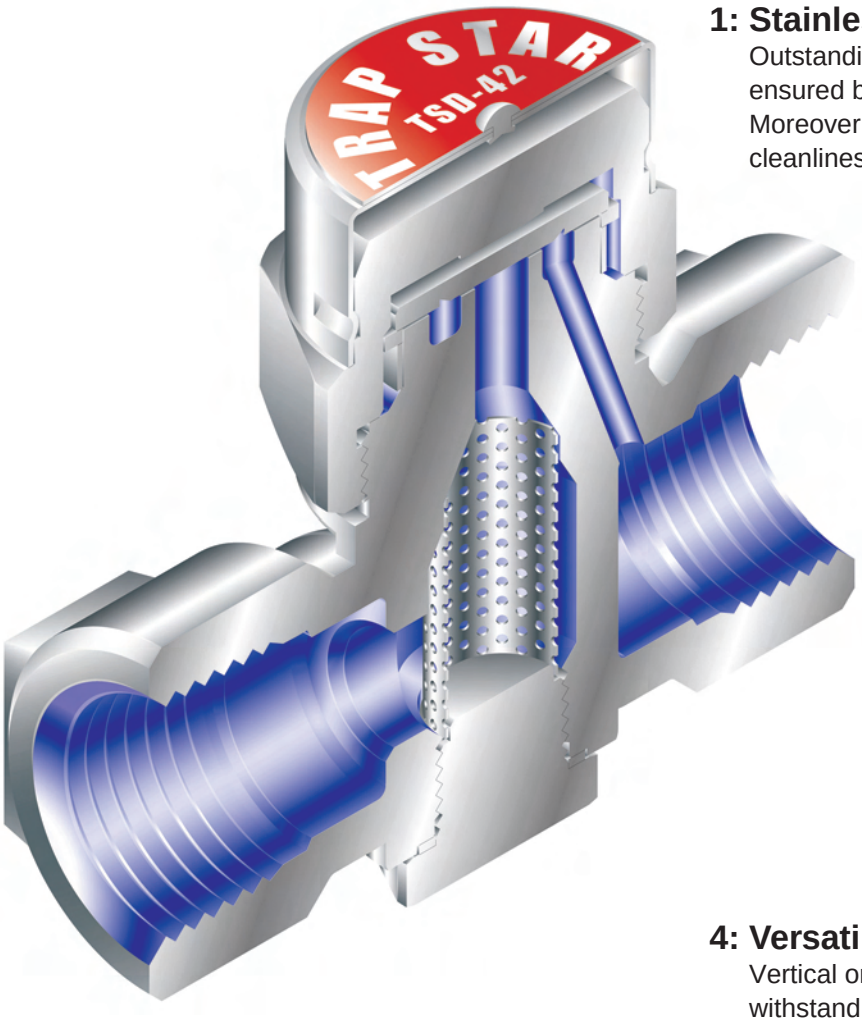
DD-2

See page 175 for details.

STAINLESS STEEL MADE DISC TRAP
UP TO 4.2 MPa

TSD-42

ULTRA STEAM TRAP
TRAP STAR™



1: Stainless steel made

Outstanding durability and corrosion resistance ensured by stainless steel made.
Moreover, suitable for a line that requires cleanliness.

2. No air-binding

Bimetal type automatic air vent capable of discharging air and condensate smoothly for a secured start-up.

3: Insulation cover

Standard insulation cover avoids erratic and frequent on-off caused by influence of atmosphere temperature.

* The product without insulation cover is also available upon request.

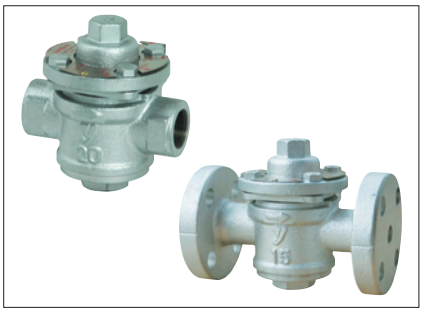
4: Versatility

Vertical or horizontal installation, and ability to withstand high pressure up to 4.2 MPa and high temperature up to 425˚C.

5: Other models

TD-10NA•30NA

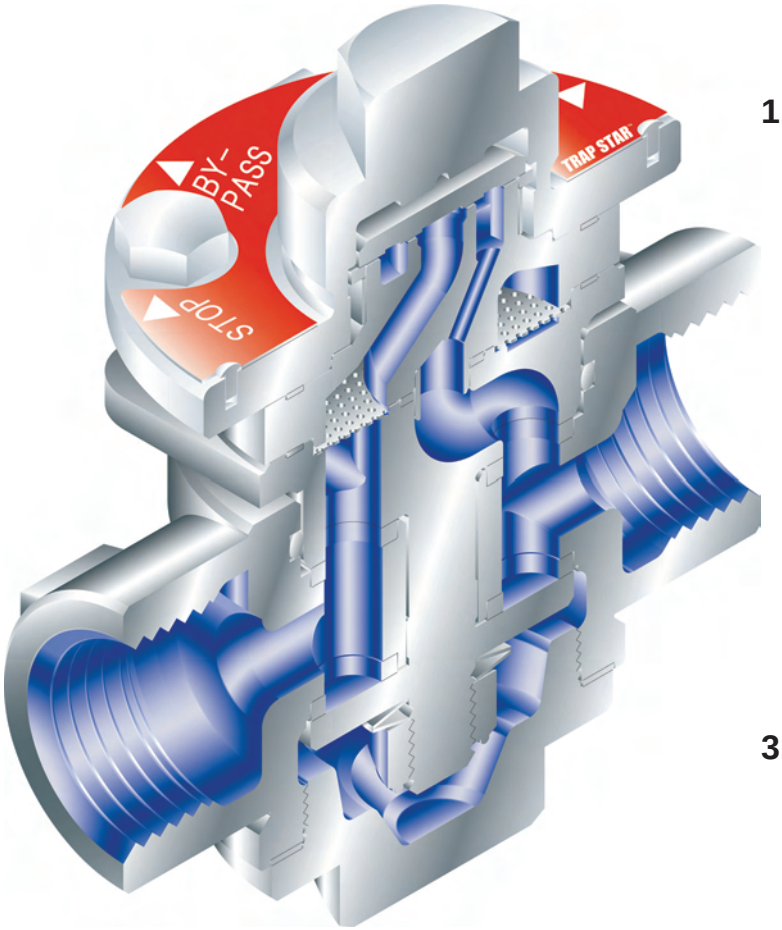
TSD-7•7F



TS-7•8

See page 226 for details.

ULTRA STEAM TRAP
TRAP STAR™

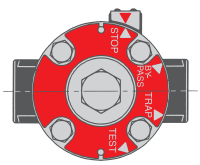
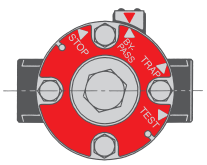
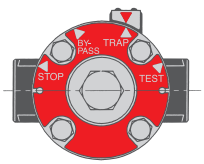
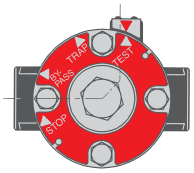
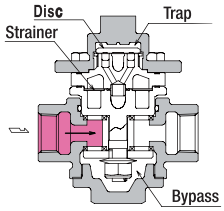
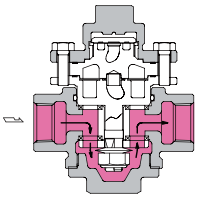
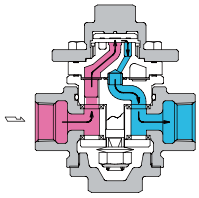
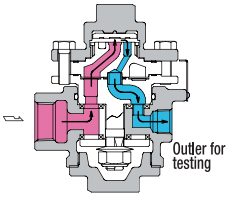
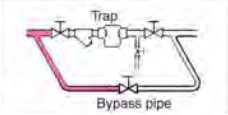
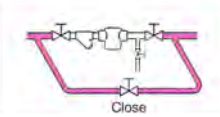
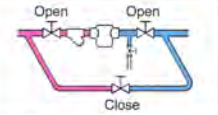
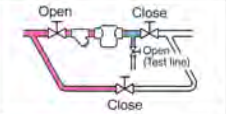


1. Easy switching of the four functions; STOP, BY-PASS, TRAP and TEST.

2. Embedded bypass function eliminates the need for installation of bypass pipe.

3. The adoption of a bimetal solves air-binding problem and ensures a smooth discharge of cold condensate and air at the start of operation.

Switching Mechanism and Operation

	STOP	BY-PASS	TRAP	TEST
Position				
Operation				
Conventional piping				

Steam Condensate

See page 228 for details.

Built-in strainer

Easy maintenance with externally cleanable strainer built-in at driving pressure inlet.

Built-in check valve

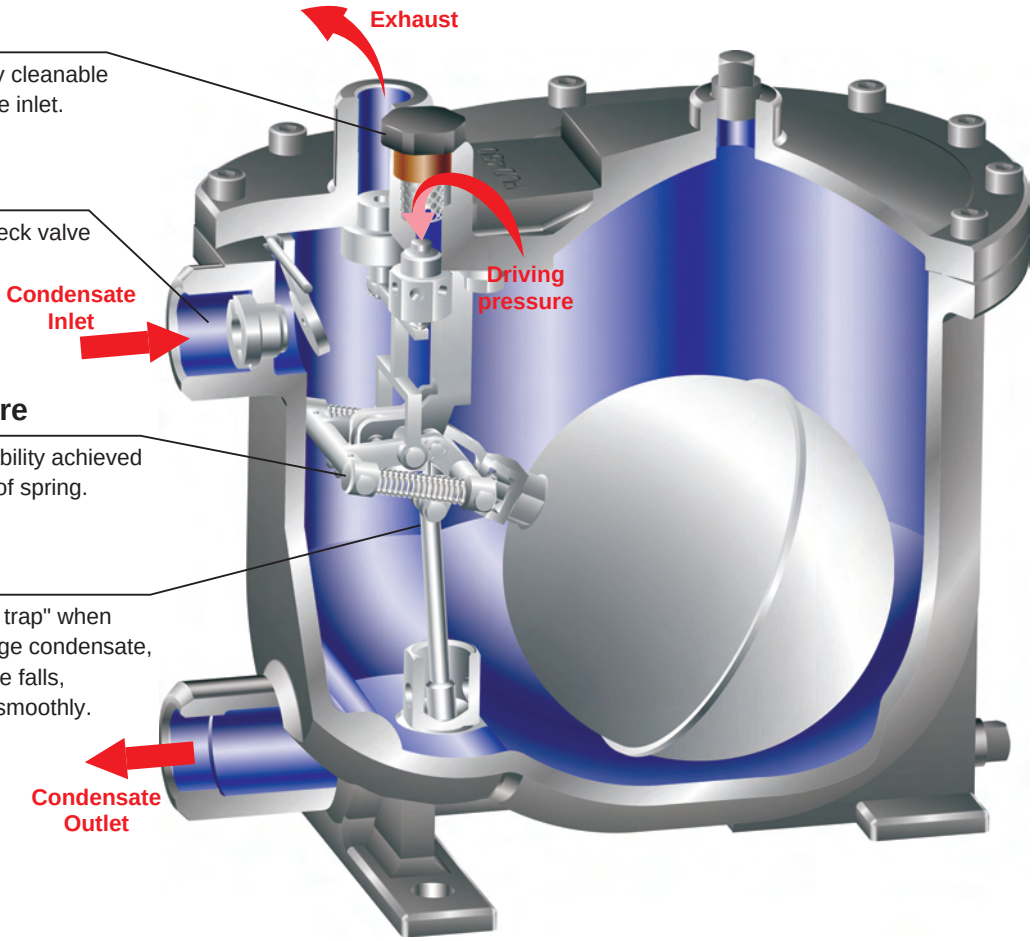
Safety ensured by swing-type check valve built-in at condensate inlet.

Unique internal structure

Easy maintenance and high durability achieved by simple and reliable operation of spring.

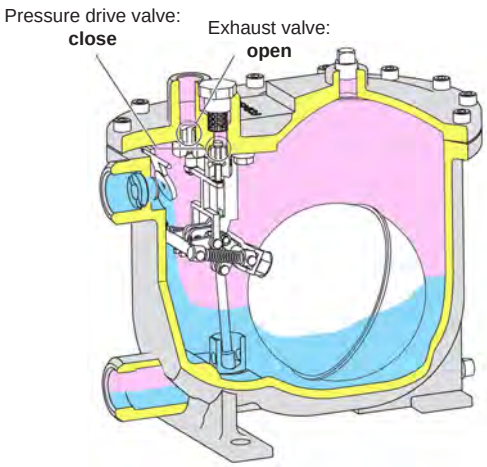
Works as Steam Trap

Automatically switches to "steam trap" when pressure rises enough to discharge condensate, and to "assist trap" when pressure falls, keeping condensate discharged smoothly.



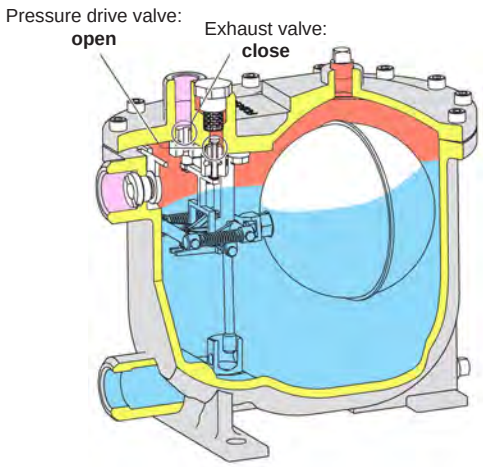
Operating Principle

●Trap operation



Works as float steam trap since condensate has pressure and can be discharged by its own pressure.

●Assist operation



Since condensate has no pressure and cannot be discharged, condensate is accumulated and the float rises to a certain level in the assist trap. Then, when mechanism is switched and drive steam flows in, this trap compresses and discharges accumulated condensate in a coercive manner.

See page 232 for details.

What would you like to do?

To keep reduced pressure at the constant level against the fluctuation in inlet pressure.

To separate drain effectively from the steam/gas piping line.

To ensure safety of piping line/equipment by preventing unusual pressure rise.

To remove dirt or foreign matter, etc. to prevent troubles on equipment.

To open/close by magnetic force of solenoid. To open/close by activating motor. To open/close by air pressure.

To detect temperature of fluid and keeps it at the set temperature.

To automatically discharge condensates from equipment in the steam line. Trap for radiator. Regulating valve for radiator.

To relieve excessive pressure and keep pressure inside piping at the constant level. To prevent falling water inside of reverse pipe and vacuum condition on stopping pump. To keep differential pressure between supply and return pipes at the constant level in closed loop.

To absorb extension/compression caused by heat inside piping and prevent damages to piping and equipment.

To visually check fluid flow inside piping.

To prevent backflow due to vacuum condition as well as automatically discharges air from liquid piping line.

To decrease noise and vibration while heating water by blowing steam into water.

Other accessories in the piping system.

Measures flow rate of oil, opaque liguid, etc.

Certification, unit conversion, etc.

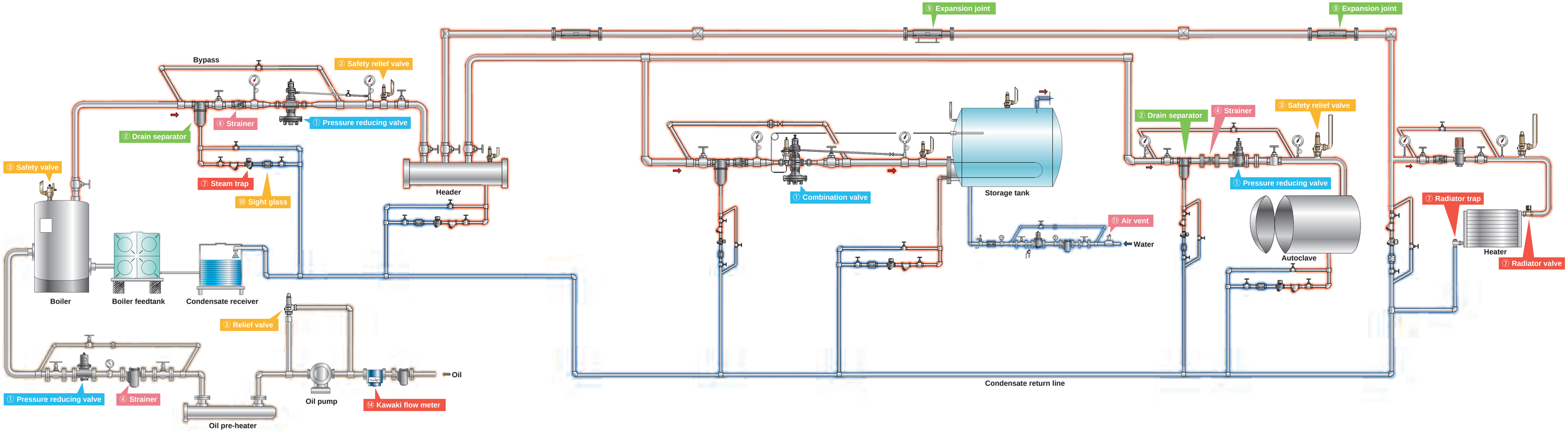
INDEX

PIPING OVERVIEW

Steam Supply Line “Boiler to Header”

Steam Supply Line from Header

Steam Supply Line for Process



Oil Supply Line

Heat Exchange Equipment

Water Supply Line

Sterilizing Equipment

Heater Equipment

Pressure Reducing Valve

Pressure Reducing Valve Selection

Application				Max. Inlet Pressure (MPa)	Reduced Pressure (MPa)	Model	Type					Page
Steam	Air	Water	Oil				Pilot Type	Direct Type	Bellows	Diaphragm	Piston	
●				1.0	0.02-0.4	GD-6N		●		●		44
●					0.03-0.8	GP-27	●				●	40
●					0.05-0.9	GP-1000 Series	●				●	32
●				1.6	0.05-1.4	GP-1000EN・1000H	●				●	38
●				1.7	0.02-1.0	GD-30		●	●			42
●				2.0	0.05-0.9	GPK-2001	●			●		22
●					0.02-1.0	GD-30S		●	●			42
●						GD-45P・45		●	●			43
●					0.02-1.4	GP-2000	●			●		19
●					0.05-1.4	GDK-2000		●		●		24
●					0.2-1.4	GPK-2003	●			●		22
●				3.0	0.02-2.0	GP-2000CS	●			●		30
	●			0.3	0.002-0.2	GD-4		●		●		83
	●			0.4	0.0005-0.02	GD-400・400SS		●		●		81
	●			0.8	0.002-0.2	GD-4B		●		●		83
	●			0.99	0.05-0.85	GD-9		●		●		83
	●			1.0	0.05-0.9	GP-1000T Series	●				●	75
	●	●	●		0.02-0.4	GD-6		●		●		69
	●	●	●		0.05-0.7	GD-200・200C・20		●		●		45
	●					GD-26G・27G		●		●		78
	●					GD-26GS・27GS		●		●		79
	●	●				GD-8N		●		●		83
●	●			2.0	0.02-0.5	GD-41G・43G		●		●		67
	●	●	●		0.05-1.0	GD-200H		●		●		45
		●		1.0	0.05-0.25	GD-15・15C		●		●		83
		●			0.05-0.3	GD-38 Series		●		●		60
		●				GD-46 Series		●		●		57
		●			0.05-0.35	GD-25GJ・25JC・25GJ-K		●		●		64
		●			0.05-0.7	GD-26-N・27-N		●		●		52
		●				GD-26S・27S		●		●		54
		●	●			GD-7・7B		●			●	71
		●			0.07-0.7	GP-50	●				●	83
		●		1.6	0.05-0.55	GD-24・24B		●		●		50
●		●		2.0	0.02-0.5	GD-41・43		●		●		67

Selection of Pressure Reducing Valve for Steam

What is a Pressure Reducing Valve ??

A reducing valve is a regulating valve which keeps outlet pressure of fluid at a certain and lower level than inlet pressure.
The original purpose of a reducing valve is, not just reducing the pressure of fluids, but also dynamically controlling the flow rate that fluctuates in response to load variations. Many types of reducing valves are available, and each of them has unique characteristics derived from each operation method, flow characteristic and material of part. None of reducing valves can meet all the requirements for pressure reduction in all sorts of applications. It is therefore important to select an optimum reducing valve for each use.

Applications	・Food machinery ・Laundry equipment ・Small heaters ・Steam sterilization system, etc. Equipment and facilities of small flow rate	・Air-conditioning facilities ・Building facilities ・Plant facilities ・Irrigation field, etc. Equipment, facilities and piping systems requiring low or medium flow rate	・Air-conditioning facilities ・Building facilities ・Plant facilities ・Main pipes of steam line ・Other applications requiring high accuracy Equipment, facilities and piping systems requiring high flow rate and stable pressure control
Types	**Direct acting type**	**Pilot operated type**	
	Sensing element for reduced pressure itself directly actuates the valve.	Pilot valve senses reduced pressure and controls the pressure that actuates operating parts, such as piston or diaphragm which opens and closes the main valve.	
		Piston type	**Diaphragm type**
		This type offers excellent durability since a piston is adopted at the operating part of the main valve.	This type secures outstanding controllability and large flow rate by wide open main valve with a large pressure receiver of a diaphragm.
	Though direct-acting type is easily affected by the change in flow rate compared with pilot-operated type, it is compact and suitable for small equipment with stable flow rate.	This type can be applied to a frequent use or wide-ranged equipment and facilities. It secures the stable control and excellent durability achieved by a piston at the pressure receiver.	This valve is a perfect choice for equipment and facilities with a large flow rate. It can be applied to facilities, etc. where the stable control of a slight variation in the reduced pressure is required, or where the flow rate violently fluctuates.
Major Products for Steam	**Compact size, for small flow rate: GD-30 Series**	**For various purposes: GP-1000 Series**	**High performance: GP-2000 Series**
			

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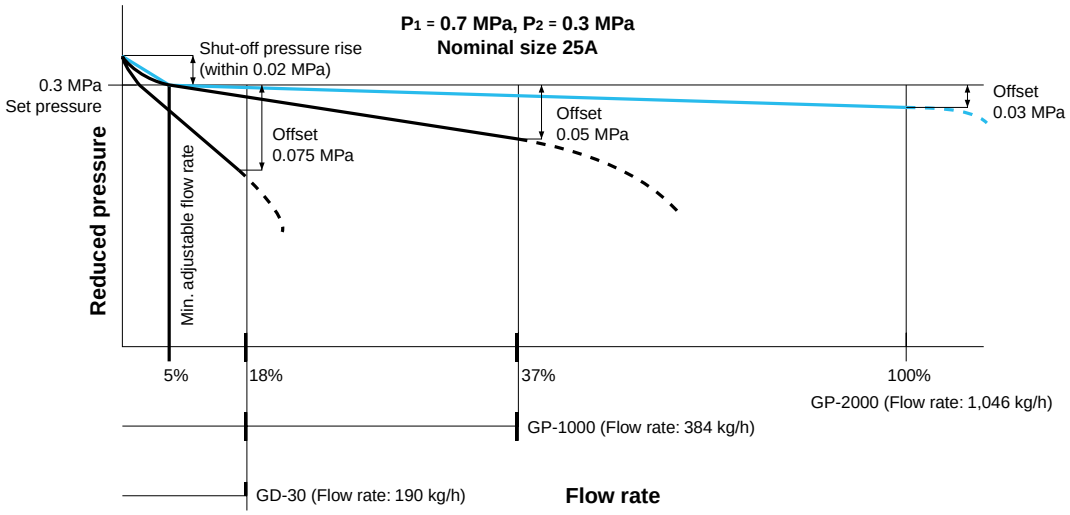
Note for Selecting Pressure Reducing Valves

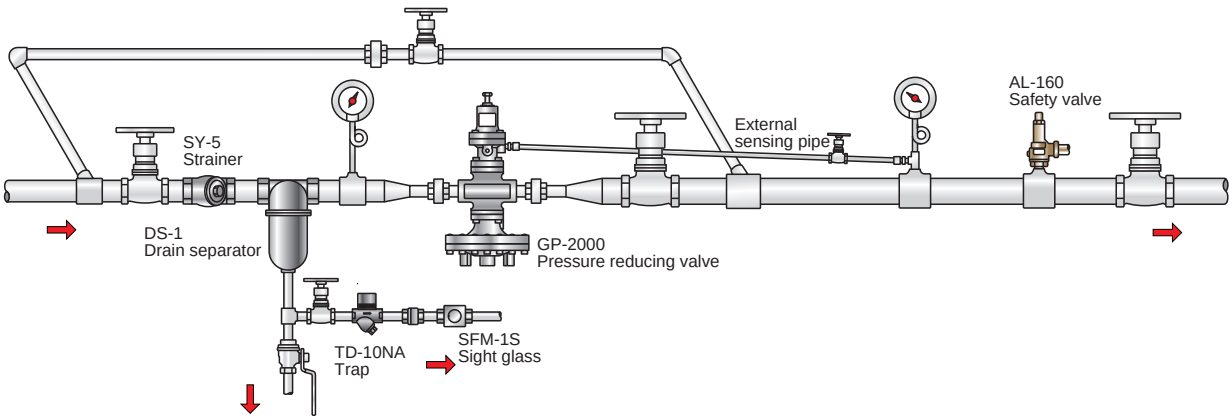
Flow Characteristics

In selecting a pressure reducing valve, the principle of "the greater embraces the less" can not be applied. Too much bigger valve is less durable and prone to cause a rise in the reduced pressure at no load. The nominal size of inlet piping, outlet piping, and pressure reducing valve should be properly and individually selected. The nominal size of the pipe at reduced pressure side, which is inevitably larger than that of the pressure reducing valve, should be large enough to cover large volume of steam with lower pressure. It is very important to select a valve of the right model and right size according to the flow rate and the pressure of steam.

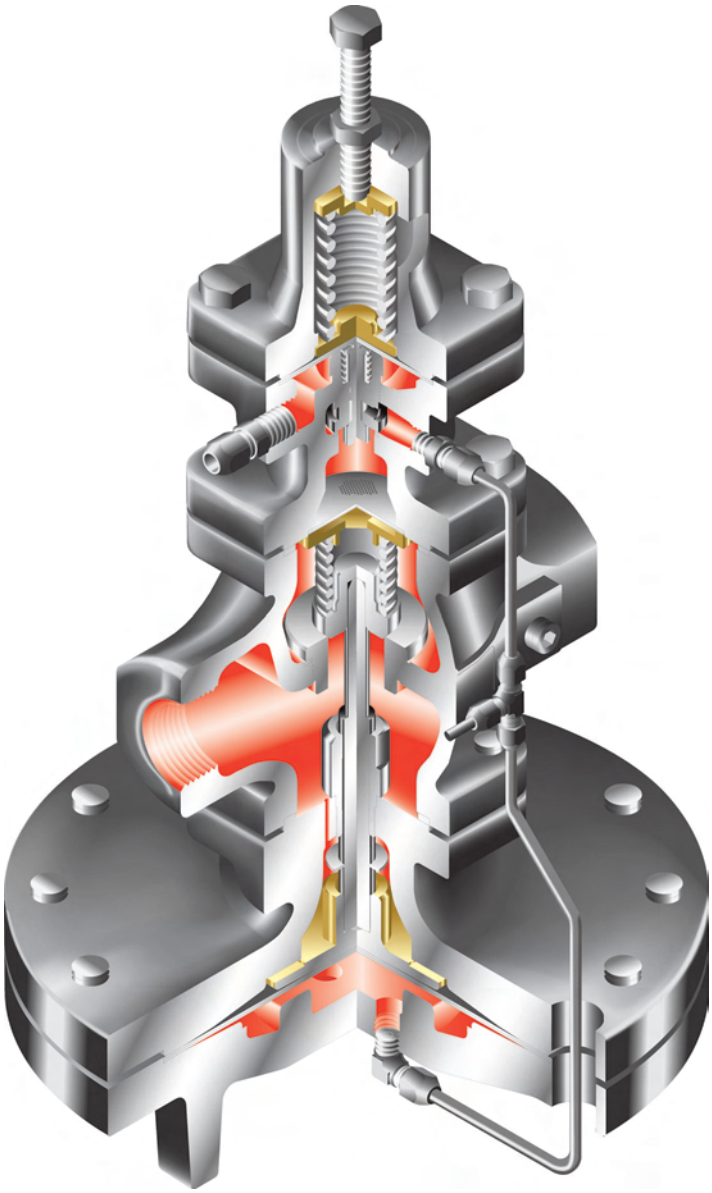


Reduced Pressure Sensing Method and Pressure Controllability

When a serious pressure loss and violent fluctuation with a wide range in flow rate are observed at the outlet piping, the pressure stability at steam equipment can be installing an external sensing pipe that directly introduce the outlet pressure from the installed point. It is because the sensing pipe enables the pressure reducing valve to detect the accurate outlet pressure not affected by steam turbulence.



Features of Pilot Operated Diaphragm Type ＜GP-2000＞



1: Greater capacity

Large-size main diaphragm lifts larger main valve than other types of the pressure reducing valves, such as piston and bellows, and it allows a greater steam capacity. Large-size main diaphragm can lead a greater steam capacity per line size.

2: Accurate control

Large-size main diaphragm is more sensitive to pressure fluctuation, and the valve adjusts the outlet pressure in an accurate fashion. Compared to an internal sensing type, this external sensing type can avoid the effect of turbulence which causes inaccurate outlet pressure control.

3: Flexibility

GP-2000 Series are designed for maximum flexibility; thereby they are enabled to be used in conjunction with other valves mounted in your system. GP-2000 Series offer a broad lineup to meet various applications and conditions, regardless of control purpose, installation space and designed method of use.

4: Variations

Combination valve

CP-2005
Pressure & Temperature control

Air-loaded pressure reducing valve

GDK-2000
Direct acting

GPK-2001
Pilot operated

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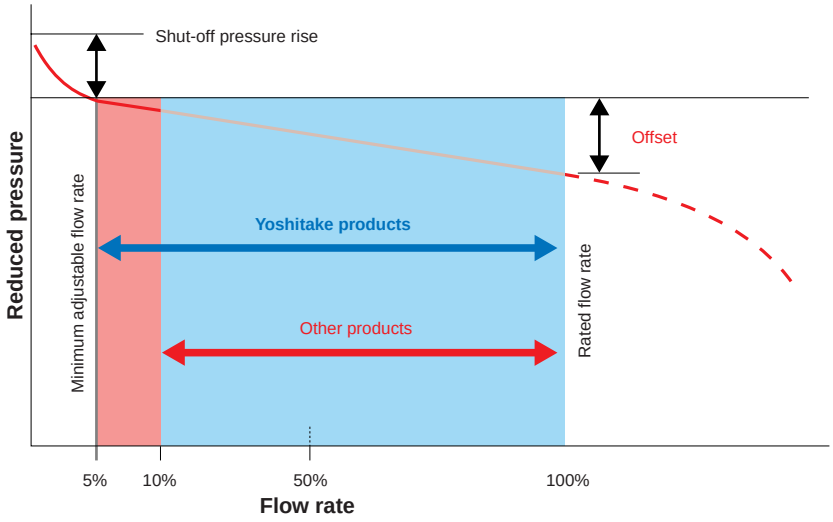
Advantage of Yoshitake Products ＜GP-2000＞

Wide Range Ability



Advantage: Wide range of steam capacity can be controlled with only one valve.
GP-2000 handles wide range of steam capacity. Yoshitake products can handle 5% of rated flow as the minimum. Most of other products on the market can adjust 10% as the minimum.

Excellent Performance in On-Off Use

Due to spherical shape of main valve, leakage from the main valve is only 0.01% of rated flow rate complying to ANSI Class IV. The most suitable line is

DEAD-END service such as ON-OFF use (Forming machine, etc.)

Normal flat main valve causes leakage easily and **not suitable** for On-Off service.

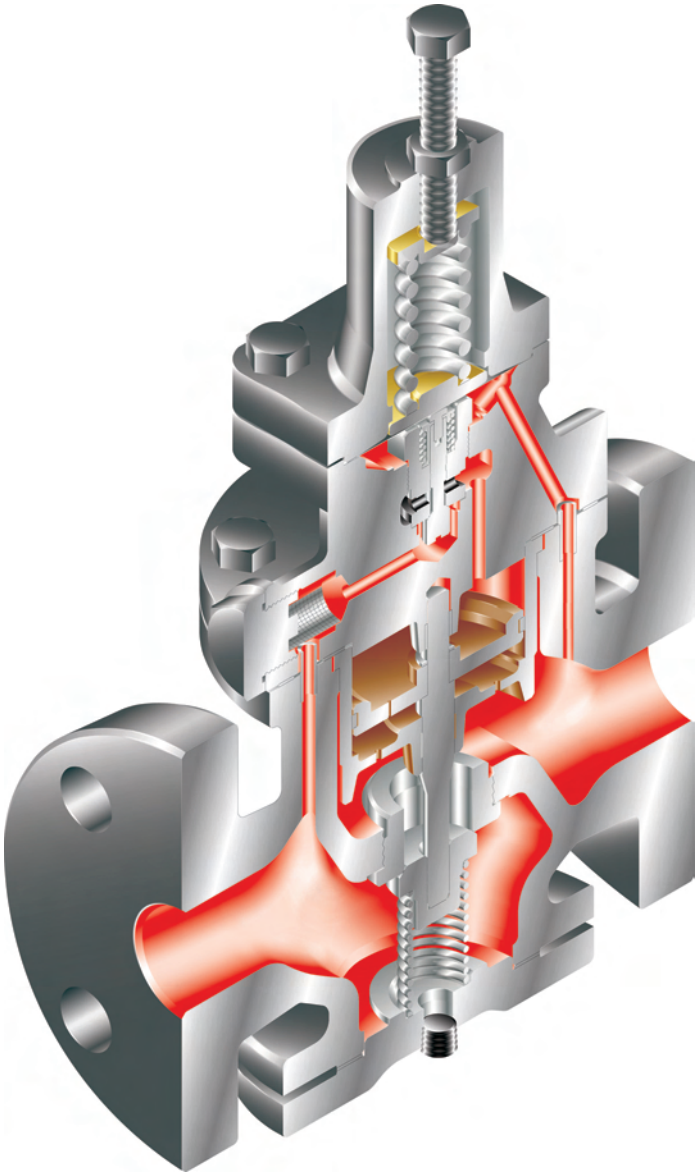
Leakage Class	Maximum Seat Leakage	Reference
Class I	—	By agreement between user and supplier
Class II	0.5% of rated valve capacity	Commercial double-seat valves or balanced single-seat valves with a piston ring seal and metal-to-metal seats
Class III	0.1% of rated valve capacity	Commercial double-seat valves or balanced single-seat valves with a higher degree of seat and seal tightness
Class IV	0.01% of rated valve capacity	Commercial unbalanced single-seat valves and balanced single-seat valves with extra tight piston rings or other sealing means and metal-to-metal seats
Class V	abbreviation	Valves for critical applications where the valve is closed for long period of time with high defferential pressure across the seating surfaces Metal seat, unbalanced single-seat valves or balanced single-seat designs with exceptional seat and seal tightness
Class VI	abbreviation	Resilient seating single-seat valves with "O" rings or similar gapless seals

Excerpt from ANSI / FCI 70-2-2006 Control Valve Seat Leakage

Long Durability

Due to special patented shape in the diaphragm case, the main diaphragm is equally pressurized and also stands for long time of usage. Compared to others on the market, the main diaphragm has ten times longer life.

Features of Pilot Operated Piston Type ＜GP-1000＞



1: Greater capacity and accuracy

Two valves are incorporated in the piston type pressure reducing valve. The pilot valve controls the pressure to piston, which opens larger main valve. Therefore, the greater capacity and accuracy are obtained in piston type pressure reducing valve compared to direct acting pressure reducing valve.

2: Easy installation

No need to install a sensing pipe additionally since designed as internal sensing type. Easy installation and a lot of flexibility in installation compared to the external sensing type.

3: Incorporating new design

Piston & Cylinder:

"Twin Guide Design" structure keeps stable vertical operation and ensures accurate operation over an extended time period.

Pull-up Pilot Valve:

Pull-up design ensures tight seal for a long period of time.

Main valve:

Spherical main valve ensures a tight shut-off meeting ANSI Class Ⅳ and can be applied to dead-end service line.

4: Variations

Easy adjustment

GP-1001
With plastic handle

For remote control

GP-1200
Air-loaded type

Anti-corrosion

GP-1000AS
All stainless steel made

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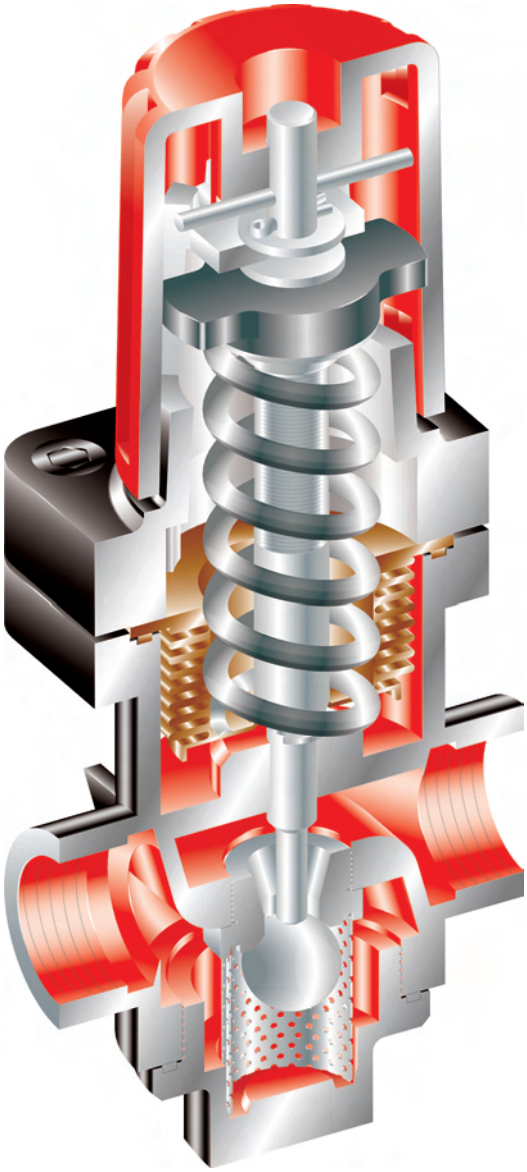
Features of Direct Acting Type ＜GD-30＞



1: Easy pressure setting
Red colored plastic cap allows changing the set pressure without tools. Simple operation is suitable for the line that requires frequent changes in set pressure.

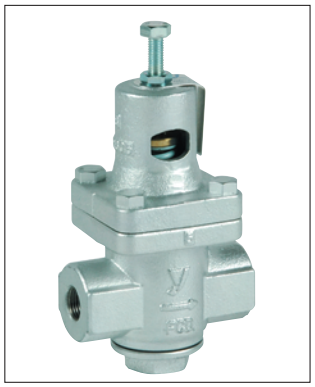
2: Simple and compact design
Fewer parts and convoluted phosphor bellows enable smaller sized body. The smallest and the most economical pressure reducing valve in our lineup permits easy maintenance.

3: Variations
Different body materials are available including stainless steel and ductile cast iron. They are suitable for a wide range of applications, including kitchen systems, cleaning machines, food processing equipment, sterilizers, air conditioning equipment, etc.

4: Variations

Cast bronze
GD-30

Stainless steel
GD-30S



Ductile cast iron
GD-45 (without handle)
GD-45P (with handle)

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Selection of Pressure Reducing Valve for Liquid

What is a Pressure Reducing Valve ??

A reducing valve is a regulating valve which keeps outlet pressure of fluid at a certain and lower level than inlet pressure.
Selecting proper pressure reducing valve is a key to maintain stable reduced pressure. Offering direct acting pressure valve is an answer from Yoshitake Inc.

Applications

・Construction equipment ・Irrigation ・Industrial or commercial air conditioning ・Building utility system ・Industrial plant system	・High-rise buildings ・Complex housing unit

Types

Balancing type		
Pressure balance structure can keep the reduced pressure at a constant level without being affected by the inlet pressure.		
Direct acting type		
Most of Yoshitake pressure reducing valve for water are categorized as direct acting type. It controls the reduced pressure even for wide range of water capacity and allows quicker response than pilot operated type. In addition, Yoshitake direct acting pressure reducing valve solves various problems such as vibration and noise.		
40-3400 L/min	30-1800 L/min	30-50 L/min

Major Products

GD-200	GD-26 Series	GD-46 Series
		

Pressure Reducing Valve

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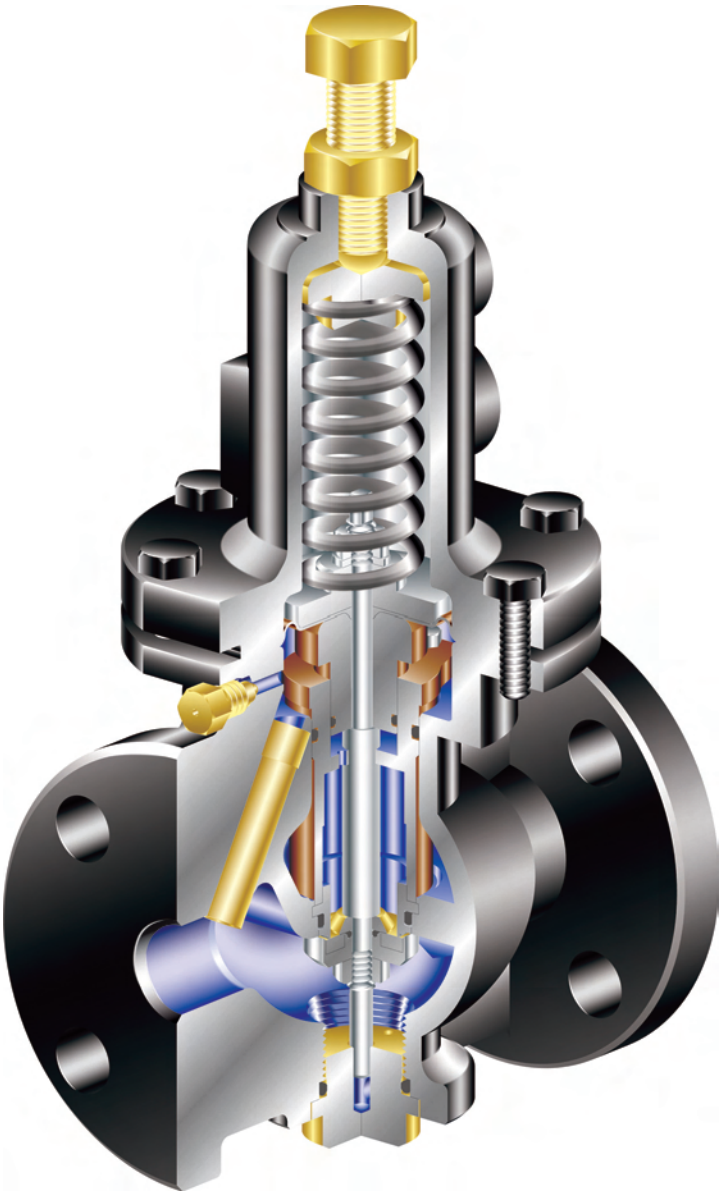
Features of Direct Acting Type for Water ＜GD-200＞



1: Accurate control
Highly accurate control is obtained with a large diaphragm and a pressure balancing mechanism, which maintains a constant reduced pressure.

2: Simple and suitable design
The product consists of less parts than a pilot operated valve and rubber diaphragm sensitively responds to slight pressure change. All materials are advisedly selected and long life durability is accomplished.

3: Variations
Electrodeposition coating is applied as standard painting. Powder and Nylon coating both inside and outside of the body for superior anti-corrosion are also available for wide range of liquid applications.

GD-200
Standard model

GD-200C
Nylon 11 coating model

GD-200HS
Epoxy powder coating model

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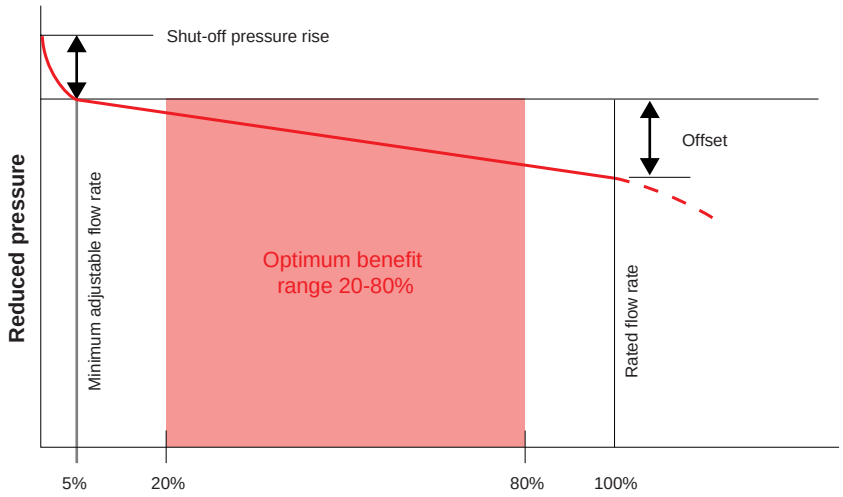
Nominal Size Selection of Pressure Reducing Valve

In selecting a pressure reducing valve, it is important to consider an appropriate nominal size. To select the optimum size, it is empirically recommended to determine its nominal size in 20% to 80% range of rated flow rate. If the operating flow rate is near to the rated flow rate, the valve constantly and fully runs, leading to shortened service life. If the operating flow rate is near to the minimum adjusting flow rate, initial cost becomes expensive.

How to Select the Optimum Size



To select the appropriate nominal size, refer to the nominal size selection chart. When selecting the nominal size, an 80% to 90% safety factor of flow rate should be used, considering the heat loss and the pressure loss which occurs at the pressure reducing valve's front and back stop valves, the strainer, and etc.
Also, the pipe resistance should be considered when selecting the pipe size (avoid too small pipe).

There are 3 kinds of charts available regarding flow rate. Please find appropriate one for your usage.

1: Calculation formula (Page: 12)
2: Nominal size selection chart (Printed as a material for selection per product)
3: Flow rate table for GP-2000 (Page: 21) / GP-1000 (Page: 37) / GD-200 (Page: 48)

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Sizing for Pressure Reducing Valve

Calculation Formula for Cv Value

〈For steam〉

When $P_2 > \frac{P_1}{2}$ $\quad Cv = \frac{Wk}{138\sqrt{\Delta P\,(P_1 + P_2)}}$

When $P_2 \leqq \frac{P_1}{2}$ $\quad Cv = \frac{Wk}{120P_1}$

〈For gas〉

When $P_2 > \frac{P_1}{2}$ $\quad Cv = \frac{Q}{2940}\sqrt{\frac{(273 + t)\,G}{\Delta P\,(P_1 + P_2)}}$

When $P_2 \leqq \frac{P_1}{2}$ $\quad Cv = \frac{Q\sqrt{(273 + t)\,G}}{2550P_1}$

〈For liquid〉 $\quad Cv = \frac{0.365V\sqrt{G}}{\sqrt{\Delta P}}$

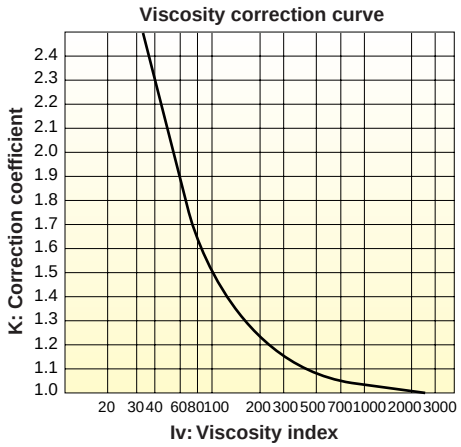
W: Max. steam flow rate [kg/h]
P_1: Inlet pressure [MPa・A]
P_2: Outlet pressure [MPa・A]
ΔP: $P_1 - P_2$ [MPa]
k : 1 + 0.0013 x {superheated steam temp. [˚C] − saturated steam temp. [˚C] }
Q : Max. gas flow rate [m³/h (standard condition)]
G : Specific gravity (relative to air for gas, or relative to water for liquid)
t : Fluid temperature [˚C]
V : Max. liquid flow rate [m³/h]
Cv: Cv value of each nominal size
Iv : Viscosity index
Mcst: Viscosity [cSt]

Formula for Correction of Viscosity

First, find viscosity index Iv.

$$Iv = \frac{72780}{Mcst}\left(\frac{\Delta P}{G}\right)^{\frac{1}{4}} V^{\frac{1}{2}}$$

Find K from calculated Iv on the viscosity correction curve.
The calculated maximum flow rate (V) devided by K is the value of the corrected flow rate.



Corrected maximum flow rate: V' = V/K (m³/h)

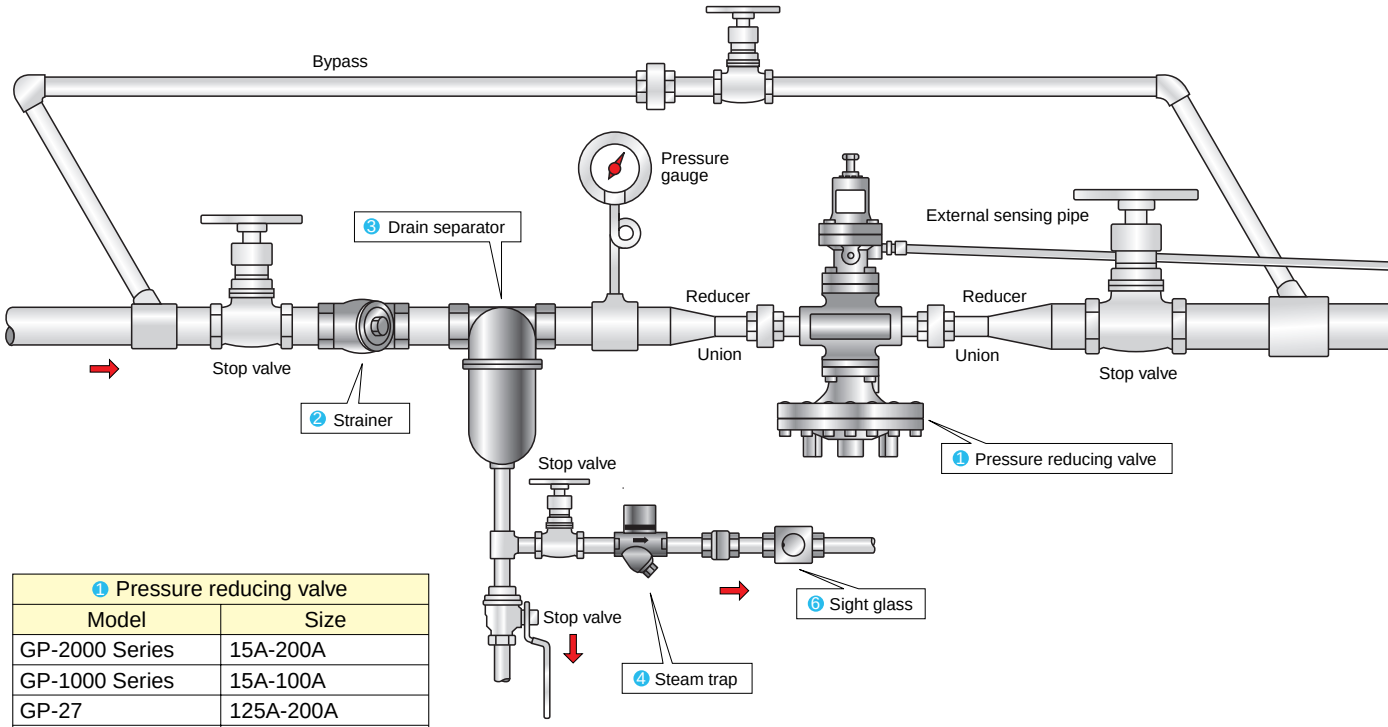
Cv Value Table

Model \ Nominal size	6A	8A	10A	15A	20A	25A	32A	40A	50A	65A	80A	100A	125A	150A	200A	250A	300A
GP-2000 screwed GPK-2001・2003 screwed				5.0	7.2	10.9	14.3	18.8	32								
GP-2000 flanged・GP-2000CS GPK-2001・2003 flanged				5.0	7.2	10.9	14.3	18.8	32	60	78	120	(125)	(250)	(260)		
GDK-2000				5.0	7.2	10.9	14.3	18.8	32	60	78	120					
GP-1000 Series				1.0	2.3	4	6.5	9	16	25	36	64					
GP-27													100	144	256		
GD-6N			0.35	0.5	1.0	1.5											
GD-4					2	3	4	5	8	21	27	42	72	94			
GD-4B					2	3	4	5	8	12	16	24	36	48			
GD-400・400SS				1.5	2	3											
GD-6			0.35	0.5	1.0	1.5											
GD-7					2	3	6	8	15	23	30	40	50	60			
GD-7B					2	3	4	5	8	12	16	20	25	30			
GP-50													180	260	470	710	900
GD-8N	0.1	0.1	0.2	0.2													
GD-9		0.2	0.4	0.8	1.0	1.5											
GD-200・200C・200H				2.5	4	5	8	12	16	28	36	68	75	108			
GD-24GS・24GS-N				1.5	1.9	3	4	7	10								
GD-26-N・28-N・26G				2	2.3	3.5	6	7	11								
GD-27-N・29-N・27G						3.5	6	7	11	21	26	38					
GD-26S・28S・26GS					2.3	3.5	6	7	11								
GD-27S・29S・27GS					2.3	3.5	6	7	11	21	26	38					
GD-41・43・41G・43G				0.4	0.6	0.8											

・The above values in parentheses are the dimensions of the GP-2000 flanged.

Guidelines for Pressure Reducing Valve for Steam

Please refer to this guidelines and confirm the adequacy for the optimum use of the pressure reducing valves for steam.



❶ Pressure reducing valve	
Model	Size
GP-2000 Series	15A-200A
GP-1000 Series	15A-100A
GP-27	125A-200A
GD-30・30S・45・45P	15A-25A
GD-6N	10A-25A

❷ Strainer

The strainer is installed in order to prevent the problems in the steam system attributable to scale. 80-100 mesh size is recommended for steam. Install it with its cap or cover for screen sideways so that the condensate accumulation is minimized.

	**SY-5** FCD450 Screwed (10-50A) Max 2.0 MPa
	**SY-40** FCD450 Flanged (15-300A) Max 1.0 MPa
	**SY-17** SCS13 Screwed (15-50A) Max 2.0 MPa
	**SY-8** SCS13 Screwed (15-150A) Max 1.0 MPa

❸ Drain separator

The drain separator efficiently separates condensate and assures that dry and clean steam is supplied to the system. It also separates scale and contributes in increasing the durability of the pressure reducing valve.

	**DS-1** FCD450 Screwed (15-50A) Max 2.0 MPa
	**DS-2** FCD450 Flanged (15-100A) Max 2.0 MPa

❹ Steam trap

The steam trap promptly discharges the condensate separated by the drain separator.

 Disc type	**TSD-42** SCS2A Screwed (15-25A) Max 4.2 MPa
 Disc type	**TD-10NA・30NA** FCD450 Screwed・Flanged (15-25A) Max 2.0 MPa

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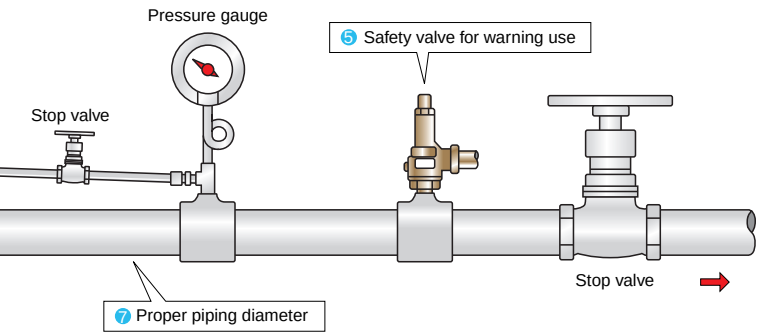


⚠ Precautions during installation

1: When installing solenoid valves or other devices which open and close abruptly, they should be installed in front of pressure reducing valve at a suitable distance (3 meters or more is adequate).
2: For external sensing type, reduced pressure sensing pipe should be installed at a point of minimum turbulence.
3: For two-stage pressure reducing systems, the distance between reducing valves should be at least 3 meters.
4: The nominal size should be usually larger than that of pressure reducing valve to prevent excessive flow velocities. The steam flow velocity should be 30 m/s or less.
5: Pressure reducing valve must be installed vertically to horizontal pipng.

⑤ Safety valve for warning use

The safety valve for warning use is safety equipment that prevents troubles caused by abnormal increase in reduced pressure of the pressure reducing valve.

AL-160
Lift type CAC406
Screwed (15-50A)
For warning use

AL-300
Lift type FCD450
Flanged (15-50A)
For warning use

AF-5
Full bore type CAC406
Screwed (20-50A)
For protection of equipment

⑥ Sight glass

With the sight glass, operation of the steam trap can be visually checked. When applied to the steam condensate, use the product with mica plate to protect the glass.


SFM-1S

SFM-1S
FCD450
Screwed (15-50A)
Flap type

SFM-1F
FCD450
Flanged (15-50A)
Flap type

⑦ Proper piping diameter

One of the essentials for optimizing a steam line is to select a proper piping diameter. Stable pressure and flow rate are not assured without a correct size of piping even if the appropriate pressure reducing vale is selected.

Ex.) P_1 = 1.0 MPa P_2 = 0.1 MPa Steam flow rate 250 kg/h
Inlet piping diameter : 25A
Pressure reducing valve: Model GP-2000 15A
Outlet piping diameter : 50A

Steam Flow Rate Table
(Saturated steam, Flow velocity 30 m/s, Carbon steel pipe) (kg/h)

Nominal size / Pressure MPa	15A	20A	25A	32A	40A	50A
0.05	18	33	55	92	125	202
0.1	24	44	72	120	164	265
0.2	35	64	105	176	240	388
0.3	47	84	138	231	314	508
0.4	58	104	170	285	387	627
0.5	69	124	202	339	460	745
0.6	79	143	234	392	533	862
0.7	90	163	266	445	605	978
0.8	101	182	297	498	676	1094
0.9	112	201	329	551	748	1209
1.0	122	220	360	603	819	1325

See page 336 “ Flow Velocity Table for Steam inside the Pipe.”

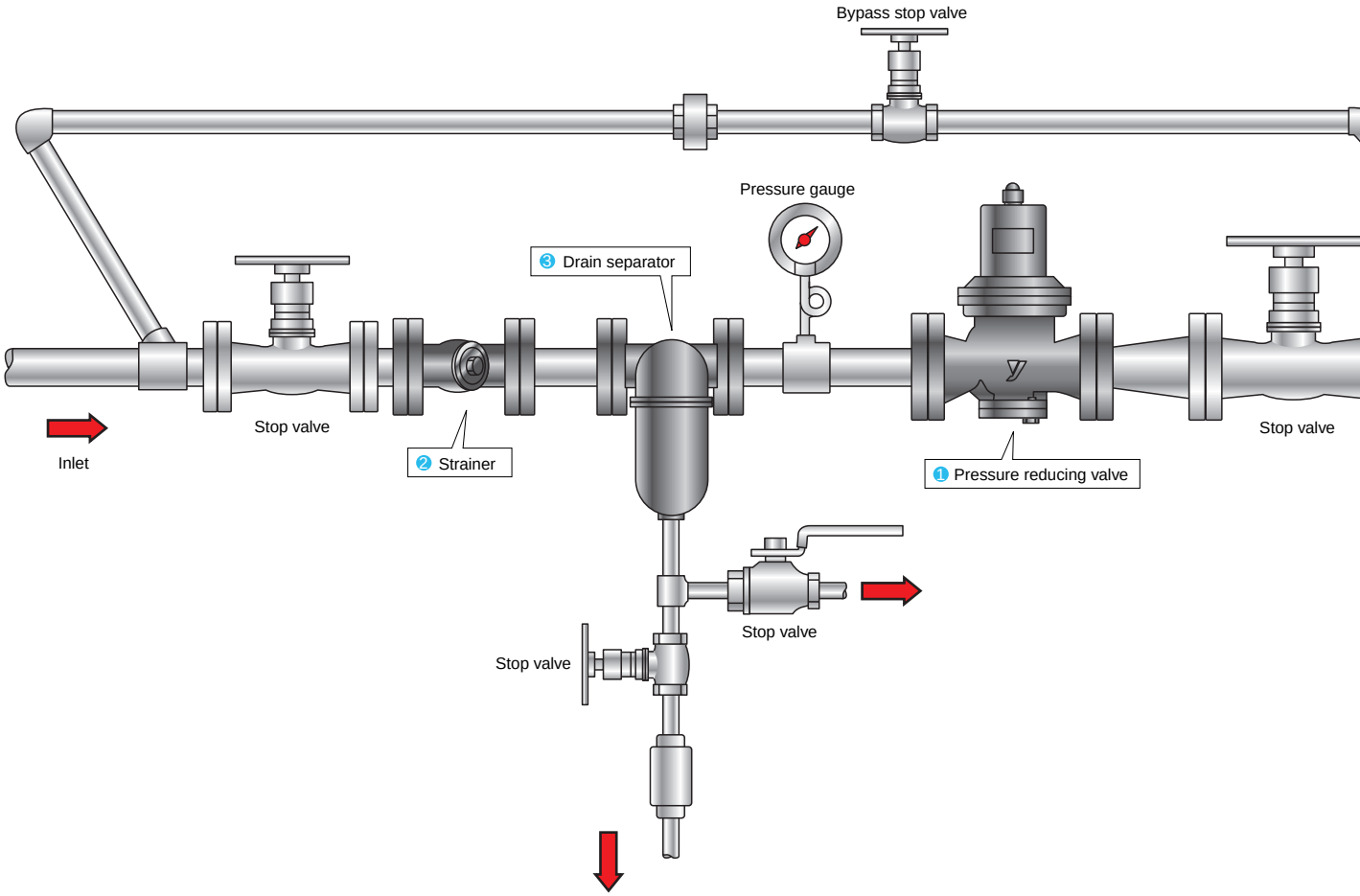
●Set pressure of safety valve for alarm use at the outlet side of the pressure reducing valve for steam

Set pressure of pressure reducing valve (MPa)	Set pressure of safety valve (MPa)
0.1 or less	Set pressure of the pressure reducing valve + 0.05 or more
0.11-0.4	Set pressure of the pressure reducing valve + 0.08 or more
0.41-0.6	Set pressure of the pressure reducing valve + 0.1 or more
0.61-0.8	Set pressure of the pressure reducing valve + 0.12 or more
More than 0.8	Set pressure of the pressure reducing valve + 15%

・When a safety valve is installed for alarm use at the outlet side of a pressure reducing valve for steam and there are no laws or regulations specified to comply with, select a safety valve whose blowout capacity is around 10% of the maximum flow rate of the pressure reducing valve.

Guidelines for Pressure Reducing Valve for Air/Gas

Please refer to this guidelines and confirm the adequacy for the optimum use of the pressure reducing valves for air/gas.



❶ Pressure reducing valve	
Model	Size
GP-1000T Series	15A-100A
GD-26G Series	15A-50A
GD-6	10A-25A
GD-41G・43G	15A-25A
GD-400・400SS	15A-25A
GD-4・4B	20A-150A
GD-8N	6A-15A
GD-9	8A-25A

❷ Strainer	
The strainer is installed to prevent troubles in the air/gas system attributable to scale. The mesh size of 60 or more is recommended. Install it with its cap or cover for screen sideways as shown in the figure so that the drain accumulation is minimized.	
	**SY-5** FCD450 Screwed (10-50A) Max 2.0 MPa
	**SY-40** FCD450 Flanged (15-300A) Max 1.0 MPa
	**SY-17** SCS13 Screwed (15-50A) Max 2.0 MPa
	**SY-8** SCS13 Screwed (15-150A) Max 1.0 MPa

❸ Drain separator	
The drain separator efficiently separates drain and assures that dry and clean air/gas is supplied to the system. It also separates scale and contributes in increasing the durability of the pressure reducing valve.	
	**DS-1** FCD450 Screwed (15-50A) Max 2.0 MPa
	**DS-2** FCD450 Flanged (15-100A) Max 2.0 MPa

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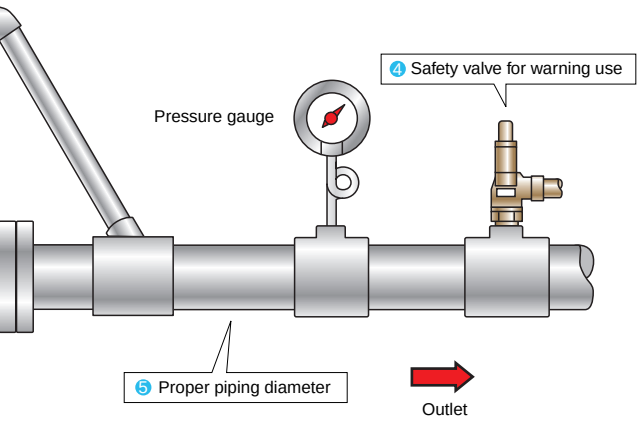


- Please contact us for the application of each model because it may require material change or confirmation of applicable fluids.

Applicable special fluids
Nitrogen
Argon
Propane
City gas
Ozone
Methane
COG gas
LNG
LPG
Oxygen
Carbon dioxide gas
Naphthalene
Xylene
Methyl isobutyl ketone
etc

❹ Safety valve for warning use

The safety valve for warning use is safety equipment that prevents troubles caused by the abnormal increase in reduced pressure of the pressure reducing valve.

AL-150T

Lift type CAC406
Screwed (15-50A)
For warning use

AL-300T

Lift type FCD450
Flanged (15-50A)
For warning use

❺ Proper piping diameter

One of the essentials for optimizing an air/gas line is to select a proper piping diameter. Stable pressure and flow rate are not assured without a correct size of piping even if the appropriate pressure reducing vale is selected.

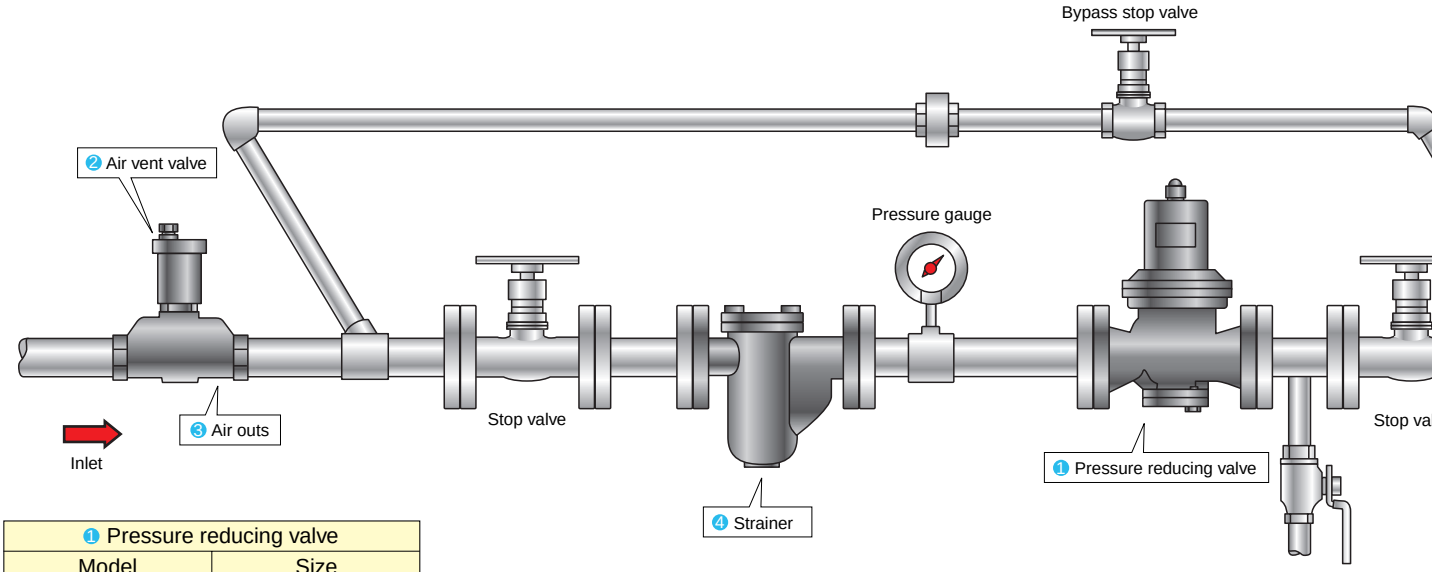
Ex.) P_1 = 0.7 MPa P_2 = 0.1 MPa Air flow rate 250 kg/h
Inlet piping diameter : 25A
Pressure reducing valve: Model GD-26G 20A
Outlet piping diameter : 50A

Air Flow Rate Table
(Flow velocity 15 m/s, t = 20˚C, Carbon steel pipe) (kg/h)

Nominal size / Pressure MPa	15A	20A	25A	32A	40A	50A
0.1	26	47	77	129	175	283
0.2	39	70	115	193	263	425
0.3	52	94	154	258	350	567
0.4	65	118	192	322	438	708
0.5	78	141	231	387	526	850
0.6	91	165	270	451	613	992
0.7	105	189	308	516	701	1134
0.8	118	212	347	581	789	1275
0.9	131	236	385	645	876	1417
1.0	144	260	424	710	964	1559

See page 337 “ Flow Velocity Table for Air inside the Pipe.”

Guidelines for Pressure Reducing Valve for Liquid



❶ Pressure reducing valve	
Model	Size
GD-200 Series	15A-150A
GD-26 Series	15A-150A
GD-24	15A-50A
GD-25 Series	25A
GD-38 Series	20A
GD-46 Series	20A
GD-15C	15A-25A
GD-41·43	15A-25A
GD-6	10A-25A
GD-7·7B	20A-150A
GD-8N	6A-15A
GP-50	125A-300A

❷ Air vent valve

The air in the piping system causes noise and unstable pressure. The air vent valve is installed to effectively discharge the air in the system.

TA-3

FCD450
(Electrodeposition coating)
Screwed (15-32A)
Max. 1.0 MPa

TA-16

SCS13
Screwed (15-25A)
Product complying with the Water Works Law

❸ Air out

The air out is used to continuously separate the air from the liquid.

AO-2

CAC406
Screwed (20-50A)
Max. 1.0 MPa

❹ Strainer

The strainer is installed to prevent troubles caused by scale.
The mesh size of 60 or more is recommended for a cold/hot water line.

SU-20

FCD450
Basket strainer
Flanged (20-150A)

SY-6

CAC406
Y-type strainer
Screwed (15-50A)

SW-10

FCD450
Duplex strainer
Flanged (20-100A)

❺ Safety valve (Relief valve)

The safety valve is a safety equipment to prevent troubles caused by abnormal increase in reduced pressure of the pressure reducing valve.

AL-150T

CAC406
Lift type
Screwed (15-50A)

AL-300T

FCD450
Lift type
Flanged (15-50A)

AL-260R

CAC406
Pump relief valve
Screwed (15-50A)

7-3, Futano-cho, Mizuho-ku, Nagoya, 467-0861, Japan Phone: 81-52-881-7199 Fax: 81-52-881-7201
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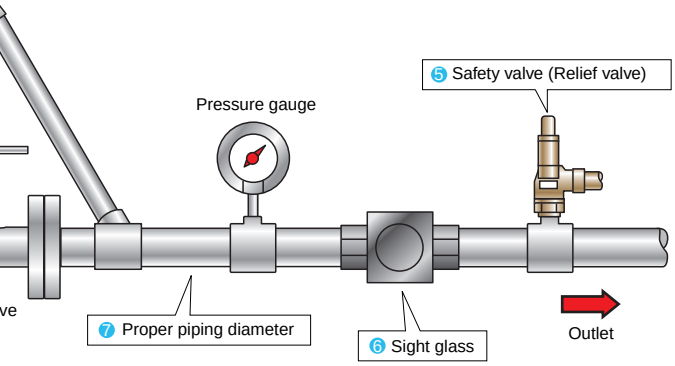
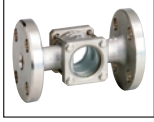
- Please contact us for the application of each model because it may require material change or confirmation of applicable fluids.



Applicable special fluids
Heavy oil A
Heavy oil B
Kerosene
Ethyl alcohol
Methanol
Toluene
Hexane
Heptane
etc

⑥ Sight glass	
With the sight glass, the flow can be visually checked.	
	**SB-1S** FCD450 Screwed (15-50A) Ball type
	**SF-1S** FCD450 Screwed (15-50A) Flap type
	**150L-13F** SCS13 Flanged (15-100A) Plain type

⑦ Proper piping diameter

Cold/hot water is an incompressible fluid and it does not change in the volume by the change in pressure. The proper piping diameter is recommended to be determined at the flow velocity of 1-3 m/s.
Serious problems such as water hammer may occur if the flow velocity is too high.

Water Flow Rate Table (Carbon steel pipe) (m^3/h)

Nominal size / Flow velocity (m/s)	15A	20A	25A	32A	40A	50A
1.0	0.73	1.32	2.15	3.60	4.89	7.91
1.2	0.88	1.58	2.58	4.32	5.87	9.49
1.4	1.03	1.85	3.01	5.04	6.85	11.07
1.6	1.17	2.11	3.44	5.76	7.82	12.65
1.8	1.32	2.37	3.87	6.48	8.80	14.23
2.0	1.47	2.64	4.31	7.20	9.78	15.82
2.5	1.83	3.30	5.38	9.00	12.23	19.77
3.0	2.20	3.96	6.46	10.81	14.67	23.72

See page 337 “ Flow Velocity Table for Water inside the Pipe.”

GP-2000

Features

1. Large-size diaphragm and external sensing method control reduced pressure more stably.
2. Since the Cv value is high, flow capability and control capability are significantly improved, one or two sizes smaller than the regular nominal size can be applied.
3. Spherical main valve offers great sealability and great reduction of valve seat leakage (compliant with ANSI Class IV).
4. Pressure management at low pressure (0.02 MPa or less) is possible.

Screwed type

Flanged type

Specifications

Model		GP-2000		
Application		Steam		
Reduced pressure sensing method		External sensing *1		
Inlet pressure		0.1-2.0 MPa		0.1-1.0 MPa
Reduced pressure		0.02-0.15 MPa *2 0.1-1.4 MPa		0.02-0.15 MPa *2 0.1-0.85 MPa
		85% or less of inlet pressure (gauge pressure)		
Minimum differential pressure		0.05 MPa		
Maximum pressure reduction ratio		20:1		
Maximum temperature		220˚C		
Valve seat leakage		0.01% or less of rated flow		
Material	Body	Ductile cast iron		
	Main valve	Stainless steel		
	Valve seat	Stainless steel		
	Pilot valve	Stainless steel		
	Pilot valve seat	Stainless steel		
	Diaphragm	Stainless steel		
Reduced pressure sensing pipe		Copper pipe ϕ 8-2 m		
Connection		JIS Rc screwed	JIS 20K RF flanged	JIS 10K FF flanged

*1 External sensing is standard. Available with internal sensing type (nominal size: 15A to 100A) in different specifications. Note that Cv value of internal sensing type is lower than that of external sensing type.

*2 Available with the GP-2000L, reduced pressure of 0.01 to 0.02 MPa, from 15A to 100A, inlet pressure of 0.1 to 0.5 MPa and maximum pressure reduction of 50:1.

- Available with external pilot type.
- Available with ASME or EN flanged.

Dimensions (mm) and Weights (kg)

●Screwed type

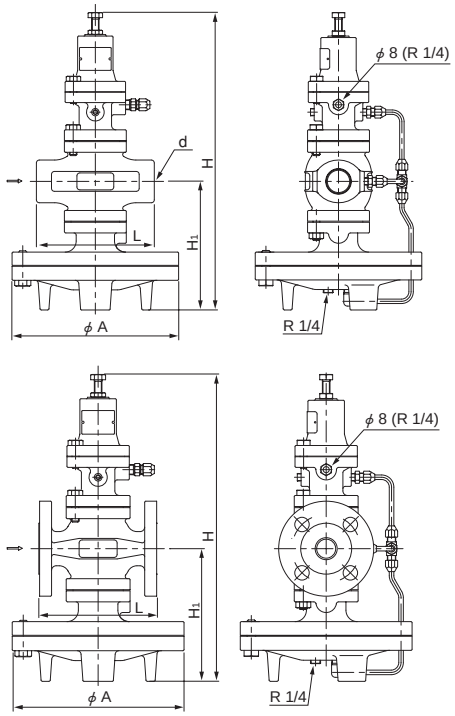
Nominal size	d	L	H1	H	A	Weight
15A	Rc 1/2	150	170	398	200	14.0
20A	Rc 3/4	150	170	398	200	14.0
25A	Rc 1	160	175	404	226	18.5
32A	Rc 1-1/4	180	192	434	226	21.5
40A	Rc 1-1/2	180	192	434	226	21.5
50A	Rc 2	230	216	498	276	33.0

- Available with NPT connection.

●Flanged type (JIS 20K RF)

Nominal size	L	H1	H	A	Weight
15A	146 (142)	170	398	200	15.5 (15.3)
20A	146 (142)	170	398	200	16.0 (15.8)
25A	156 (152)	175	404	226	21.0 (20.6)
32A	176 (172)	192	434	226	24.0 (23.6)
40A	196 (192)	192	434	226	24.5 (24.1)
50A	222 (218)	216	498	276	36.0 (35.8)
65A	282 (278)	251	552	352	64.5 (64.2)
80A	302 (294)	264	575	352	71.5 (68.8)
100A	342 (330)	321	658	401	111.0 (106.9)
125A	400 (388)	321	658	401	115.0 (112.0)
150A	465 (453)	414	814	502	234.3 (230.0)
200A	469 (469)	414	814	502	242.0 (238.0)

- The above values in parentheses are the dimensions of JIS 10K FF flanged.



Pressure Reducing Valve

7-3, Futano-cho, Mizuho-ku, Nagoya, 467-0861, Japan Phone: 81-52-881-7199 Fax: 81-52-881-7201
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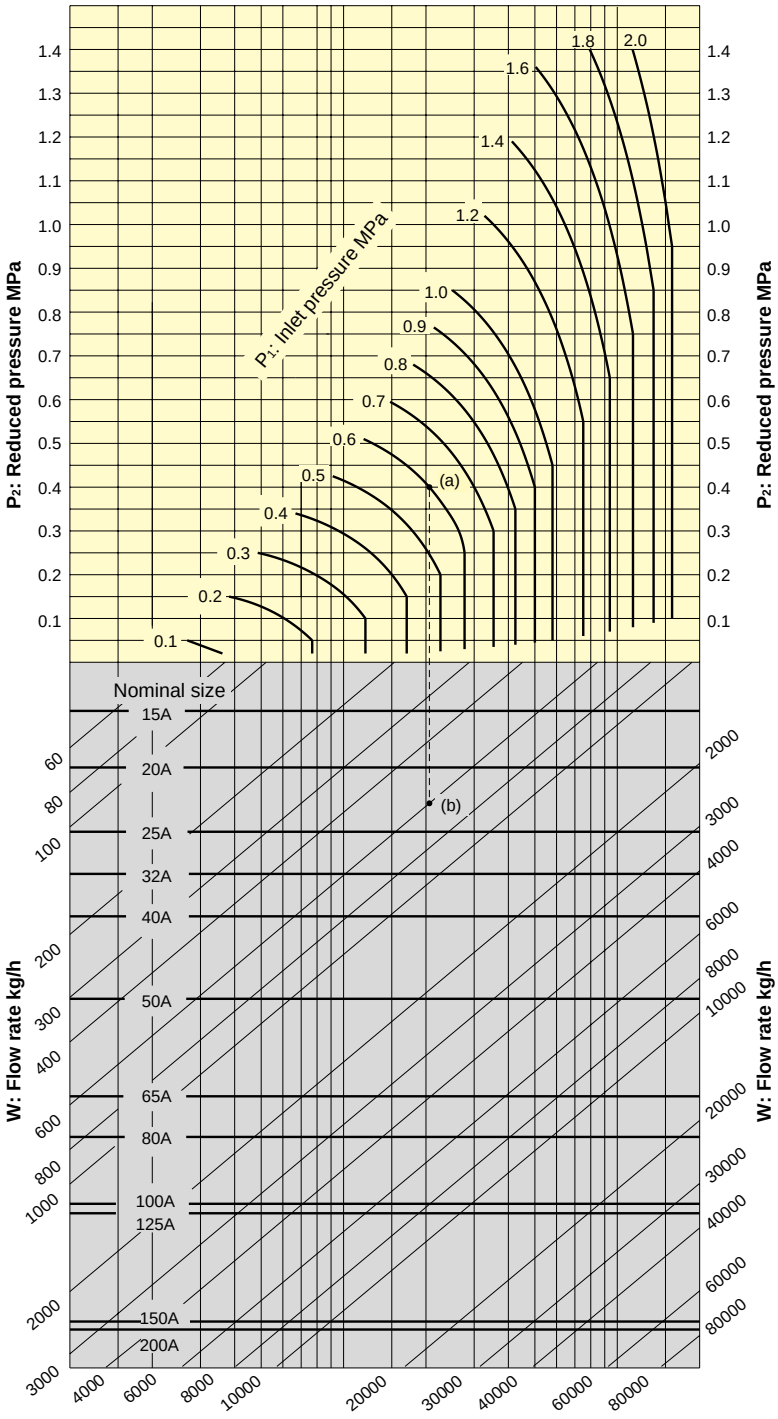
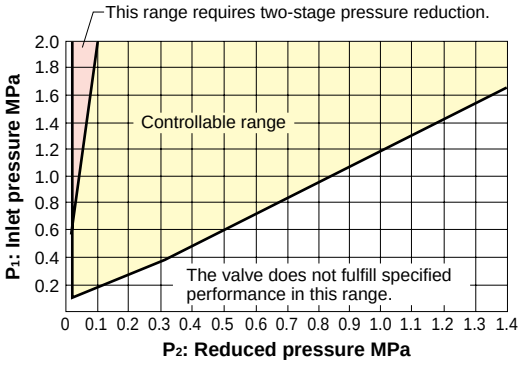
Nominal Sizes Selection Chart (For Steam/External Sensing)



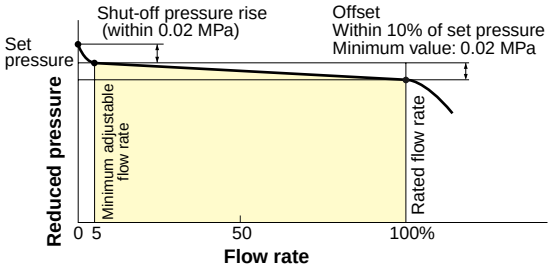
[Example]
When selecting the nominal size of a pressure reducing valve whose inlet pressure (P_1), reduced pressure (P_2), and flow rate are 0.6 MPa, 0.4 MPa, and 600 kg/h, respectively, first find intersection point (a) of the inlet pressure of 0.6 MPa and the reduced pressure of 0.4 MPa. Trace down vertically from this intersection point to find intersection point (b) with the flow rate of 600 kg/h. Since intersection point (b) lies between nominal sizes 20A and 25A, select the larger one, 25A.

・Set the safety factor at 80 to 90%.

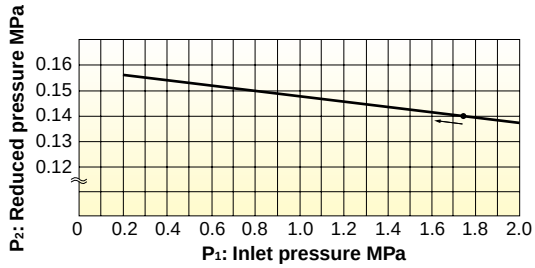
Specifications Selection Chart



Flow Characteristic Chart



Pressure Characteristic Chart



This chart shows a variation in the reduced pressure when the inlet pressure of 1.75 MPa is changed between the range from 0.2 MPa to 2.0 MPa with the reduced pressure set at 0.14 MPa.

GP-2000 Flow Rate Table

(kg/h)

P_1 (MPa)	P_2 (MPa)	15A	20A	25A	32A	40A	50A	65A	80A	100A	125A	150A	200A
2.0	0.1-0.9	1,260	1,814	2,746	3,603	4,737	8,064	15,120	19,656	30,240	31,500	63,000	65,520
	1	1,232	1,775	2,687	3,525	4,634	7,889	14,792	19,230	29,584	30,817	61,635	64,100
	1.2	1,136	1,636	2,477	3,250	4,273	7,273	13,637	17,729	27,275	28,412	56,824	59,097
	1.4	1,012	1,458	2,207	2,896	3,808	6,481	12,153	15,799	24,306	25,319	50,638	52,664
1.8	0.1-0.8	1,140	1,641	2,485	3,260	4,286	7,296	13,680	17,784	27,360	28,500	57,000	59,280
	0.9	1,113	1,603	2,426	3,183	4,185	7,125	13,359	17,367	26,718	27,832	55,664	57,890
	1	1,067	1,537	2,327	3,053	4,014	6,832	12,810	16,653	25,621	26,688	53,377	55,512
	1.2	954	1,374	2,081	2,730	3,590	6,111	11,458	14,895	22,916	23,871	47,742	49,652
	1.4	803	1,157	1,751	2,298	3,021	5,143	9,643	12,536	19,287	20,090	40,181	41,788
1.6	0.1-0.7	1,020	1,468	2,223	2,917	3,835	6,528	12,240	15,912	24,480	25,500	51,000	53,040
	1	893	1,286	1,947	2,554	3,358	5,716	10,718	13,933	21,436	22,329	44,659	46,445
	1.3	664	956	1,448	1,900	2,498	4,253	7,974	10,366	15,949	16,613	33,227	34,556
1.4	0.1-0.6	900	1,296	1,962	2,574	3,384	5,760	10,800	14,040	21,600	22,500	45,000	46,800
	1	702	1,011	1,531	2,009	2,642	4,497	8,433	10,962	16,866	17,568	35,137	36,543
	1.1	620	893	1,352	1,773	2,331	3,969	7,442	9,675	14,884	15,504	31,009	32,250
1.2	0.1-0.5	780	1,123	1,700	2,230	2,932	4,992	9,360	12,168	18,720	19,500	39,000	40,560
	1	477	687	1,040	1,365	1,795	3,055	5,729	7,447	11,458	11,935	23,871	24,826
1.0	0.1-0.4	660	950	1,438	1,887	2,481	4,224	7,920	10,296	15,840	16,500	33,000	34,320
	0.5	635	914	1,385	1,817	2,388	4,066	7,623	9,911	15,247	15,883	31,766	33,036
	0.8	435	627	950	1,246	1,638	2,789	5,229	6,798	10,459	10,895	21,791	22,663
0.9	0.1-0.4	600	864	1,308	1,716	2,256	3,840	7,200	9,360	14,400	15,000	30,000	31,200
	0.5	551	793	1,201	1,576	2,072	3,528	6,615	8,600	13,230	13,782	27,564	28,666
	0.7	413	595	901	1,182	1,554	2,646	4,961	6,450	9,923	10,336	20,673	21,500
0.8	0.1-0.3	540	777	1,177	1,544	2,030	3,456	6,480	8,424	12,960	13,500	27,000	28,080
	0.5	462	665	1,007	1,322	1,738	2,958	5,547	7,211	11,094	11,556	23,113	24,037
0.7	0.1-0.3	480	691	1,046	1,372	1,804	3,072	5,760	7,488	11,520	12,000	24,000	24,960
	0.5	364	525	794	1,042	1,371	2,333	4,375	5,688	8,751	9,115	18,231	18,961
0.6	0.1-0.2	420	604	915	1,201	1,579	2,688	5,040	6,552	10,080	10,500	21,000	21,840
	0.3	395	570	862	1,132	1,488	2,533	4,750	6,175	9,500	9,896	19,793	20,584
	0.5	248	357	541	710	934	1,590	2,981	3,875	5,963	6,211	12,423	12,919
0.5	0.1-0.2	360	518	784	1,029	1,353	2,304	4,320	5,616	8,640	9,000	18,000	18,720
	0.3	308	443	671	881	1,158	1,972	3,698	4,807	7,396	7,704	15,408	16,025
	0.4	228	329	498	653	859	1,462	2,742	3,565	5,485	5,713	11,427	11,884
0.4	0.05-0.15	300	432	654	858	1,128	1,920	3,600	4,680	7,200	7,500	15,000	15,600
	0.3	206	297	450	591	777	1,323	2,480	3,225	4,961	5,168	10,336	10,750
0.3	0.05-0.1	240	345	523	686	902	1,536	2,880	3,744	5,760	6,000	12,000	12480
	0.2	182	262	397	521	685	1,166	2,187	2,844	4,375	4,557	9,115	9,480
0.2	0.05	180	259	392	515	677	1,152	2,160	2,808	4,320	4,500	9,000	9,360
	0.1	154	221	335	440	579	986	1,849	2,403	3,698	3,852	7,704	8,012
0.1	0.05	91	131	198	260	342	583	1,093	1,422	2,187	2,278	4,557	4,740

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GPK-2001・2003

Features

1. Superior to piston type valve in capacity and performance. Very effective in controlling inlet pressure and flow rate fluctuations.
2. Spherical main valve offers great sealability and great reduction of valve seat leakage (compliant with ANSI Class IV).
3. Remote control makes pressure adjustment easy, and the pressure setting is wide.
4. The GPK-2001 and GPK-2003 can be selected according to the loading air pressure.

GPK-2001 screwed type

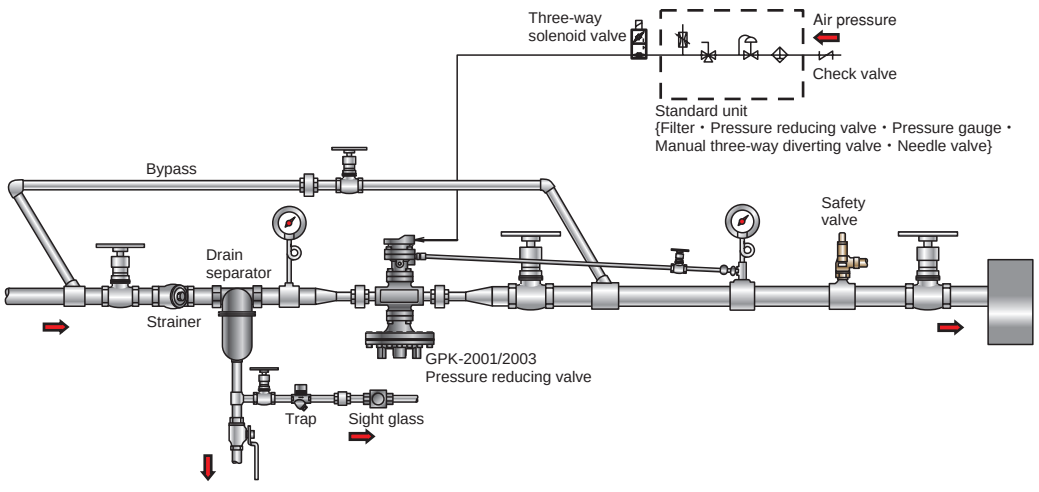
GPK-2003 flanged type

Specifications

Model		GPK-2001	GPK-2003
Application		Steam	
Reduced pressure sensing method		External sensing *	
Inlet pressure	JIS Rc JIS 20K RF	0.1-2.0 MPa	0.25-2.0 MPa
	JIS 10K FF	0.1-1.0 MPa	0.25-1.0 MPa
Reduced pressure		0.05-0.9 MPa (0.85 MPa for JIS 10K)	0.2-1.4 MPa (0.85 MPa for JIS 10K)
		85% or less of inlet pressure (gauge pressure)	
Loading air pressure		Refer to the loading air pressure-set pressure chart.	
Minimum differential pressure		0.05 MPa	
Maximum pressure reduction ratio		20:1	10:1
Maximum temperature		220˚C	
Valve seat leakage		0.01% or less of rated flow	
Material	Body	Ductile cast iron	
	Main valve	Stainless steel	
	Valve seat	Stainless steel	
	Pilot valve	Stainless steel	
	Pilot valve seat	Stainless steel	
	Diaphragm	Stainless steel	
Reduced pressure detection pipe		Copper pipe ϕ 8-2 m	
Connection		JIS Rc screwed JIS 20K RF and 10K FF flanged	

* External sensing is standard. Available with internal sensing type in different specifications. Note that the Cv value of internal sensing type is lower than that of external sensing type.
・Available with ASME or EN flanged.

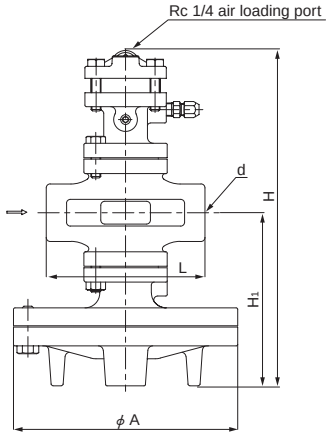
Piping Example



Dimensions (mm) and Weights (kg)

●GPK-2001 screwed type

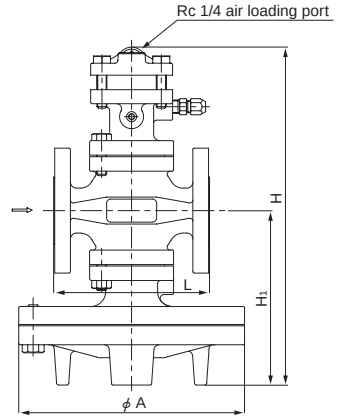
Nominal size	d	L	H1	H	A	Weight
15A	Rc 1/2	150	170	335	200	14.0
20A	Rc 3/4	150	170	335	200	14.0
25A	Rc 1	160	175	341	226	18.5
32A	Rc 1-1/4	180	192	371	226	21.5
40A	Rc 1-1/2	180	192	371	226	21.5
50A	Rc 2	230	216	435	276	33.0



●GPK-2001 flanged type (JIS 20K RF)

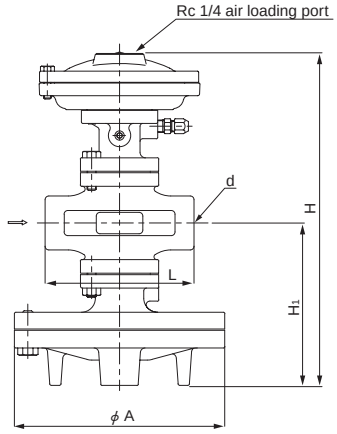
Nominal size	L	H1	H	A	Weight
15A	146 (142)	170	335	200	15.5 (15.3)
20A	146 (142)	170	335	200	16.0 (15.8)
25A	156 (152)	175	341	226	21.0 (20.6)
32A	176 (172)	192	371	226	24.0 (23.4)
40A	196 (192)	192	371	226	24.5 (24.1)
50A	222 (218)	216	435	276	36.0 (35.8)
65A	282 (278)	251	489	352	64.5 (64.2)
80A	302 (294)	264	512	352	71.5 (69.3)
100A	342 (330)	321	595	401	111.0 (107.4)

・The above values in parentheses are the dimensions and weights of JIS 10K FF flanged.



●GPK-2003 screwed type

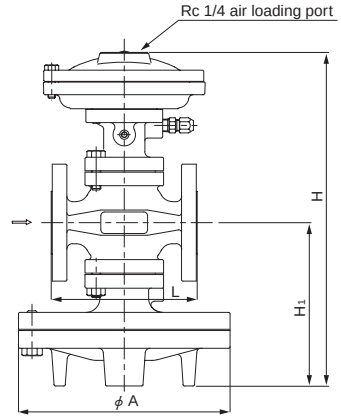
Nominal size	d	L	H1	H	A	Weight
15A	Rc 1/2	150	170	353	200	17.5
20A	Rc 3/4	150	170	353	200	17.5
25A	Rc 1	160	175	359	226	22.0
32A	Rc 1-1/4	180	192	389	226	25.0
40A	Rc 1-1/2	180	192	389	226	25.0
50A	Rc 2	230	216	453	276	36.5



●GPK-2003 flanged type (JIS 20K RF)

Nominal size	L	H1	H	A	Weight
15A	146 (142)	170	353	200	19.0 (18.8)
20A	146 (142)	170	353	200	19.5 (19.3)
25A	156 (152)	175	359	226	24.5 (24.1)
32A	176 (172)	192	389	226	27.5 (27.1)
40A	196 (192)	192	389	226	28.0 (27.6)
50A	222 (218)	216	453	276	39.5 (39.3)
65A	282 (278)	251	507	352	68.0 (67.7)
80A	302 (294)	264	530	352	75.0 (72.8)
100A	342 (330)	321	613	401	114.5 (113.9)

・The above values in parentheses are the dimensions and weights of JIS 10K FF flanged.



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GDK-2000

Features

1. Due to direct acting type the actuating parts are fewer and structure is simple but robust.
2. Spherical main valve offers great sealability and great reduction of valve seat leakage (compliant with ANSI Class IV).
3. Large-size diaphragm ensures high Cv value and distinguished controllability against load fluctuations.
4. Remote operation makes pressure adjustment easy, and the pressure setting is wide.

Flanged type

Specifications

Model		GDK-2000		
Application		Steam		
Reduced pressure sensing method		External sensing		
Inlet pressure		0.1-2.0 MPa		0.1-1.0 MPa
Reduced pressure		0.05-1.4 MPa		0.05-0.9 MPa
		90% or less of inlet pressure (gauge pressure)		
Operation air pressure		Refer to the loading air pressure-set pressure chart.		
Minimum differential pressure		0.05 MPa		
Maximum pressure reduction ratio		10:1		
Maximum temperature		220˚C		
Valve seat leakage		0.01% or less of rated flow		
Material	Body	Ductile cast iron		
	Valve	Stainless steel		
	Valve seat	Stainless steel		
	Diaphragm	Stainless steel		
Reduced pressure sensing pipe		Copper pipe ϕ 8-2 m		
Connection		JIS Rc screwed	JIS 20K RF flanged	JIS 10K FF flanged

・Available with ASME or EN flanged.

Dimensions (mm) and Weights (kg)

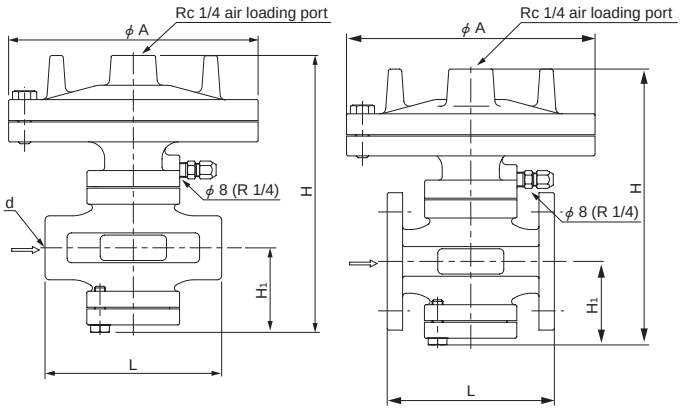
●Screwed type

Nominal size	d	L	H1	H	A	Weight
15A	Rc 1/2	150	74	244	200	12.4
20A	Rc 3/4	150	74	244	200	12.4
25A	Rc 1	160	76	251	226	16.4
32A	Rc 1-1/4	180	90	282	226	19.9
40A	Rc 1-1/2	180	90	282	226	19.9
50A	Rc 2	230	103	319	276	30.5

●Flanged type

Nominal size	L	H1	H	A	Weight
15A	146 (142)	74	244	200	13.9 (13.7)
20A	146 (142)	74	244	200	14.4 (14.2)
25A	156 (152)	76	251	226	19.2 (18.8)
32A	176 (172)	90	282	226	22.4 (22.0)
40A	196 (192)	90	282	226	22.9 (22.5)
50A	222 (218)	103	319	276	33.5 (33.5)
65A	282 (278)	122	373	352	61.8 (61.5)
80A	302 (294)	135	399	352	69.1 (66.9)
100A	342 (330)	167	488	401	108.6 (105.0)

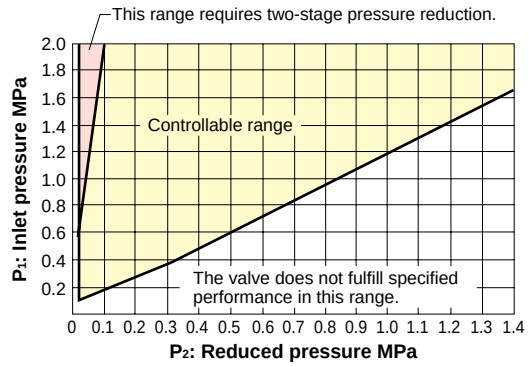
・The above values in parentheses are the dimensions and weights of JIS 10K FF flanged.



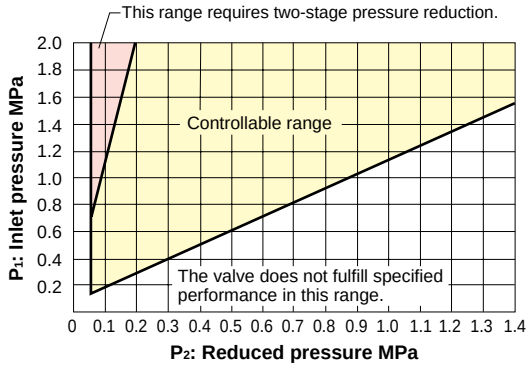
Screwed type　　Flanged type

Specifications Selection Chart

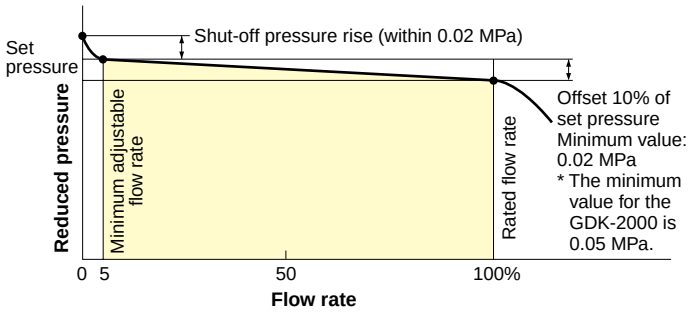
●GPK-2001・2003



●GDK-2000

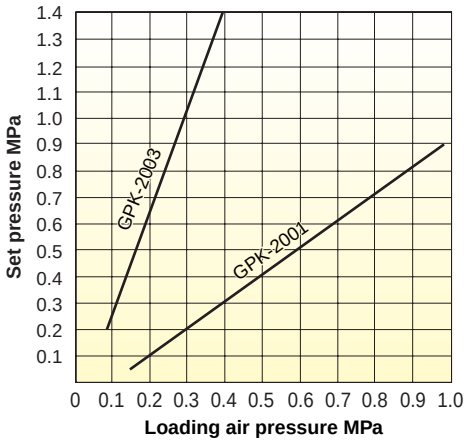


Flow Characteristic Chart



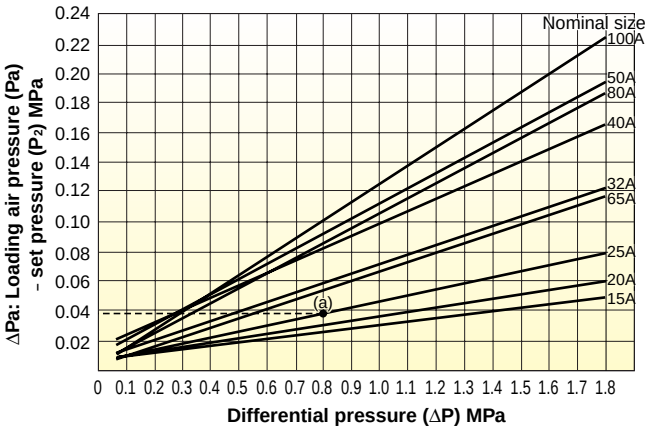
Loading Air Pressure-set Pressure Chart

●GPK-2001・2003



Basically, the set pressure to the loading air pressure is as shown in the chart above. The set pressure is slightly different depending on the working conditions. For the actual use, adjust loading air pressure suitable for the necessary set pressure.

●GDK-2000

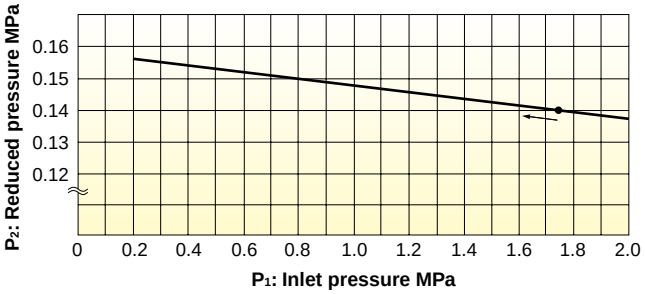


How to read the chart (GDK-2000)

When the nominal size is 25A, the inlet pressure (P_1) is 1.0 MPa, and the reduced pressure (P_2) is 0.2 MPa, the loading air pressure is calculated as follows: Trace up vertically from the differential pressure (ΔP) before and after the pressure reducing valve (1.0 MPa − 0.2 MPa = 0.8 MPa) to find intersection point (a) with the nominal size of 25A. Calculate ΔPa [loading air pressure (Pa) − set pressure (P_2)] = 0.037 MPa by horizontally tracing to the left from intersection point (a). Thus, the loading air pressure is: (Pa) = $\Delta Pa + P_2$ = 0.037 + 0.2 = 0.237 MPa.

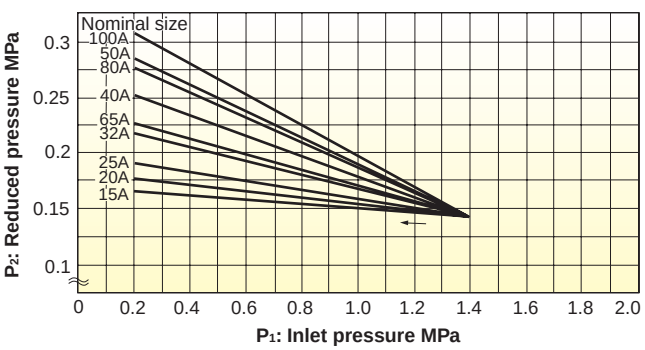
Pressure Characteristic Chart

●GPK-2001・2003



This chart shows variation in reduced pressure when the inlet pressure of 1.75 MPa is changed between 0.3 MPa and 1.0 MPa while the reduced pressure is set at 0.14 MPa.

●GDK-2000



This chart shows variation in reduced pressure when the inlet pressure of 1.4 MPa is changed between 0.2 MPa and 1.4 MPa while the reduced pressure is set at 0.14 MPa.

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CP-2000 Series 〈combination valve〉

Need to use pressure reducing valves, solenoid valves, temperature regulators or its combination for a specific purpose, with large space and great cost for installation . . . Have you ever imagined that it may be helpful if a single valve combines such functions? Yoshitake CP-2000 Series integrates such functions into a single valve to realize space reduction, cost saving and controllability of plural valves without efforts.

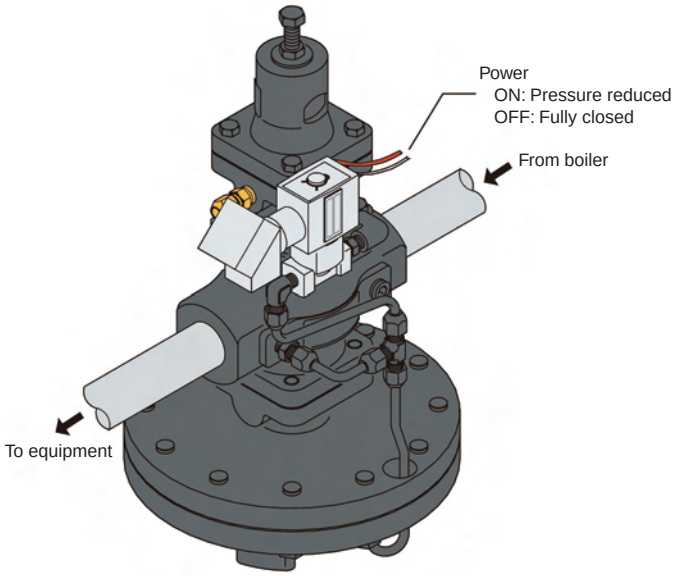
Reliable ON-OFF system by the CP-2001

■CP-2001

Steam is usually supplied only when required. This means that steam is controlled as a batch (intermittent) system. Steam ON/OFF is switched by solenoid valve, however, rapid opening/closing operation of solenoid valve causes various problems to other devices such as pressure reducing valve. To solve such problems, we recommend CP-2001.

〔Control example〕

Solenoid valve ON	P_1 = 1.0 MPa P_2 = 0.2 MPa
Solenoid valve OFF	P_1 = 1.0 MPa P_2 = 0 MPa



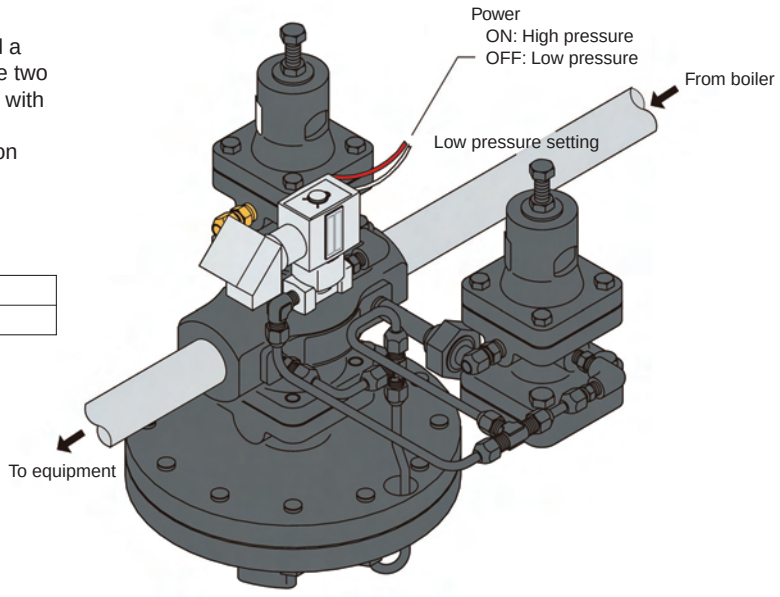
Quicker startup feasible with the CP-2003

■CP-2003

In order to increase the performance and efficiency of the system and to save energy, a high-pressure steam line and a low-pressure steam line are used together. For this purpose two or more pressure valves have been used. Air is discharged with low-pressure steam and then rapidly raised to the intended temperature with high-pressure steam, and regular operation begins with low-pressure steam.
Our CP-2003 can perform these operations alone.

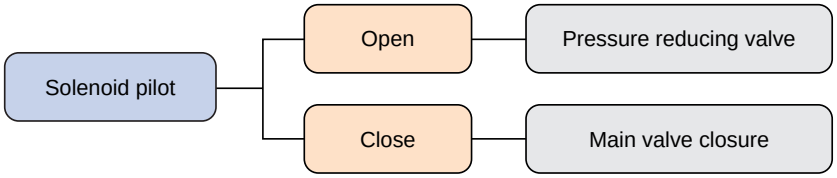
〔Control example〕

Solenoid valve ON	P_1 = 1.0 MPa P_2 = 0.5 MPa
Solenoid valve OFF	P_1 = 1.0 MPa P_2 = 0.2 MPa



■CP-2001

Pressure reducing valve with ON-OFF control



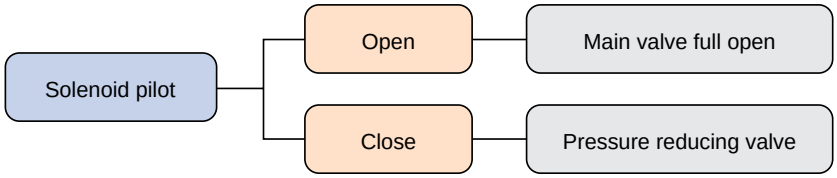
Application		Steam
Inlet pressure		0.1-1.0 MPa
Reduced pressure		0.02-0.15 MPa 0.1-0.85 MPa
Maximum temperature		183˚C
Actuation of solenoid valve		Normally closed
Rated voltage		AC 100 V, 50 / 60 Hz available AC 200 V, 50 / 60 Hz available
Connection		JIS Rc screwed JIS 10K flanged
Material	Main valve body	Ductile cast iron
	Main valve, valve seat	Stainless steel
	Diaphragm	Stainless steel
Nominal size		Screwed: 15A-50A Flanged: 15A-100A

・Please contact us about other specifications.

CP-2001 flanged type

■CP-2002

Pressure reducing valve and full-open valve



Application		Steam
Inlet pressure		0.1-1.0 MPa
Reduced pressure		0.02-0.15 MPa 0.1-0.85 MPa
Maximum temperature		183˚C
Actuation of solenoid valve		Normally closed
Rated voltage		AC 100 V, 50 / 60 Hz available AC 200 V, 50 / 60 Hz available
Connection		JIS Rc screwed JIS 10K flanged
Material	Main valve body	Ductile cast iron
	Main valve, valve seat	Stainless steel
	Diaphragm	Stainless steel
Nominal size		Screwed: 15A-50A Flanged: 15A-100A

・Please contact us about other specifications.

CP-2002 flanged type

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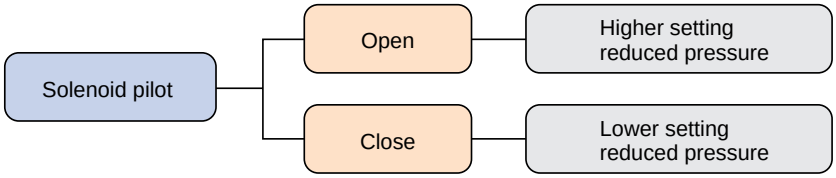
■CP-2003

Two-point switching of reduced pressure



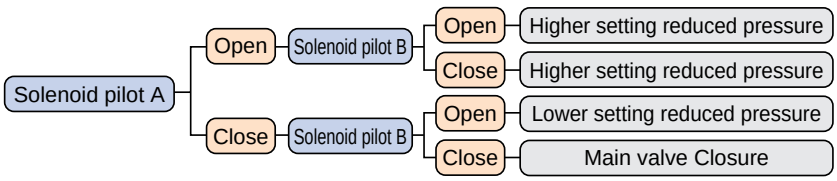
Application		Steam
Inlet pressure		0.1-1.0 MPa
Reduced pressure		0.02-0.15 MPa 0.1-0.85 MPa
Maximum temperature		183˚C
Actuation of solenoid valve		Normally closed
Rated voltage		AC 100 V, 50 / 60 Hz available AC 200 V, 50 / 60 Hz available
Connection		JIS Rc screwed JIS 10K flanged
Material	Main valve body	Ductile cast iron
	Main valve, valve seat	Stainless steel
	Diaphragm	Stainless steel
Nominal size		Screwed: 15A-50A Flanged: 15A-100A

・Please contact us about other specifications.

CP-2003 flanged type

■CP-2004

Switching of reduced pressure with ON-OFF control



Application		Steam
Inlet pressure		0.1-1.0 MPa
Reduced pressure		0.02-0.15 MPa 0.1-0.85 MPa
Maximum temperature		183˚C
Actuation of solenoid valve		Normally closed
Rated voltage		AC 100 V, 50 / 60 Hz available AC 200 V, 50 / 60 Hz available
Connection		JIS Rc screwed JIS 10K flanged
Material	Main valve body	Ductile cast iron
	Main valve, valve seat	Stainless steel
	Diaphragm	Stainless steel
Nominal size		Screwed: 15A-50A Flanged: 15A-100A

・Please contact us about other specifications.

CP-2004 flanged type

■CP-2005

Temperature regulating valve with pressure control

Pressure pilot → Temperature pilot → Temperature regulating valve while reducing pressure

Application	Heating fluid	Steam
	Heated fluid	Water, Oil, Liquid
Inlet pressure		0.1-2.0 MPa
Reduced pressure		0.02-0.15 MPa 0.1-1.4 MPa
Maximum temperature		220˚C
Bulb maximum pressure		1.0 MPa
Temperature adjustment range		-8 – 183˚C
Connection		JIS Rc screwed JIS 10K/20K flanged
Material	Main valve body	Ductile cast iron
	Main valve, valve seat	Stainless steel
	Diaphragm	Stainless steel
Nominal size		Screwed: 15A-50A Flanged: 15A-100A

・Please contact us about other specifications.

CP-2005 flanged type

■CP-2006

Temperature regulating valve with ON-OFF control

Solenoid pilot → Open → Temperature regulating valve
Solenoid pilot → Close → Main valve closure

Application	Heating fluid	Steam
	Heated fluid	Water, Oil, Liquid
Maximum pressure		1.0 MPa
Maximum temperature		183˚C
Actuation of solenoid valve		Normally closed
Rated voltage		AC 100 V, 50 / 60 Hz available AC 200 V, 50 / 60 Hz available
Bulb maximum pressure		1.0 MPa
Temperature adjustment range		-8 – 183˚C
Connection		JIS Rc screwed JIS 10K flanged
Material	Body	Ductile cast iron
	Main valve, valve seat	Stainless steel
	Diaphragm	Stainless steel
Nominal size		Screwed: 15A-50A Flanged: 15A-100A

・Please contact us about other specifications.

CP-2006 flanged type

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GP-2000CS

Features

1. Unique patented diaphragms enable superior durability.
2. 200 mesh integral strainer prevents most scale problem on the pilot valve.
3. The GP-2000 Series, Yoshitake's original pilot-operated valve, has proven its contribution to various systems.
4. Spherical valve provides a tight seal meeting ANSI Class Ⅳ.

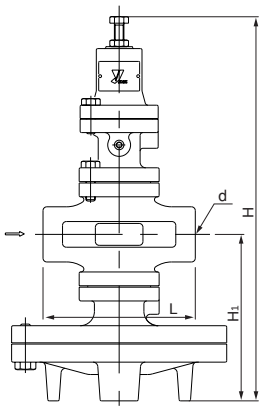
Screwed type

Flanged type

Specifications

Model		GP-2000CS			
Application		Steam			
Max. inlet pressure		3.0 MPa	1.0 MPa	2.0 MPa	3.0 MPa
Reduced pressure		0.02-0.15 MPa 0.1-1.4 MPa 1.3-2.0 MPa	0.02-0.15 MPa 0.1-0.85 MPa	0.02-0.15 MPa 0.1-1.4 MPa 1.3-1.7 MPa	0.02-0.15 MPa 0.1-1.4 MPa 1.3-2.0 MPa
		85% or less of inlet pressure (gauge pressure)			
Minimum differential pressure		0.05 MPa			
Maximum pressure reduction ratio		20:1			
Maximum temperature		260˚C			
Valve seat leakage		0.01% or less of rated flow rate			
Material	Body	Cast carbon steel			
	Main valve, valve seat	Stellite overlaid stainless steel			
	Pilot valve, pilot valve seat	Stainless steel			
	Diaphragm	Stainless steel			
Connection		JIS Rc screwed	JIS 10K FF flanged	JIS 20K RF flanged	JIS 30K RF flanged

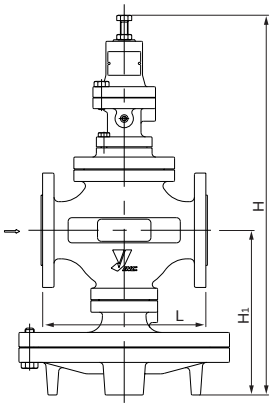
・Available with ASME or EN flanged.



Dimensions (mm) and Weights (kg)

●JIS Rc screwed

Nominal size	d	L	H	H1	Weight
15A	Rc 1/2	150	398	170	16
20A	Rc 3/4	150	398	170	16
25A	Rc 1	160	404	175	21.5
32A	Rc 1-1/4	180	434	192	24
40A	Rc 1-1/2	180	434	192	24
50A	Rc 2	230	498	216	37



●JIS 30K RF flanged

Nominal size	L	H	H1	Weight
15A	240	398	170	18
20A	240	398	170	18
25A	250	404	175	24.5
32A	260	434	192	27
40A	260	434	192	27
50A	230	498	216	42
65A	294	552	251	75
80A	314	575	264	84
100A	358	658	321	133

・15A to 40A are welded flanged.

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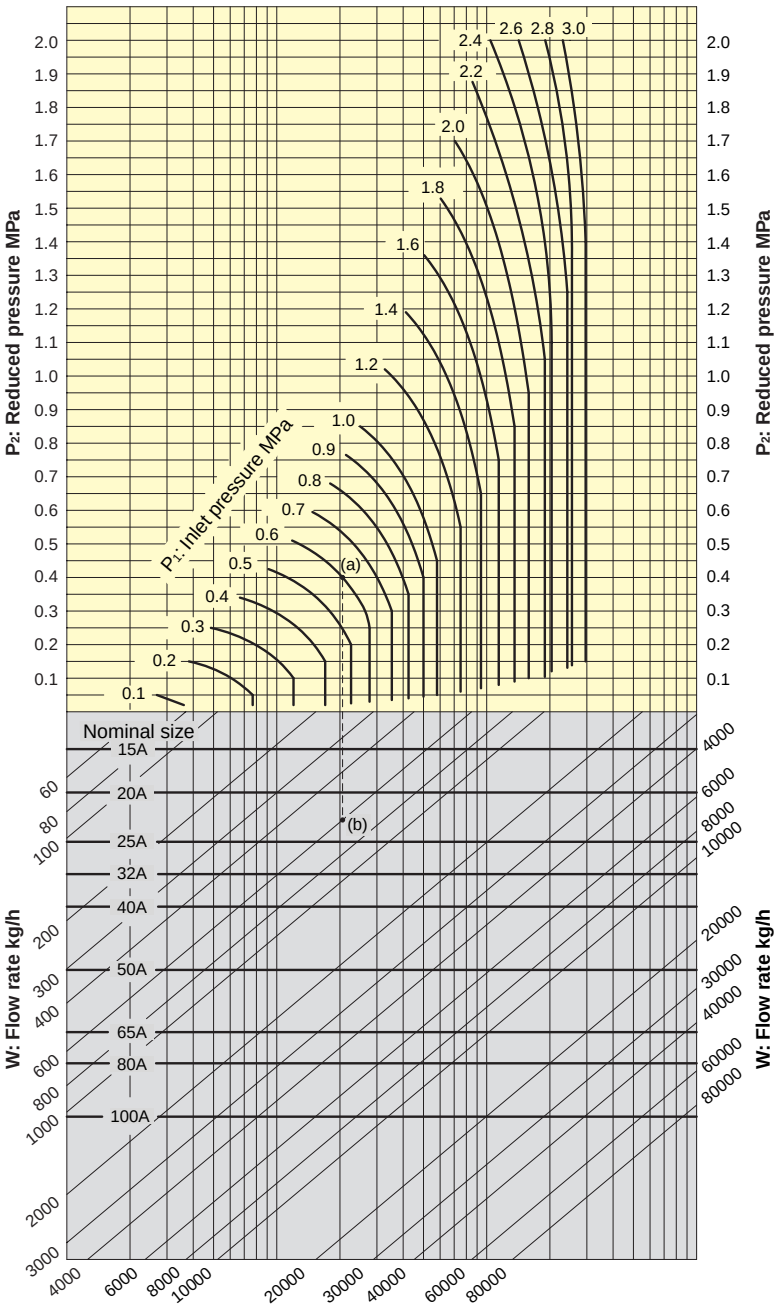
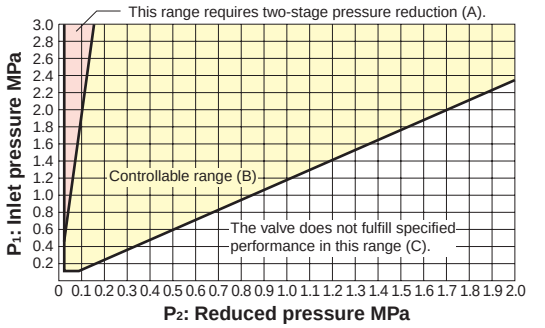
Nominal Sizes Selection Chart (For Steam)



[Example]
When selecting the nominal size of a pressure reducing valve whose inlet pressure (P_1), reduced pressure (P_2), and flow rate are 0.6 MPa, 0.4 MPa, and 600 kg/h, respectively, first find intersection point (a) of the inlet pressure of 0.6 MPa and the reduced pressure of 0.4 MPa. Trace down vertically from this intersection point to find intersection point (b) with the flow rate of 600 kg/h. Since intersection point (b) lies between nominal sizes 20A and 25A, select the larger one, 25A.

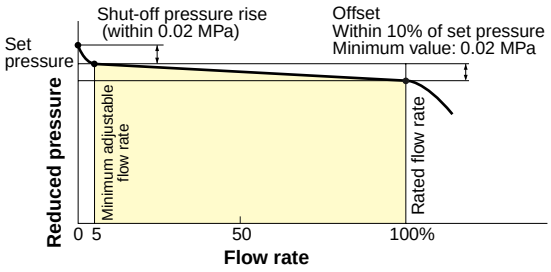
- Set the safety factor at 80 to 90%.

Specifications Selection Chart



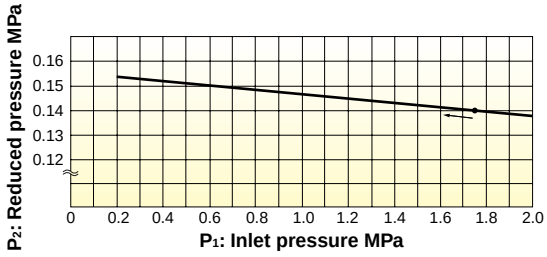
Based on the selection chart above, select a pressure reducing valve in the optimum manner. On the selection chart, first find the intersection point of the inlet pressure (P_1) and the reduced pressure (P_2). Two-stage pressure reduction is required if the intersection point lies in range (A), or the pressures are controllable with a single pressure reducing valve if the intersection point is within range (B). The valve does not fulfill specified performance in range (C). To adopt two-stage pressure reduction, separate two pressure reducing valves as far away from each other as possible.

Flow Characteristic Chart



When selecting a nominal size, set the flow rate at 80 to 90% of the rated flow rate, allowing for the pressure loss and heat loss of the stop valve, strainer, etc. to be used before or after the pressure reducing valve. To enable the pressure reducing valve to show a maximum flow characteristic, do not select a small piping diameter, as a countermeasure against the effect of piping resistance. Select a nominal size based on the nominal sizes selection chart.

Pressure Characteristic Chart



This chart shows variation in reduced pressure when the inlet pressure of 1.75 MPa is changed between 0.2 MPa and 2.0 MPa while the reduced pressure is set at 0.14 MPa.

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GP-1000

GP-1000·1002

GP-1200

GP-1010

GP-1001

Features

1. Significantly improved workability and durability compared with conventional pressure reducing valves.
2. Spherical main valve offers great sealability and great reduction of valve seat leakage (compliant with ANSI Class IV).
3. Compliant with SHASE-S106 Pressure Reducing Valves (by the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan).
4. Simple and robust internal structure.

Description of GP-1000 Series model code

GP-1000□

- □ (4th): Material, S: trim parts made of stainless steel, SS: wetted parts made of stainless steel, AS: all stainless steel
- □ (3rd): 0: standard, 1: equipped with a handle, 2: for low pressure
- □ (2nd): 0: flanged, 1: screwed
- □ (1st): 0: standard, 2: air loading type

Specifications

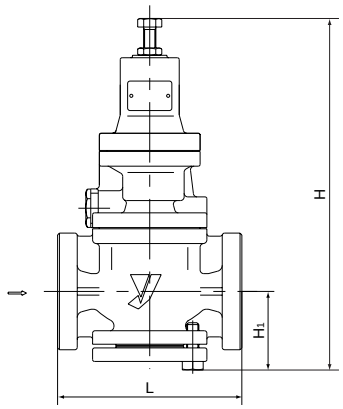
Model		GP-1000·1001	GP-1002	GP-1010	GP-1200	GP-1210
Application		Steam				
Inlet pressure		0.1-1.0 MPa	0.1-0.5 MPa	0.1-1.0 MPa		
Reduced pressure		0.05-0.9 MPa	0.03-0.15 MPa	0.05-0.9 MPa		
		90% or less of inlet pressure (gauge pressure)				
Minimum differential pressure		0.05 MPa				
Maximum pressure reduction ratio		20:1				
Maximum temperature		220˚C				
Valve seat leakage		0.01% or less of rated flow				
Material	Body	Ductile cast iron				
	Valve, valve seat	Stainless steel				
	Piston, cylinder	Brass or bronze				
Connection		JIS 10K FF flanged		JIS Rc screwed	JIS 10K FF flanged	JIS Rc screwed

・Available with trim parts (piston and cylinder) made of stainless steel (GP-□□□□S).

Dimensions (mm) and Weights (kg)

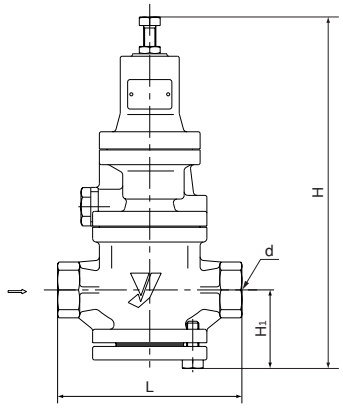
●GP-1000・1002

Nominal size	L	H1	H	Weight
15A	150	64	285	8.0
20A	155	64	285	8.5
25A	160	67	300	10.0
32A	190	82	323	14.0
40A	190	82	323	14.5
50A	220	93	347	20.0
65A	245	100	357	30.0
80A	290	122	404	35.0
100A	330	144	450	52.5



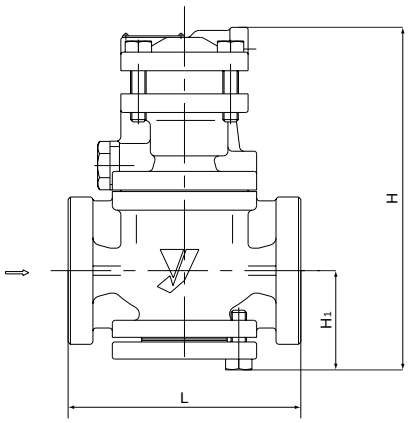
●GP-1010

Nominal size	d	L	H1	H	Weight
15A	Rc 1/2	150	64	285	7.0
20A	Rc 3/4	155	64	285	7.0
25A	Rc 1	160	67	300	8.5
32A	Rc 1-1/4	190	82	323	12.0
40A	Rc 1-1/2	190	82	323	12.5
50A	Rc 2	220	93	347	18.0



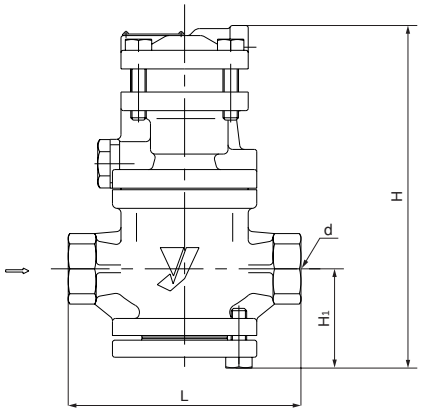
●GP-1200

Nominal size	L	H1	H	Weight
15A	150	64	220	8.0
20A	155	64	220	8.5
25A	160	67	235	10.0
32A	190	82	258	14.0
40A	190	82	258	14.5
50A	220	93	282	20.0
65A	245	100	292	30.0
80A	290	122	339	35.0
100A	330	144	385	52.5



●GP-1210

Nominal size	d	L	H1	H	Weight
15A	Rc 1/2	150	64	220	7.0
20A	Rc 3/4	155	64	220	7.0
25A	Rc 1	160	67	235	8.5
32A	Rc 1-1/4	190	82	258	12.0
40A	Rc 1-1/2	190	82	258	12.5
50A	Rc 2	220	93	282	18.0



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GP-1000SS·1000AS

Features

1. Improved corrosion resistance by stainless steel wetted parts (GP-1000SS) or all stainless steel made (GP-1000AS).
2. Spherical main valve offers great sealability and great reduction of valve seat leakage (compliant with ANSI Class IV).
3. Compliant with SHASE-S106 Pressure Reducing Valves (by the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan).

Specifications

		Stainless steel wetted parts	All stainless steel made
Model		**GP-1000SS**	**GP1000AS**
Application		Steam	
Inlet pressure		0.1-1.0 MPa	
Reduced pressure		0.05-0.9 MPa	
		90% or less of inlet pressure (gauge pressure)	
Minimum differential pressure		0.05 MPa	
Maximum pressure reduction ratio		20:1	
Maximum temperature		220˚C	
Valve seat leakage		0.01% or less of rated flow	
Material	Body	Cast stainless steel	
	Valve, valve seat	Stainless steel	
	Piston, cylinder	Stainless steel	
Connection		JIS 10K FF flanged	

GP-1000AS

Dimensions (mm) and Weights (kg)

Nominal size	L	H1	H	Weight
15A	150	288 (298)	67	8.3 (8.5)
20A	155	288 (298)	67	8.8 (9.0)
25A	160	303 (313)	70	10.5 (10.7)
32A	190	326 (336)	85	14.8 (15.0)
40A	190	326 (336)	85	15.3 (15.5)
50A	220	350 (360)	96	20.8 (21.0)
65A	245	360 (370)	103	27.4 (27.6)
80A	290	407 (417)	125	38.8 (39.0)
100A	330	454 (464)	148	54.5 (54.7)

・The values in parentheses are the dimensions and weights of the GP-1000AS.

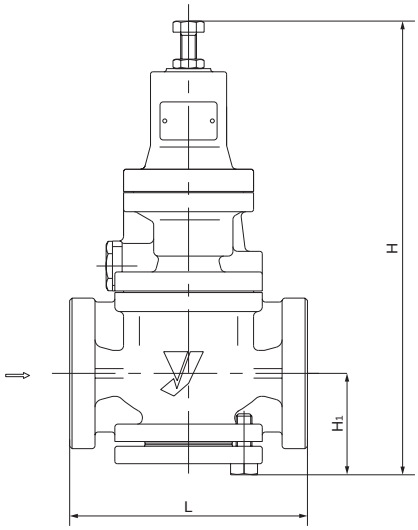


Table of Corrected Cv Values

●Table of rated Cv values (Cv value when the correction factor C = 1)

Nominal size	15A	20A	25A	32A	40A	50A	65A	80A	100A
Cv values	1	2.3	4	6.5	9	16	25	36	64

Note) When the inlet pressure is more than 0.7 MPa and the pressure reduction ratio is more than 10:1, calculate the corrected Cv value by multiplying the rated Cv value by the correction factor C obtained from Fig. 1.

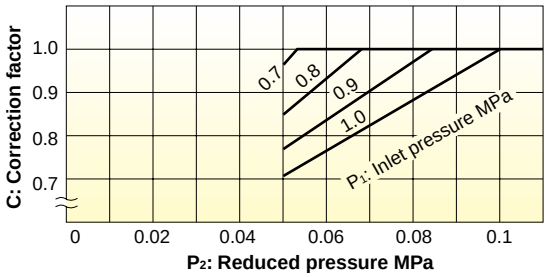
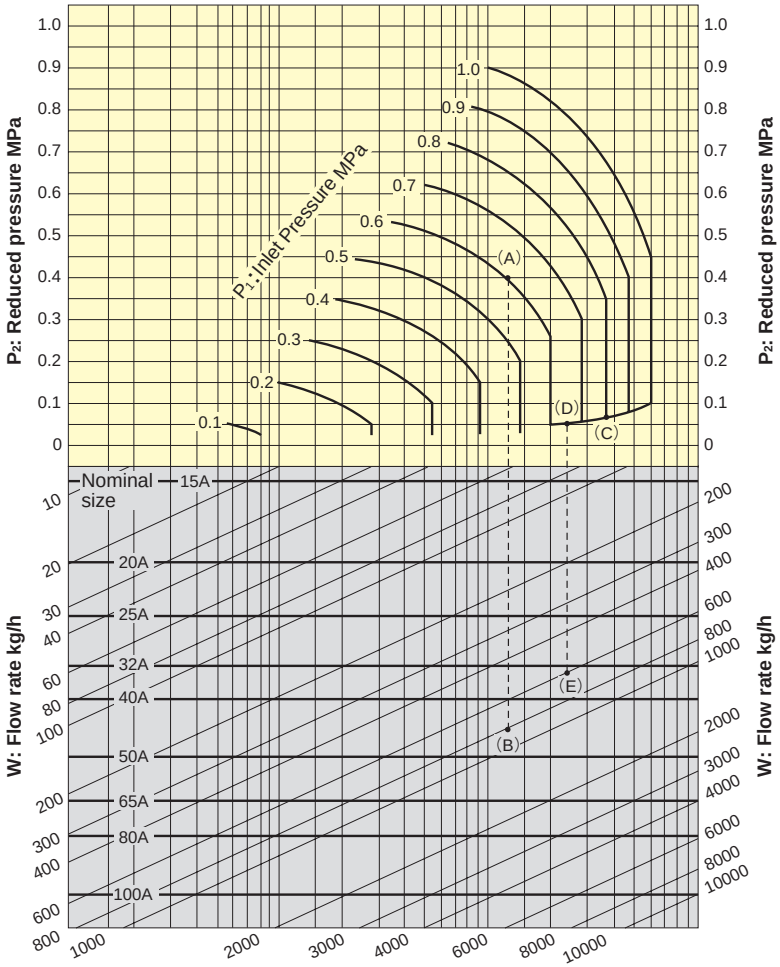


Fig. 1: Corrected Cv value

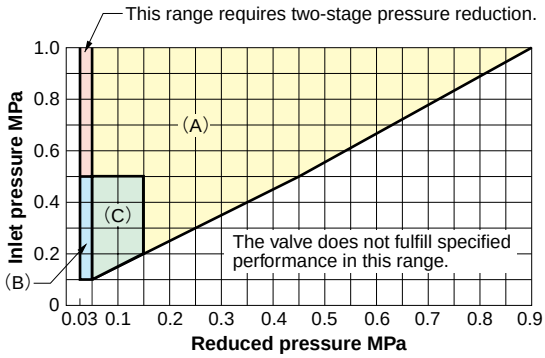
Nominal Sizes Selection Chart (For Steam)



[Example 1]
When selecting the nominal size of a pressure reducing valve whose inlet pressure (P_1), reduced pressure (P_2), and steam flow rate are 0.6 MPa, 0.4 MPa, and 800 kg/h, respectively, first find intersection point (A) of the inlet pressure of 0.6 MPa and the reduced pressure of 0.4 MPa. Trace down vertically from this intersection point to find intersection point (B) with the flow rate of 800 kg/h. Since intersection point (B) lies between nominal sizes 40A and 50A, select the larger one, 50A.

[Example 2]
When selecting the nominal size of a pressure reducing valve whose inlet pressure (P_1), reduced pressure (P_2), and steam flow rate are 0.8 MPa, 0.05 MPa, and 600 kg/h, respectively, first find intersection point (C) of the inlet pressure of 0.8 MPa and the diagonal line. Trace down to the left from this intersection point to find intersection point (D) with the reduced pressure of 0.05 MPa.
Trace down vertically from intersection point (D) to find intersection point (E) with the flow rate of 600 kg/h. Since intersection point (E) lies between nominal sizes 32A and 40A, select the larger one, 40A.
・Set the safety factor at 80 to 90%.

Specifications Selection Chart



Find the intersection point of the inlet and reduced pressures. If the intersection point is within any of the ranges shown in the chart above, the pressures are controllable.
・Range (A) and (C): GP-1000 Series except GP-1002 and 1012
・Range (B) and (C): GP-1002 and 1012

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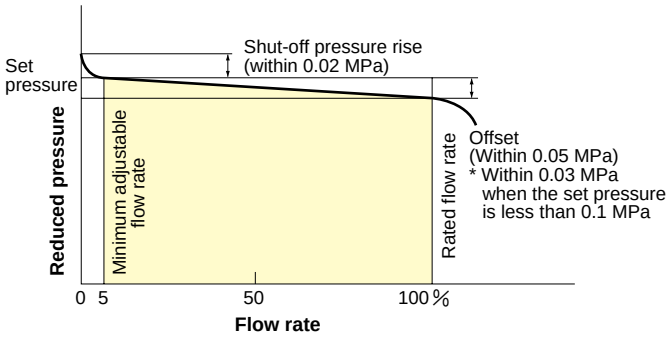
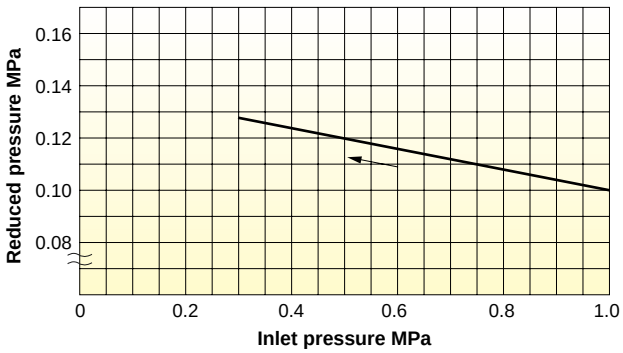
Flow Characteristic Chart

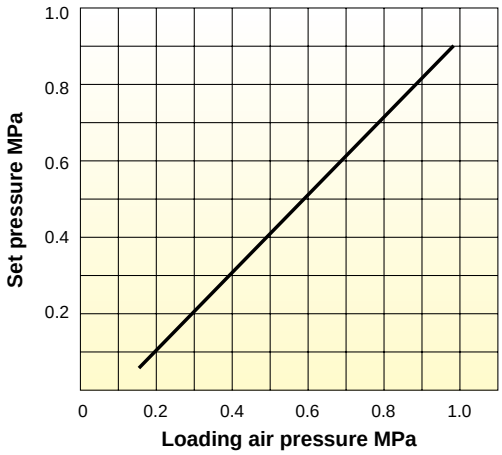


Pressure Characteristic Chart



This chart shows variation in reduced pressure when the inlet pressure of 1.0 MPa is changed between 0.3 MPa and 1.0 MPa while the reduced pressure is set at 0.1 MPa.

Loading Air Pressure-set Pressure Chart (GP-1200・1210)



Basically, the set pressure to the loading air pressure is as shown on the left.
The set pressure is slightly different depending on the conditions. For the actual use, adjust the loading air pressure suitable for necessary set pressure.

GP-1000 Flow Rate Table

(kg/h)

P_1 (MPa)	P_2 (MPa)	15A	20A	25A	32A	40A	50A	65A	80A	100A
1	0.05 *	92	212	369	600	831	1,478	2,310	3,326	5,913
	0.1-0.4	132	303	528	858	1,188	2,112	3,300	4,752	8,448
	0.5	127	292	508	825	1,143	2,033	3,176	4,574	8,132
	0.6	116	268	467	760	1,052	1,871	2,923	4,210	7,484
	0.7	104	239	416	676	936	1,664	2,601	3,745	6,659
	0.8	87	200	348	566	784	1,394	2,179	3,137	5,578
	0.9	63	145	252	410	568	1,010	1,578	2,273	4042
0.9	0.1-0.4	120	276	480	780	1,080	1,920	3,000	4,320	7,680
	0.5	110	253	441	716	992	1,764	2,756	3,969	7,056
	0.6	98	226	393	639	885	1,574	2,460	3,543	6,299
	0.7	82	190	330	537	744	1,323	2,067	2,976	5,292
	0.8	60	138	240	390	540	961	1,501	2,162	3,844
0.8	0.1-0.3	108	248	432	702	972	1,728	2,700	3,888	6,912
	0.4	103	237	412	670	928	1,650	2,578	3,712	6,600
	0.5	92	212	369	600	832	1,479	2,311	3,328	5,916
	0.6	77	179	311	506	701	1,247	1,949	2,806	4,989
	0.7	56	130	227	369	511	909	1,420	2,045	3,636
0.7	0.1-0.3	96	220	384	624	864	1,536	2,400	3,456	6,144
	0.4	86	197	344	559	774	1,377	2,151	3,098	5,508
	0.5	72	167	291	474	656	1,166	1,823	2,625	4,667
	0.6	53	122	213	346	480	854	1,334	1,921	3,416
0.6	0.1-0.2	84	193	336	546	756	1,344	2,100	3,024	5,376
	0.3	79	182	316	514	712	1,266	1,979	2,850	5,067
	0.4	67	155	270	438	607	1,080	1,687	2,430	4,321
	0.5	49	114	198	322	447	795	1,242	1,788	3,180
0.5	0.1-0.2	72	165	288	468	648	1,152	1,800	2,592	4,608
	0.3	61	141	246	400	554	986	1,540	2,218	3,944
	0.4	45	105	182	297	411	731	1,142	1,645	2,925
0.4	0.1	60	138	240	390	540	960	1,500	2,160	3,840
	0.2	55	126	220	358	496	882	1,378	1,984	3,528
	0.3	41	95	165	268	372	661	1,033	1,488	2,646
0.3	0.1	48	110	192	312	432	768	1,200	1,728	3,072
	0.2	36	83	145	237	328	583	911	1,312	2,333
0.2	0.1	30	70	123	200	277	493	770	1,109	1,972
0.1	0.05	18	41	72	118	164	291	455	656	1,166

* When the inlet pressure is more than 0.7 MPa and the pressure reduction ratio is more than 10:1, calculate the corrected Cv value multiplying the rated Cv value by the correction factor C obtained from Fig.1.

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GP-1000EN・1000H

Features

1. The GP-1000EN can be replaced easily from existing valve because it complies with face-to-face dimensions of the EN standard.
2. Respond very sharply to the fluctuation of inlet pressure and the change of the flow rate, so that the reduced pressure can be kept at a constant level.
3. Pressure adjustment is easy, and the set pressure range is wide.
4. Compliant with the standard of SHASE-S106 Pressure Reducing Valves (by the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan).

Specifications

Model		GP-1000EN	GP-1000H
Application		Steam	
Inlet pressure		0.1-1.6 MPa	
Reduced pressure		(A) 0.05-0.9 MPa (B) 0.9-1.4 MPa	
		90% or less of inlet pressure (gauge pressure)	
Minimum differential pressure		0.05 MPa	
Maximum pressure reduction ratio		20:1	
Maximum temperature		220˚C	
Valve seat leakage		0.01% or less of rated flow rate	
Material	Body	Ductile cast iron	
	Main valve, valve seat	Stainless steel	
	Pilot valve, pilot valve seat	Stainless steel	
	Piston, cylinder	Stainless steel	
	Diaphragm	Stainless steel	
Connection		EN1092 PN25	JIS 16K FF flanged ASME Class 300 flanged

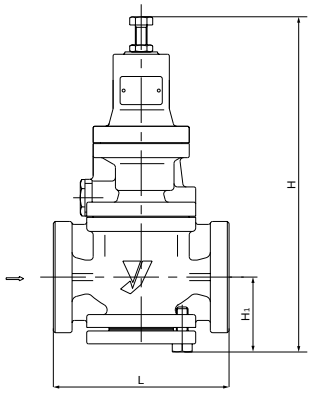
・Available with JIS Rc screwed (GP-1010H).

GP-1000H

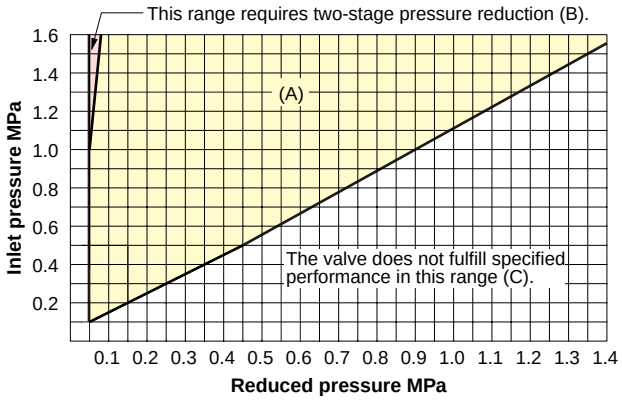
Dimensions (mm) and Weights (kg)

Nominal size	L		H	H1	Weight	
	GP-1000EN	GP-1000H			GP-1000EN	GP-1000H
15A	150	150 (-)	291	64	8.0	8.0 (-)
20A	150	155 (-)	291	64	8.5	8.5 (-)
25A	160	160 (160)	300	67	10.0	10.0 (10.0)
32A	180	190 (180)	333	82	14.0	14.0 (14.0)
40A	200	190 (200)	333	82	15.5	14.5 (15.5)
50A	230	220 (230)	353	93	21.0	20.0 (21.0)
65A	290	245 (278)	357	100	30.0	30.0 (30.0)
80A	310	290 (310)	404	122	37.0	35.0 (37.0)
100A	350	330 (350)	450	144	57.0	52.5 (57.0)

・The values in parentheses are the dimensions of ASME Class 300 flanged.



Specifications Selection Chart



Find the intersection point of the inlet and reduced pressures. If the intersection point is within range (A) in the chart, the pressures are controllable with a single pressure reducing valve. They can be controlled by two-stage pressure reduction if the intersection point is within range (B). The valve does not fulfill specified performance in range (C).

Table of Corrected Cv Values

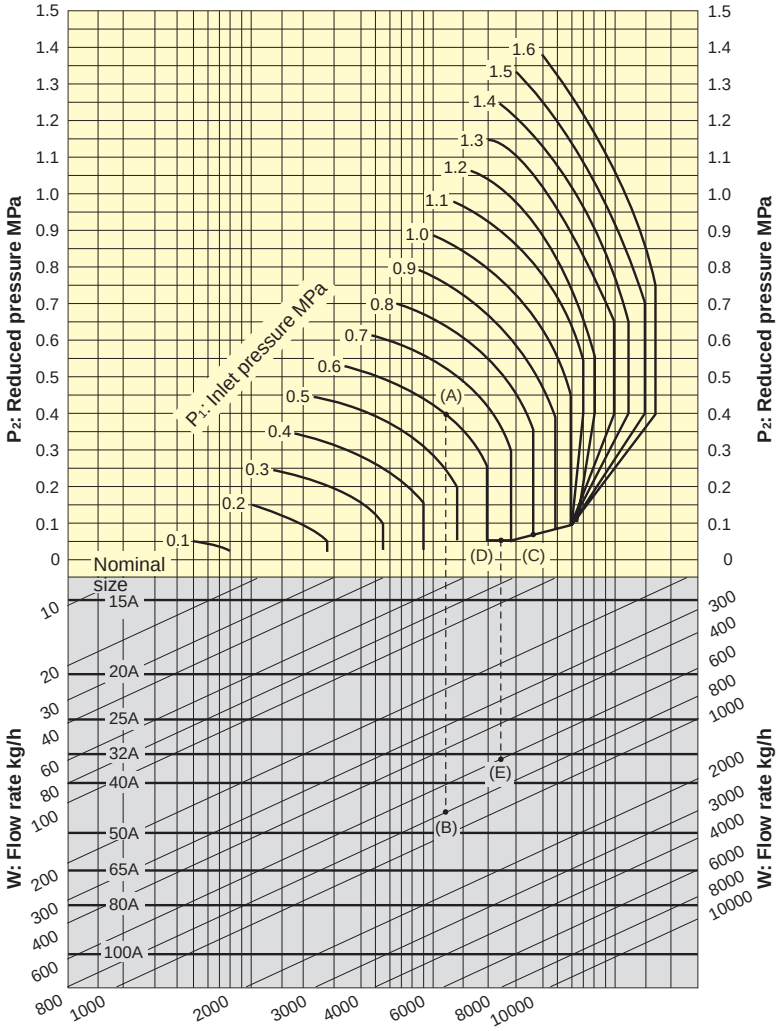
●Table of rated Cv values (Cv value when the correction factor C = 1)

Nominal size	15A	20A	25A	32A	40A	50A	65A	80A	100A
Cv values	1	2.3	4	6.5	9	16	25	36	64

Note) When the reduced pressure is within either of the ranges shown below, calculate the corrected Cv value by multiplying the rated Cv value by the correction factor C obtained from the Fig.1.

- When the inlet pressure is between 0.7 MPa and 1.0 MPa and the pressure reduction ratio is more than 10:1
- When the inlet pressure is more than 1.0 MPa and the reduced pressure is 0.4 MPa or less

Nominal Sizes Selection Chart (For Steam)



[Example 1]
When selecting the nominal size of a pressure reducing valve whose inlet pressure (P_1), reduced pressure (P_2), and steam flow rate are 0.6 MPa, 0.4 MPa, and 800 kg/h, respectively, first find intersection point (A) of the inlet pressure of 0.6 MPa and the reduced pressure of 0.4 MPa. Trace down vertically from this intersection point to find intersection point (B) with the flow rate of 800 kg/h. Since intersection point (B) lies between nominal sizes 40A and 50A, select the larger one, 50A.

[Example 2]
When selecting the nominal size of a pressure reducing valve whose inlet pressure (P_1), reduced pressure (P_2), and steam flow rate are 0.8 MPa, 0.05 MPa, and 600 kg/h, respectively, first find intersection point (C) of the inlet pressure of 0.8 MPa and the diagonal line. Trace down to the left from this diagonal line to find intersection point (D) with the reduced pressure of 0.05 MPa. Trace down vertically from intersection point (D) to find intersection point (E) with the flow rate of 600 kg/h. Since intersection point (E) lies between nominal sizes 32A and 40A, select the larger one, 40A.

- Set the safety factor at 80 to 90%.

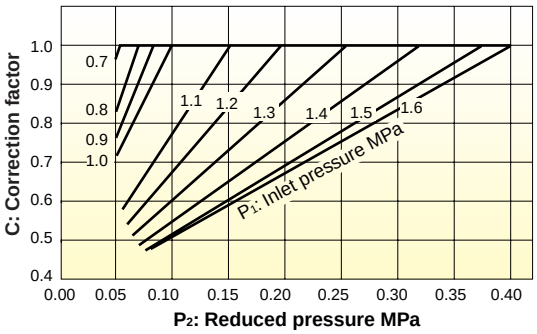
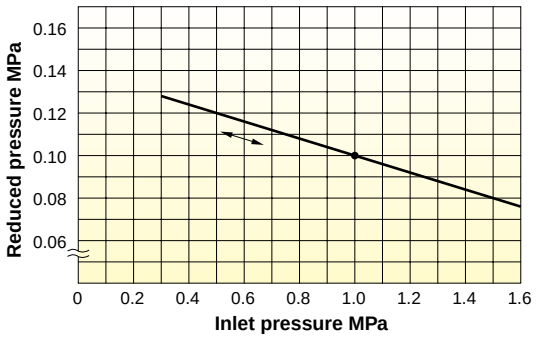


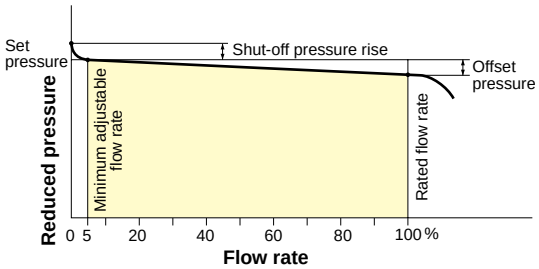
Fig. 1: Corrected Cv value

Pressure Characteristic Chart



This chart shows variation in reduced pressure when the inlet pressure of 1.0 MPa is changed between 0.3 MPa and 1.6 MPa while the reduced pressure is set at 0.1 MPa.

Flow Characteristic Chart



- Shut-off pressure rise: Within 0.02 MPa
- Offset pressure: Within 0.03 MPa
  (when the set pressure is between 0.05 MPa and 0.1 MPa)
  Within 0.05 MPa
  (when the set pressure is more than 0.1 MPa and 1.4 MPa or less)

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GP-27

Features

1. Large capacity and distinguished performance. Can respond very immediately to the fluctuation of inlet pressure and the change of flow rate to keep reduced pressure at a constant level.
2. Quite simple structure, less prone to fail and easy to handle.
3. Easy pressure adjustment and wide set pressure range.
4. No need for auxiliary power (air or electricity). Compactness makes plumbing work easy.
5. Compliant with SHASE-S106 Pressure Reducing Valves (by the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan).

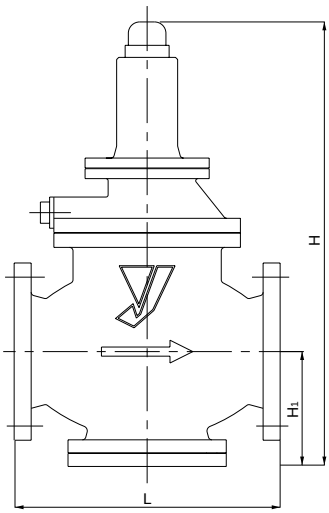
Specifications

Model		**GP-27**
Application		Steam
Inlet pressure		0.1-1.0 MPa
Reduced pressure		0.03-0.8 MPa
		80% or less of inlet pressure (absolute pressure)
Minimum differential pressure		0.07 MPa
Maximum pressure reduction ratio		10:1
Maximum temperature		220˚C
Valve seat leakage		0.05% or less of rated flow rate
Material	Body	Ductile cast iron
	Main valve, valve seat	Stainless steel
	Pilot valve, pilot valve seat	Stainless steel
	Piston, cylinder	Bronze
	Diaphragm	Stainless steel
Connection		JIS 10K FF flanged

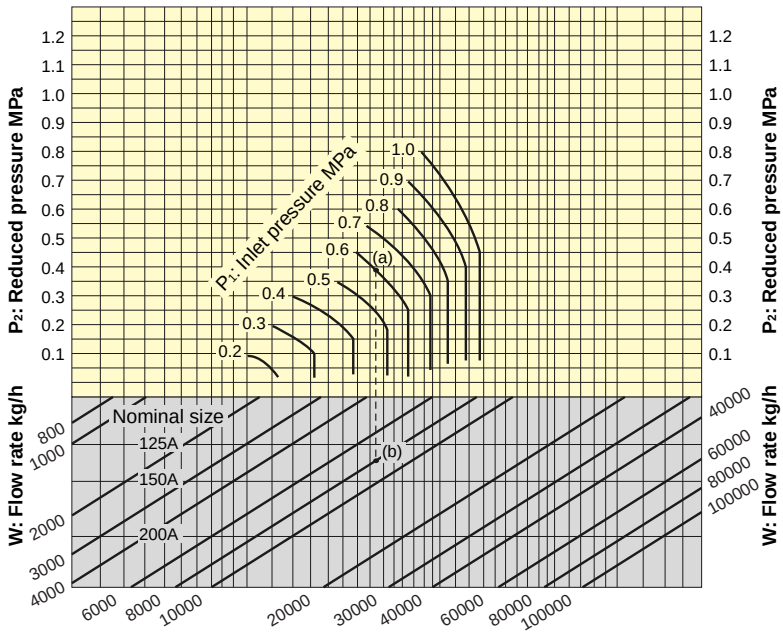
・Available with trim parts (piston and cylinder) made of stainless steel.

Dimensions (mm) and Weights (kg)

Nominal size	L	H	H1	Weight
125A	375	627	162	90.0
150A	420	686	190	135.0
200A	490	765	220	204.0



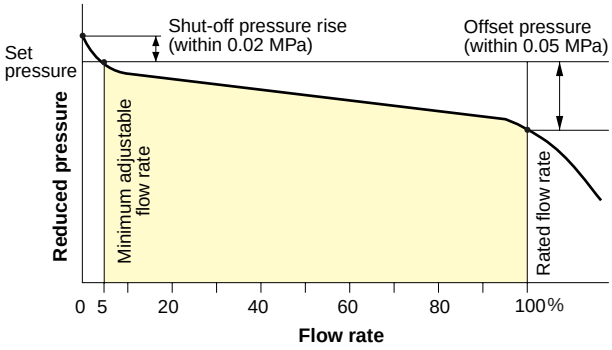
Nominal Sizes Selection Chart (For Steam)



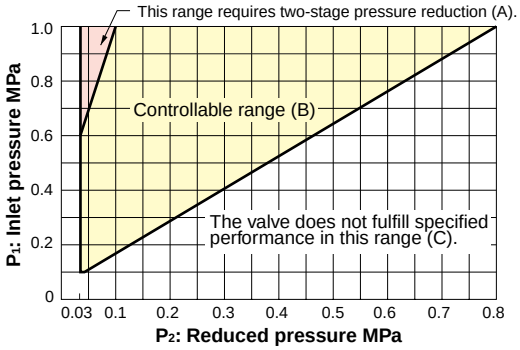
[Example]
When selecting the nominal size of a pressure reducing valve whose inlet pressure (P_1), reduced pressure (P_2), and steam flow rate are 0.6 MPa, 0.4 MPa, and 8000 kg/h, respectively, first find intersection point (a) of the inlet pressure of 0.6 MPa and the reduced pressure of 0.4 MPa. Trace down vertically from this intersection point to find intersection point (b) with the flow rate of 8000 kg/h. Since intersection point (b) lies between nominal sizes 125A and 150A, select the larger one, 150A.

- Set the safety factor at 80 to 90%.

Flow Characteristic Chart

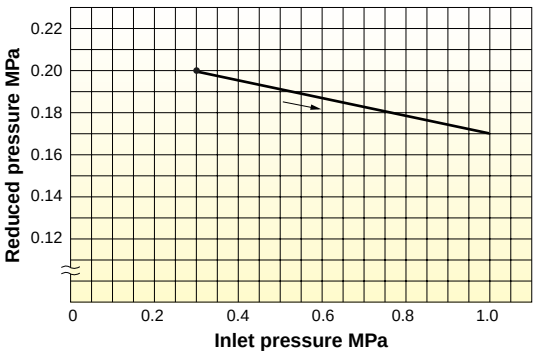


Specifications Selection Chart



Based on the selection chart shown above, select a pressure reducing valve in the optimum manner. On the selection chart, find the intersection point of the inlet pressure (P_1) and the reduced pressure (P_2). Two-stage pressure reduction is required if the intersection point lies in range (A), or the pressures are controllable with a single pressure reducing valve if the intersection point is within range (B). The valve does not fulfill specified performance in range (C). To adopt two-stage pressure reduction, separate two pressure reducing valves as far away from each other as possible (preferably at least 3 meters).

Pressure Characteristic Chart



This chart shows variation in reduced pressure when the inlet pressure of 0.3 MPa is changed between 0.3 MPa and 1.0 MPa while the reduced pressure is set at 0.2 MPa.

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GD-30・30S

Features

1. Sophisticated design, compact and lightweight.
2. Simple structure, great durability and easy maintenance.
3. Easy to install due to screwed connections.
4. Pressure adjustment is handle-operated without any tool.
5. Highly wear-resistance and durability of stainless steel made valve and valve seat.
6. A screen (60 mesh) is incorporated to protect the valve and valve seat from dirt.
7. Excellent workability accomplished by the external pressure type bellows of pressure sensing part.

GD-30

GD-30S

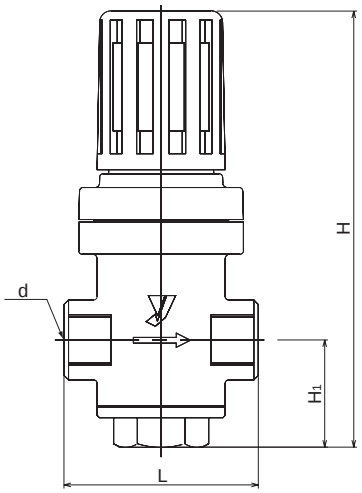
Specifications

Model		GD-30	GD-30S
Nominal size		15A-25A 40A・50A	15A-25A
Application		Steam	
Inlet pressure		1.7 MPa or less	2.0 MPa or less
Reduced pressure		(A) 0.02-0.1 MPa	
		(B) 0.05-0.4 MPa	
		(C) 0.35-1.0 MPa	
Minimum differential pressure		0.05 MPa	
Maximum pressure reduction ratio		10:1	
Maximum temperature		210˚C	220˚C
Valve seat leakage		0.1% or less of rated flow rate	
Material	Body	Cast bronze	Cast stainless steel (SCS14A)
	Valve, valve seat	Stainless steel	
	Bellows	Phosphor bronze	Stainless steel
Connection		JIS Rc screwed	

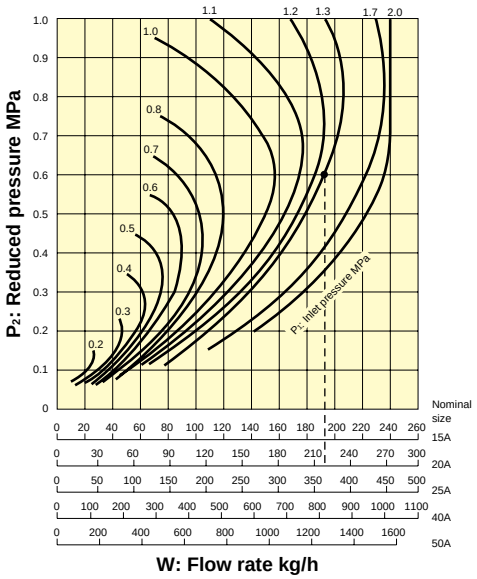
Dimensions (mm) and Weights (kg)

Nominal size	d	L	H	H1	Weight
15A	Rc 1/2	80	191 (196)	47 (50.5)	1.9
20A	Rc 3/4	85	191 (196)	47 (50.5)	1.9
25A	Rc 1	95	191 (196)	47 (50.5)	2.0
40A	Rc 1-1/2	140	307	77	10.1
50A	Rc 2	150	307	77	10.4

・The values in parentheses are the dimensions of the GD-30S.



Nominal Sizes Selection Chart (For Steam)



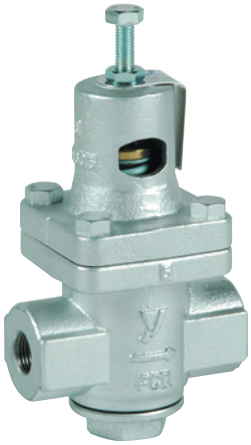
[Example]
When selecting the nominal size of a pressure reducing valve whose inlet pressure (P_1), reduced pressure (P_2), and flow rate are 1.3 MPa, 0.6 MPa, and 200 kg/h, respectively, first find the intersection point of the inlet pressure of 1.3 MPa and the reduced pressure of 0.6 MPa. Trace down vertically from this intersection point to find the nominal size with a flow rate of 200 kg/h or over. In this case, the nominal size is 20A.
Note) The nominal sizes selection chart is based on measured data. As you can see, there is no specific relationship between the pressure difference and the flow rate in the chart above, and it is, therefore, impossible to calculate a fixed Cv value.
・Set the safety factor at 80 to 90%.

GD-45P·45

Features

1. Compact and lightweight.
2. Simple structure and easy maintenance.
3. Applicable to inlet pressure of up to 2.0 MPa.
4. A screen (60 mesh) is incorporated to protect the valve and valve seat from dirt.
5. Excellent workability accomplished by the external pressure type bellows of pressure sensing part.
6. Pressure adjustment is handle-operated without any tool (GD-45P).

GD-45P



GD-45

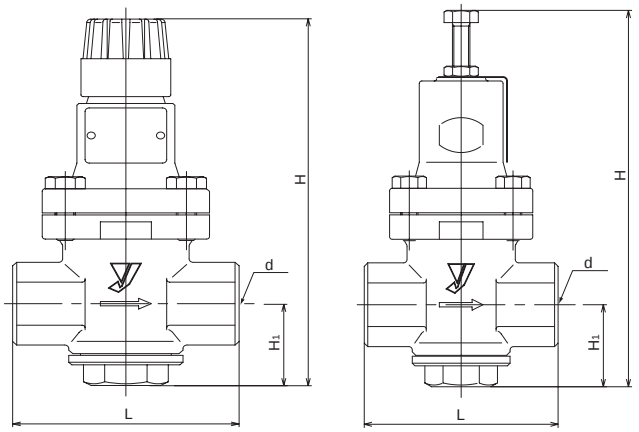
Specifications

Model		GD-45P·45
Application		Steam
Inlet pressure		2.0 MPa or less
Reduced pressure		(A) 0.02-0.1 MPa
		(B) 0.05-0.4 MPa
		(C) 0.35-1.0 MPa
Minimum differential pressure		0.05 MPa
Maximum pressure reduction ratio		10:1
Maximum temperature		220˚C
Valve seat leakage		0.1% or less of rated flow rate
Material	Body	Ductile cast iron
	Valve, valve seat	Stainless steel
	Bellows	Phosphor bronze
Connection		JIS Rc screwed

Dimensions (mm) and Weights (kg)

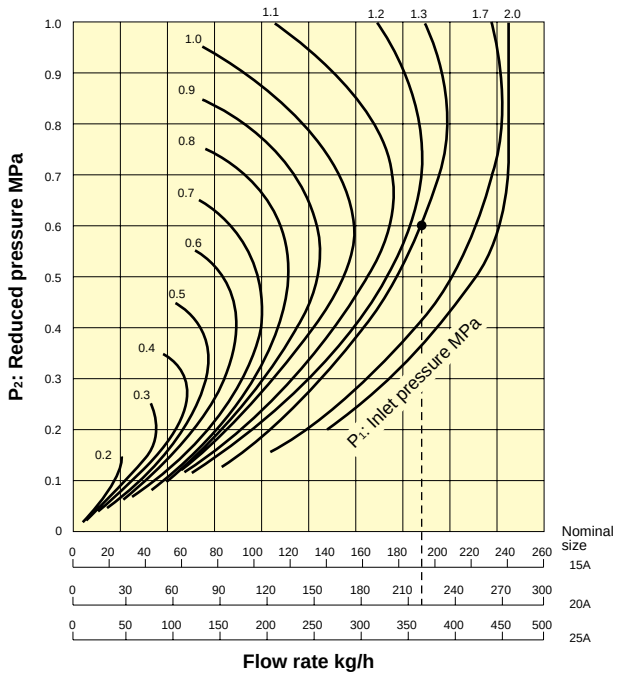
Nominal size	d	L	H1	H	Weight
15A	Rc 1/2	111	47	213 (216)	3.2
20A	Rc 3/4	111	47	213 (216)	3.2
25A	Rc 1	111	47	213 (216)	3.2

・The above values in parentheses are the dimensions of the GD-45.



GD-45P　　GD-45

Chart for Selecting Nominal Sizes



[Example]
When selecting the nominal size of a pressure reducing valve whose inlet pressure (P_1), reduced pressure (P_2), and flow rate are 1.3 MPa, 0.6 MPa, and 200 kg/h, respectively, first find the intersection point of the inlet pressure of 1.3 MPa and the reduced pressure of 0.6 MPa. Trace down vertically from this intersection point to find the nominal size with a flow rate of 200 kg/h or over. In this case, the nominal size is 20A.
・Set the safety factor at 80 to 90%.

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GD-6N

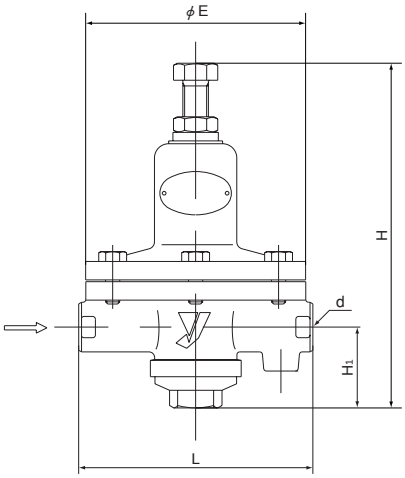
Features

1. High accurate controllability of reduced pressure even at small flow rate.
2. Simple in structure, less prone to fail and easy to maintain.
3. Compact and lightweight.
4. Easy to install due to screwed connections.
5. Highly wear-resistance and durability of stainless steel made valve and valve seat. A screen (60 mesh) is incorporated to protect the valve and valve seat from dirt such as pipe scale and pipe chips.

Specifications

Model		GD-6N
Application		Steam
Inlet pressure		1.0 MPa or less
Reduced pressure		(A) 0.02-0.1 MPa (B) 0.1-0.4 MPa
Minimum differential pressure		0.05 MPa
Maximum pressure reduction ratio		10:1
Maximum temperature		220˚C
Valve seat leakage		0.1% or less of rated flow rate
Material	Body	Ductile cast iron
	Valve, valve seat	Stainless steel
	Diaphragm	Stainless steel
Connection		JIS Rc screwed

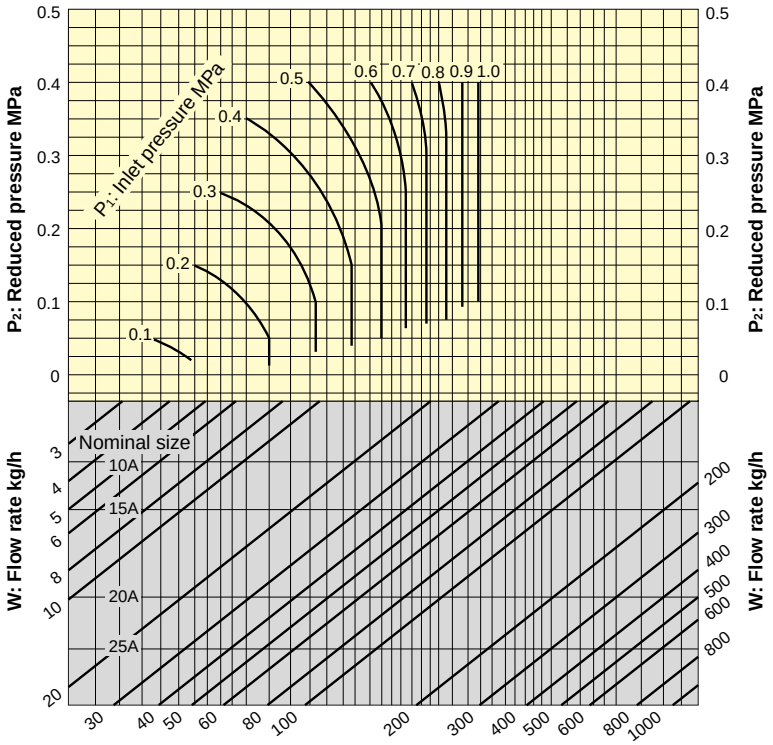
・Available with stainless steel wetted parts and all stainless steel made.



Dimensions (mm) and Weights (kg)

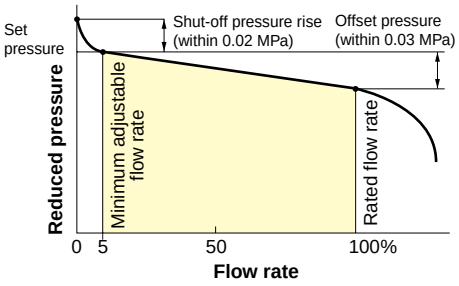
Nominal size	d	L	H	H1	E	Weight
10A	Rc 3/8	165	243	57	155	5.5
15A	Rc 1/2	165	243	57	155	5.5
20A	Rc 3/4	185	267	76	175	8.2
25A	Rc 1	185	267	76	175	8.2

Nominal Sizes Selection Chart (For Steam)

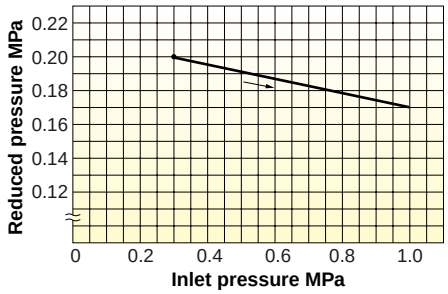


・Set the safety factor at 80 to 90%.

Flow Characteristic Chart



Pressure Characteristic Chart



This chart shows variation in reduced pressure when the inlet pressure of 0.3 MPa is changed between 0.3 MPa and 1.0 MPa while the reduced pressure is set at 0.2 MPa.

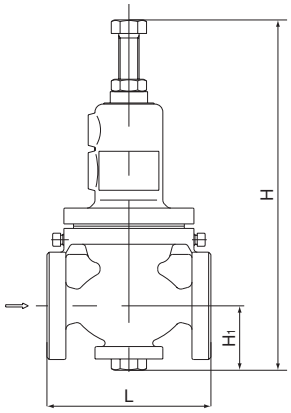
GD-200・200H・200C

Features

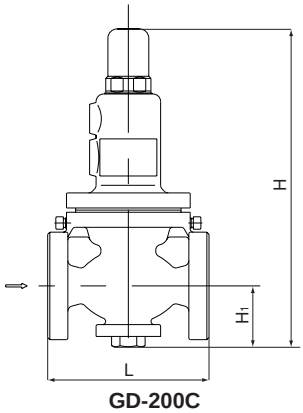
1. Pressure balance structure can keep the reduced pressure at a constant level without being affected by inlet pressure.
2. Highly wear-resistance and durability of stainless steel made valve seat.
3. Maintenance and inspection can be conducted easily by disassembling simply from the upper side.
4. A rubber disc prevents leakage when the valve is closed.
5. The GD-200C provides excellent corrosion resistance due to inner and outer body surface coated with Nylon 11.

GD-200・200H

GD-200C



GD-200・200H



GD-200C

Specifications

Model		GD-200	GD-200C	GD-200H
Application		Cold and hot water, Oil (kerosene, heavy oils A and B), Air, Other non-dangerous fluids		
Inlet pressure		1.0 MPa or less		2.0 MPa or less
Reduced pressure		15A-80A (A) 0.05-0.25 MPa (B) 0.26-0.7 MPa 100A-150A (A) 0.05-0.25 MPa (B) 0.26-0.5 MPa		15A-50A (A) 0.05-0.25 MPa (B) 0.26-0.7 MPa (C) 0.5-1.0 MPa 65A-80A (A) 0.05-0.25 MPa (B) 0.26-0.7 MPa (C) 0.5-0.9 MPa 100A-150A (A) 0.05-0.25 MPa (B) 0.26-0.5 MPa (C) 0.5-0.75 MPa
Minimum differential pressure		0.05 MPa		
Maximum pressure reduction ratio		10:1		
Minimum adjustable flow rate		Water: 5 L/min Air: 10 m³/h (standard condition)		
Application temperature		5-80˚C	5-60˚C	5-80˚C
Fluid viscosity		600 cSt or less		
Material	Body	Ductile cast iron		
	Valve seat	Stainless steel		
	Valve disc	NBR		
	Diaphragm	NBR		
	Connection	JIS 10K FF flanged		JIS 20K RF flanged
Inside surface treatment of body		15A-100A: Electrodeposition coating 125A-150A: Tar-based coating (black) or electrodeposition coating	Nylon 11 (inside and outside surfaces of body)	15A-100A: Electrodeposition coating 125A-150A: Tar-based coating (black) or electrodeposition coating

・Available with FKM type (except for the GD-200H (C) of 65A to 150A).
・Available with pressure gauge.
・Available with the GD-200HS for flushing water.

Dimensions (mm) and Weights (kg)

Nominal size	L	H		H1		Weight	
		GD-200・200H	GD-200C	GD-200・200H	GD-200C	GD-200・200H	GD-200C
15A	145	310	296	57		8.2	8.3
20A	150	310	296	57		8.2	8.3
25A	150	333	318	67		10.0	10.1
32A	195	397	398	76		17.3	17.4
40A	195	397	398	76		17.3	17.4
50A	195	415	412	81		19.2	19.3
65A	270	555	573	110	113	40.0	40.1
80A	270	582	598	125	128	43.7	43.8
100A	308	645	666	143	146	70.7	70.8
125A	380 (384)	849	875	179	182	144.0 (145.0)	144.1
150A	400 (404)	918	930	204	207	173.0 (175.0)	173.1

・The above values in parentheses are the dimensions and weights of the GD-200H.

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GD-20

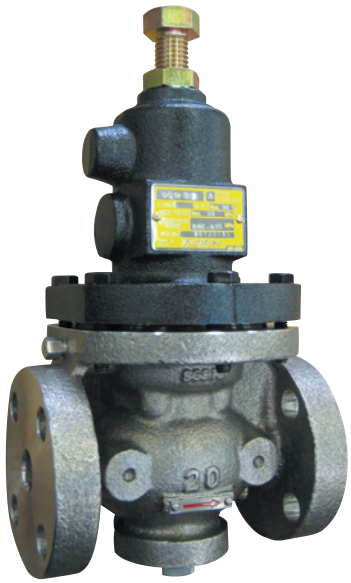
Features

1. Pressure balance structure can keep the reduced pressure at a constant level without being affected by inlet pressure.
2. Available with stainless steel wetted parts and all stainless steel made.
3. Valve disc prevents leakage when the valve is closed.

Specifications

Model		Stainless steel wetted parts	All stainless steel made
Application		Cold and hot water, Oil (kerosene, heavy oils A and B), Air, Other non-dangerous fluids	
Inlet pressure		1.0 MPa or less	
Reduced pressure		15A-80A (A) 0.05-0.25 MPa (B) 0.26-0.7 MPa 100A (A) 0.05-0.25 MPa (B) 0.26-0.5 MPa	15A-25A (A) 0.05-0.2 MPa (B) 0.21-0.6 MPa 32A-50A (A) 0.05-0.2 MPa (B) 0.21-0.46 MPa
Minimum differential pressure		0.05 MPa	
Maximum pressure reduction ratio		10:1	
Application temperature		5-80˚C	
Fluid viscosity		600 cSt or less	
Material	Body	Cast Stainless steel	
	Valve seat	Stainless steel	
	Valve disc	NBR	
	Diaphragm	NBR	
Connection		JIS 10K FF flanged	

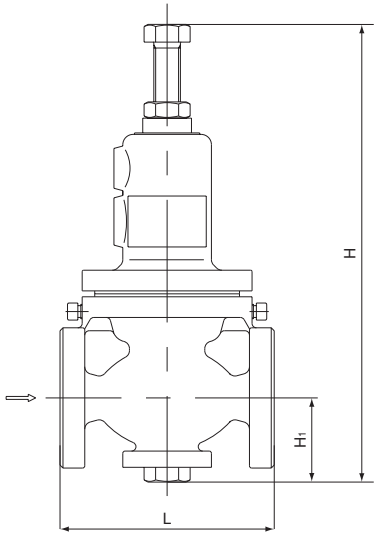
・Available with FKM.



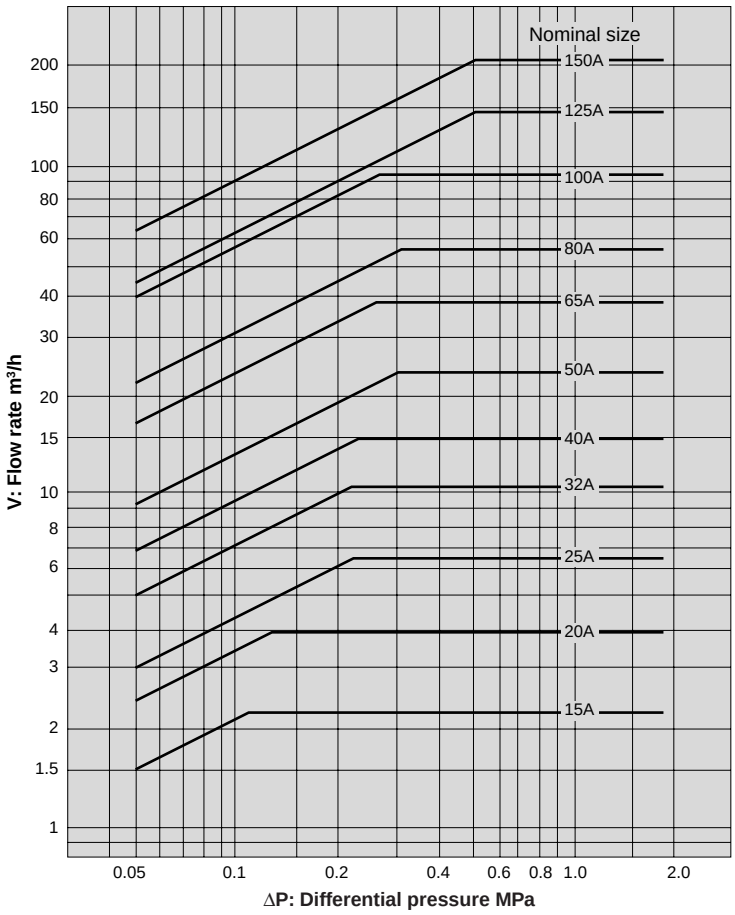
Dimensions (mm) and Weights (kg)

Nominal size	L	H		H_1	Weight	
		Stainless steel wetted parts	All stainless steel made		Stainless steel wetted parts	All stainless steel made
15A	145	310	297	57	9.8	10.6
20A	150	310	297	57	9.8	10.6
25A	150	333	320	67	12.0	13.0
32A	195	397	397	76	20.7	22.5
40A	195	397	397	76	20.7	22.5
50A	195	415	415	81	23.0	25.0
65A	270	555	555	110	48.0	52.0
80A	270	582	582	125	52.4	56.8
100A	308	645	645	143	84.0	91.0

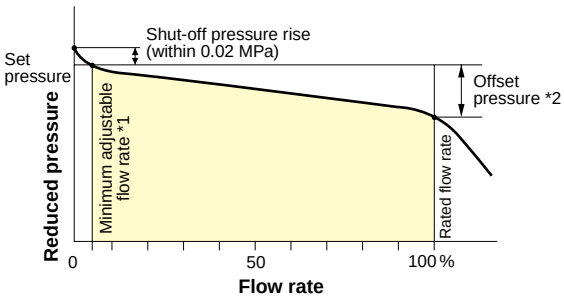
・Please contact us about availability of 65A to 100A.



Nominal Sizes Selection Chart (For Water)



Flow Characteristic Chart

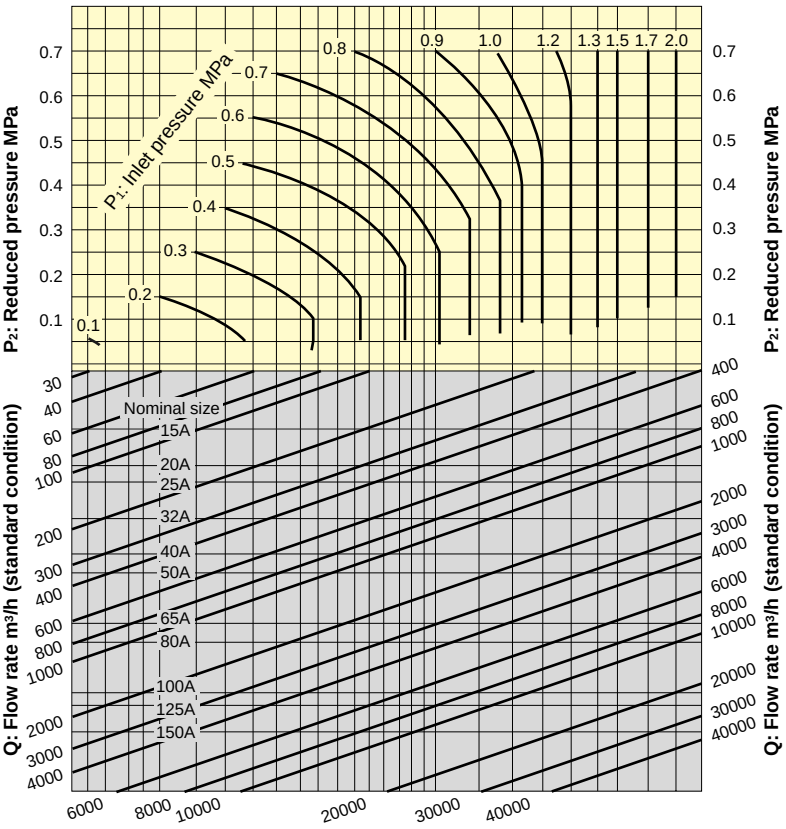


*1 Minimum adjustable flow rate
For water: 5 L/min
For air: 10 m³/h (standard condition)

*2 Offset pressure

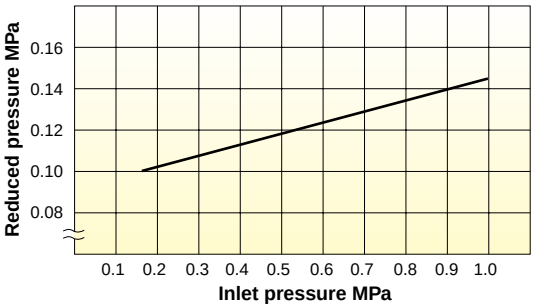
Nominal size	Pressure range	Offset pressure
15-100A	(A), (B)	Within 0.05 MPa
	(C)	Within 0.11 MPa
125,150A	(A)	Within 0.05 MPa
	(B)	Within 0.07 MPa
	(C)	Within 0.11 MPa

Nominal Sizes Selection Chart (For Air)



・ Set the safety factor at 80 to 90%.

Pressure Characteristic Chart



This chart shows variation in reduced pressure when the inlet pressure of 1.0 MPa is changed between 0.15 MPa and 1.0 MPa while the reduced pressure is set at 0.10 MPa.

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GD-200·GD-200H·GD-20 Flow Rate Table for Liquid

(m³/h)

P1 (MPa)	P2 (MPa)	15A	20A	25A	32A	40A	50A	65A	80A	100A	125A	150A
2.0	0.2-1.0	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	145.3	209.2
1.9	0.19-1.0	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	145.3	209.2
1.8	0.18-1.0	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	145.3	209.2
1.7	0.17-1.0	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	145.3	209.2
1.6	0.16-1.0	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	145.3	209.2
1.5	0.15-1.0	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	145.3	209.2
1.4	0.14-0.9	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	145.3	209.2
	1	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	130.0	187.1
1.3	0.15-0.8	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	145.3	209.2
	0.9	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	130.0	187.1
	1	2.3	4.0	6.4	10.0	15.4	24.0	42.0	54.0	93.2	112.5	162.1
1.2	0.12-0.7	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	145.3	209.2
	0.8	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	130.0	187.1
	0.9	2.3	4.0	6.4	10.0	15.4	24.0	42.0	54.0	93.2	112.5	162.1
	1	2.3	4.0	6.1	9.8	14.7	19.6	34.3	44.1	83.3	91.9	132.3
1.1	0.11-0.6	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	145.3	209.2
	0.7	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	130.0	187.1
	0.8	2.3	4.0	6.4	10.0	15.4	24.0	42.0	54.0	93.2	112.5	162.1
	0.9	2.3	4.0	6.1	9.8	14.7	19.6	34.3	44.1	83.3	91.9	132.3
	1	2.2	3.5	4.3	6.9	10.4	13.9	24.3	31.2	58.9	65.0	93.6
1	0.1-0.5	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	145.3	209.2
	0.6	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	130.0	187.1
	0.7	2.3	4.0	6.4	10.0	15.4	24.0	42.0	54.0	93.2	112.5	162.1
	0.8	2.3	4.0	6.1	9.8	14.7	19.6	34.3	44.1	83.3	91.9	132.3
	0.9	2.2	3.5	4.3	6.9	10.4	13.9	24.3	31.2	58.9	65.0	93.6
0.9	0.09-0.4	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	145.3	209.2
	0.5	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	130.0	187.1
	0.6	2.3	4.0	6.4	10.0	15.4	24.0	42.0	54.0	93.2	112.5	162.1
	0.7	2.3	4.0	6.1	9.8	14.7	19.6	34.3	44.1	83.3	91.9	132.3
	0.8	2.2	3.5	4.3	6.9	10.4	13.9	24.3	31.2	58.9	65.0	93.6
0.8	0.08-0.3	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	145.3	209.2
	0.4	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	130.0	187.1
	0.5	2.3	4.0	6.4	10.0	15.4	24.0	42.0	54.0	93.2	112.5	162.1
	0.6	2.3	4.0	6.1	9.8	14.7	19.6	34.3	44.1	83.3	91.9	132.3
	0.7	2.2	3.5	4.3	6.9	10.4	13.9	24.3	31.2	58.9	65.0	93.6
0.7	0.07-0.2	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	145.3	209.2
	0.3	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	130.0	187.1
	0.4	2.3	4.0	6.4	10.0	15.4	24.0	42.0	54.0	93.2	112.5	162.1
	0.5	2.3	4.0	6.1	9.8	14.7	19.6	34.3	44.1	83.3	91.9	132.3
	0.6	2.2	3.5	4.3	6.9	10.4	13.9	24.3	31.2	58.9	65.0	93.6
0.6	0.1	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	145.3	209.2
	0.2	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	130.0	187.1
	0.3	2.3	4.0	6.4	10.0	15.4	24.0	42.0	54.0	93.2	112.5	162.1
	0.4	2.3	4.0	6.1	9.8	14.7	19.6	34.3	44.1	83.3	91.9	132.3
	0.5	2.2	3.5	4.3	6.9	10.4	13.9	24.3	31.2	58.9	65.0	93.6
0.5	0.1	2.3	4.0	6.4	10.0	15.4	24.0	45.4	54.0	93.2	130.0	187.1
	0.2	2.3	4.0	6.4	10.0	15.4	24.0	42.0	54.0	93.2	112.5	162.1
	0.3	2.3	4.0	6.1	9.8	14.7	19.6	34.3	44.1	83.3	91.9	132.3
	0.4	2.2	3.5	4.3	6.9	10.4	13.9	24.3	31.2	58.9	65.0	93.6
0.4	0.1	2.3	4.0	6.4	10.0	15.4	24.0	42.0	54.0	93.2	112.5	162.1
	0.2	2.3	4.0	6.1	9.8	14.7	19.6	34.3	44.1	83.3	91.9	132.3
	0.3	2.2	3.5	4.3	6.9	10.4	13.9	24.3	31.2	58.9	65.0	93.6
0.3	0.1	2.3	4.0	6.1	9.8	14.7	19.6	34.3	44.1	83.3	91.9	132.3
	0.2	2.2	3.5	4.3	6.9	10.4	13.9	24.3	31.2	58.9	65.0	93.6
0.2	0.1	2.2	3.5	4.3	6.9	10.4	13.9	24.3	31.2	58.9	65.0	93.6
0.1	0.05	1.5	2.5	3.1	4.9	7.4	9.8	17.2	22.1	41.7	45.9	66.2

Features of Nylon 11 used for GD-200 Series

○ Water absorption is low, and wear resistance is excellent.
○ Nylon 11 is applicable to food-related equipment because it is nontoxic (it is accepted by FDA).
○ Seawater resistance and critical atmosphere resistance are very good.
○ Outdoor weather resistance is outstanding.
○ Chemical resistance is great.
○ Heat resistance and hot water resistance are fine.
○ Electric insulation and sound damping performance are superb.

●Characteristic comparison of powder coating film

Characteristics \ Coating	Nylon 11	Epoxy	Acrylic	Polyester	Polyethylene	PVC (Polyvinyl chloride)
Specific gravity	1.04-1.1	1.3-1.6	1.3-1.6	1.3-1.6	1.0	1.3
Hardness (Pencil hardness)	F	2H	H	H	HB	B
Maximum working temperature (˚C)	100-130	100-150	100-120	100-170	70-80	70-80
Wear resistance	◎	○	△	△	△	△
Impact resistance	◎	○	△	△	△	◎
Adhesion	◎	○	○	○	△	△
Low-temperature characteristics	◎-50˚C	○	○	○	○	×
Weather resistance	○	×	◎	○	△	○
Alkali resistance	◎	○	○	△	○	○
Acid resistance	△	○	○	○	◎	◎
Solvent resistance	◎	◎	×	◎	△	×
Salt water resistance	◎	○	△	○	○	○

[Meanings of symbols] ◎: excellent, ○: good, △: care required in use, ×: unacceptable
・Note that the table above shows the features of Nylon 11 and does not describe the working conditions of the GD-200 Series.

Features of Nylon 11

Item		Measured value
Melting point		184-186˚C
Specific gravity (20˚C)		1.04
Coefficient of friction		0.18
*Tensile strength (ASTM D 638)		40-48 MPa
*Elongation (within Elastic limit)(ASTM D 638)		18-34%
Hardness (shore D, Film thickness 5 mm, 20˚C)		75
*Impact resistance test〈50 cm height falling of hemishperical weight (ϕ 25 mm x 2 kg)〉		No peeling
*Bending test〈JIS K 5400 (180 degree twist around ϕ 10 mm rod)〉		No crack, No peeling
*Wear resistance test〈Wear amount after 1000 revolutions of Taber tester (CS-17 griding wheel,1 kg load)〉		5-8 mg
*Erichsen test (JIS Z 2247 B)		10 mm, No crack
Thermal conductivity (under the condition of 50-170˚C)		29.4 x 10^{-4} J/g/˚C
Coefficient of linear expansion (under the condition of -20 – 100˚C)		15 x 10^{-5}
Specific heat		2.1 J/g/˚C
Volume resistivity〈ASTM D 257 (20˚C, 65%RH, 500 V)〉		3.5 x 10^{14} Ω/cm²/cm
Salt spray test (ASTM D 117)		Not particular for 2 thousands hour
*Water absorption	Under the conditions of 20˚C and 100%RH	1.6-2.6%
	immersed in boiling water, 100˚C	2.4-3%
*Immersion test	5% NaCl 70˚C x 3 days	1.8volume%, 2.6weight%
	10% NaOH 70˚C x 3 days	4.1volume%, 4.9weight%
	Gasoline Room temperature x 30 days	1.5volume%, 1.7weight%
	Insulating oil Room temperature x 30 days	2.5volume%, 1.9weight%

(Note) The asterisk (*) mark indicates a measured value obtained from a test piece coated to a film thickness of 300 μm by fluidization dip coating, and the above information in parentheses is a test method.

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GD-24・24B

Features

1. Direct acting and hanging type, no sliding parts. Free of performance deterioration caused by wear of sliding parts and great durability.
2. Wetted parts are made of corrosion-resistant material to prevent rusty water.
3. Highly wear-resistance and durability of stainless steel made valve seat.
4. Closed structure keeps fluid inside even if the diaphragm is damaged or broken.
5. Horizontal or vertical piping is possible.

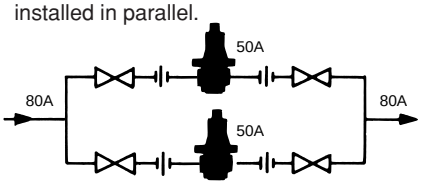
GD-24 GD-24B

Specifications

Model		GD-24	GD-24B
Application		Cold and hot water	Cold and hot water, Flushing water
Inlet pressure		0.2-1.6 MPa	
Reduced pressure		0.05-0.55 MPa	
Minimum differential pressure		0.05 MPa	
Maximum pressure reduction ratio		10:1	
Application temperature		5-80˚C *	
Material	Body	Cast bronze	
	Valve	Brass	Bronze
	Valve disc	Urethane rubber	
	Valve seat	Stainless steel	
	Diaphragm	NBR	
	Cap	Brass	Bronze
	Plug	Stainless steel	
Connection		JIS Rc screwed	

* Avoid use at temperature of 70˚C or more.

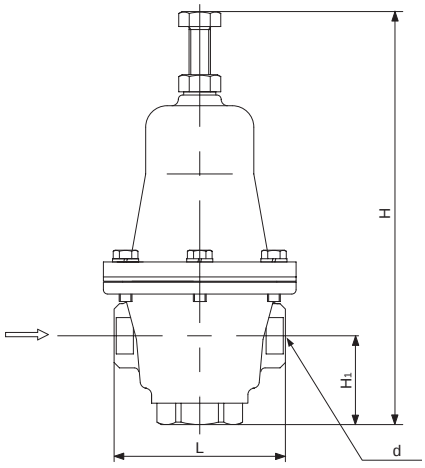
・If a large capacity is required, valves can be installed in parallel.



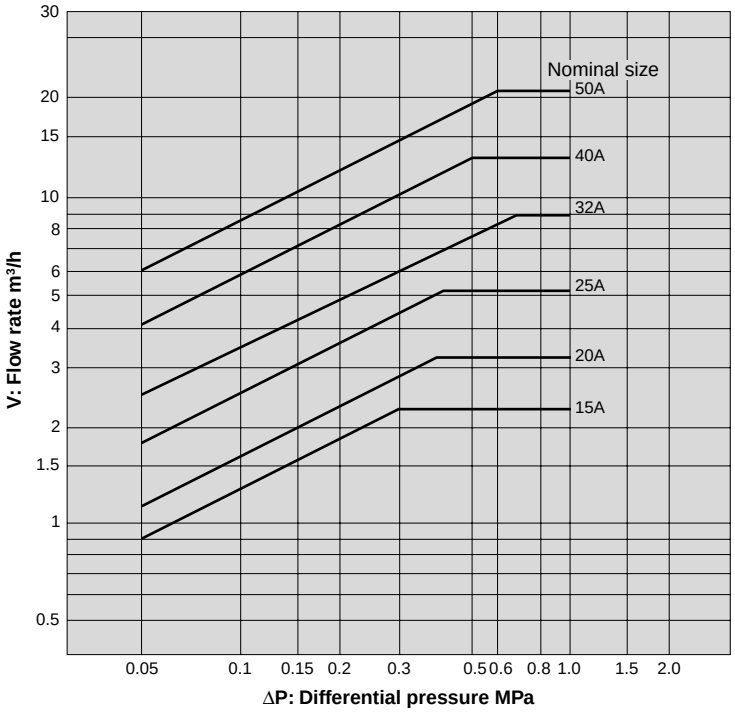
40A × 2 Valves = 65A
50A × 2 Valves = 80A
50A × 3 Valves = 100A

Dimensions (mm) and Weights (kg)

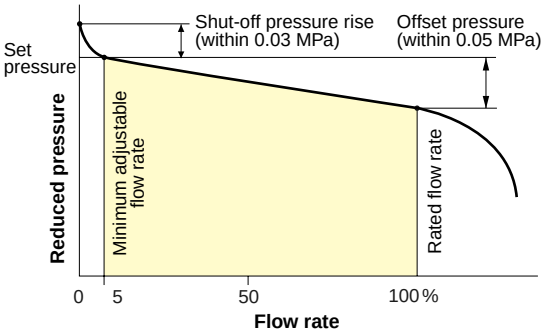
Nominal size	d	L	H	H_1	Weight
15A	Rc 1/2	80	193	42	1.8
20A	Rc 3/4	90	210	45	2.4
25A	Rc 1	100	230	50	3.3
32A	Rc 1-1/4	120	265	60	4.7
40A	Rc 1-1/2	150	315	62	8.2
50A	Rc 2	185	365	73	14.3



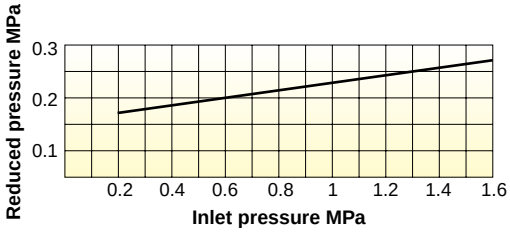
Nominal Sizes Selection Chart (For Water)



Flow Characteristic Chart



Pressure Characteristic Chart



This chart shows variation in reduced pressure when the inlet pressure of 0.6 MPa is changed between 0.2 MPa and 1.6 MPa while the reduced pressure is set at 0.2 MPa.

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GD-26-N Series

GD-26-N・28-N

GD-27-N・29-N

Features

1. Wetted parts are made of corrosion-resistant material to prevent rusty water.
2. Reduced noise.
3. Pressure balance structure can keep the reduced pressure at a constant level without being affected by inlet pressure.
4. Closed structure keeps fluid inside even if the diaphragm is damaged or broken.
5. Maintenance and inspection can be conducted easily by disassembling the upper side only.
6. Compact and lightweight design makes piping works easy.

Specifications

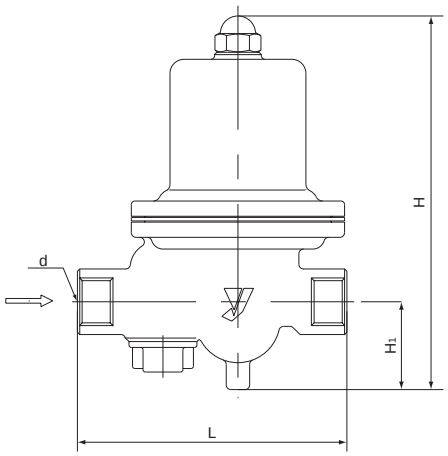
Model		GD-26-N	GD-27-N	GD-28-N	GD-29-N
Application		Cold and hot water			
Inlet pressure		1.0 MPa or less		1.6 MPa or less	
Reduced pressure		(A) 0.05-0.35 MPa (B) 0.3-0.7 MPa	25A-100A (A) 0.05-0.35 MPa (B) 0.3-0.7 MPa 125A-150A (A) 0.05-0.2 MPa (B) 0.2-0.5 MPa	(A) 0.05-0.35 MPa (B) 0.3-0.7 MPa	
Minimum differential pressure		0.05 MPa			
Maximum pressure reduction ratio		10:1			
Application temperature		5-90˚C	25A-100A 5-90˚C 125A-150A 5-80˚C *	5-90˚C	
Material	Body	Cast bronze (NPb-treated)			
	Valve seat	Cast bronze (NPb-treated)			
	Valve disc	EPDM	25A-100A EPDM 125A-150A NBR	EPDM	
	Diaphragm	EPDM	25A-100A EPDM 125A-150A NBR	EPDM	
Connection		JIS Rc screwed	JIS 10K FF flanged	JIS Rc screwed	JIS 16K FF flanged

* Available with the GD-27F withstanding 90˚C, of 125A and 150A.
- A strainer (40 mesh) is incorporated in 15A to 50A.
- Pressure gauge connection port is JIS Rc 1/8 (for 40 ϕ , 1.0 MPa).
- Available with pipe end core (GD-26L-N, maximum temperature: 40˚C)
- Avoid use of 125A and 150A under differential pressure of more than 0.8 MPa.

Dimensions (mm) and Weights (kg)

●GD-26-N and GD-28-N

Nominal size	d	L	H	H_1	Weight
15A	Rc 1/2	115	159.5	37.5	1.6
20A	Rc 3/4	120	159.5	38.5	1.7
25A	Rc 1	135	170	41	2.1
32A	Rc 1-1/4	180	224	57	4.0
40A	Rc 1-1/2	180	224	57	4.4
50A	Rc 2	200	239.5	61	6.5

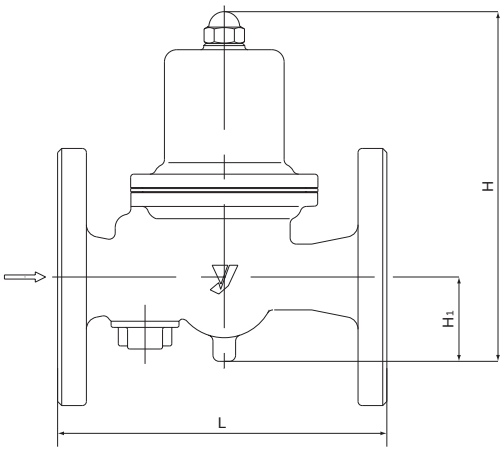


GD-26-N
GD-28-N

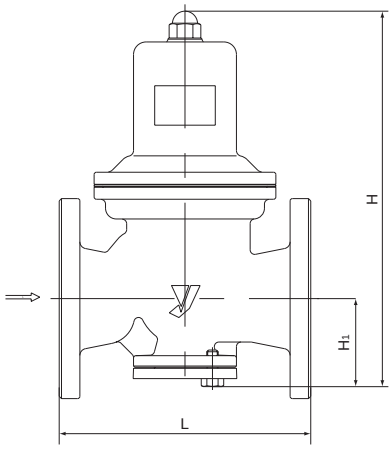
●GD-27-N and GD-29-N

Nominal size	L	H	H_1	Weight
25A	160	170	41	5.1
32A	200	224	57	7.5
40A	200	224	57	7.7
50A	220	239.5	61	10.9
65A	220	329	77	20.0
80A	230 (234)	345	82	22.0 (24.0)
100A	270 (278)	412	94	33.0 (36.5)
125A	360	771	148	90.0
150A	380	771	148	97.0

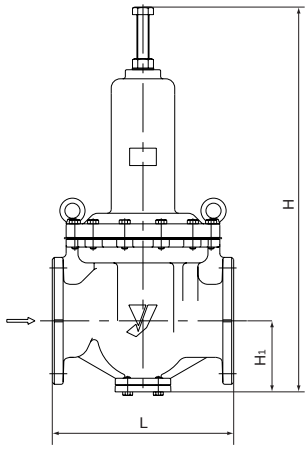
- The above values in parentheses are the dimension and weights of the GD-29-N.
- The above values of 125A and 150A are only for the GD-27-N.



GD-27-N
GD-29-N
25A-50A



GD-27-N
GD-29-N
65A-100A



GD-27-N
125A-150A

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GD-26S Series

Features

1. Wetted parts are made of corrosion-resistant material to prevent rusty water.
2. Reduced noise.
3. Pressure balance structure can keep the reduced pressure at a constant level without being affected by inlet pressure.
4. Closed structure keeps fluid inside even if the diaphragm is damaged or broken.
5. Maintenance and inspection can be conducted easily by disassembling simply from the upper side.
6. Compact and lightweight design makes piping works easy.

GD-26S・28S

GD-27S・29S

Specifications

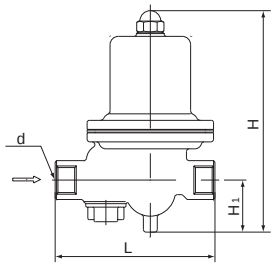
Model		GD-26S	GD-27S	GD-28S	GD-29S
Application		Cold and hot water			
Inlet pressure		1.0 MPa or less		1.6 MPa or less	
Reduced pressure		(A) 0.05-0.35 MPa (B) 0.3-0.7 MPa			
Minimum differential pressure		0.05 MPa			
Maximum pressure reduction ratio		10:1			
Application temperature		5-90˚C			
Material	Body	Cast stainless steel			
	Valve seat	Cast stainless steel			
	Valve disc	EPDM			
	Diaphragm	EPDM			
Connection		JIS Rc screwed	JIS 10K FF flanged	JIS Rc screwed	JIS 16K FF flanged

- A strainer (40 mesh) is incorporated in 15A to 50A.
- Pressure gauge connection port is JIS Rc 1/4.
- Available with FKM.

Dimensions (mm) and Weights (kg)

●GD-26S and GD-28S

Nominal size	d	L	H	H_1	Weight
20A	Rc 3/4	135	170	41	2.2
25A	Rc 1	135	170	41	2.2
32A	Rc 1-1/4	180	224	57	4.7
40A	Rc 1-1/2	180	224	57	4.5
50A	Rc 2	200	239.5	61	6.5

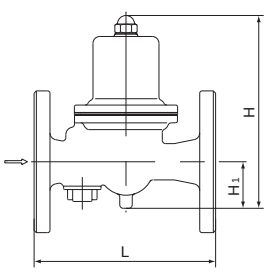


GD-26S・GD-28S

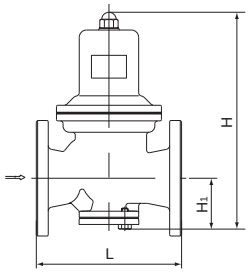
●GD-27S and GD-29S

Nominal size	L	H	H_1	Weight
20A	160	170	41	3.9
25A	160	170	41	4.8
32A	200	224	57	8.0
40A	200	224	57	8.3
50A	220	239.5	61	10.8
65A	220	329	77	20.6
80A	230 (234)	345	82	22.0 (25.0)
100A	270 (278)	412	94	34.5 (36.5)

- The values in parentheses are the dimensions and weights of the GD-29S.



GD-27S・GD-29S
25A-50A



GD-27S・GD-29S
65A-100A

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Rated Flow Rate

●For water

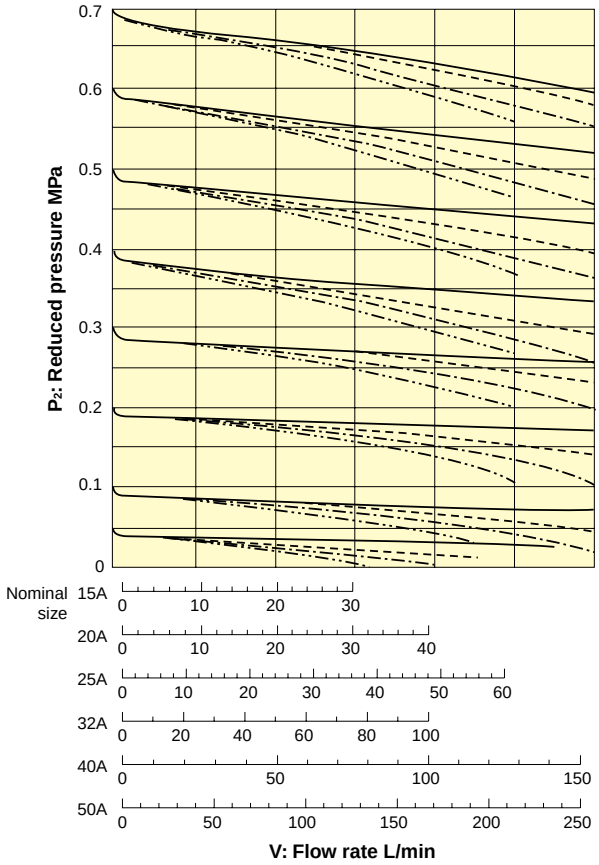
〔The differential pressure before and after the valve is 0.15 MPa or more.〕

Nominal size	15A	20A	25A	32A	40A	50A	65A	80A	100A	125A	150A
Rated flow rate L/min	30	40	60	100	150	250	300	450	700	1,600	1,800

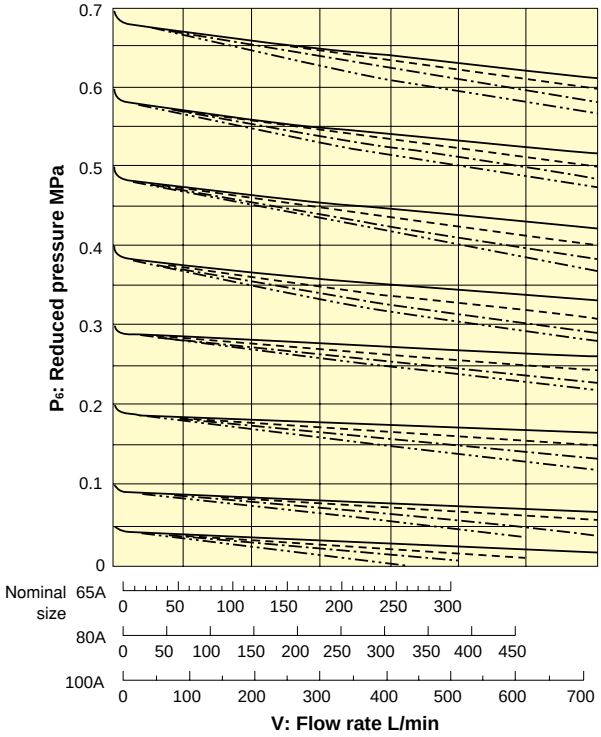
・If the differential pressure before and after the valve is less than 0.15 MPa, select a proper nominal size from the appropriate chart shown below.

Flow Rate Chart

●Nominal size: 15A to 50A

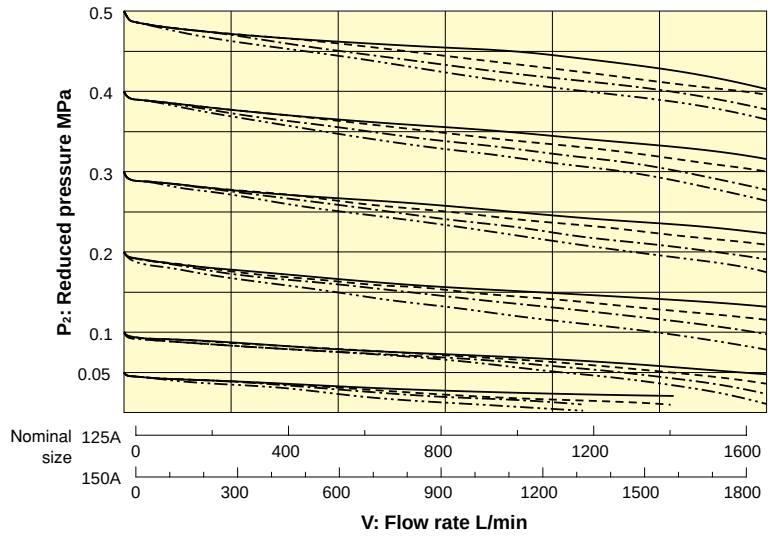


●Nominal size: 65A to 100A



Inlet pressure
- 1.0 to 1.6 MPa
- Reduced pressure + 0.2 MPa
- Reduced pressure + 0.1 MPa
- Reduced pressure + 0.05 MPa

●Nominal size: 125A to 150A



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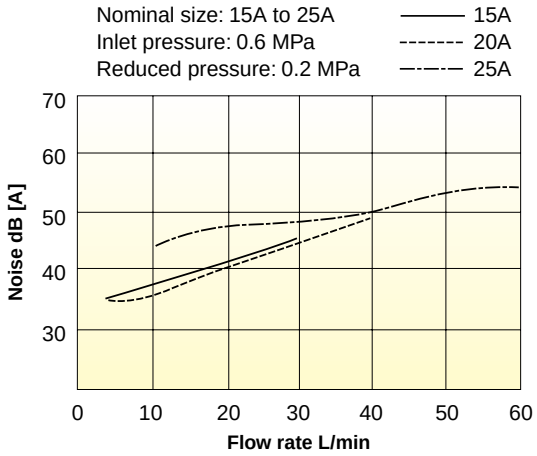
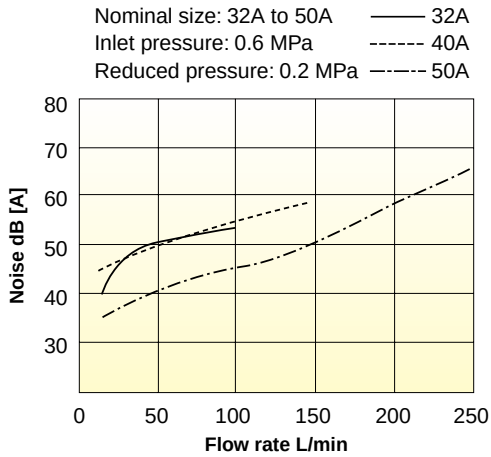
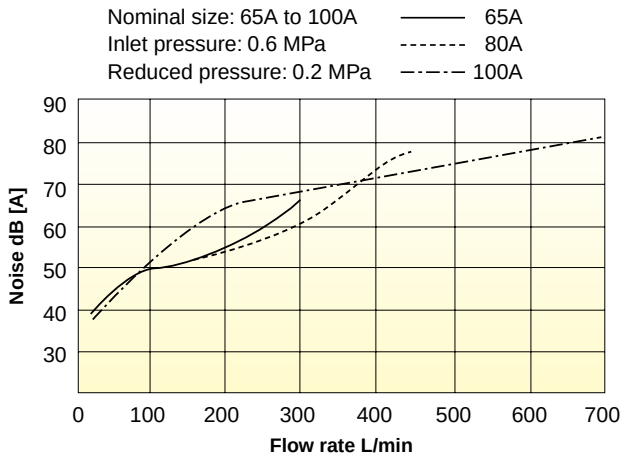
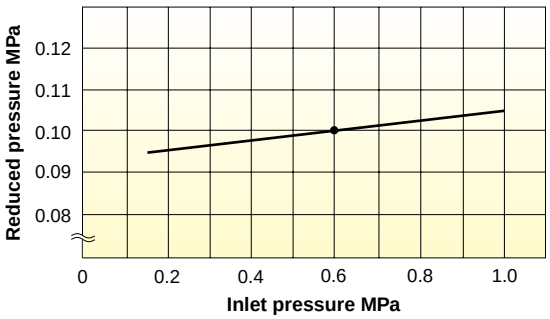
Noise Characteristic Chart





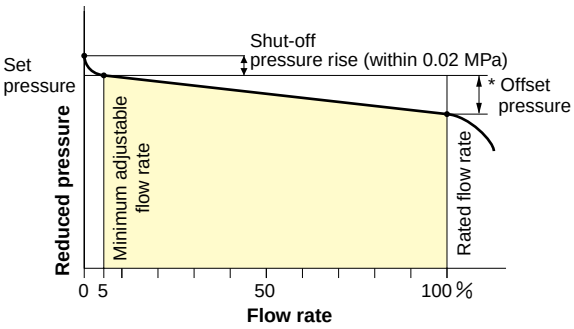


Pressure Characteristic Chart



This chart shows variation in reduced pressure when the inlet pressure of 0.6 MPa is changed between 0.15 MPa and 1.0 MPa while the reduced pressure is set at 0.1 MPa.

Flow Characteristic Chart



* Offset pressure

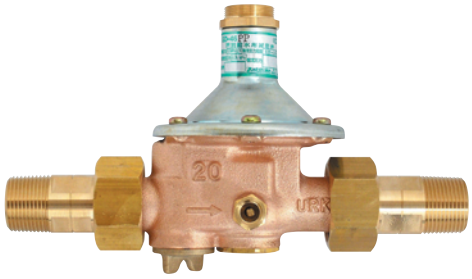
Nominal size	Pressure range	Reduced pressure range	Offset pressure
15-100A	A	0.05-0.35 MPa	Within 0.05 MPa
	B	0.3-0.7 MPa	Within 0.10 MPa
125,150A	A	0.05-0.20 MPa	Within 0.07 MPa
	B	0.2-0.5 MPa	Within 0.12 MPa

GD-46 Series

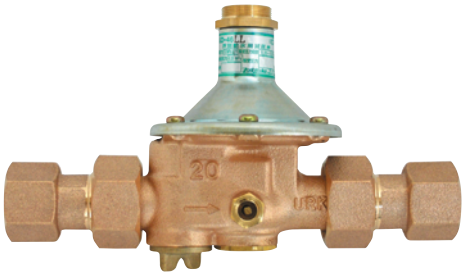
The GD-46 Series water pressure reducing valve enables to shorten a construction work period since water pressure inspection can be performed easily by turning the cap upside down with the valve installed.

Features

1. Reduced noise. Can be used even late at night.
2. Water pressure inspection can be performed easily by turning the cap upside down with the valve installed.
3. Pressure balance structure can keep the reduced pressure at a constant level without being affected by inlet pressure.
4. Attached pressure gauge joint allows a pressure gauge to be installed while water is supplied so that the set pressure can be checked easily.
5. Noise characteristics and flow characteristics conform to the "Quality Criterion on Materials" of Urban Renaissance Agency in Japan.



GD-46PP



GD-46LL・GD-46KK

Specifications

Nominal size		20A
Application		City water
Inlet pressure		1.0 MPa or less
Reduced pressure		(A) 0.05-0.10 MPa〔Standard setting: 0.09 MPa〕
		(B) 0.10-0.22 MPa〔Standard setting: 0.20 MPa〕
		(C) 0.20-0.30 MPa〔Standard setting: 0.25 MPa〕
Minimum differential pressure		0.02 MPa
Maximum pressure reduction ratio		10:1
Working temperature	Without pipe end core	5-90˚C
	Equipped with pipe end core	5-40˚C
	Equipped with check valve	5-60˚C
Minimum adjustable flow rate		0.5 L/min
Rated flow rate	Without check valve	50 L/min (Differential pressure before and after valve: 0.10 MPa or more)
	Equipped with check valve	30 L/min (Differential pressure before and after valve: 0.10 MPa or more)
Material	Body	Cast bronze (NPb-treated)
	Spindle	Dezincification resistant material
	Valve disc	FKM
	Diaphragm	FKM
Pressure check function		Pressure gauge joint (JIS Rc 1/8 screwed)
Outlet withstand pressure		0.36 MPa (at pressure reducing valve function)

・Available with pressure gauge (type A or type D) as an optional extra (for 0.5 MPa).
・The accuracy of a pressure gauge is ±3% F.S.
・The strainer is 60 mesh.
・The product is set to the pressure reducing valve function when it is delivered from our plant.
・An incombustible material is used for heat insulating material.

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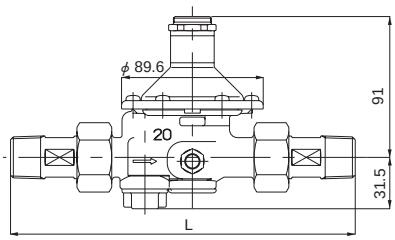
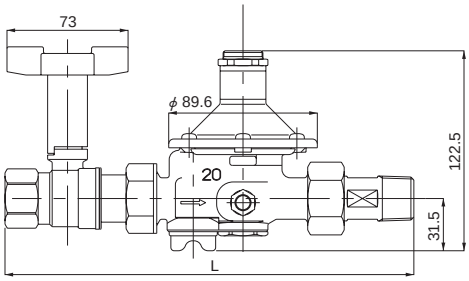
Dimensions (mm) and Weights (kg)

Model	Connection Inlet × outlet	L	Weight
GD-46	G 1 × G 1	—	1.0
GD-46PP・46PPC	R 3/4 × R 3/4	218	1.4
GD-46KK・46KKC・46LL・46LLC	Rc 3/4 × Rc 3/4	214	1.5
GD-46PK・46PKC・46PL・46PLC	R 3/4 × Rc 3/4	216	1.4
GD-46KP・46KPC・46LP・46LPC	Rc 3/4 × R 3/4	216	1.4
GD-46PG	R 3/4 × G 1-3/4	165	1.2
GD-46GP・46GPC	G 1 × R 3/4	165	1.2
GD-46KG・46LG	Rc 3/4 × G 1	163	1.2
GD-46GK・46GKC・46GL・46GLC	G 1 × Rc 3/4	163	1.2
GD-46SG	Rc 3/4 × G 1	194.5	1.4
GD-46SP・46SPC	Rc 3/4 × R 3/4	247.5	1.6
GD-46SL・46SLC・46SK・46SKC	Rc 3/4 × Rc 3/4	245.5	1.6

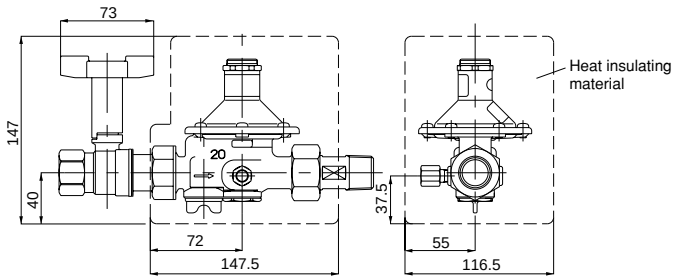
〔GD-46PP〕



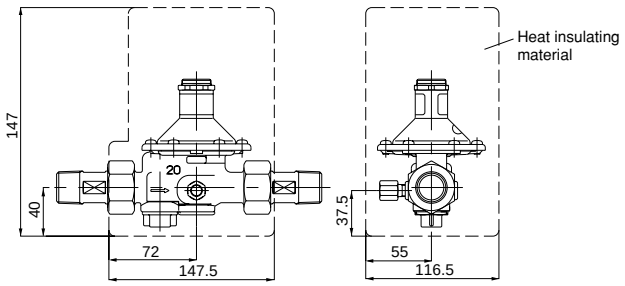
〔GD-46SP Equipped with stop valve〕



Dimensions of the Heat Insulating Material



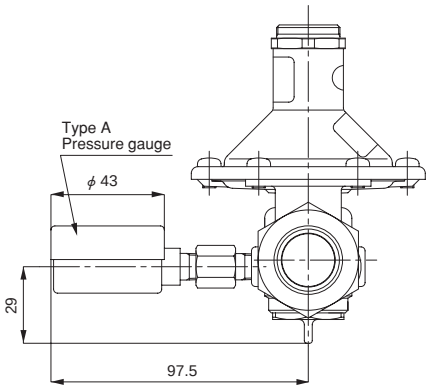
GD-46SP



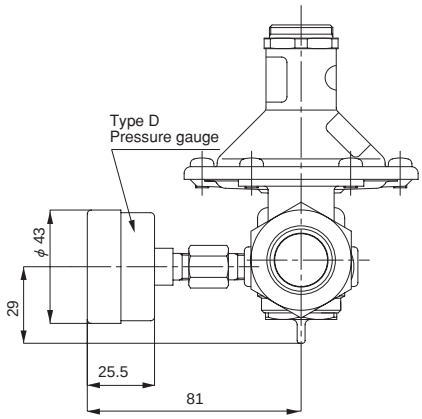
GD-46PP

Note) The heat insulating material is common to all GD-46 Series valves. However, no heat insulating material is used for the water stop valve.

Dimensions of the Valve Equipped with the Optional Pressure Gauge

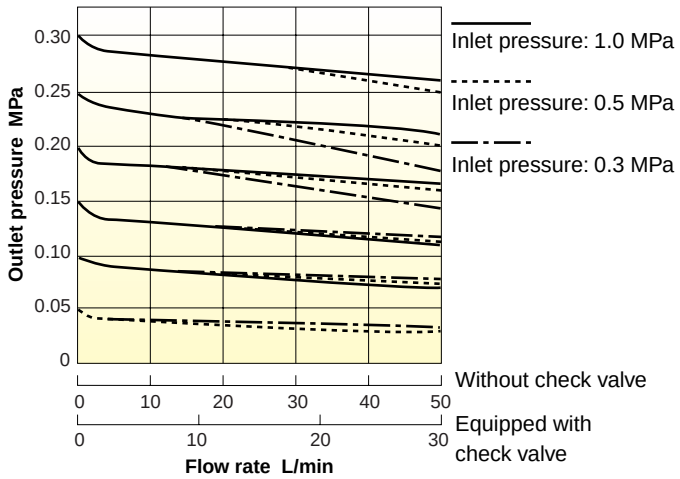


Equipped with the pressure gauge Type A

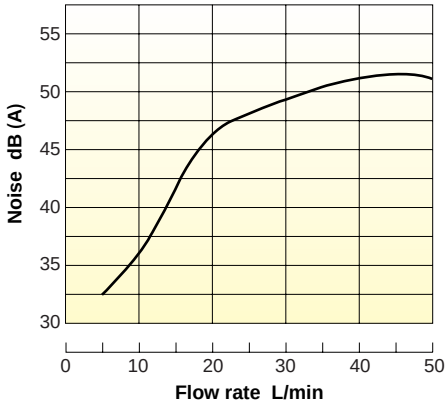


Equipped with the pressure gauge Type D

Flow Characteristic Chart



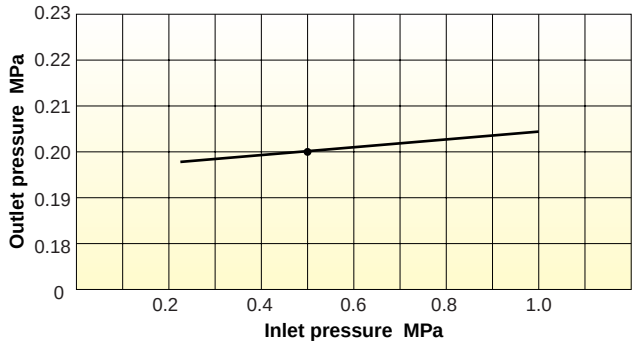
Noise Characteristic Chart



〈Test conditions〉

- Inlet pressure: 0.6 MPa
- Reduced pressure: 0.2 MPa
- Distance from the sample valve to the microphone: 15 cm
- Background noise: 30 dB (A)
  (Except for the valve equipped with a check valve)

Pressure Characteristic Chart



This chart shows variation in reduced pressure when the inlet pressure of 0.5 MPa is changed between 0.22 MPa and 1.0 MPa while the reduced pressure is set at 0.2 MPa.

How to Adjust the Pressure

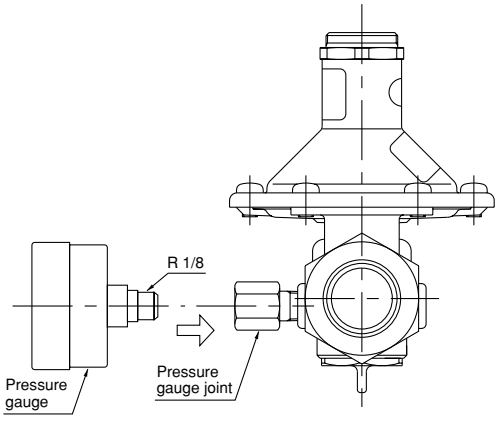


Fig. 1

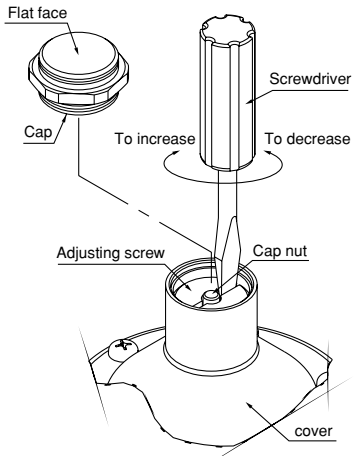


Fig. 2

1. Screw the pressure gauge into the pressure gauge joint (Fig. 1).
2. Remove the cap. Checking the pressure gauge, turn the adjusting screw to adjust the reduced pressure to a desired level (Fig. 2).
   - The reduced pressure increases when the adjusting screw is turned clockwise.
   - The reduced pressure decreases when the adjusting screw is turned counterclockwise.

   Note) Use a keystone tip screwdriver of 4.5 to 6 mm in nominal width for slotted head screws.
   Set the screwdriver in the slot of the adjusting screw avoiding the cap nut attached in the center of the screw, and adjust the reduced pressure.
   If pressure adjustment is difficult to make, please contact us.
3. After reduced pressure adjustment, attach the cap with the flat face up.
4. Remove the pressure gauge.

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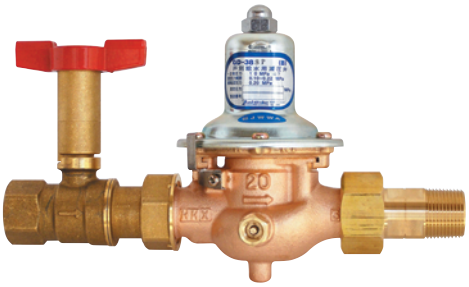
GD-38 Series

The GD-38 Series is a bypass equipped water pressure reducing valve for individual water supply to complex housing, and does not require substitute piping.
Water washing of piping and water pressure inspection can be performed by turning the spring case with the reducing valve installed. For labor saving and resource saving, no accessory parts required.

GD-38PP・GD-38VV

GD-38LL



GD-38SP

Features

1. Reduced noise. Can be used even late at night.
2. Pressure balance structure can keep the reduced pressure at a constant level without being affected by inlet pressure.
3. Bypass function allows water pressure inspection to be performed easily with the valve installed to significantly shorten a construction work period.
4. Cartridge system is used for the pressure reducing function, making maintenance and inspection easy.
5. Closed structure keeps fluid from flowing to outside even if the diaphragm is damaged or broken.
6. Attached pressure gauge joint allows a pressure gauge to be installed while water is supplied so that the set pressure can be checked easily.

Specifications

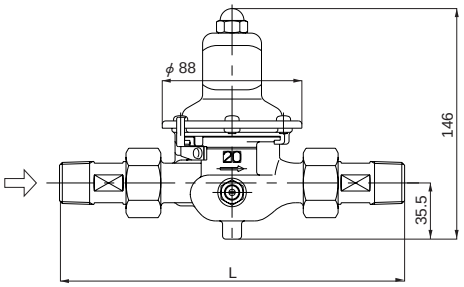
Nominal size		20A
Application		City water
Inlet pressure		1.0 MPa or less
Reduced pressure		(A) 0.05-0.10 MPa〔Standard setting: 0.09 MPa〕
		(B) 0.10-0.22 MPa〔Standard setting: 0.20 MPa〕
		(C) 0.20-0.30 MPa〔Standard setting: 0.25 MPa〕
Minimum differential pressure		0.05 MPa
Maximum pressure reduction ratio		10:1
Working temperature	Without pipe end core	5-90˚C
	Equipped with pipe end core	5-40˚C
	Equipped with check valve	5-60˚C
Minimum adjustable flow rate		0.5 L/min
Rated flow rate	Without check valve	70 L/min (Differential pressure before and after valve: 0.10 MPa or more)
	Equipped with check valve	30 L/min (Differential pressure before and after valve: 0.10 MPa or more)
Material	Body	Cast bronze (NPb-treated)
	Valve seat	Cast bronze (NPb-treated)
	Spindle	Brass
	Valve disc	EPDM
	Diaphragm	EPDM
Pressure check function		Pressure gauge joint (JIS Rc 1/8 screwed)
Outlet withstand pressure		0.36 MPa (at pressure reducing valve function)

- Available with pressure gauge (type A or type D) as an optional extra (for 0.5 MPa).
- The strainer is 60 mesh.
- The accuracy of a pressure gauge is ±3% F.S.
- The product is set to the "bypass" position when it is delivered from our plant.
- An incombustible material is used for heat insulating material.

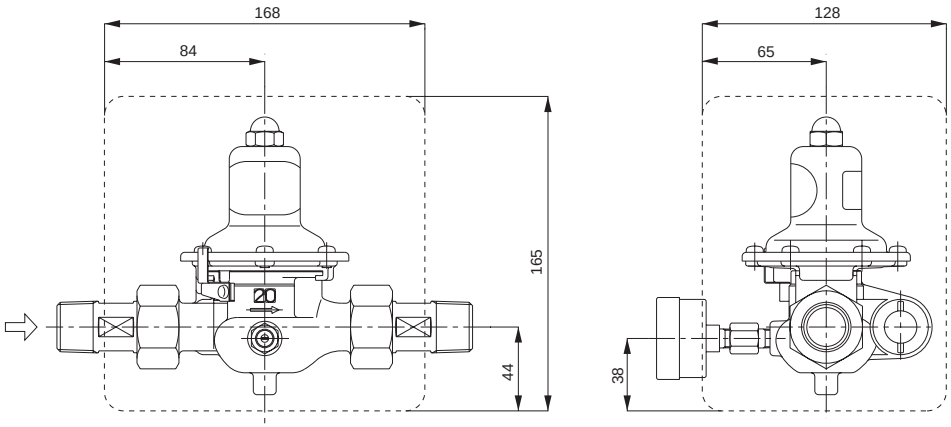
Dimensions (mm) and Weights (kg)

Model	Connection Inlet × outlet	L	Weight
GD-38	G 1 × G 1	—	1.4
GD-38VV・38VVC・38PP・38PPC	R 3/4 × R 3/4	218	1.8
GD-38KK・38KKC・38LL・38LLC	Rc 3/4 × Rc 3/4	214	1.9
GD-38VK・38VKC・38VL・38VLC	R 3/4 × Rc 3/4	216	1.8
GD-38PK・38PKC・38PL・38PLC	R 3/4 × Rc 3/4	216	1.8
GD-38KV・38KVC・38LV・38LVC	Rc 3/4 × R 3/4	216	1.8
GD-38KP・38KPC・38LP・38LPC	Rc 3/4 × R 3/4	216	1.8
GD-38VG・38PG	R 3/4 × G 1	165	1.6
GD-38GV・38GVC・38GP・38GPC	G 1 × R 3/4	165	1.6
GD-38KG・38LG	Rc 3/4 × G 1	163	1.6
GD-38GK・38GKC・38GL・38GLC	G 1 × Rc 3/4	163	1.6
GD-38SG	Rc 3/4 × G 1	193.5	1.8
GD-38SP・38SPC・38SV・38SVC	Rc 3/4 × R 3/4	246.5	2.0
GD-38SL・38SLC・38SK・38SKC	Rc 3/4 × Rc 3/4	244.5	2.0

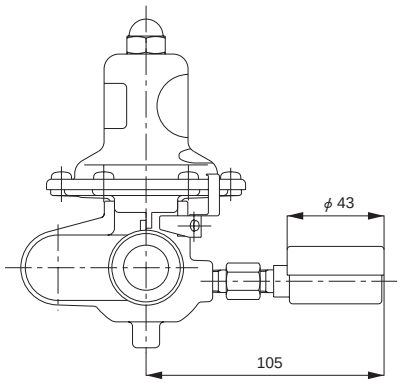
〔GD-38 Series〕



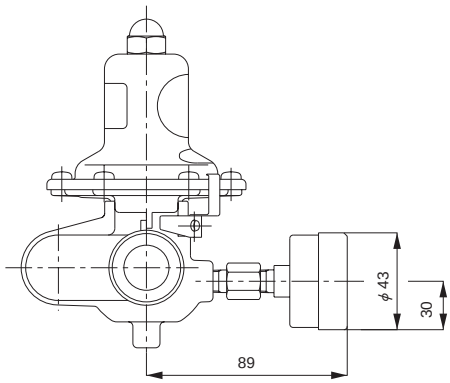
Dimensions of the Heat Insulating Material



Dimensions of the Valve Equipped with the Optional Pressure Gauge



Equipped with the pressure gauge Type A



Equipped with the pressure gauge Type D

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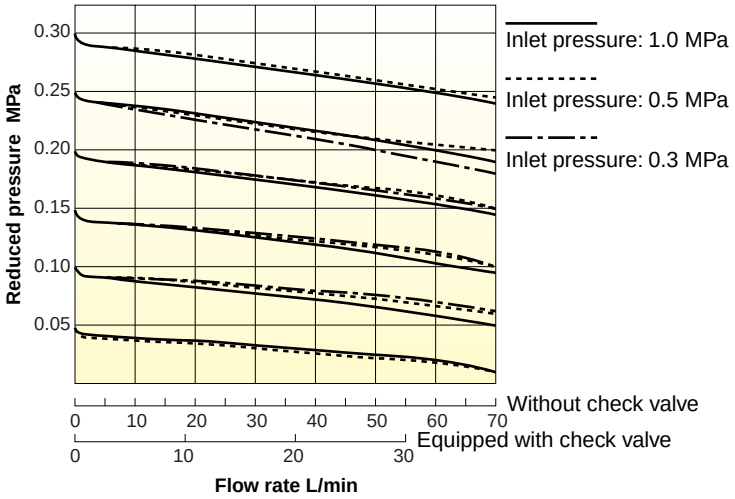
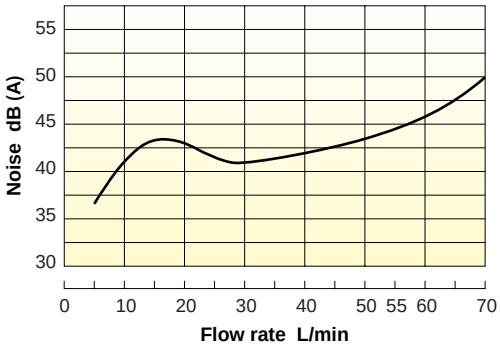
Flow Characteristic Chart

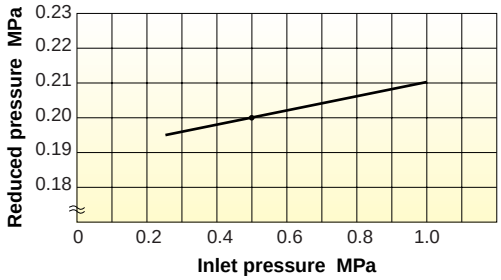


Noise Characteristic Chart



- Inlet pressure: 0.6 MPa
- Reduced pressure: 0.2 MPa
- Distance from the sample valve to the microphone: 15 cm
- Background noise: 30 dB (A)

Pressure Characteristic Chart



- This chart shows variation in reduced pressure when the inlet pressure of 0.5 MPa is changed between 0.25 MPa and 1.0 MPa while the reduced pressure is set at 0.2 MPa.

How to Adjust the Pressure

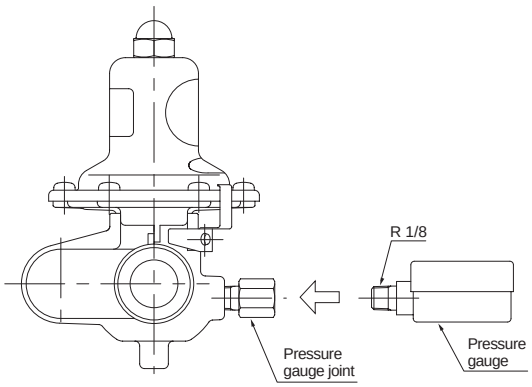


Fig. 1

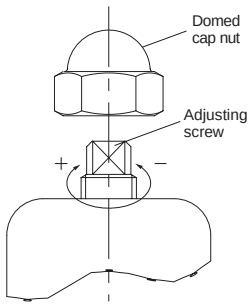
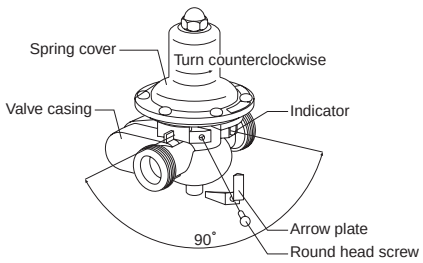


Fig. 2

1. Screw the pressure gauge into the pressure gauge joint (Fig. 1).
2. Remove the domed cap nut. Checking the pressure gauge, turn the adjusting screw to adjust the reduced pressure to a desired level (Fig. 2).
   - The reduced pressure increases when the adjusting screw is turned clockwise.
   - The reduced pressure decreases when the adjusting screw is turned counterclockwise.
3. After reduced pressure adjustment, attach the domed cap nut.
4. Remove the pressure gauge.

● How to remove the pressure reducing cartridge

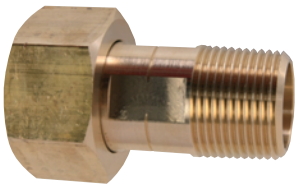
1. Close the inlet-side stop valve. Open the faucet at the end to completely release internal pressure.
2. Remove the round head screw and the arrow plate.
3. Turn the spring cover 90˚ counterclockwise.
4. Remove the pressure reducing cartridge by pulling the spring cover upward.



Joints and Water Stop Valves Used for GD-46・38 Series Valves

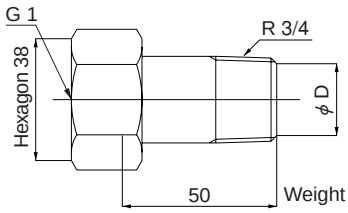
● **Standard type**

JO-36UP
JO-36UV

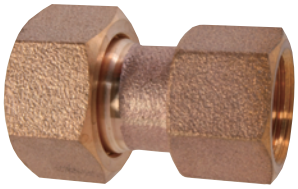


● **Dimensions and weights**

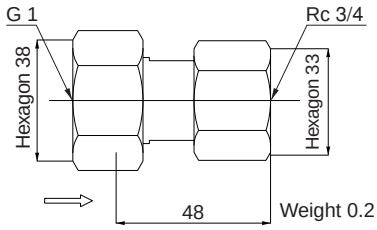
JO-36UV: ϕ D = 18.6
JO-36UP: ϕ D = 20.4



JO-36UL
JO-36UK

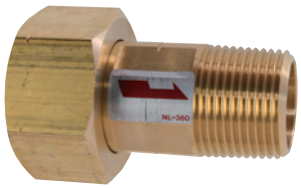


JO-36UK・JO-36UL

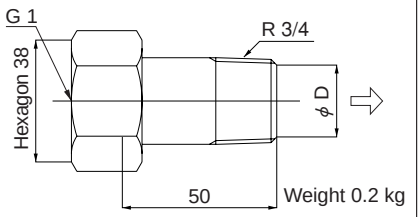


● **Check valve incorporated type**

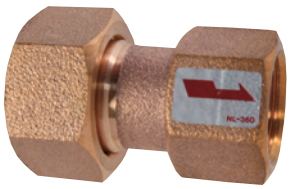
CV-36UP
CV-36UV



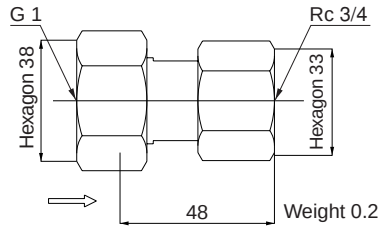
CV-36UV: ϕ D = 18.6
CV-36UP: ϕ D = 20.4



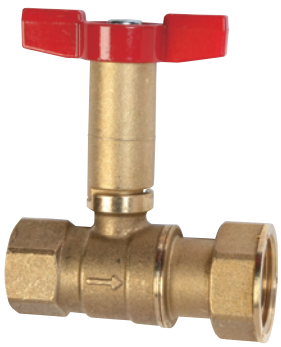
CV-36UL
CV-36UK

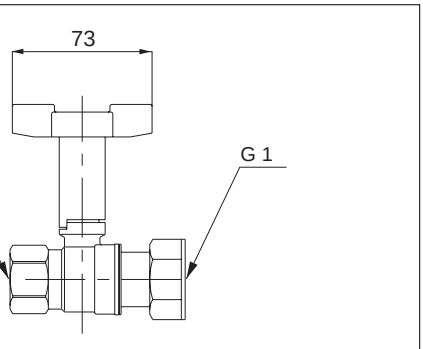


CV-36UK・CV-36UL



● **Water stop valve**





・Available with pipe end core.

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GD-25GJ・25JC・25GJ-K

The GD-25 Series achieves low-noise water supply as pressure reducing valves for individual water supply to complex housing. Reduced pressure can be kept highly stable against a variation of supply water pressure. Incorporated strainer and its compact and lightweight design ensure easy handling of piping.

GD-25GJ · 25JC

Features

1. Reduced noise. Can be used even late at night.
2. Pressure balance structure can keep the reduced pressure at a constant level without being affected by inlet pressure.
3. Incorporated strainer prevents foreign substances such as dirt and sand from flowing to the outlet side.
4. Attached pressure gauge joint allows a pressure gauge to be installed while water is supplied so that the set pressure can be checked easily.
5. The GD-25JC incorporates check valve and the GD-25GJ-K(P) is provided with built-in pipe end core for lining steel piping.

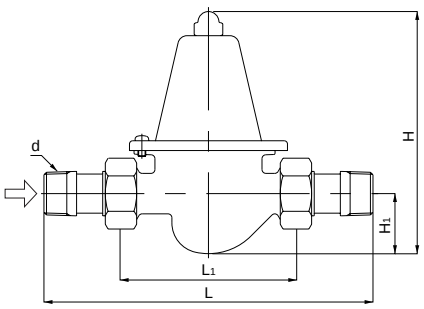
Specifications

Model		GD-25GJ	GD-25JC	GD-25GJ-K	GD-25GJ-K(P)
Nominal size		25A			
Application		City water			
Inlet pressure		1.0 MPa or less			
Reduced pressure		(A) 0.05-0.10 MPa〔Standard setting: 0.09 MPa〕			
		(B) 0.10-0.22 MPa〔Standard setting: 0.20 MPa〕			
		(C) 0.20-0.35 MPa〔Standard setting: 0.25 MPa〕			
Minimum differential pressure		0.02 MPa			
Maximum pressure reduction ratio		10:1			
Minimum adjustable flow rate		0.5 L/min			
Fluid temperature		5-90˚C			5-40˚C
Rated flow rate		85 L/min (100 L/min when the differential pressure is 0.10 MPa or more)			
Material	Body	Cast bronze (NPb-treated)			
	Valve seat	Cast bronze (NPb-treated)			
	Spindle	Brass			
	Valve disc	FKM			
	Diaphragm	EPDM			
Connection		JIS R 1 screwed (union joint)		JIS Rc 1 screwed (union joint)	
Pressure gauge joint		JIS Rc 1/8 screwed			
Outlet withstand pressure		0.42 MPa			

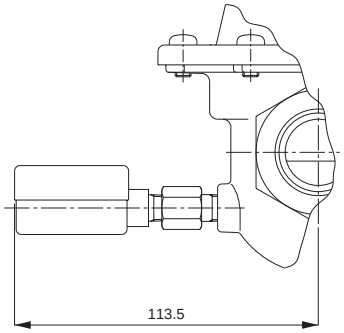
- The strainer is 40 mesh.
- Available with pressure gauge (type A or type D) as optionale extra (for 0.5 MPa).
- The accuracy of a pressure gauge is ±3% F.S.
- The closing pressure of the check valve for the GD-25JC is 0.005 MPa or less.
- An incombustible material is used for heat insulating material.

Dimensions (mm) and Weights (kg)

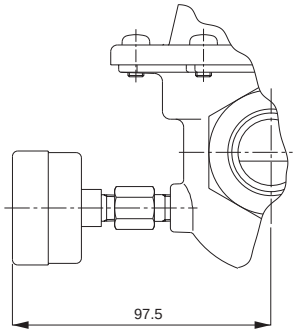
Model	d	L	L_1	H	H_1	Weight
GD-25GJ GD-25JC	R 1	252	136	186	46	3.5
GD-25GJ-K GD-25GJ-K(P)	Rc 1	250				3.9



Dimensions of the Valve Equipped with the Optional Pressure Gauge for GD-25GJ・25JC・25GJ-K

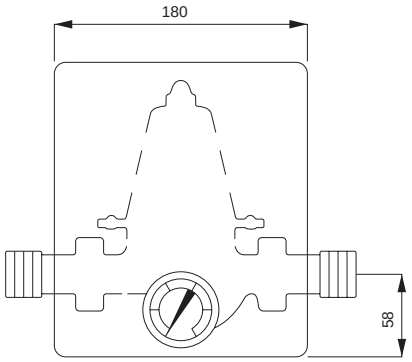


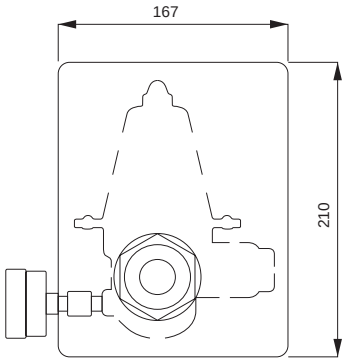
Equipped with the pressure gauge Type A



Equipped with the pressure gauge Type D

Dimensions of the Heat Insulating Material





How to Adjust the Pressure

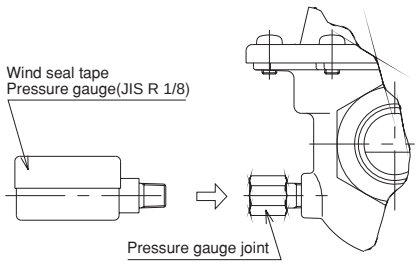


Fig. 1

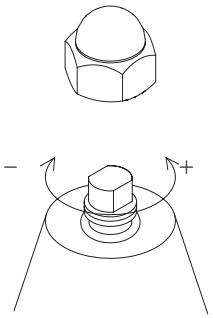


Fig. 2

1. Screw the pressure gauge into the pressure gauge joint (Fig. 1).
2. Remove the cap. Checking the pressure gauge, turn the adjusting screw to adjust the reduced pressure to a desired level (Fig. 2).
   - The reduced pressure decreases when the adjusting screw is turned clockwise.
   - The reduced pressure increases when the adjusting screw is turned counterclockwise.
3. After reduced pressure adjustment, attach the cap.
4. Remove the pressure gauge.

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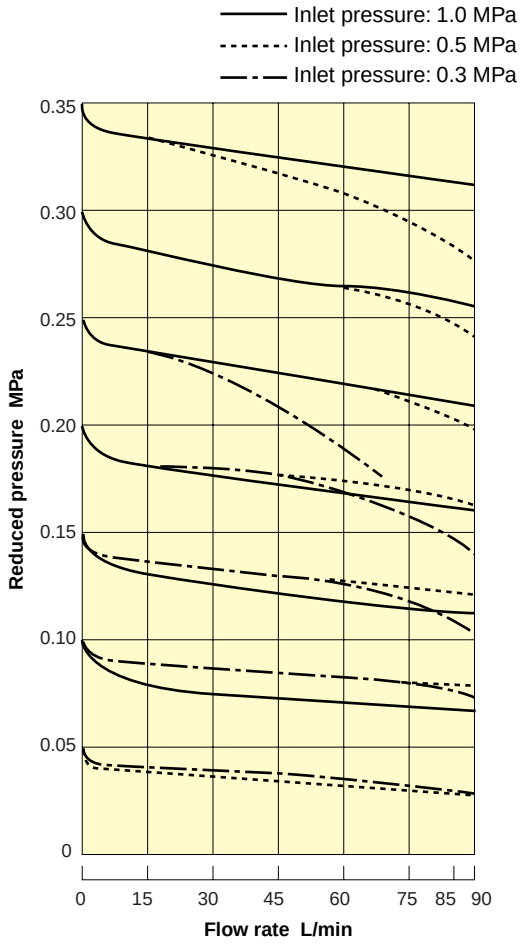
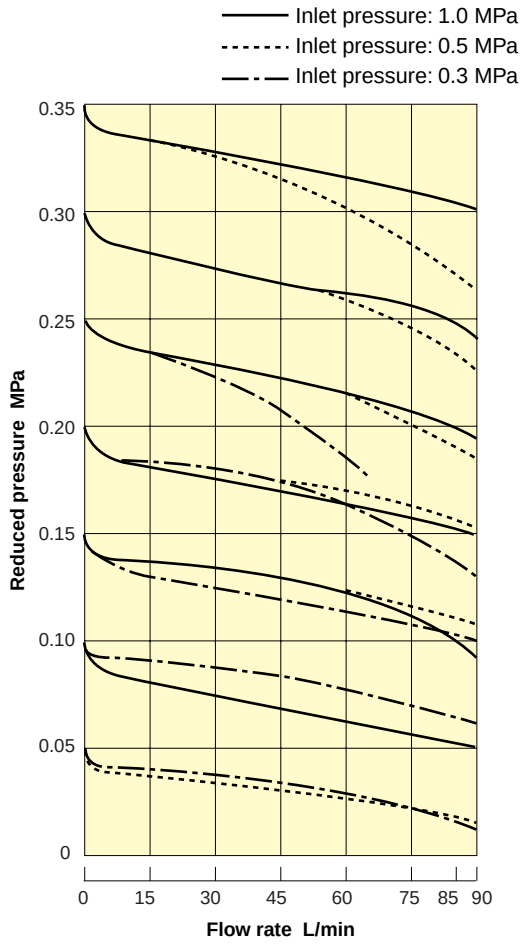
Flow Rate Characteristic Chart

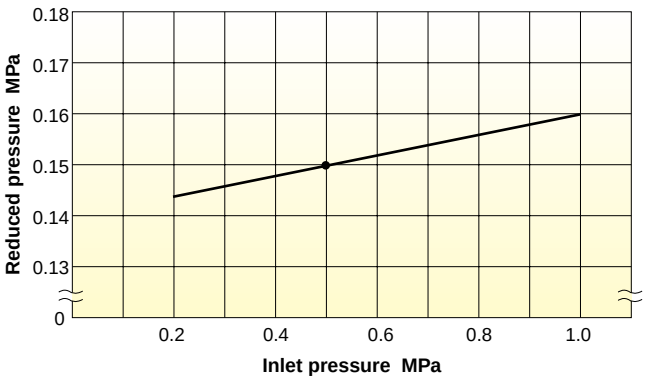
●GD-25GJ･GJ-K･GJ-K (P)



●GD-25JC

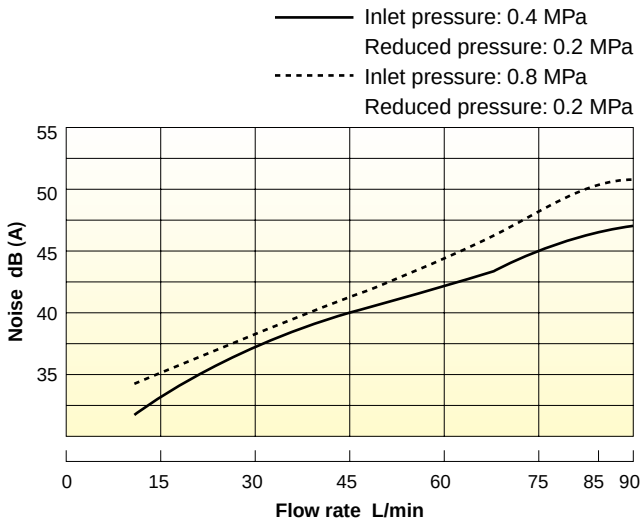


Pressure Characteristic Chart



This chart shows variation in reduced pressure when the inlet pressure of 0.5 MPa is changed between 0.25 MPa and 1.0 MPa while the reduced pressure is set at 0.15 MPa.

Noise Characteristic Chart



- Distance from the sample valve to the microphone: 15 cm
- Background noise: 30 dB (A)

GD-41・43・41G・43G

Features

1. Space saving and resource saving are achieved (used materials are shown on the body and lower cap, thus separate collection of parts for resource recycling is easy).
2. Stainless steel (SCS14A and SUS316) is used for wetted parts, improving corrosion resistance.
3. PTFE covers diaphragm contact surface to fluid, making the diaphragm less liable to deteriorate and highly durable.
4. Special fluorine-contained rubber parts are resistant to corrosion.
5. Pressure balance structure can keep the reduced pressure at a constant level without being affected by inlet pressure.
6. Closed structure keeps fluid from flowing to outside even if the diaphragm is damaged or broken.
7. Safe fluorine grease is applied to O-ring.
8. Can be applied to piping washing, system washing, sterilization washing and steam for sterilization.

GD-41

Specifications

Model		GD-41	GD-43-10	GD-43-20	GD-41G	GD-43G-10	GD-43G-20
Application		Cold and hot water			Air, Carbon dioxide gas *1, Nitrogen gas		
		Steam for washing or sterilization					
Inlet pressure		0.07-2.0 MPa (0.2 MPa or less for steam for washing or sterilization) *2					
Reduced pressure		(A) Yellow spring: 0.02-0.1 MPa〔Standard setting: 0.05 MPa〕 (B) Red spring: 0.1-0.25 MPa〔Standard setting: 0.1 MPa〕 (C) Black spring: 0.25-0.5 MPa〔Standard setting: 0.3 MPa〕					
Minimum differential pressure		0.05 MPa					
Maximum pressure reduction ratio		Cold and hot water: 10:1 Air, Carbon dioxide gas, Nitrogen gas: 20:1					
Fluid temperature		5-90˚C (The maximum temperature of steam for washing or sterilization is 130˚C. Allow an interval of at least four hours between steam flows.)					
Material	Body	Cast Stainless steel (SCS14A)					
	Valve disc	Special synthetic rubber (special FKM)					
	Diaphragm	Heat-resistant synthetic rubber and PTFE (PTFE applied to wetted face)					
Connection		JIS Rc screwed	JIS 10K FF flanged	JIS 20K RF flanged	JIS Rc screwed	JIS 10K FF flanged	JIS 20K RF flanged

*1 Please contact us when using for carbon dioxide gas.
*2 The inlet pressure of the GD-43-10 is 0.07 to 1.0 MPa.
・If using for washing steam or sterilization steam, be sure that maximum temperature is 130˚C and avoid continuous use for more than 30 minutes.

Dimensions (mm) and Weights (kg)

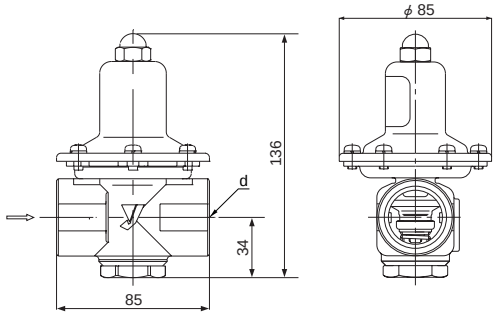
●GD-41・41G

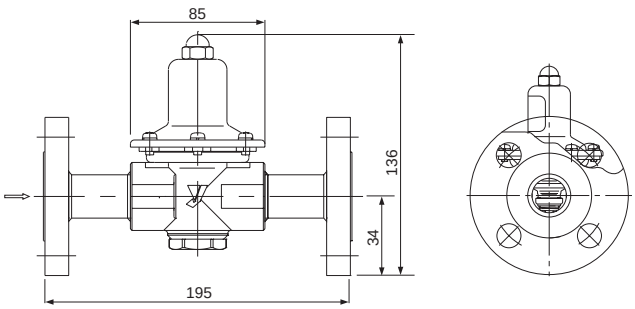
Nominal size	d	Weight
15A	Rc 1/2	1.2
20A	Rc 3/4	1.1
25A	Rc 1	1.0

●GD-43・43G

Nominal size	Weight
15A	2.8 (2.6)
20A	3.0 (2.9)
25A	4.0 (3.7)

・The values in parentheses are the weights of the GD-43-10.





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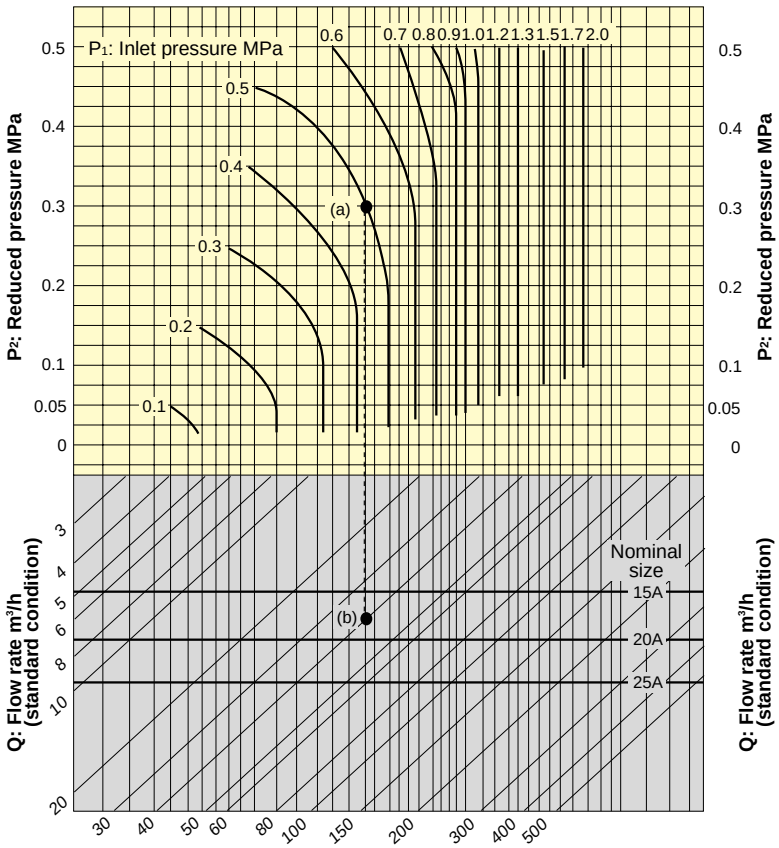
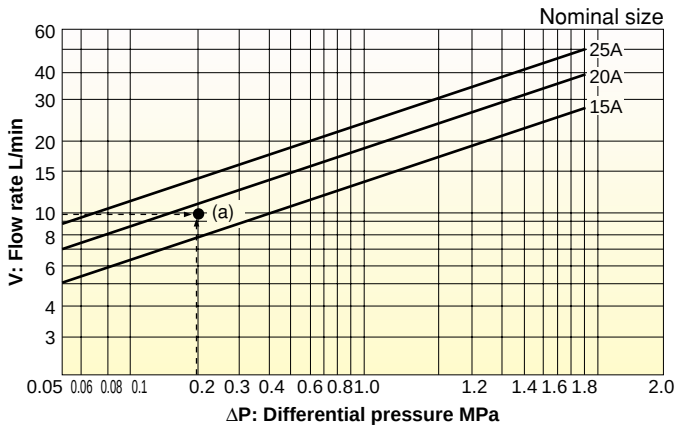
Nominal Sizes Selection Chart (For Air)



[Example]
When selecting the nominal size of a pressure reducing valve whose inlet pressure (P_1), reduced pressure (P_2), and flow rate are 0.5 MPa, 0.3 MPa, and 40 m³/h (standard condition), respectively, first find intersection point (a) of the inlet pressure of 0.5 MPa and the reduced pressure of 0.3 MPa. Trace down vertically from this intersection point to find intersection point (b) with the flow rate of 40 m³/h (standard condition). Since intersection point (b) lies between nominal sizes 15A and 20A, select the larger one, 20A.

- Set the safety factor at 80 to 90%.

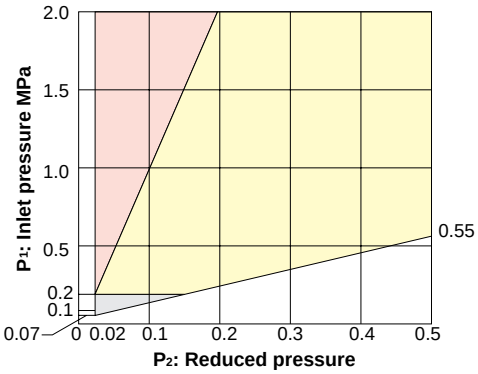
Nominal Sizes Selection Chart (For Cold and Hot Water)



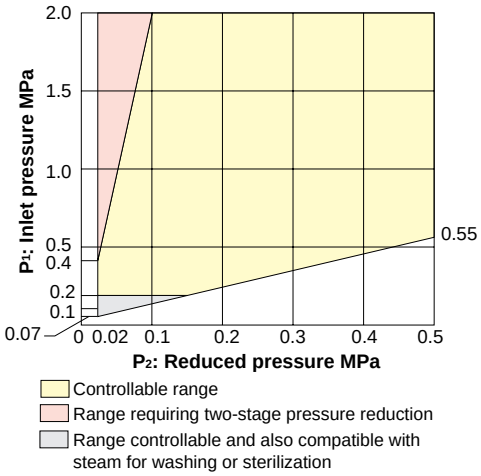
[Example]
When selecting the nominal size of a pressure reducing valve whose inlet pressure (P_1), reduced pressure (P_2), and flow rate are 0.5 MPa, 0.3 MPa, and 10 L/min, respectively, trace up vertically from the 0.2 MPa point of differential pressure before and after the valve to find intersection point (a) with the flow rate of 10 L/min. Since intersection point (a) is between nominal sizes 15A and 20A, select the larger one, 20A.

Specifications Selection Chart

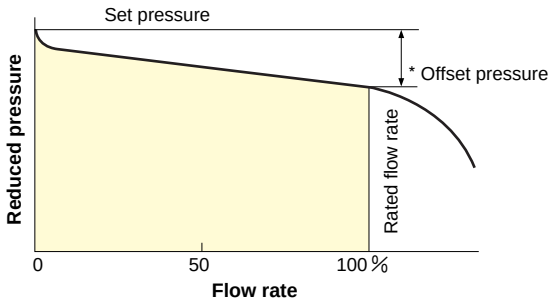
(Cold and hot water)



(Air, carbon dioxide gas, and nitrogen gas)



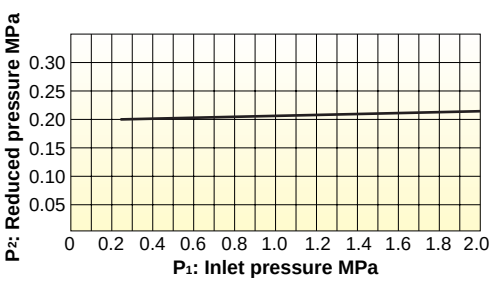
Flow Characteristic Chart



* Offset pressure

Set pressure	Offset pressure
0.2 MPa or less	Within 0.05 MPa
More than 0.2 MPa	Within 0.08 MPa

Pressure Characteristic Chart



This chart shows variation in reduced pressure when the inlet pressure of 0.25 MPa is changed to 2.0 MPa while the reduced pressure is set at 0.20 MPa.

GD-6

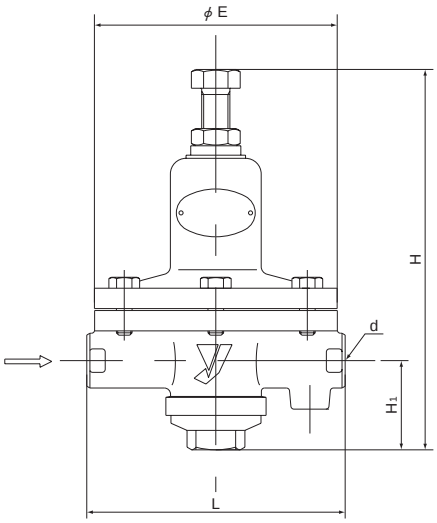
Features

1. High accurate controllability of reduced pressure even at small flow rate.
2. Simple in structure, less prone to fail and easy to maintain.
3. Compact and lightweight.
4. Easy to install due to screwed connections.

Specifications

Model		GD-6
Application		Cold and hot water, Oil, Air, Other non-dangerous fluids
Inlet pressure		0.1-1.0 MPa
Reduced pressure		(A) 0.02-0.1 MPa (Nameplate color: yellow) (B) 0.1-0.4 MPa (Nameplate color: blue)
Minimum differential pressure		0.05 MPa
Maximum pressure reduction ratio		10:1
Application temperature		5-80˚C
Valve seat leakage		None
Fluid viscosity		300 cSt or less
Material	Body	Ductile cast iron *1
	Valve disc, valve seat	Brass and bronze (FKM disc incorporated) *2
	Diaphragm	Stainless steel
Connection		JIS Rc screwed

*1 Available with stainless steel wetted parts and all stainless steel made on request.
*2 Available with stainless steel made valve disc and valve seat on request. Also available with PTFE disc on request.
・ Available with anticorrosive (fluororesin-coated) type on request.



Dimensions (mm) and Weights (kg)

Nominal size	d	L	H	H_1	E	Weight
10A	Rc 3/8	165	243	57	155	5.5
15A	Rc 1/2	165	243	57	155	5.5
20A	Rc 3/4	185	267	76	175	8.2
25A	Rc 1	185	267	76	175	8.2

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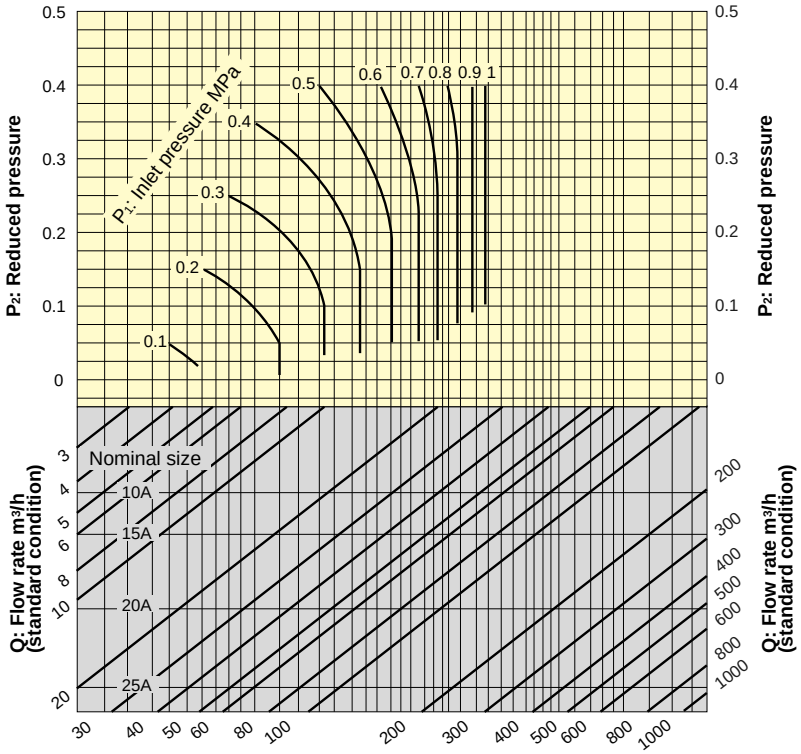
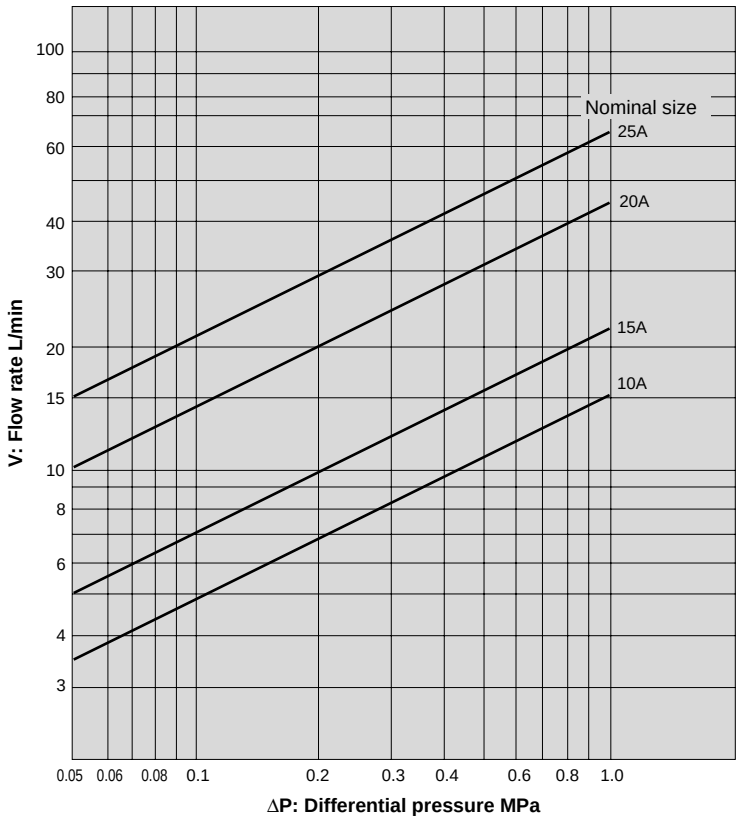
Nominal Sizes Selection Chart (For Air)

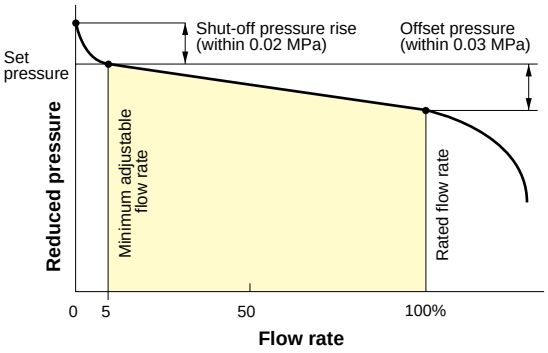


・Set the safety factor at 80 to 90%.

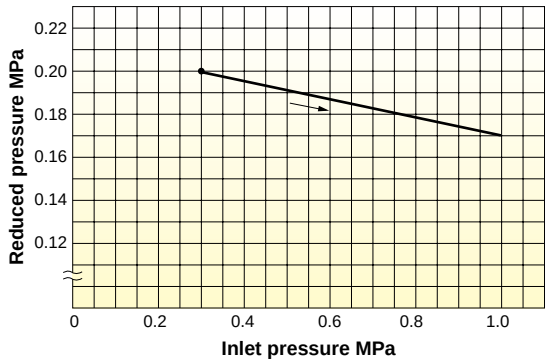
Nominal Sizes Selection Chart (For Water)



Flow Characteristic Chart



Pressure Characteristic Chart



This chart shows variation in reduced pressure when the inlet pressure of 0.3 MPa is changed between 0.3 MPa and 1.0 MPa while the reduced pressure is set at 0.2 MPa.

GD-7

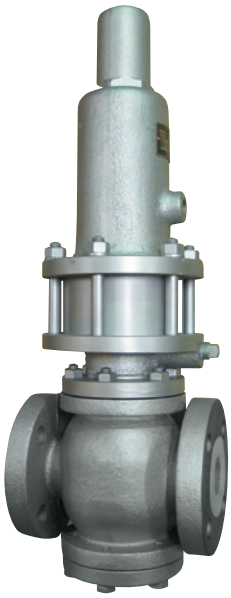
Features

1. Simple in structure, less prone to fail and easy to maintain.
2. Insusceptible to effect of inlet pressure fluctuation due to dual valve.
3. Outstanding performance as a pressure reducer for lubricant grease and heavy oil.

Specifications

Model		GD-7	
Application		Cold and hot water, Oil, Other non-dangerous fluids	
Nominal size		20A-50A	65A-150A
Inlet pressure		0.1-1.0 MPa	
Reduced pressure		(A) 0.05-0.25 MPa (B) 0.25-0.45 MPa (C) 0.45-0.7 MPa	(A) 0.05-0.2 MPa (B) 0.2-0.5 MPa (C) 0.5-0.7 MPa
		70% or less of inlet pressure (gauge pressure)	
Minimum differential pressure		0.05 MPa	
Maximum differential pressure		0.7 MPa	
Maximum pressure reduction ratio		10:1	
Application temperature		5-80˚C *1	
Fluid viscosity		700 cSt or less	
Material	Body	Cast iron	
	Valve, valve seat	Phosphor bronze *2	
	Spindle	Stainless steel	
	Piston	Bronze	
Connection		JIS 10K FF flanged	

*1 Available with withstanding up to 120˚C.
*2 Available with stainless steel made valve and valve seat.
・Available with the GD-7H, made of cast steel, with inlet pressure of 2.0 MPa or less and reduced pressure of 0.7 to 1.6 MPa.

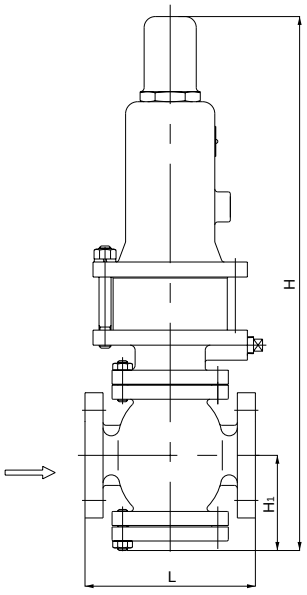


● Valve seat leakage (L/min)

Nominal size	20	25	32	40	50	65	80	100	125	150
Leakage	0.16	0.2	0.25	0.32	0.4	0.52	0.64	0.8	1.0	1.2

Dimensions (mm) and Weights (kg)

Nominal size	L	H	H_1	Weight
20A	170	535	95	20
25A	170	535	95	22
32A	180	545	100	23
40A	180	545	100	23
50A	180	565	110	26
65A	215	680	125	41
80A	260	700	135	51
100A	300	750	160	66
125A	360	810	190	90
150A	382	875	220	129



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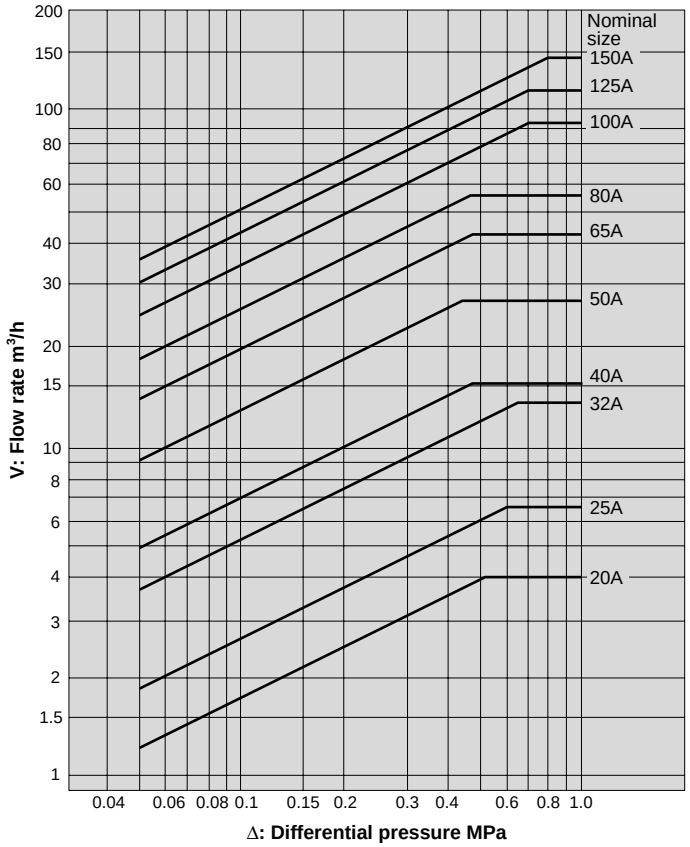
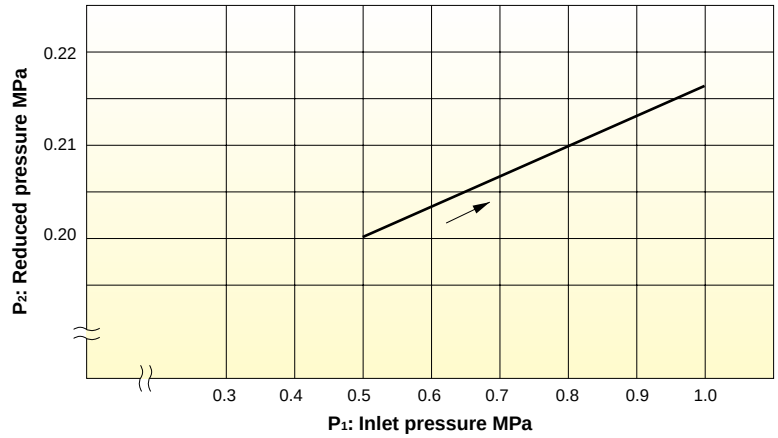
Nominal Sizes Selection Chart (For Water)

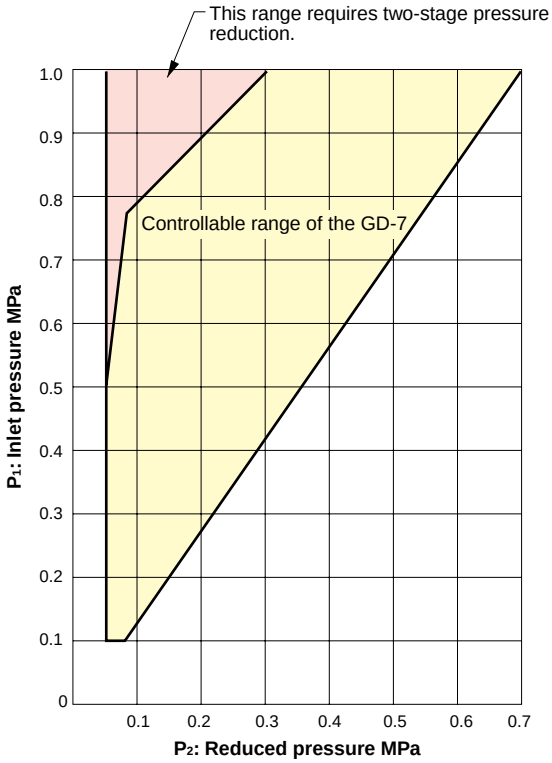


Pressure Characteristic Chart



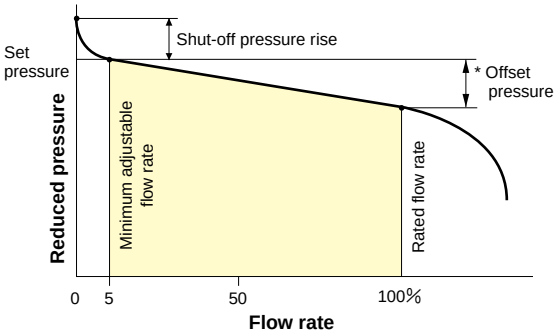
This chart shows variation in reduced pressure when the inlet pressure of 0.5 MPa is changed between 0.5 MPa and 1.0 MPa while the reduced pressure is set at 0.2 MPa.

Specifications Selection Chart



Flow Characteristic Chart

Nominal size	Shut-off pressure rise
20A-50A	Within 10% of set pressure
65A-100A	Within 15% of set pressure
125A-150A	Within 20% of set pressure



* Offset pressure

Nominal size	Offset pressure MPa	
	GD-7	GD-7H
20A-50A	Within 0.08	Within 0.23
65A-150A	Within 0.11	Within 0.18

GD-7B

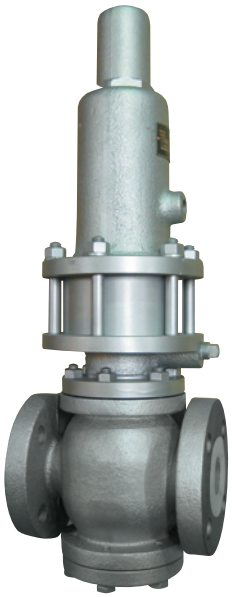
Features

1. Simple in structure, less prone to fail and easy to maintain.
2. Outstanding performance as a pressure reducer for lubricant grease and heavy oil.
3. Pressure balance structure provides stable reduced pressure to inlet pressure and increased maximum pressure ratio.

Specifications

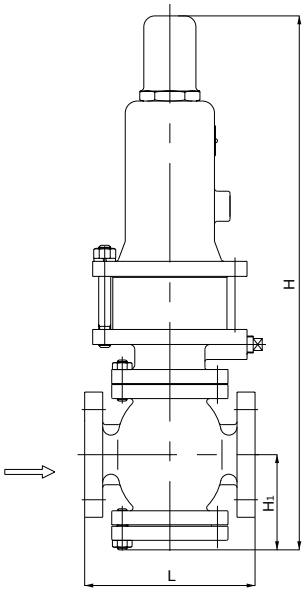
Model		GD-7B	
Application		Cold and hot water, Oil, Other non-dangerous fluids	
Nominal size		20A-50A	65A-150A
Inlet pressure		0.1-1.0 MPa	
Reduced pressure		(A) 0.05-0.25 MPa (B) 0.25-0.45 MPa (C) 0.45-0.7 MPa	(A) 0.05-0.2 MPa (B) 0.2-0.5 MPa (C) 0.5-0.7 MPa
		85% or less of inlet pressure (gauge pressure)	
Minimum differential pressure		0.05 MPa	
Maximum pressure reduction ratio		20A-50A: 20:1 65A-150A: 15:1	
Application temperature		5-80˚C *	
Valve seat leakage		None	
Fluid viscosity		700 cSt or less	
Material	Body	Cast iron	
	Valve	NBR	
	Valve seat	Stainless steel	
	Spindle	Stainless steel	
	Piston	Bronze	
Connection		JIS 10K FF flanged	

* Available with withstanding up to 120˚C.
・ Available with the GD-7BH, made of cast steel, with inlet pressure of 2.0 MPa or less and reduced pressure of 0.7 to 1.6 MPa.



Dimensions (mm) and Weights (kg)

Nominal size	L	H	H_1	Weight
20A	170	535	95	20
25A	170	535	95	22
32A	180	545	100	23
40A	180	545	100	23
50A	180	565	110	26
65A	215	680	125	41
80A	260	705	140	51
100A	300	755	165	66
125A	360	815	195	90
150A	382	885	225	129



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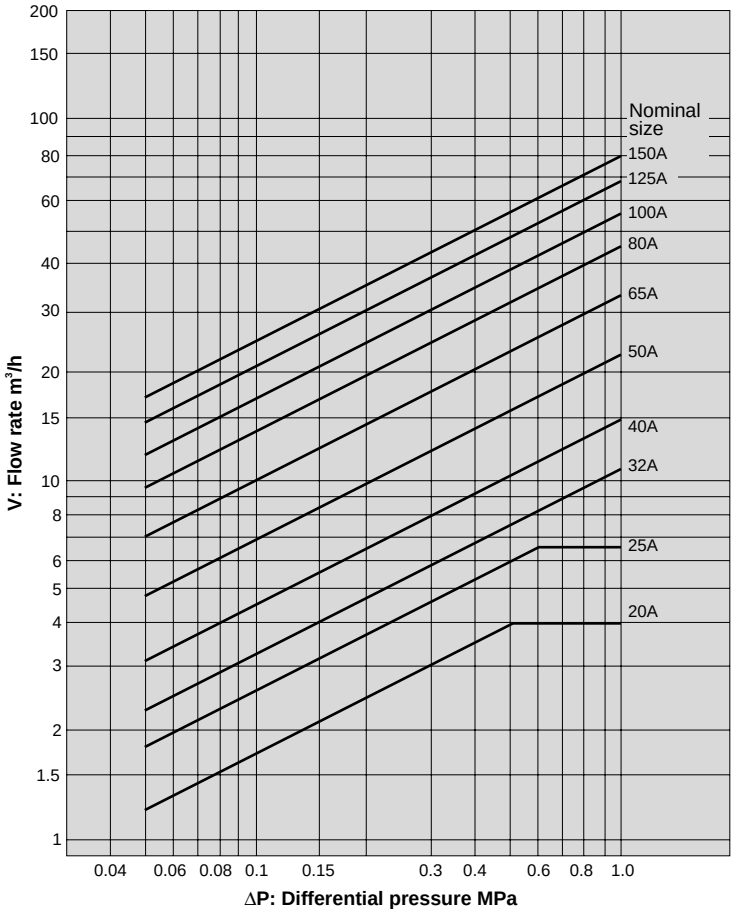
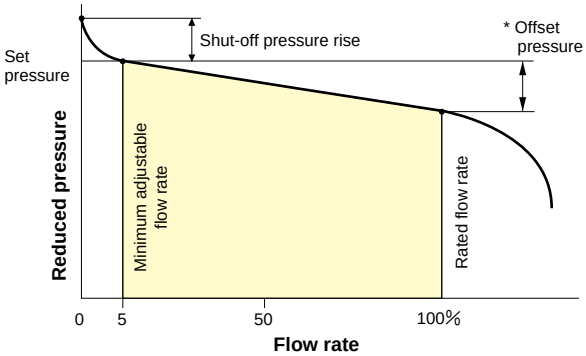
Nominal Sizes Selection Chart (For Water)



Flow Characteristic Chart

Nominal size	Shut-off pressure rise	
	GD-7B	GD-7BH
20A-50A	Within 10% of set pressure	Within 15% of set pressure
65A-150A	Within 15% of set pressure	Within 15% of set pressure

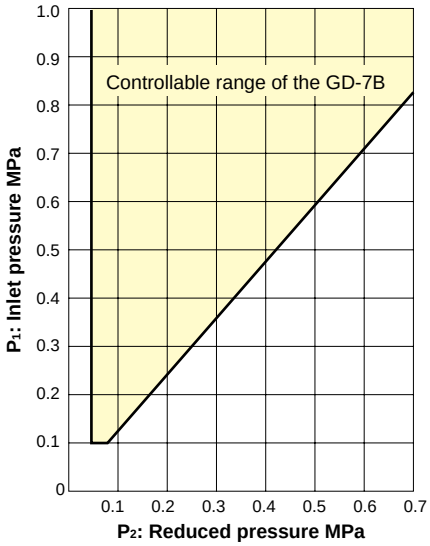


* Offset pressure

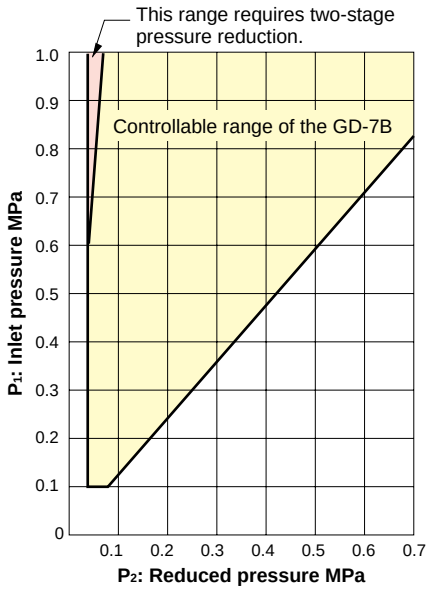
Nominal size	Offset pressure MPa	
	GD-7B	GD-7BH
20A-50A	Within 0.08	Within 0.23
65A-150A	Within 0.11	Within 0.18

Specifications Selection Chart

● Nominal sizes 20A to 50A



● Nominal sizes 65A to 150A



GP-1000T

Features

1. Far superior to conventional pressure reducing valve in workability and durability.
2. Free of valve seat leakage. Improved workability as a result of refinement of sliding parts.
3. Simple and robust internal structure.


GP-1000T


GP-1010T


GP-1200T

Description of GP-1000T Series model code

GP-1000T □

- Material, S: trim parts made of stainless steel, SS: wetted parts made of stainless steel, AS: all stainless steel
- 0: standard, 1: equipped with a handle, 2: for low pressure
- 0: flanged, 1: screwed
- 0: standard, 2: air loading type

Specifications

Model		GP-1000T	GP-1010T	GP-1200T	GP-1210T
Application		Air, Other non-dangerous fluids			
Inlet pressure		0.1-1.0 MPa			
Reduced pressure		0.05-0.9 MPa			
		90% or less of inlet pressure (gauge pressure)			
Minimum differential pressure		0.05 MPa			
Maximum pressure reduction ratio		20:1			
Application temperature		5-80˚C			
Valve seat leakage		None			
Material	Body	Ductile cast iron			
	Valve	Brass (NBR contained)			
	Valve seat	Stainless steel			
	Piston, cylinder	Brass or bronze			
	Diaphragm	Stainless steel			
Connection		JIS 10K FF flanged	JIS Rc screwed	JIS 10K FF flanged	JIS Rc screwed

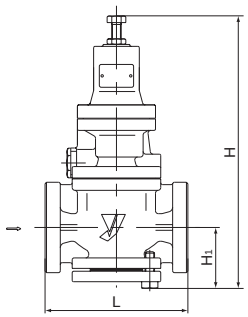
・Available with stainless steel made trim parts (piston, cylinder and valve) as GP-□□□□TS.

Dimensions (mm) and Weights (kg)

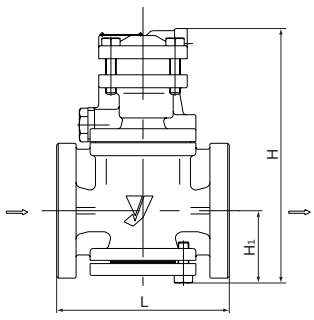
●GP-1000T・1200T

Nominal size	L	H1	H	Weight
15A	150	64	285 (220)	8.0
20A	155	64	285 (220)	8.5
25A	160	67	300 (235)	10.0
32A	190	82	323 (258)	14.0
40A	190	82	323 (258)	14.5
50A	220	93	347 (282)	20.0
65A	245	100	357 (292)	30.0
80A	290	122	404 (339)	35.0
100A	330	144	450 (385)	52.5

・The above values in parentheses are the dimensions of the GP-1200T.



GP-1000T

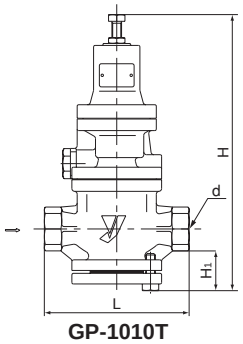


GP-1200T

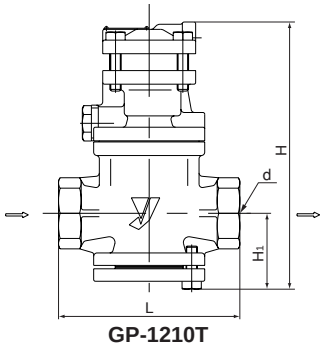
●GP-1010T・1210T

Nominal size	d	L	H1	H	Weight
15A	Rc 1/2	150	64	285 (220)	7.0
20A	Rc 3/4	155	64	285 (220)	7.0
25A	Rc 1	160	67	300 (235)	8.5
32A	Rc 1-1/4	190	82	323 (258)	12.0
40A	Rc 1-1/2	190	82	323 (258)	12.5
50A	Rc 2	220	93	347 (282)	18.0

・The above values in parentheses are the dimensions of the GP-1210T.



GP-1010T



GP-1210T

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GP-1000TSS·1000TAS

Features

1. Stainless steel is used for wetted parts (GP-1000TSS) and all parts (GP-1000TAS), improving corrosion resistance.
2. Free of valve seat leakage. Improved workability as a result of refinement of sliding parts.
3. Simple and robust internal structure.

Specifications

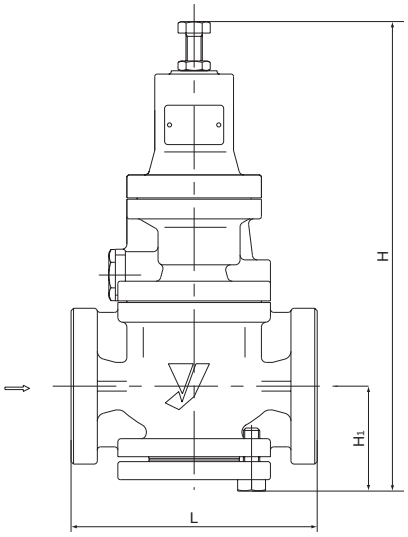
		Stainless steel wetted parts	All stainless steel made
Model		**GP-1000TSS**	**GP-1000TAS**
Application		Air, Other non-dangerous fluids	
Inlet pressure		0.1-1.0 MPa	
Reduced pressure		0.05-0.9 MPa	
Adjusted reduced pressure		90% or less of inlet pressure (gauge pressure)	
Minimum differential pressure		0.05 MPa	
Maximum pressure reduction ratio		20:1	
Application temperature		5-80˚C	
Valve seat leakage		None	
Material	Body	Cast stainless steel	
	Valve	Stainless steel (NBR contained)	
	Valve seat	Stainless steel	
	Piston, cylinder	Stainless steel	
	Diaphragm	Stainless steel	
Connection		JIS 10K FF flanged	

GP-1000TAS

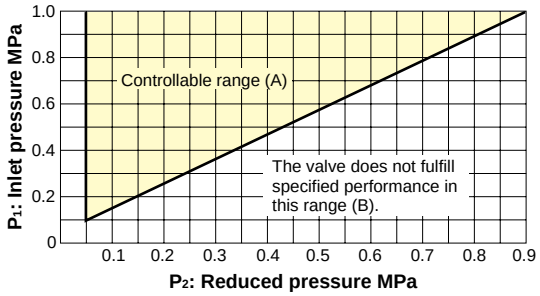
Dimensions (mm) and Weights (kg)

Nominal size	L	H1	H	Weight
15A	150	67	288 (298)	8.3 (8.5)
20A	155	67	288 (298)	8.8 (9.0)
25A	160	70	303 (313)	10.5 (10.7)
32A	190	85	326 (336)	14.8 (15.0)
40A	190	85	326 (336)	15.3 (15.5)
50A	220	96	350 (360)	20.8 (21.0)

・The above values in parentheses are the dimensions and weights of the GP-1000TAS.



Specifications Selection Chart



Find the intersection point of the inlet and reduced pressures. If the intersection point is within range (A), the pressures are controllable. The valve does not fulfill specified performance if the intersection point lies in range (B).

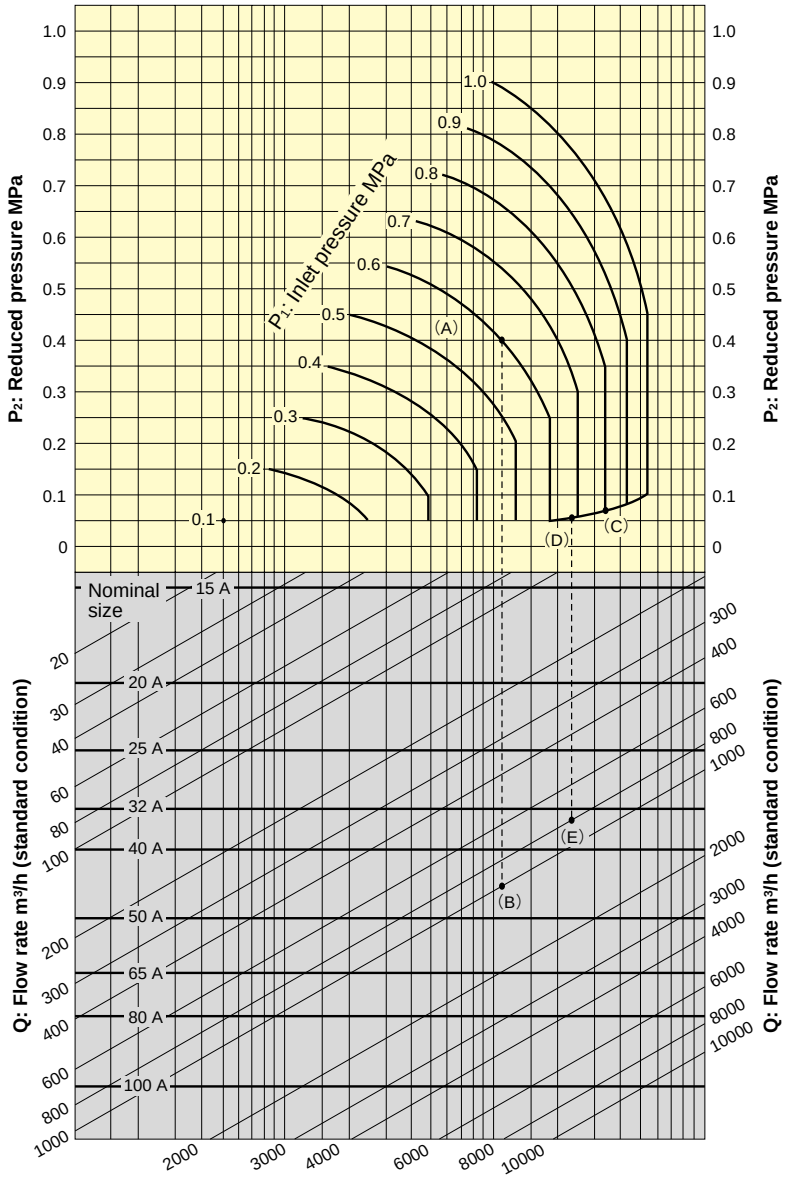
Table of Corrected Cv Values

●Table of rated Cv values (Cv value when the correction factor C = 1)

Nominal size	15A	20A	25A	32A	40A	50A	65A	80A	100A
Cv values	1	2.3	4	6.5	9	16	25	36	64

Note) When the inlet pressure is more than 0.7 MPa and the pressure reduction ratio is more than 10:1, calculate the corrected Cv value by multiplying the rated Cv value by the correction factor C obtained from the Fig. 1.

Nominal Sizes Selection Chart (Fluid: 20˚C Air)



[Example 1]
When selecting the nominal size of a pressure reducing valve whose inlet pressure (P_1), reduced pressure (P_2), and air flow rate are 0.6 MPa, 0.4 MPa, and 1,000 m³/h (standard condition), respectively, first find intersection point (A) of the inlet pressure of 0.6 MPa and the reduced pressure of 0.4 MPa. Trace down vertically from this intersection point to find intersection point (B) with the flow rate of 1,000 m³/h (standard condition). Since intersection point (B) lies between nominal sizes 40A and 50A, select the larger one, 50A.

[Example 2]
When selecting the nominal size of a pressure reducing valve whose inlet pressure (P_1), reduced pressure (P_2), and air flow rate are 0.8 MPa, 0.05 MPa, and 800 m³/h (standard condition), respectively, first find intersection point (C) of the inlet pressure of 0.8 MPa and the diagonal line. Trace down to the left from the diagonal line to find intersection point (D) with the reduced pressure of 0.05 MPa. Trace down vertically from intersection point (D) to find intersection point (E) with the flow rate of 800 m³/h (standard condition). Since intersection point (E) lies between nominal sizes 32A and 40A, select the larger one, 40A.

・Set the safety factor at 80 to 90%.

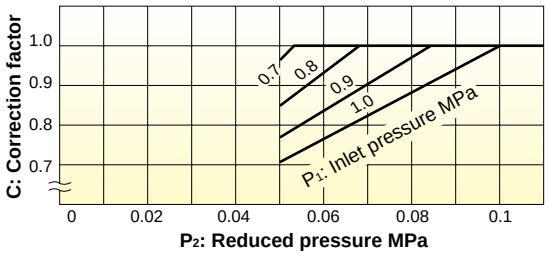
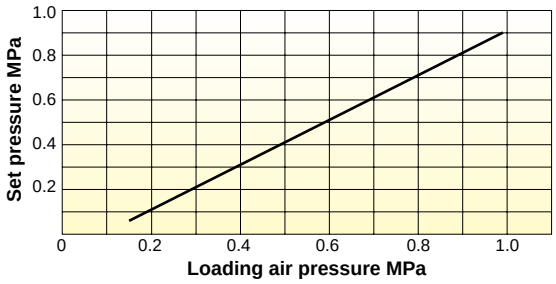


Fig. 1: Corrected Cv value

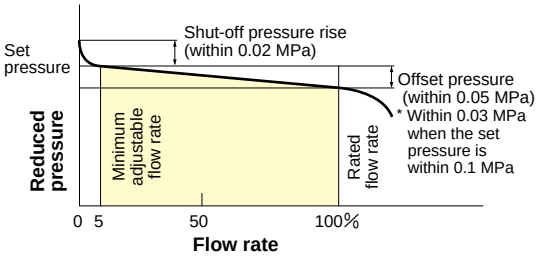
Loading Air Pressure-set Pressure Chart

●GP-1200T・1210T

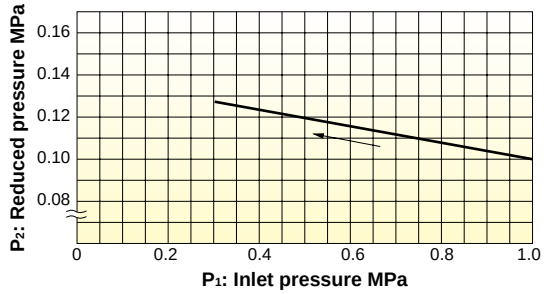


Basically, the set pressure to the loading air pressure is as shown in the chart above. The set pressure is slightly different depending on the conditions. In this case, adjust the loading air pressure.

Flow Characteristic Chart



Pressure Characteristic Chart



This chart shows variation in reduced pressure when the inlet pressure of 1.0 MPa is changed between 0.3 MPa and 1.0 MPa while the reduced pressure is set at 0.1 MPa.

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GD-26G・27G

Features

1. Corrosion-resistant materials are used for wetted parts.
2. Reduced noise.
3. Pressure balance structure can keep the reduced pressure at a constant level without being affected by inlet pressure.
4. Maintenance and inspection can be conducted easily by disassembling simply from the upper side.
5. Compact and lightweight, easy to handle on piping.

GD-26G

Specifications

Model		GD-26G	GD-27G
Application		Air, Other non-dangerous fluids *	
Inlet pressure		1.0 MPa or less	
Reduced pressure		(A) 0.05-0.35 MPa (B) 0.3-0.7 MPa	
Fluid temperature		5-90˚C	
Minimum differential pressure		0.05 MPa	
Maximum pressure reduction ratio		10:1	
Material	Body	Cast bronze	
	Valve seat	Bronze	
	Valve disc	EPDM	
	Diaphragm	EPDM	
Connection		JIS Rc screwed	JIS 10K FF flanged

GD-27G

* Please contact us when using for gas containing oil.
・A strainer (40 mesh) is incorporated in 15A to 50A.
・Pressure gauge connection port is JIS Rc 1/8.

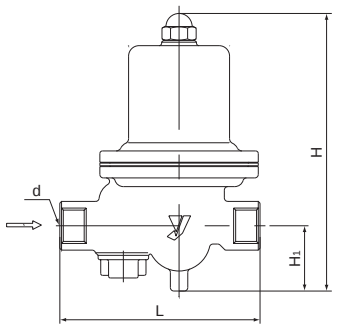
Dimensions (mm) and Weights (kg)

●GD-26G

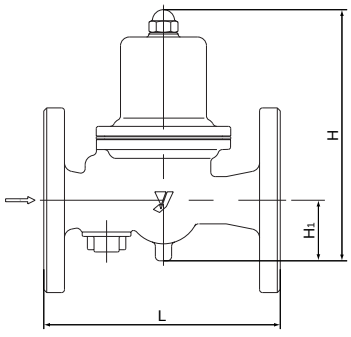
Nominal size	d	L	H	H1	Weight
15A	Rc 1/2	115	159.5	37.5	1.6
20A	Rc 3/4	120	159.5	38.5	1.7
25A	Rc 1	135	170	41	2.1
32A	Rc 1-1/4	180	224	57	4.0
40A	Rc 1-1/2	180	224	57	4.4
50A	Rc 2	200	239.5	61	6.5

●GD-27G

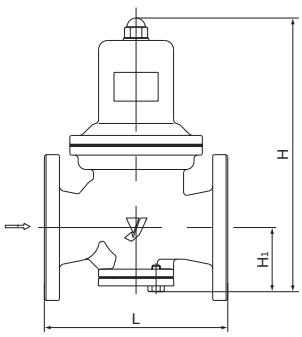
Nominal size	L	H	H1	Weight
25A	160	170	41	5.1
32A	200	224	57	7.5
40A	200	224	57	7.7
50A	220	239.5	61	10.9
65A	220	329	77	20.0
80A	230	345	82	22.0
100A	270	412	94	33.0



GD-26G



GD-27G 25A-50A



GD-27G 65A-100A

GD-26GS・27GS

Features

1. Corrosion-resistant materials are used for wetted parts.
2. Reduced noise.
3. Pressure balance structure can keep the reduced pressure at a constant level without being affected by inlet pressure.
4. Maintenance and inspection can be conducted easily by disassembling simply from the upper side.
5. Compact and lightweight, easy to handle on piping.

GD-26GS

GD-27GS

Specifications

Model		GD-26GS	GD-27GS
Application		Air, Other non-dangerous fluids *	
Inlet pressure		1.0 MPa or less	
Reduced pressure		(A) 0.05-0.35 MPa (B) 0.3-0.7 MPa	
Application temperature		5-90˚C	
Minimum differential pressure		0.05 MPa	
Maximum pressure reduction ratio		10:1	
Material	Body	Cast stainless steel	
	Valve seat	Cast stainless steel	
	Valve disc	EPDM	
	Diaphragm	EPDM	
Connection		JIS Rc screwed	JIS 10K FF flanged

* Please contact us when using for gas containing oil.
・A strainer (40 mesh) is incorporated in 15A to 50A.
・Pressure gauge connection port is JIS Rc 1/8.
・Available with FKM.

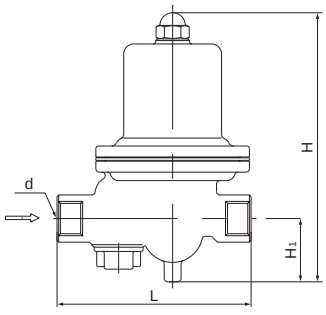
Dimensions (mm) and Weights (kg)

●GD-26GS

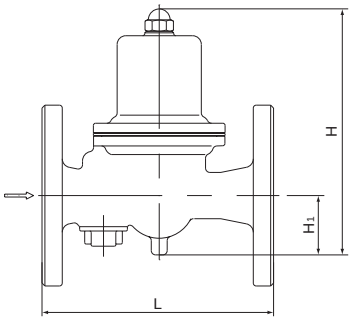
Nominal size	d	L	H	H1	Weight
20A	Rc 3/4	135	170	41	2.2
25A	Rc 1	135	170	41	2.2
32A	Rc 1-1/4	180	224	57	4.7
40A	Rc 1-1/2	180	224	57	4.5
50A	Rc 2	200	239.5	61	6.5

●GD-27GS

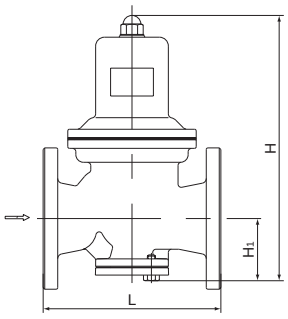
Nominal size	L	H	H1	Weight
20A	160	170	41	3.9
25A	160	170	41	4.8
32A	200	224	57	8.0
40A	200	224	57	8.3
50A	220	239.5	61	10.8
65A	220	329	77	20.6
80A	230	345	82	22.0
100A	270	412	94	34.5



GD-26GS



GD-27GS 25A-50A



GD-27GS 65A-100A

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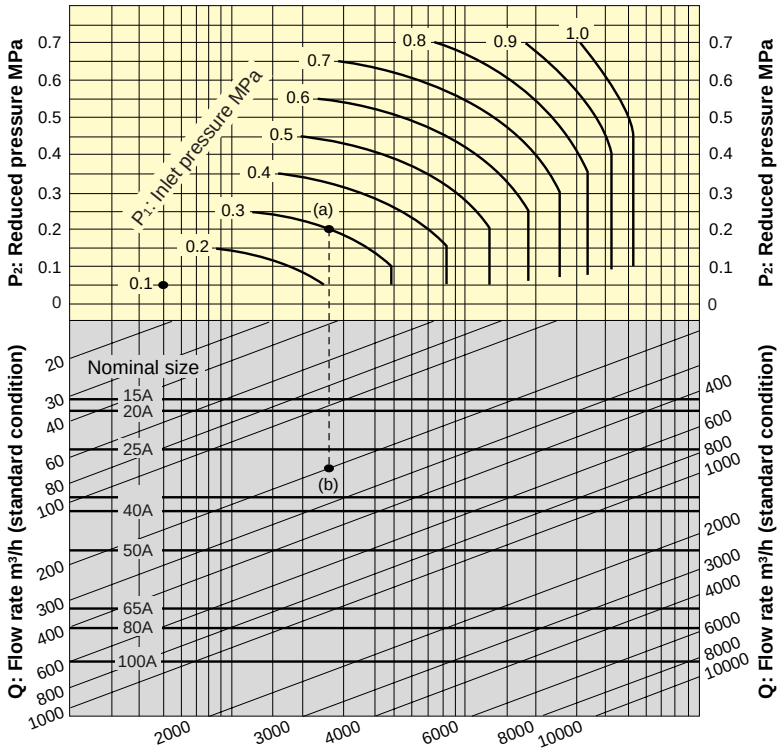
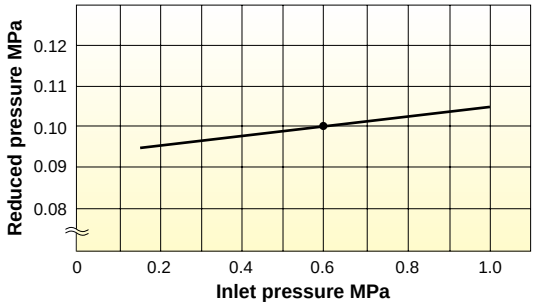
Nominal Sizes Selection Chart



[Example]
When selecting the nominal size of a pressure reducing valve whose inlet pressure (P_1), reduced pressure (P_2), and flow rate are 0.3 MPa, 0.2 MPa, and 200 m³/h (standard condition), respectively, first find intersection point (a) of the inlet pressure (P_1) of 0.3 MPa and the reduced pressure (P_2) of 0.2 MPa. Trace down vertically from this intersection point to find intersection point (b) with the flow rate of 200 m³/h (standard condition). Since intersection point (b) lies between nominal sizes 25A and 32A, select the larger one, 32A.

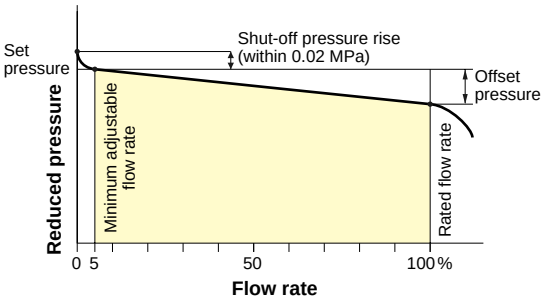
- Set the safety factor at 80 to 90%.

Pressure Characteristic Chart



This chart shows variation in reduced pressure when the inlet pressure of 0.6 MPa is changed between 0.15 MPa and 1.0 MPa while the reduced pressure is set at 0.1 MPa.

Flow Characteristic Chart



Nominal size	Pressure range	Offset pressure
15-100A	(A) 0.05-0.35 MPa	Within 0.05 MPa
	(B) 0.3-0.7 MPa	Within 0.10 MPa

GD-400・400SS

Features

1. Pressure balance structure can keep the reduced pressure at a constant level without being affected by inlet pressure.
2. Due to simple structure, disassembly and maintenance can be conducted easily.
3. Wide range of use due to high maximum pressure ratio.
4. Diaphragm with a large pressure sensing area has accuracy to high set pressure.

Specifications

Model		GD-400	GD-400SS
Nominal size		15-25A	
Application		Air, Nitrogen gas *1	
Inlet pressure		2.5-400 kPa	
Reduced pressure		(A) 0.5-1.4 kPa (B) 1.2-3.3 kPa (C) 3.0-8.0 kPa (D) 7.0-20 kPa	
Working temperature		5-60˚C	
Minimum differential pressure		2.0 kPa	
Maximum pressure reduction ratio		400:1	
Reduced pressure detection method		External sensing *2	
Minimum adjustable flow rate		1.2 m³/h (standard condition)	
Material	Body	Cast iron	Cast stainless steel (SCS14)
	Valve	Stainless steel	
	Valves seat	Stainless steel	
	Disc	NBR *3	
	Spindle	Stainless steel	
	Diaphragm	NBR *3	
Connection		JIS 10K FF flanged	

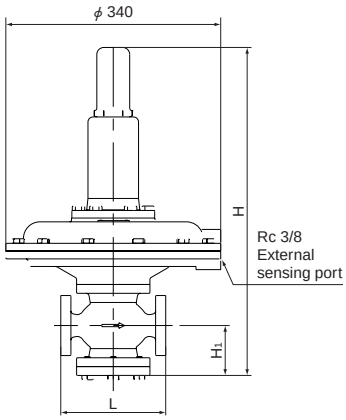
*1 Please contact us when using for other fluids.
*2 A conduit (ϕ 8-2 m) and a joint for external sensing are optional extras.
*3 Available with FKM type.

GD-400SS

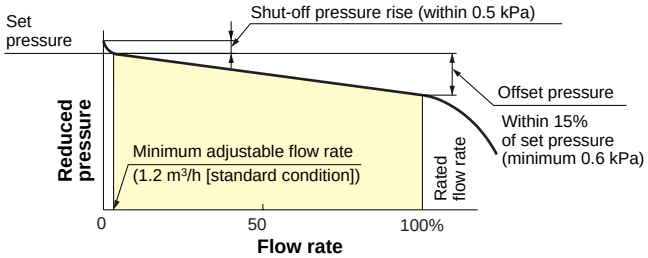
Dimensions (mm) and Weights (kg)

Nominal size	L	H1	H	Weight
15A	166	86	526	29.0 (32.0)
20A	170	86	526	29.0 (32.0)
25A	170	86	526	30.0 (33.0)

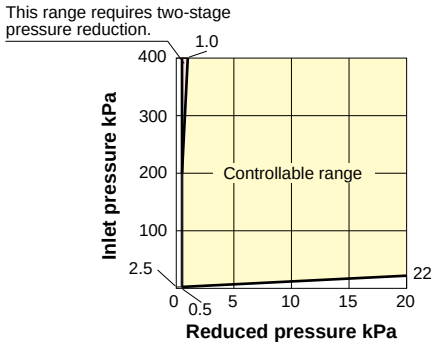
・The values in parentheses are the weights of the GD-400SS.



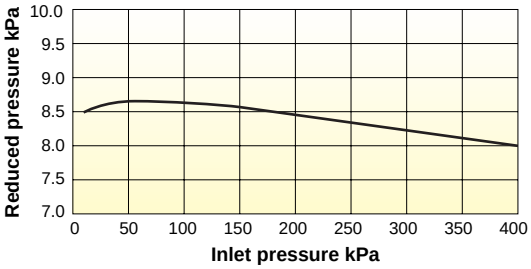
Flow Characteristic Chart



Specifications Chart



Pressure Characteristic Chart



This chart shows variation in reduced pressure when the inlet pressure of 400 kPa is changed to 10 kPa while the reduced pressure is set at 8.0 kPa.

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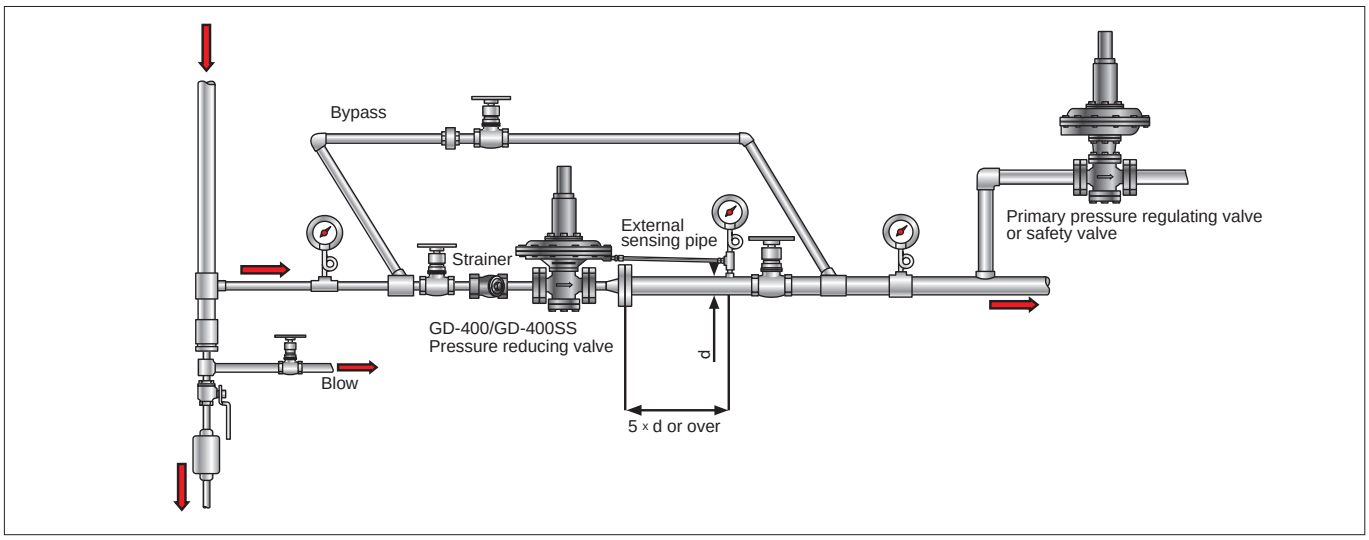
Piping Diagram Example



[Precautions]

1. Connect the external sensing part to the outlet side.
2. Do not adjust needle valve of the pressure reducing valve.
3. For the outlet side pipe, use a pipe with a diameter that can keep the inside flow velocity between 5 m/s and 15 m/s.
4. When performing pressure test or airtight test after connected to the piping, apply the airtest pressure specified in the right table.
   - If pressure beyond the specified airtest pressure is applied, internal parts may be damaged.

Airtight test	Airtight test pressure			
	Inlet pressure			400 kPa or less
	Reduced pressure	Pressure range	A	1.8 kPa or less
			B	4.2 kPa or less
			C	10 kPa or less
			D	25 kPa or less

Chart for Selecting Nominal Sizes

●When the inlet pressure is between 2.5 kPa and 200 kPa (Fluid: 20˚C Air)

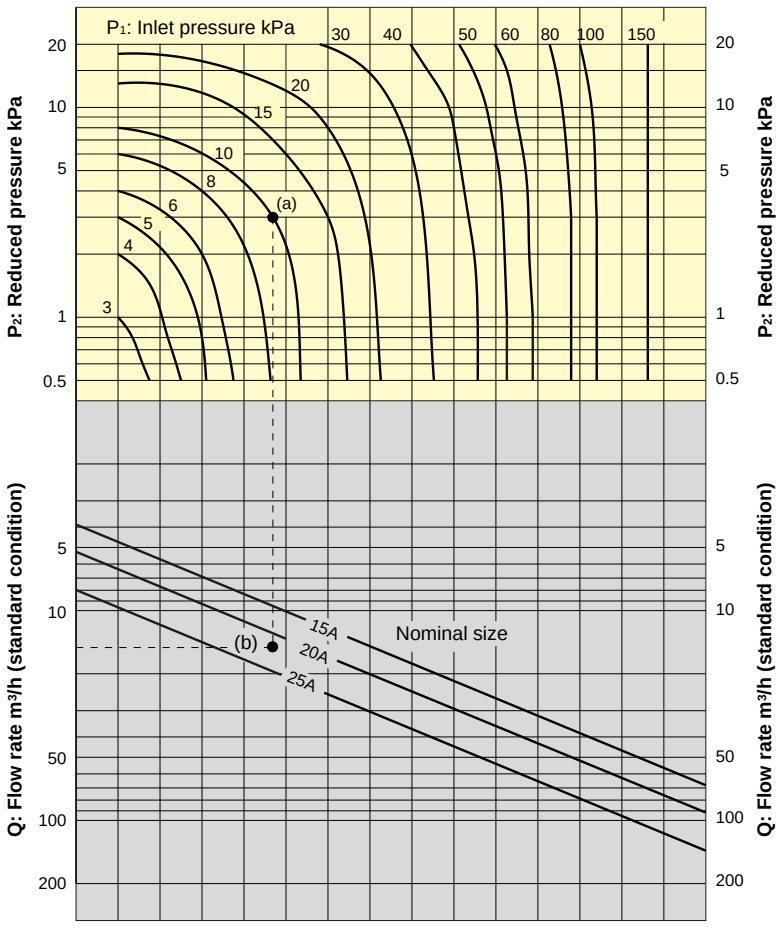


Table 1: When the inlet pressure is between 200 kPa and 400 kPa

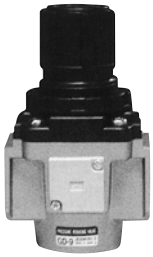
Nominal size	Inlet pressure (kPa)	Rated flow rate (m³/h [standard condition])	
		Reduced pressure (kPa)	
		0.5-4	4-20
15A	200-400	60	60
20A	200-300	90	90
	300-400	90	120
25A	200-300	120	120
	300-400	120	150
	400	120	190

[Example]

When selecting the nominal size of a pressure reducing valve whose inlet pressure (P_1), reduced pressure (P_2), and flow rate are 10 kPa, 3 kPa, and 15 m³/h (standard condition), respectively, first find intersection point (a) of the inlet pressure of 10 kPa and the reduced pressure of 3 kPa. Trace down vertically from this intersection point to find intersection point (b) with the flow rate of 15 m³/h (standard condition). Since intersection point (b) lies between nominal sizes 20A and 25A, select the larger one, 25A.

- Set the safety factor at 80 to 90%.

Feature		Water pressure reducing valve		Low pressure	Low pressure / balance type
Model		GD-15・15C		GD-4	GD-4B
Picture					
Application		City water		Air, Other non-dangerous fluids	
Inlet pressure		0.1-1.0 MPa		Max. 300 kPa	Max. 800 kPa (20A-50A) Max. 500 kPa (65A-150A)
Reduced pressure		0.05-0.25 MPa (Standard setting: 0.2 MPa)		2-200 kPa ・Contact us for pressure range for each valve.	
Max. temperature		60˚C		80˚C	
Connection		JIS Rc screwed		JIS 10K FF flanged	
Material	Body	Cast bronze (NPb-treated)		Cast iron *	
	Valve	NBR		NBR (20A-50A) Stainless steel (65A-150A)	NBR
	Valve seat	Cast bronze (NPb-treated)		Stainless steel	
	Diaphragm	NBR		NBR	
Size		15A	20A	20A-150A	
Others		・The closing pressure of the check valve for the GD-15C is 0.005 MPa or less. ・The strainer is 40 mesh.		* Available with carbon steel or stainless steel body.	

Feature		316 Stainless steel	General air regulator	Large capacity
Model		GD-8N	GD-9	GP-50
Picture				
Application		Pure water, Cold and hot water, Air, Nitrogen gas, Carbon dioxide gas, Argon gas	Air, Other non-dangerous fluids	Cold and hot water
Inlet pressure		0.1-1.0 MPa	0.1-0.99 MPa	0.14-1.0 MPa
Reduced pressure		0.05-0.7 MPa	0.05-0.85 MPa	0.07-0.2 MPa 0.2-0.4 MPa 0.4-0.7 MPa
Max. temperature		60˚C	60˚C	70˚C
Connection		JIS Rc screwed	JIS Rc screwed	JIS 10K RF flanged
Material	Body	Stainless steel (SUS316)	Aluminum die casting	Cast iron
	Valve	Stainless steel	NBR	NBR, Stainless steel
	Valve seat	Stainless steel	Brass	Stainless steel
	Diaphragm	Fluororesin	NBR	—
	Piston & Cylinder	—	—	Bronze
Size		6A-15A	8A-25A	125A-300A
Others		・Available with reduced pressure of 0.02 to 0.2 MPa (for low pressure). ・Pressure gauge connection port is JIS Rc 1/4 screwed. ・Available with dedicated brackets.	・The product cannot be used for toxic and flammable gases. ・Available with dedicated brackets.	—

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M e m o

Drain Separator

About Drain Separator

What is a Drain Separator ??

In a steam/air piping system, drain (water) causes problems, such as rust and water hammer. It also decreases the dryness and heat quantity content of steam and thermal efficiency in a steam system. The DS-1 and DS-2 are separators making use of centrifugal force and impact force to effectively separate drain inside piping.

■ Problems related to existence of drain in the piping system

Failure to properly handle drain in steam piping and air/gas systems results in various problems.

Case 1: Declined thermal efficiency

Drain in a steam system reduces the effective heat quantity (latent heat) in addition to the dryness of steam. In some situations, drain exposes an excessive load on a steam trap, making the discharge capacity insufficient. It also forms water film on the heating surface of the system, which prevents thermal conduction and reduces the system's efficiency.
Additionally, the water directly carried over from a boiler (hot water before evaporation) contains a lot of impurities, and part of them form scale that blocks thermal conduction on the heating surface.

Case 2: Outbreak of water hammer

Water is higher than steam in density and slows its velocity inside piping because of its characteristics. However, drain inside steam piping is carried by steam flowing at high velocity and may give a strong vibration or load to a valve or controlling unit when drain strikes against it. This is called water hammer and causes damage to or wear (erosion) in units.

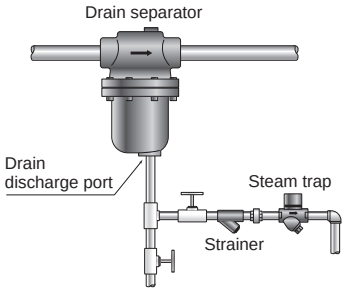
Case 3: Formation of scale

In general, carbon steel pipes for piping are widely used for steam piping. When drain or another liquid contacts them, rust forms. It is quite likely that pressure reducing valves and other control units will malfunction due to scale, including rust.

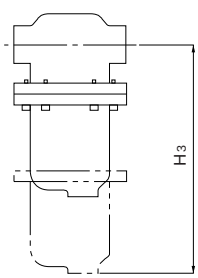
Case 4: Drain problems in air / gas systems

Piping or valve corrosion attributable to drain causes a strainer or trap to clog, and cleaning by air blowing sometimes increases contamination against expectations.

Guidelines for Drain Separator



- Connect the drain separator horizontally to piping with the drain discharge port down.
- Place a trap under the drain discharge port.
- Set the top of the trap lower than the drain discharge port of the drain separator.
- Check the flowing direction of the fluid and the inlet and outlet directions of the drain separator in advance, and properly install it.
- This product is heavy. When connecting it to piping, securely support the product and the piping with a lifting device.
- When installing the product, secure the space of the dimension H_3 shown in the figure below, which is required for maintenance and inspections.



Nominal size	H_3
15A	210
20A	210
25A	210
32A	240
40A	240
50A	290
65A	350
80A	410
100A	550

Nominal Size Selection Table

- Drain separator causes almost no pressure loss, so select the same size as piping size.

●SPG piping v = 30 m/s Saturated steam (kg/h)

Pressure (MPa) \ Nominal size	15A	20A	25A	32A	40A	50A	65A	80A	100A
0.05	18	33	55	92	125	202	334	471	803
0.1	24	44	72	120	164	265	437	617	1051
0.2	35	64	105	176	240	388	639	903	1538
0.3	47	84	138	231	314	508	837	1183	2015
0.4	58	104	170	285	387	627	1033	1460	2485
0.5	69	124	202	339	460	745	1227	1734	2952
0.6	79	143	234	392	533	862	1420	2006	3415
0.7	90	163	266	445	605	978	1611	2276	3876
0.8	101	182	297	498	676	1094	1802	2546	4335
0.9	112	201	329	551	748	1209	1993	2815	4793
1.0	122	220	360	603	819	1325	2183	3083	5250
1.1	133	240	392	655	890	1440	2372	3351	5707
1.2	144	259	423	708	961	1555	2562	3619	6162
1.3	154	278	454	760	1033	1670	2752	3887	6618
1.4	165	297	486	813	1104	1785	2941	4155	7074
1.5	176	316	517	865	1175	1900	3131	4422	7530
1.6	186	336	548	917	1246	2015	3320	4690	7986
1.7	197	355	580	970	1317	2130	3510	4958	8442
1.8	208	374	611	1022	1389	2246	3700	5227	8899
1.9	218	393	642	1075	1460	2361	3890	5496	9357
2.0	229	413	674	1128	1532	2477	4081	5765	9816

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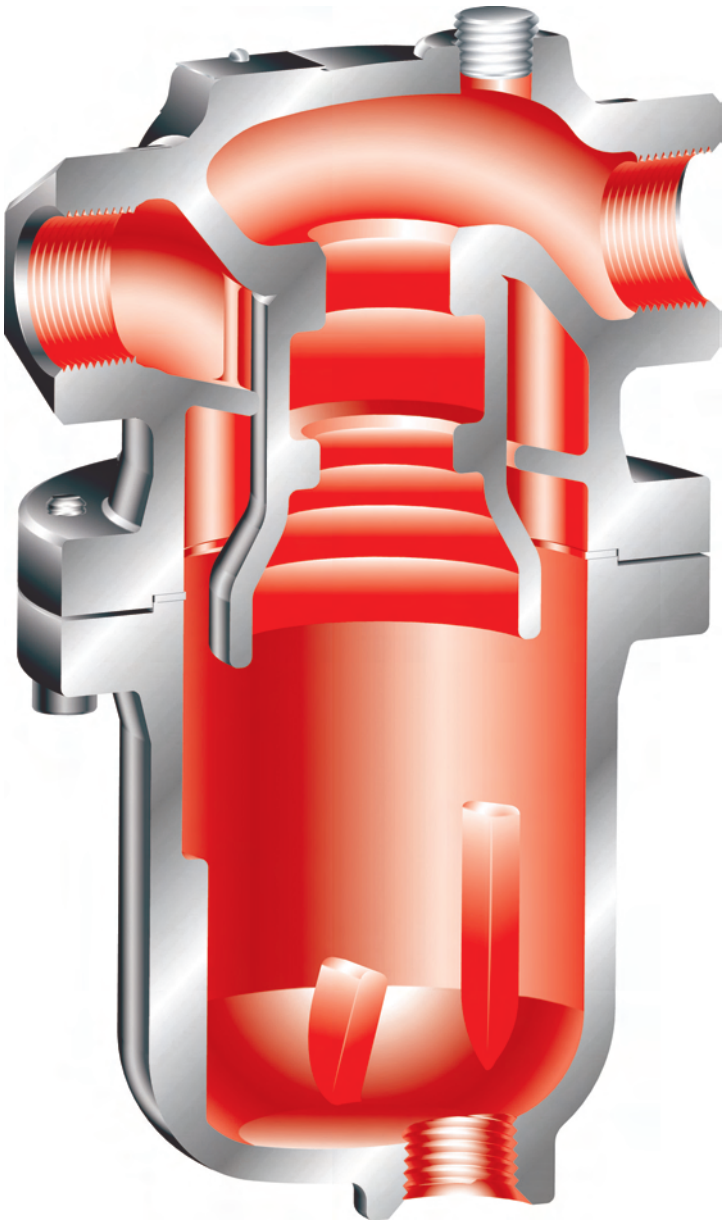
Features of drain separator



1: High separating efficiency

As soon as steam or air flows into the drain separator, centrifugal force starts to work by the internal structure of the body. Drain swirls along the wall surface in consequence of the difference in specific gravity between it and the steam or air, and strikes against the baffle.
The drain is then guided to discharge port and released by the installed trap.

2: No pressure loss

Size of separator can be the same as piping size. Since sectional area of inside separator is larger than piping size, pressure loss is considered as zero.

3: Advantages

- **Improve dryness of steam**
  The water content of the steam will lead to have heat loss. The more dried steam gets more useful heat energy.

- **Prevent problem associated with contained water or air**
  Water in steam or air may cause erosion on valve, valve seat and fittings due to high velocity water, and valve or piping system may fail because of rapid wear or water hammer.

- **Supply less wet compressed air**
  The air compressed by compressor will be cooled at piping, cooler, or receiver tank, etc. Such resulting wetness in the air may cause corrosion in piping line and less durability of the piping system.

- **Maintenance-free**
  Since no movable parts are used inside, the drain separator is maintenance-free (except the aging of the gasket).

DS-1・2

Drain (condensate) in steam and air piping causes a decline in thermal efficiency, water hammer, corrosion of devices, valves, and pipes, and many other problems.
The DS-1 and DS-2 drain separators are capable of efficiently separating condensate from steam and air with the aid of centrifugal force generated from the configuration of the passage. In normal condition, use a separator of the same size as piping for both steam and compressed air systems.


DS-1


DS-2

Features

1. High efficient drain separation due to cyclone type.
2. Extremely low pressure loss.
3. Trouble-free by minimizing the number of moving parts.

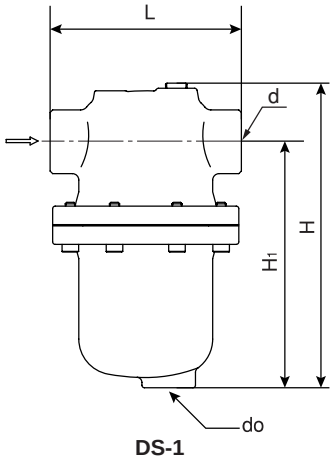
Specifications

Model		DS-1	DS-2
Application		Steam, Air	
Maximum pressure		2.0 MPa (1.0 MPa for air)	
Maximum temperature		220˚C	
Material	Body	Ductile cast iron	
	Nozzle	Cast iron	
	Receiver	Ductile cast iron	
Connection		JIS Rc screwed	JIS 10K/20K FF flanged

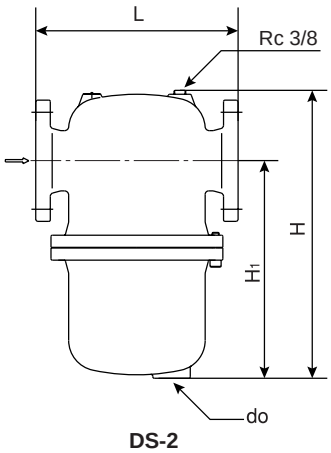
Dimensions (mm) and Weights (kg)

Model	Nominal size	d	L	H	H_1	d_0	Weight
DS-1	15A	Rc 1/2	150	243	193	Rc 3/4	7.1
	20A	Rc 3/4	150	243	193	Rc 3/4	7.1
	25A	Rc 1	150	243	193	Rc 3/4	7.3
	32A	Rc 1-1/4	190	282	213	Rc 1	12.5
	40A	Rc 1-1/2	190	282	213	Rc 1	12.5
	50A	Rc 2	219	342	260	Rc 1	20.5
DS-2	15A	—	174 (178)	243	193	Rc 3/4	8.5 (8.7)
	20A	—	204 (208)	243	193	Rc 3/4	9.6 (9.8)
	25A	—	204 (208)	243	193	Rc 3/4	10.1 (10.5)
	32A	—	222 (226)	282	213	Rc 1	15.6 (16.0)
	40A	—	242 (246)	282	213	Rc 1	16.3 (16.7)
	50A	—	246 (250)	342	260	Rc 1	24.7 (24.9)
	65A	—	288 (292)	418	314	Rc 1	40.0
	80A	—	335 (343)	484	361	Rc 1-1/4	56.0
	100A	—	390 (402)	594	445	Rc 1-1/4	100.0

・The above values in parentheses are the dimensions and weights of JIS 20K FF flanged.



DS-1



DS-2

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Selecting a Nominal Size

Keep the instruction described below in mind to enable the drain separator to operate most effectively and meet working conditions to the fullest extent possible.

●Selecting a drain separator nominal size

Select the same nominal size as that of piping (nominal size of piping = nominal size of drain separator). Using a drain separator of a smaller nominal size may increase pressure loss, resulting in failure to keep the specified pressure at the outlet of a unit.

Table 1: Working flow velocity

Application	Flow velocity
Steam	30 m/sec or less
Air	15 m/sec or less

・Keep the fluid below the specified flow velocity.
・A higher flow velocity may cause drain separation to fail.

Nominal Size Selection Table

Drain separator causes almost no pressure loss, so select the same size as piping size.

●SPG piping v = 30 m/s Saturated steam

(kg/h)

Pressure (MPa) \ Nominal size	15A	20A	25A	32A	40A	50A	65A	80A	100A
0.05	18	33	55	92	125	202	334	471	803
0.1	24	44	72	120	164	265	437	617	1051
0.2	35	64	105	176	240	388	639	903	1538
0.3	47	84	138	231	314	508	837	1183	2015
0.4	58	104	170	285	387	627	1033	1460	2485
0.5	69	124	202	339	460	745	1227	1734	2952
0.6	79	143	234	392	533	862	1420	2006	3415
0.7	90	163	266	445	605	978	1611	2276	3876
0.8	101	182	297	498	676	1094	1802	2546	4335
0.9	112	201	329	551	748	1209	1993	2815	4793
1.0	122	220	360	603	819	1325	2183	3083	5250
1.1	133	240	392	655	890	1440	2372	3351	5707
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1.4	165	297	486	813	1104	1785	2941	4155	7074
1.5	176	316	517	865	1175	1900	3131	4422	7530
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1.7	197	355	580	970	1317	2130	3510	4958	8442
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1.9	218	393	642	1075	1460	2361	3890	5496	9357
2.0	229	413	674	1128	1532	2477	4081	5765	9816

Safety Relief Valve

Safety Valve
Relief Valve

Safety Relief Valve Selection

Application				Working Pressure (MPa)	Model	Type					Page
Steam	Air	Water	Oil			Lift Type	Full Bore Type	Lever Type	Closed Type	Open Type	
●	●	●	●	0.05-1.0	AL-140	●			●		111
●	●	●	●		AL-150	●			●		137
●	●				AL-150L	●		●		●	137
●	●	●	●		AL-160	●			●		105
●	●				AL-160L	●		●		●	105
●	●	●	●		AL-31	●			●		124
●	●	●	●	0.05-1.6	AL-17	●			●		116
●	●	●	●	1.0-1.6	AL-150H	●			●		110
●	●				AL-150HL	●		●		●	137
●	●	●	●	1.0-2.0	AL-140H	●			●		111
●	●	●	●		AL-31H	●			●		124
	●	●	●	0.05-1.0	AL-1T	●			●		114
	●	●	●		AL-140T	●			●		113
	●	●	●		AL-150T	●			●		106
	●	●	●		AL-150TML	●		●	●		108
	●	●	●		AL-300T	●			●		118
	●	●	●	0.05-1.3	AL-301T	●			●		118
	●	●	●	0.05-1.5	AL-4T	●			●		120
	●	●	●	0.05-2.0	AL-4ST	●			●		120

Safety Valve Selection

Application				Working Pressure (MPa)	Model	Type					Page
Steam	Air	Water	Oil			Lift Type	Full Bore Type	Lever Type	Closed Type	Open Type	
●				0.05-1.0	AL-1	●				●	114
●					AL-10	●		●		●	115
●					AL-300	●			●		117
●					AL-5·6	●		●		●	122
●	●			0.1-1.0	AF-4		●	●		●	134
●	●				AF-4M		●			●	134
●	●				AF-5S		●	●		●	132
●	●				AF-7		●	●		●	138
●				0.05-1.5	AL-4	●				●	119
●				0.05-1.6	AL-301	●			●		117
●				0.18-1.6	AF-1		●	●		●	138
●					AF-2		●	●		●	136
●	●			0.1-1.6	AF-5		●	●		●	132
●				0.05-2.0	AL-4S	●				●	119
	●			0.1-1.0	AF-7M		●		●		138
	●			0.1-1.96	AF-6H·6HS		●		●		137

Relief Valve Selection

Application				Working Pressure (MPa)	Model	Type					Page
Steam	Air	Water	Oil			Lift Type	Proportional Type	With Handle	Closed Type	Open Type	
		●	●	0.05-1.0	AL-150TR	●		●	●		107
		●	●		AL-250		●		●		127
		●	●		AL-250R		●	●	●		127
		●	●		AL-260		●		●		126
		●	●		AL-260R		●	●	●		126
		●	●		AL-280		●		●		129
		●	●	0.05-1.6	AL-27		●		●		125
		●		0.1-0.7	AL-24		●	●	●		137

Selection of Safety & Relief Valves

What is a Safety and Relief Valve ??

A safety and relief valve ensures the safety of equipment and a system by automatically operating to open its valve when the inlet pressure rises and reaches the set pressure, and to close the valve when the inlet pressure falls to the set pressure.

Applications	• Steam boiler	• Pressure vessel • Heat exchanger • Outlet side of PRV	• Hot-water boiler • Electric water heater • Pressure vessel • Heat exchanger	• Hot-water boiler • Electric water heater • Pressure vessel • Heat exchanger
	Steam	**Steam/Gas**	**Liquid (Water, Oil, etc)**	**Steam/Gas/Liquid**
Types	**Full bore type safety valve**	**Lift type safety valve**	**Relief valve**	**Safety relief valve**
	The flow passage area at valve seat is bigger enough than the nozzle throat area at the inlet side.	The lift of the valve is 1/40 or more and less than 1/4 of the inside diameter of valve seat, and the flow passage area of valve port becomes the smallest in the flow passage area when the valve disc is opened.	The valve is mainly applied to liquid. It automatically operates to open its valve disc when the inlet pressure rises and reaches the set pressure, and to close the valve disc when the inlet pressure falls to the set pressure.	The valve is mainly applied to steam, gas, and liquid. It has both functions of a safety valve and a relief valve.
Major Products	**AF-5・AF-4**	**AL-160・AL-140**	**AL-260・AL-280**	**AL-160・AL-300**
				
				

Safety Relief Valve

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Note for Selecting a Safety Valve

Laws and Regulations

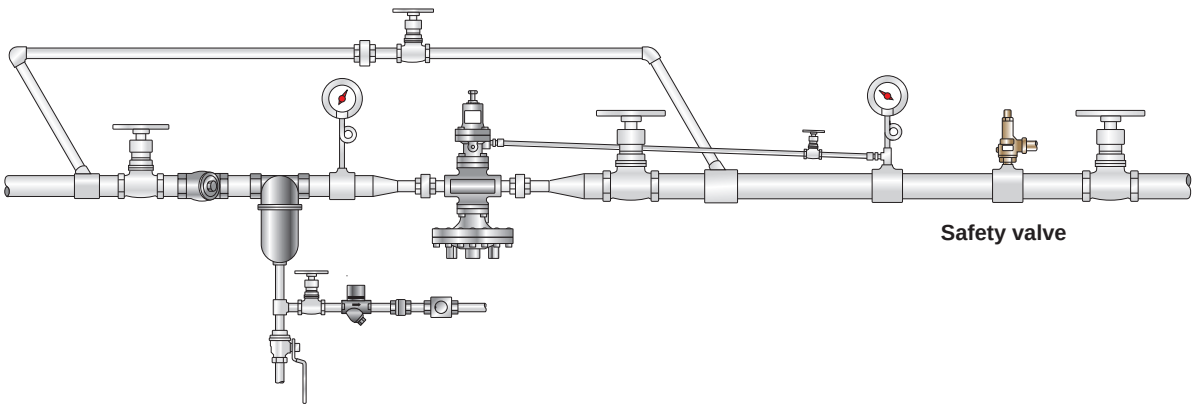
The structure, the formula for calculating discharge capacity, etc. applied to the safety valves are defined in the laws and regulations. The generally-applied laws and regulations both in Japan and overseas are shown below. Most of Yoshitake's valves comply with JIS B8210, and the rest of our products are generally in accordance with the Pressure Vessel Structure Standard.

Country	Standard No.	Description
Japan	JIS B 8210	Spring loaded safety valves for steam boilers and pressure vessels
China	GB/T 12243-2005	Spring loaded safety valves
USA	ASME/ANSI PTC 25.3	Safety and relief valves - performance test codes
Europe	EN ISO 4126	Safety devices for protection against excessive pressure

The Set Pressure of Safety Valve for Alarm Use at Outlet Side of Pressure Reducing Valve

Set pressure of PRV (MPa)	Set pressure of safety valve (MPa)
0.1 or less	Set pressure of PRV + 0.05 or more
0.11-0.4	Set pressure of PRV + 0.08 or more
0.41-0.6	Set pressure of PRV + 0.1 or more
0.61-0.8	Set pressure of PRV + 0.12 or more
More than 0.8	Set pressure of PRV + 15%

When a safety valve is installed for alarm use at the outlet side of a pressure reducing valve, there is no laws or regulations specified to comply with. In this case, select a safety valve whose discharge capacity is around 10% of the max. flow rate of the pressure reducing valve.



Features of Lift Type Safety Relief Valve ＜AL-160 Series＞

1: Ultimate in rust-resistance

Corrosion-proof material "Stainless steel" used for the trim parts, such as valve and valve seat, offers long durability.

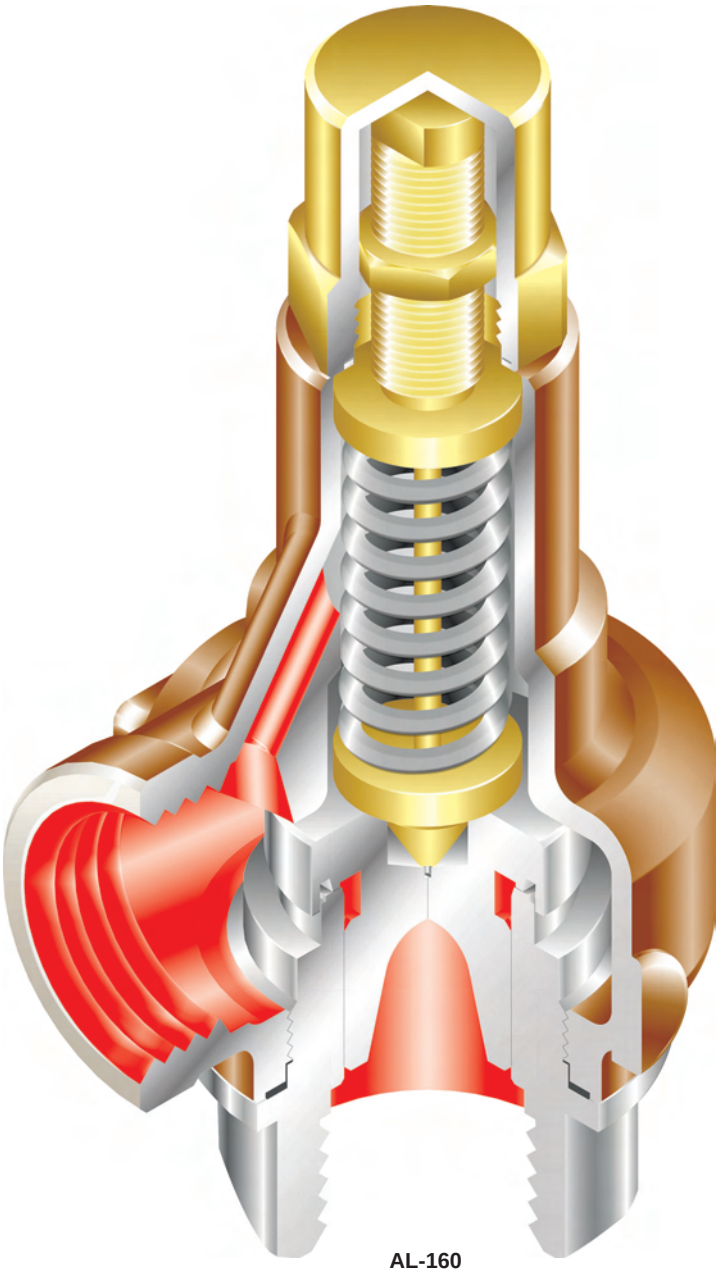
2: No blowdown ring

The design of valve and valve seat fixes the blowdown pressure within a standard requirement to set up the blowdown pressure.

3: Non-leakage

AL-150 with "T" letter adopting a valve with O-ring provides Zero seat leakage.

・Non-leakage at 90% of set pressure.



AL-160

4: Variations

AL-160L

AL-150H

AL-150TML

AL-140

AL-140H

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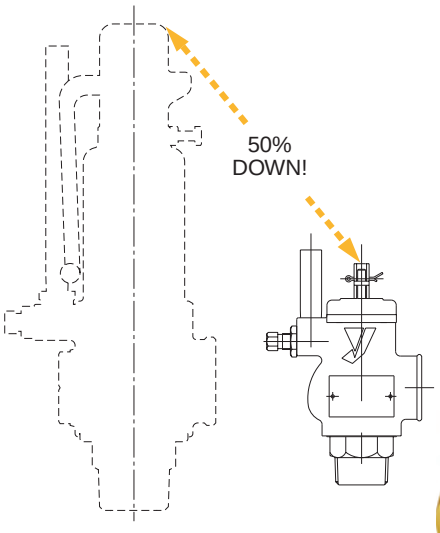
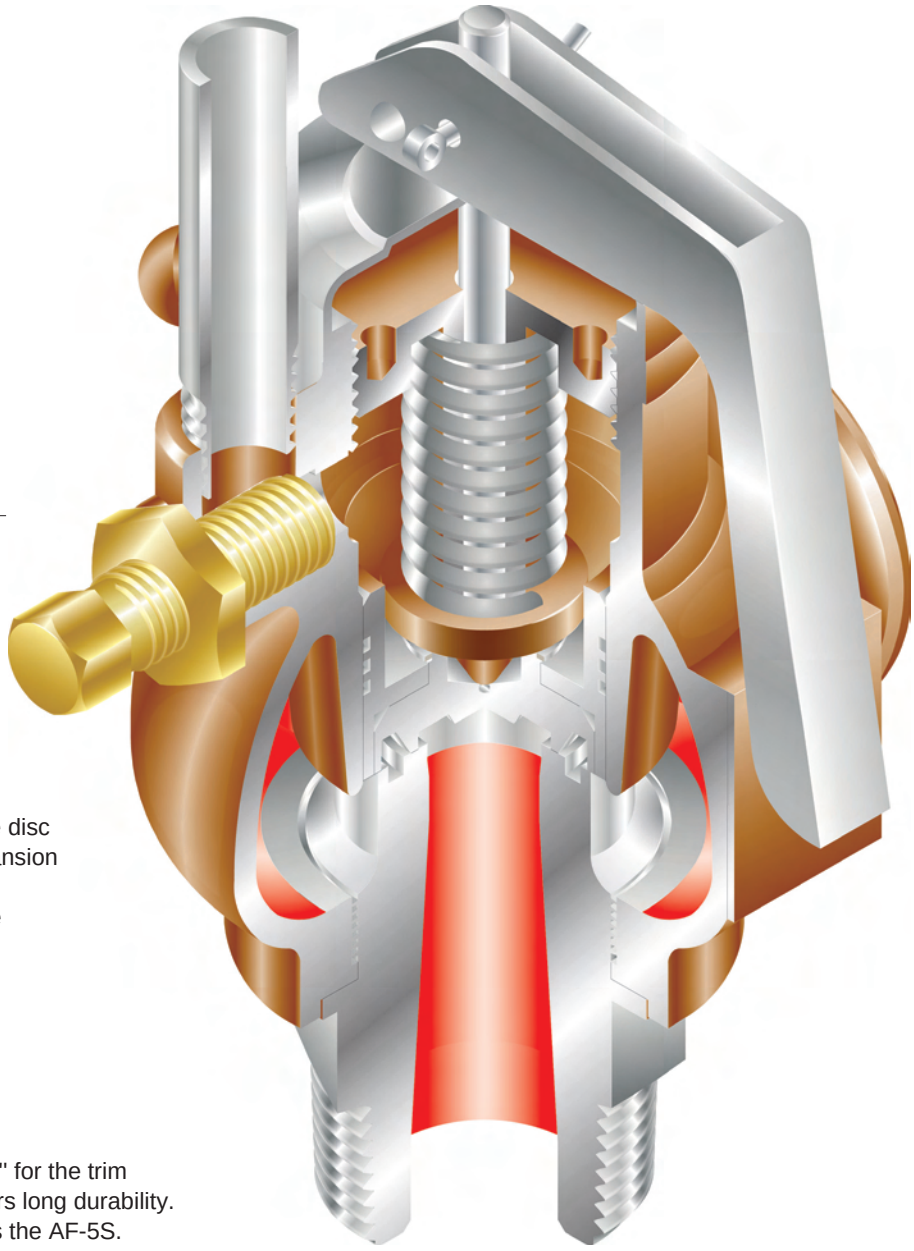
Features of Full Bore Type Safety Valve ＜AF-5 Series＞

1: Smaller & Lighter

Size and weight are about half of the conventional full bore type safety valve.





2: Tight-seal valve design

The unique and whippy form of the valve disc enables the disc to respond to heat expansion to prevent seat leakage, and precision machining and heat treatment guarantee continued high performance.

3: Anti-corrosive material

Corrosion-proof material "Stainless steel" for the trim parts, such as valve and valve seat, offers long durability. Available with all stainless steel made as the AF-5S.

4: Lift lever mechanism

Due to lift lever mechanism, discharge inspection can be performed at more than 75% of the opening pressure.

5: Variations

AF-5

AF-5S

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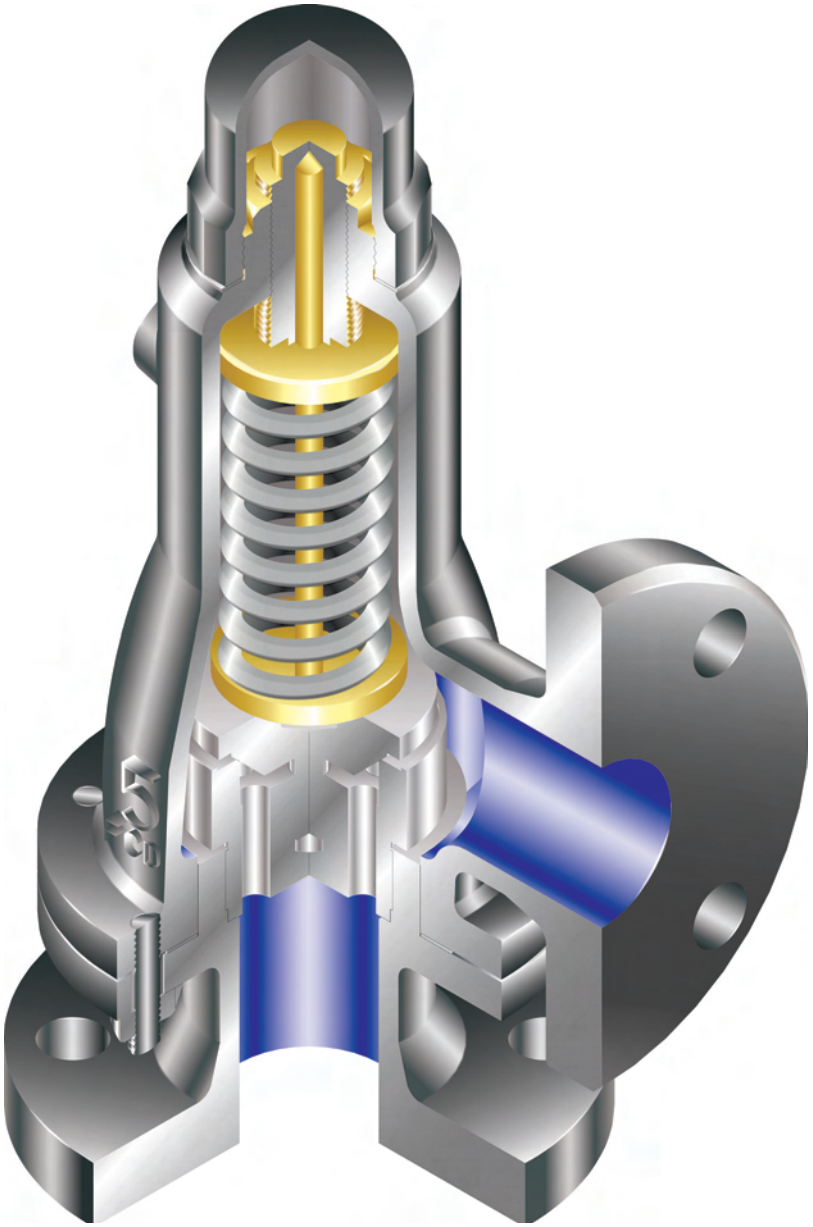
Features of Relief Valve ＜AL-280 Series＞

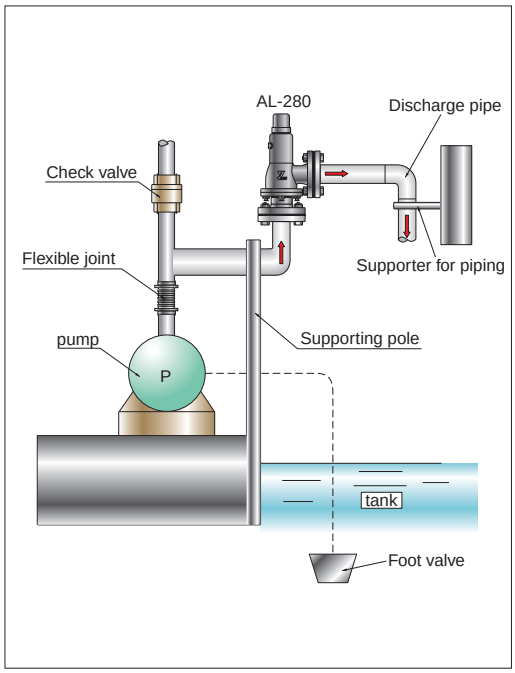
1: Advanced structure

Newly patent pended design (Dash-pot structure) is applied to the valve and valve seat design. It effectively prevents chattering or hunting caused by pulsatile or fluctuating pressure from the pump.



AL-280

2: Piping example



3: Variations

AL-260

AL-250

AL-27

AL-24

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Calculation Formula for Selecting Nominal Size

■ Formula for certified capacity (JIS B 8210:2009)

Boiler Structure Standard

$Qm = 5.25 \times C' \times Kdr \times AP$

Qm: Certified capacity (kg/h)
C': Coefficient depending on steam properties, which is shown in Table-5 on page 103.
Kdr: Certified derated coefficient of discharge (= measured value x 0.9)
[Lift type: 0.883(AL-150H: 0.816) Full bore type: 0.777]
AL-160・150 Series 32A: 0.844
40A: 0.872
50A: 0.874
A: Flow area (mm²)
P: Absolute flow rating pressure (MPa)
For boiler, (set pressure x 1.03 + 0.101) or (set pressure + 0.015 + 0.101), whichever larger.
For pressure vessel, (set pressure x 1.1 + 0.101) or (set pressure + 0.020 + 0.101), whichever larger.
However, if allowable over pressure is specified, it shall be followed.

Pressure Vessel Structure Standard

[Steam]
$Qm = 5.25 \times C' \times Kdr \times AP$

[Gas]
$Qm = C'' \times Kdr \times P_1 \times Kb \times \sqrt{\frac{M}{ZT}}$

Qm: Certified capacity (kg/h)
C": Coefficient depending on adiabatic exponent (k), which is evaluated by the following formula.

$$C'' = 39.48 \left(\sqrt{\frac{2}{k+1}}\right)^{\frac{k+1}{k-1}}$$

When adiabatic exponent (k) is unknown, supposing that k = 1.001, C" = 23.96.
Kdr: Certified derated coefficient of discharge
[Lift type: 0.883(AL-150H: 0.816) Full bore type: 0.777]
AL-160・150 Series 32A: 0.844
40A: 0.872
50A: 0.874
A: Flow area (mm²)
P_1: Absolute flow rating pressure (MPa)
P_1 = (set pressure x 1.1 + 0.101) or (set pressure x 0.020 + 0.101), whichever larger.
However, if allowable over pressure is specified, it shall be followed.
M: Molecular weight of gas (kg/kmol)
Z: Compression coefficient (if unknown, Z = 1.0)
T: Absolute temperature of gas at flow rating pressure (K)
Kb: Corrective coefficient of back pressure

When $\frac{P_2}{P_1} > \left(\frac{2}{k+1}\right)^{\frac{k}{k+1}}$

$$Kb = \frac{55.83}{C''}\sqrt{\frac{k}{(k-1)}\left(\left(\frac{P_2}{P_1}\right)^{\frac{2}{k}} - \left(\frac{P_2}{P_1}\right)^{\frac{k-1}{k}}\right)}$$

When $\frac{P_2}{P_1} \leqq \left(\frac{2}{k+1}\right)^{\frac{k}{k+1}}$

Kb = 1.0

Yoshitake Standard for Liquid (25% Accumulation)

● Except AL-160・150 Series

$$V = \frac{AK}{12.4\sqrt{\frac{G}{P}}}$$

V : Discharge capacity (m³/h) K : 0.7 (Flow rate coefficient)
A : Flow area (mm²) G : Specific gravity
P : Opening pressure (MPa)

● AL-160・150・150T・140T・150TML・150TR

$$V = 0.161AK\sqrt{PG}$$

V : Discharge capacity (m³/h)
A : Flow area (mm²)
K : Flow rate coefficient: 0.5 (when set pressure is 0.1 MPa or less)
0.6 (when set pressure is more than 0.1 MPa)
P : Pressure to determine discharge capacity (MPa): Opening pressure x 1.25
G : Specific gravity

■ Formula for viscosity correction

First, calculate the discharge capacity (V) leaving the viscosity out of consideration.

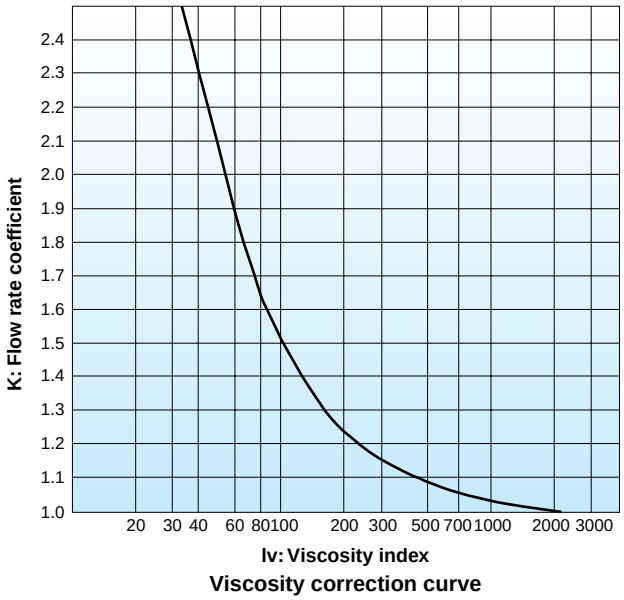
$$V = \frac{AK}{12.4\sqrt{\frac{G}{P}}}$$

Next, find viscosity index (Iv).

$$Iv = \frac{72780}{Mcst}\left(\frac{\Delta P}{G}\right)^{\frac{1}{4}} V^{\frac{1}{2}}$$

Find K from calculated Iv on the viscosity correction curve.
The calculated discharge capacity (V) divided by K is the value of the corrected flow rate.

Corrected discharge capacity: V' = V/K (m³/h)



Viscosity correction curve

V : Discharge capacity (m³/h) P : Opening pressure (MPa)
A : Flow area (mm²) ΔP : $P_1 - P_2$ (MPa)
K : Correction coefficient Cv : Cv value
G : Specific gravity Iv : Viscosity index
Mcst : Viscosity [cSt]

Definitions

Start to Discharge Pressure : The inlet pressure at which the safety valve actually starts to discharge and outflow of an extremely small quantity of fluid (steam or gas) is detected at the outlet. The extremely small quantity means a minimum amount of visually or audibly detectable steam, or a minimum amount of gas that can be detected audibly or by using soap solution. The outflow does not mean the leakage from the valve seat.

Opening Pressure : The inlet pressure at which the valve disc "Pops."
The opening pressure is also called "popping pressure."
"Popping" is an action of discharging fluid inside the valve due to the sudden rise of the valve disc.

Set Pressure : The opening pressure or start to discharge pressure determined in designing.

Closing Pressure : The inlet pressure fallen down to the level at which the valve disc and the valve seat are in contact and the lift becomes zero. It is also called "reseating pressure."

Blowdown : The difference between opening pressure or start to discharge pressure and closing pressure.

Over Pressure : The increasing pressure that exceeds the set pressure of the safety valve.

Allowable Over Pressure : The over pressure within the allowable range.

Coefficient of Discharge : The coefficient used to calculate the actual discharge capacity from the theoretical discharge capacity. The coefficient is the ratio between the two capacities, and it counts the frictional resistance.

Certified Derated Coefficient of Discharge : The coefficient of discharge to be applied to calculate the certified capacity.

Flow Rating Pressure : The inlet pressure taken as the basis for determining the certified capacity of the safety valve, which is the sum of the set pressure and the allowable over pressure.

Back Pressure : The pressures existing at the outlet of the safety valve. There are two types as the following:
(a) Accumulated back pressure: The pressure existing at the outlet of a safety valve caused by the resistance of the outlet side when the safety valve has been relieved.
(b) Existing back pressure: The pressure which has already been superimposed at the outlet before the safety valve is relieved.

Theoretical Discharge Capacity : The discharge capacity calculated supposing that the fluid is free from friction and its flow rate coefficient is 1, and that the valve discharges the ideal gas of fixed specific heat with isentropic change.

Certified Capacity : The certified discharge capacity for each safety valve.
That is obtained by the formula of Theoretical Discharge Capacity x Certified Derated Coefficient of Discharge x 0.9. (Theoretical Discharge Capacity is specified in JIS B 8225.)

Lift : The amount of travel, in axial direction of the valve or valve rod, away from the closed position to the opened position during discharge of the safety valve.

Rated Lift : The lift determined in designing, at which the certified capacity is exercised.

Seat Diameter : The inside diameter of setting surface of a valve with valve seat.

Throat Diameter : The diameter of the smallest portion of a nozzle from intake opening of fluid to valve seat face.

Throat Area : The flow passage area calculated using the throat diameter.

Seat Flow Area : The cylindrical or conical flow passage area between the valve and the valve seat secured when the valve lifts up. It is also called "curtain area."

Flow Area : The area of the part which determines the flow capacity that passes through a safety valve and is used to calculate the certified capacity.

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Guidelines for Installing Safety Valve

Pipe Mount for Installing Safety Valve

1. Pipe mount of a safety valve should have sufficient strength and rigidity against compression, shear stress, and bending stress caused by reaction because the pipe mount is subject to the reaction which is caused along the center line of outlet of a blowout pipe connected to the safety valve in the direction contrary to the discharging direction.
2. The pressure loss in the pipe mount for a safety valve makes the discharge quantity decreased and the function of the safety valve unstable. Therefore a safety valve should be installed vertically as near as possible to a vessel, a header, etc. (See Fig.1.)

Exhaust Pipe of Safety Valve

An exhaust pipe and an drip pan elbow should be installed so that a safety valve may not be subject to stress caused by the thermal expansion of a boiler or equipment and by the expansion or contraction of a discharge pipe due to the thermal action of blowout of the safety valve. (See Fig.1.)
The inner diameter of a exhaust pipe should be as larger as possible than that of an outlet pipe of a safety valve, and the exhaust pipe should be lead to outside or a safe place.

Installation of Safety Valve

1. Do not remove the blind plate before completing the preparation for installation so that any foreign matter does not come into a safety valve.
2. Be sure to remove foreign matter completely from equipment, pipes, and vessels by washing their insides before installation.
3. In installing a safety valve, do not apply a pipe wrench, etc. to the places other than the specified ones.
4. Do not apply any force from the outside.
5. Equip a valve casing and a exhaust pipe with a drain pipe for each to prevent raindrops and dirt, etc. from accumulating.

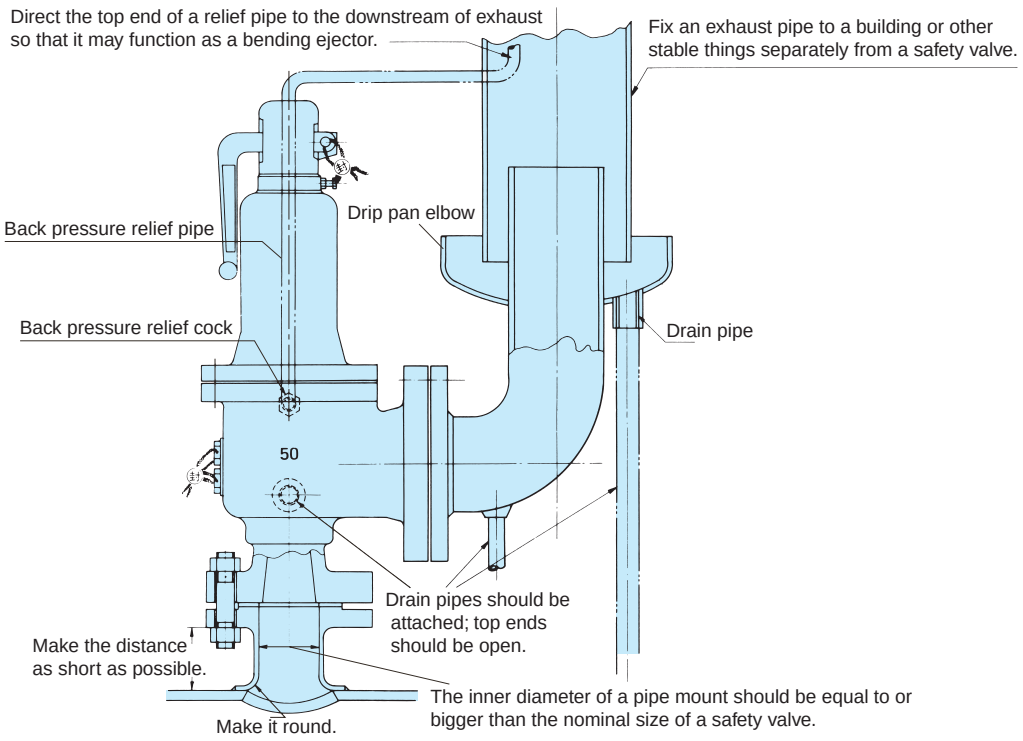

Fig. 1 Piping Instruction

Abstract of JIS B 8210 "Steam boilers and pressure vessels-Spring loaded safety valves"

⚠ Warning Do not apply the product to devices which do not allow any valve seat leakage.
* The product has allowable valve seat leakage and does not close completely (valve seat leakage cannot be zero).

⚠ Caution For installation and operation, see the manual "instruction manual" attached with the product.

Capability

1. Tolerance of start to discharge pressure

●**Safety valve for steam**

There is no regulation for start to discharge pressure of safety valve for steam.

●**Safety valve for gas**

Tolerance of start to discharge pressure of safety valve for gas is ±5% (however, ±0.025 MPa in minimum). If exceeding set pressure is not acceptable, add absolute value of positive side to one of negative. For gas, set pressure is generally start to discharge pressure.

2. Tolerance of opening (popping) pressure

●**Safety valve for steam**

Opening pressure tolerance of safety valve for steam is shown in Table-1 below. If exceeding set pressure is not acceptable, add absolute value of positive side to one of negative.

Table-1 Opening pressure tolerance of safety valve for steam (MPa)

Set pressure	Tolerance
Less than 0.5	± 0.015
0.5-2.29	± (3% of set pressure)
2.3-6.99	± 0.07 {± 0.7}
7.0 or more	± (1% of set pressure)

Note 1) As to safety valve for steam, set pressure is generally start to discharge pressure.
2) Opening pressure tolerance of safety valve for steam except for boilers is ±3% (however, ±0.015 MPa in minimum).

●**Safety valve for gas**

Opening pressure tolerance of safety valve for gas is less than 1.1 times of start to discharge pressure. However, to set by set pressure, opening pressure tolerance is ±3% (±0.015 MPa in minimum) of set pressure.

3. Blowdown

●**Safety valve for steam**

Opening of safety valve for steam is shown in Table-2 below. If discharge pressure of safety valve for steam, which is used for through flow boiler, reheater and piping, exceeds 0.3 MPa, blowdown can be less than 10% of set pressure.

Table-2 Blowdown of safety valve for steam (MPa)

Set pressure	Blowdown
0.4 or less	0.03
More than 0.4	7% (4%) or less of set pressure

Note 1) As to safety valve for gas, blowdown is generally difference between start to discharge pressure and closing pressure.
2) If there is an agreement between the parties, the value in ( ) can be applied.

●**Safety valve for gas**

Blowdown of safety valve for gas is shown in Table-3 below.

Table-3 Blowdown of safety valve for gas (MPa)

Set pressure	Blowdown	
	Metal seat type	Soft seat type
0.2 or less	0.03 or less	0.05 or less
More than 0.2	15% or less of set pressure	25% or less of set pressure

Note 1) As to safety valve for gas, blowdown is generally difference between start to discharge pressure and closing pressure. However, to set by start to discharge pressure, it is difference between opening pressure and closing pressure.
2) As to the definitions of metal seat type and soft seat type, see JIS B 0100.

●**Safety valve for liquid (Yoshitake standard)**

Blowdown of safety valve for liquid is shown in Table-4 below.

Table-4 Blowdown of safety valve for liquid (MPa)

Set pressure	Blowdown	
	Metal seat type	Soft seat type
0.2 or less	0.03 or less	0.05 or less
More than 0.2	15% or less of set pressure	25% or less of set pressure

Note 1) As to the definitions of metal seat type and soft seat type, see JIS B 0100.

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Calculation methods of certified capacity for safety valve

⚠ Warning Do not apply the product to devices which do not allow any valve seat leakage.
* The product has allowable valve seat leakage and does not close completely (valve seat leakage cannot be zero).

⚠ Caution For installation and operation, see the manual "instruction manual" attached with the product.

1. Certified capacity for safety valve for steam

(1) To calculate by certified coefficient of discharge, use the following formula:

Qm = 5.25 x C'' x Kdr x AP

Qm: Certified capacity (kg/h)
A: Flow area (mm^2)
P: For boiler, (set pressure x 1.03 + 0.101) or (set pressure + 0.015 + 0.101), whichever larger.
For pressure vessel, (set pressure x 1.1 + 0.101) or (set pressure + 0.020 + 0.101), whichever larger.
However, if allowable over pressure is specified, it shall be followed.
Kdr: Certified derated coefficient of discharge
(= measured value x 0.9)
C': Coefficient depending on the properties of steam, which is shown in Table-5 on page 103.

(2) If not measuring certified coefficient of discharge, calculate certified capacity using the value of Kdr' in Fig. 2 below instead of Kdr in (1). For full bore type safety valve, use Kdr' = 0.777.

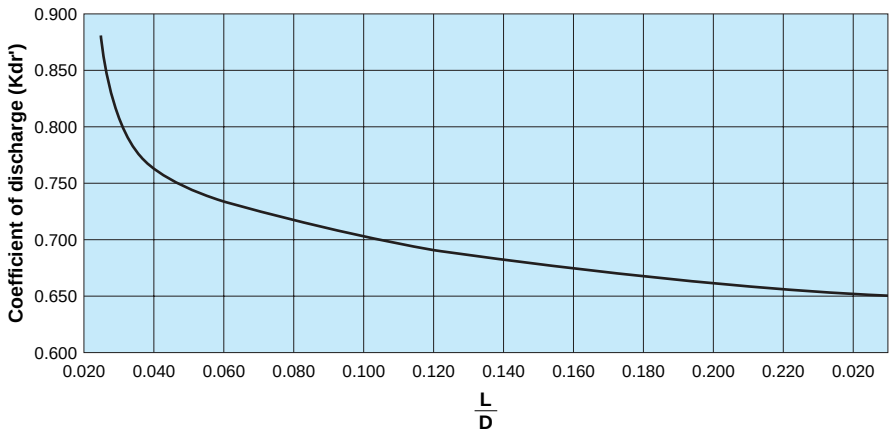

Fig. 2 Coefficient of discharge Kdr'

Table-5 Coefficient depending on properties of steam (C')

Absolute pressure MPa	Temperature ˚C																											
	Saturation pressure	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500	520	540	560	580	600	620	640	660	680	700
0.5	1.004	0.994	0.971	0.950	0.931	0.912	0.895	0.879	0.863	0.848	0.834	0.821	0.808	0.796	0.784	0.773	0.763	0.752	0.742	0.733	0.724	0.715	0.706	0.698	0.690	0.682	0.675
1	0.986	0.980	0.982	0.960	0.938	0.919	0.900	0.883	0.867	0.852	0.837	0.824	0.810	0.798	0.786	0.775	0.764	0.753	0.743	0.734	0.725	0.716	0.707	0.699	0.691	0.683	0.675
1.5	0.976	0.975	0.969	0.969	0.946	0.825	0.906	0.888	0.871	0.855	0.843	0.826	0.813	0.800	0.788	0.777	0.765	0.755	0.745	0.735	0.726	0.717	0.708	0.699	0.691	0.684	0.676
2	0.971		0.966	0.963	0.955	0.932	0.912	0.893	0.875	0.859	0.844	0.829	0.815	0.802	0.790	0.778	0.767	0.756	0.746	0.736	0.727	0.717	0.709	0.700	0.692	0.684	0.676
2.5	0.968			0.960	0.965	0.940	0.918	0.898	0.880	0.863	0.847	0.832	0.818	0.805	0.792	0.780	0.769	0.758	0.747	0.737	0.728	0.718	0.709	0.701	0.693	0.685	0.677
3	0.966			0.961	0.956	0.948	0.925	0.904	0.884	0.867	0.850	0.835	0.821	0.807	0.794	0.782	0.770	0.759	0.748	0.738	0.729	0.719	0.710	0.702	0.693	0.685	0.678
4	0.964				0.957	0.953	0.939	0.915	0.895	0.875	0.857	0.841	0.826	0.811	0.798	0.785	0.773	0.762	0.751	0.741	0.731	0.721	0.712	0.703	0.695	0.687	0.679
5	0.965					0.955	0.952	0.929	0.905	0.884	0.865	0.847	0.831	0.816	0.802	0.789	0.776	0.765	0.753	0.743	0.733	0.723	0.714	0.705	0.696	0.688	0.680
6	0.968					0.962	0.953	0.943	0.917	0.893	0.873	0.854	0.837	0.821	0.807	0.793	0.780	0.768	0.756	0.745	0.735	0.725	0.715	0.706	0.698	0.689	0.681
7	0.971						0.959	0.954	0.930	0.904	0.881	0.861	0.843	0.826	0.811	0.797	0.783	0.771	0.759	0.748	0.737	0.727	0.717	0.708	0.699	0.690	0.682
8	0.975						0.968	0.956	0.944	0.915	0.890	0.869	0.849	0.832	0.816	0.801	0.787	0.774	0.762	0.750	0.739	0.729	0.719	0.709	0.701	0.691	0.683
9	0.980							0.963	0.960	0.927	0.900	0.877	0.856	0.837	0.820	0.805	0.791	0.777	0.765	0.753	0.741	0.731	0.721	0.711	0.702	0.693	0.685
10	0.987							0.972	0.962	0.941	0.911	0.885	0.863	0.843	0.825	0.809	0.794	0.780	0.767	0.755	0.744	0.733	0.723	0.713	0.703	0.695	0.686
12	1.000								0.977	0.973	0.935	0.904	0.878	0.856	0.836	0.818	0.802	0.787	0.773	0.761	0.748	0.737	0.726	0.716	0.707	0.697	0.688
14	1.019								1.005	0.982	0.964	0.926	0.896	0.870	0.848	0.828	0.811	0.795	0.780	0.766	0.753	0.741	0.730	0.720	0.710	0.700	0.691
16	1.039									1.005	1.001	0.952	0.916	0.886	0.861	0.839	0.820	0.802	0.786	0.772	0.758	0.746	0.734	0.723	0.713	0.703	0.694
18	1.068									1.044	1.007	0.977	0.933	0.903	0.875	0.851	0.829	0.811	0.793	0.778	0.764	0.751	0.738	0.727	0.716	0.706	0.696
20	1.100										1.036	1.011	0.958	0.917	0.890	0.863	0.840	0.819	0.801	0.785	0.769	0.756	0.743	0.731	0.720	0.709	0.699
22	1.136										1.081	1.038	0.989	0.937	0.903	0.877	0.851	0.828	0.809	0.791	0.775	0.761	0.747	0.735	0.723	0.712	0.702
24												1.068	1.024	0.963	0.919	0.888	0.863	0.839	0.817	0.798	0.783	0.767	0.752	0.740	0.727	0.716	0.705
26												1.116	1.065	0.989	0.940	0.902	0.873	0.849	0.827	0.805	0.787	0.772	0.757	0.742	0.731	0.719	0.708
28												1.185	1.105	1.022	0.962	0.917	0.886	0.856	0.834	0.813	0.794	0.777	0.762	0.748	0.734	0.721	0.711
30													1.142	1.059	0.986	0.936	0.898	0.869	0.841	0.821	0.800	0.782	0.764	0.752	0.737	0.725	0.714
32													1.180	1.103	1.015	0.956	0.912	0.880	0.852	0.827	0.807	0.788	0.771	0.754	0.743	0.728	0.715
34														1.154	1.042	0.974	0.928	0.891	0.862	0.837	0.813	0.793	0.776	0.758	0.747	0.730	0.719
36														1.210	1.075	0.998	0.946	0.903	0.872	0.844	0.819	0.800	0.781	0.762	0.749	0.735	0.724
38															1.112	1.023	0.961	0.918	0.881	0.852	0.826	0.805	0.786	0.766	0.751	0.740	0.725
40															1.152	1.047	0.980	0.933	0.892	0.861	0.834	0.810	0.790	0.770	0.755	0.743	0.726
42																1.075	1.001	0.947	0.906	0.871	0.841	0.817	0.795	0.775	0.759	0.746	0.729
44																1.104	1.021	0.961	0.918	0.881	0.849	0.823	0.802	0.781	0.7623	0.750	0.733
46																1.135	1.045	0.978	0.928	0.893	0.857	0.831	0.807	0.787	0.767	0.755	0.741

Note 1) Intermediate value of pressure and temperature in this chart is calculated by proportion method.
2) Absolute pressure shall be absolute value of pressure to determine discharge capacity.

Calculation methods of certified capacity for safety valve

Warning

Do not apply the product to devices which do not allow any valve seat leakage.
* The product has allowable valve seat leakage and does not close completely (valve seat leakage cannot be zero).

Caution

For installation and operation, see the manual "instruction manual" attached with the product.

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Calculation methods of certified capacity for safety valve

⚠ Warning Do not apply the product to devices which do not allow any valve seat leakage.
* The product has allowable valve seat leakage and does not close completely (valve seat leakage cannot be zero).

⚠ Caution For installation and operation, see the manual "instruction manual" attached with the product.

2. Certified capacity for safety valve for gas

(1) To calculate by certified coefficient of discharge, use the following formula:

$$Qm = C'' \times Kdr \times P_1 \times A \times Kb \times \sqrt{\frac{M}{ZT}}$$

Qm: Certified capacity (kg/h)
C": Coefficient depending on adiabatic exponent (k), calculated by the following formula:.

$$C'' = 39.48 \left\{ \sqrt{\frac{2}{k+1}} \right\}^{\frac{k+1}{k-1}}$$

If adiabatic exponent (k) is unknown, setting k = 1.001, C" = 23.96.
P_1: Absolute flow rating pressure (MPa)
P_1 = (set pressure x 1.1 + 0.101) or (set pressure x 0.020 + 0.101), whichever greater.
However, if allowable over pressure is specified, it shall be followed.
Kdr: Certified derated coefficient of discharge (= measured value x 0.9)
A: Flow area (mm^2)
M: Molecular weight of gas (kg/kmol)
Z: Compression coefficient shown in Table 2 (if unknown, Z = 1.0)
T: Absolute temperature of gas under flow rating pressure (K)
Kb: Corrective coefficient of back pressure

In case of $\frac{P_2}{P_1} > \left(\frac{2}{k+1}\right)^{\frac{k}{k+1}}$

$$Kb = \frac{55.83}{C''} \sqrt{\frac{k}{(k-1)} \left\{ \left(\frac{P_2}{P_1}\right)^{\frac{2}{k}} - \left(\frac{P_2}{P_1}\right)^{\frac{k-1}{k}} \right\}}$$

In case of $\frac{P_2}{P_1} \leqq \left(\frac{2}{k+1}\right)^{\frac{k}{k+1}}$

Kb = 1.0

(2) If not measuring certified coefficient of discharge, calculate certified capacity using the value of Kdr' in Fig. 3 below instead of Kdr in (1). For full bore type safety valve, set Kdr = 0.777.

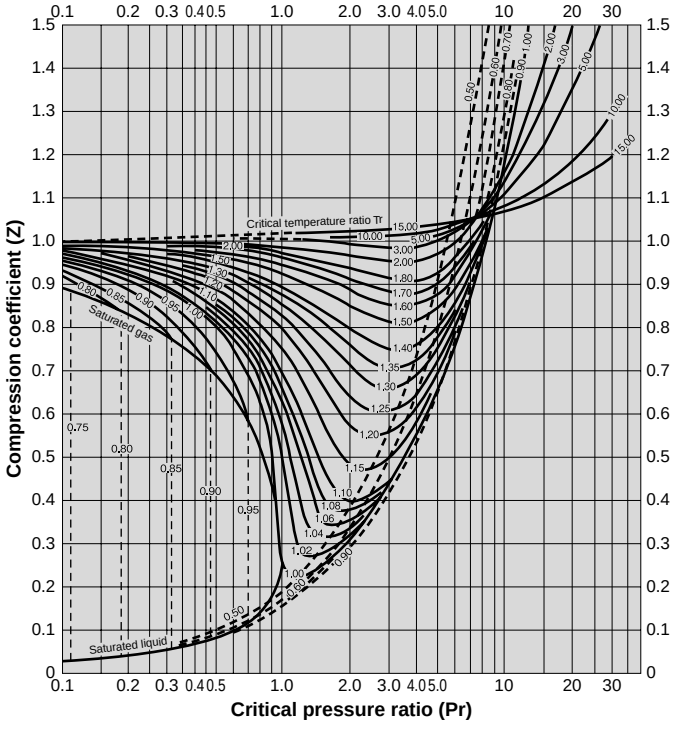


Fig. 3 Compression coefficient

Note) Critical temperature ratio

$$Tr = \frac{\text{Discharge temperature (K)}}{\text{Critical temperature (K)}}$$

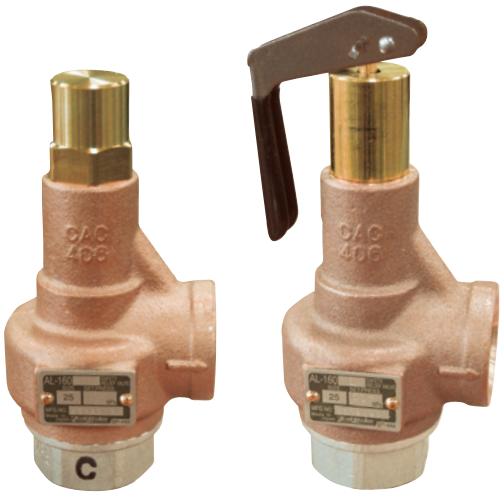
Critical pressure ratio

$$Pr = \frac{\text{Opening pressure (absolute value)}}{\text{Critical pressure (absolute value)}}$$

AL-160・160L

Features

1. Versatile type, compatible with fluids such as steam, air, water, and oil.
2. Popping structure ensures reliable discharge.
3. The AL-160L is lift lever type, and a discharge inspection can be manually performed on the valve at more than 75% of opening pressure.
4. The trim parts (valve and valve seat) are made of stainless steel. Used for the trim parts is SCS14A (equivalent to SUS316) with outstanding corrosion resistance.
5. Advanced technology, high-quality materials and a simple structure ensure easy maintenance and inspections and astonishing durability.



AL-160 AL-160L

Specifications

Model		AL-160	AL-160L
Structure		Closed type	Open type with a lever
Application		Steam, Air, Water, Oil, Non-dangerous fluids	Steam, Air
Working pressure		0.05-1.0 MPa	
Maximum temperature		220℃ *	220℃
Material	Spring case	Cast bronze	
	Valve, valve seat	Cast stainless steel (SCS14A)	
Connection		JIS Rc screwed	

* The maximum temperature is 150˚C when using for water, oil, or other liquids.

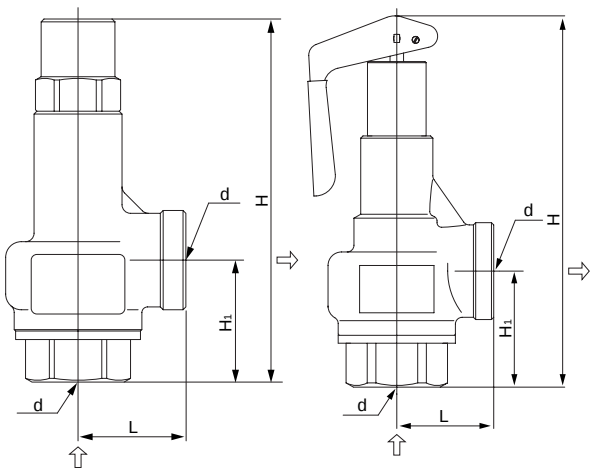
Dimensions and Weights

●AL-160

Nominal size	Dimension (mm)					Flow area πD ℓ (mm²)	Weight (kg)
	d	L	H1	H	Seat diameter		
15A	Rc 1/2	34	40	126	16	20.1	0.7
20A	Rc 3/4	38	43	126.5	21	34.6	0.8
25A	Rc 1	43	51.5	142.5	26	53.0	1.1
32A	Rc 1-1/4	50	61.5	179.5	33	93.3	1.8
40A	Rc 1-1/2	60	60	203	41	135.2	2.8
50A	Rc 2	75	76	243.5	51	208.2	4.7

●AL-160L

Nominal size	Dimension (mm)					Flow area πD ℓ (mm²)	Weight (kg)
	d	L	H1	H	Seat diameter		
15A	Rc 1/2	34	40	148	16	20.1	0.8
20A	Rc 3/4	38	43	148	21	34.6	0.9
25A	Rc 1	43	51.5	165	26	53.0	1.2
32A	Rc 1-1/4	50	61.5	201	33	93.3	1.9
40A	Rc 1-1/2	60	60	226	41	135.2	2.9
50A	Rc 2	75	76	266	51	208.2	4.8



AL-160 AL-160L

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AL-150T

Features

1. Safety relief valve with excellent airtightness ensured by the valve seat incorporating soft seat. Most suitable for applications where valve seat leakage is not tolerated.
2. The trim parts (valve and valve seat) and adjusting spring are made of stainless steel. Used for the trim parts is SCS14A (equivalent to SUS316) with outstanding corrosion resistance.
3. Simple structure and easy to handle.
4. Closed structure prevents fluid leakage.

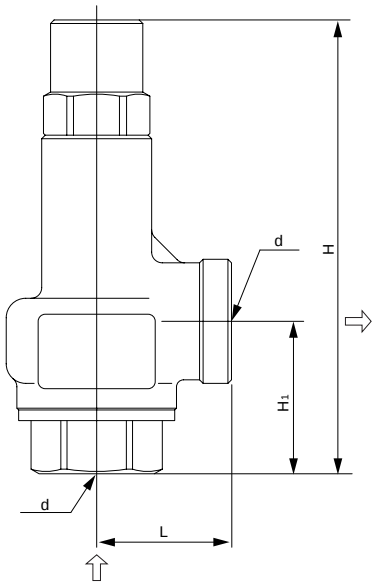
Specifications

Structure		Closed type
Application		Air, Cold and hot water, Oil, Other non-dangerous fluids *
Working pressure		0.05-1.0 MPa
Maximum temperature		120˚C
Material	Spring case	Cast bronze
	Valve, valve seat	Cast stainless steel (SCS14A)
	Adjusting spring	Stainless steel
	O-ring	FKM
Connection		JIS Rc screwed

* Please contact us when using for oil.

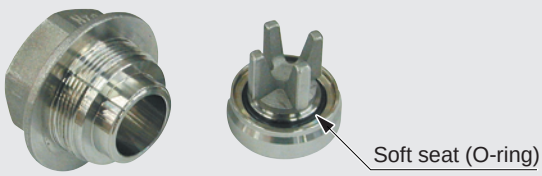
Dimensions and Weights

Nominal size	Dimension (mm)					Flow area $\pi D \ell$ (mm²)	Weight (kg)
	d	L	H_1	H	Seat diameter		
15A	Rc 1/2	34	40	128	16	20.1	0.7
20A	Rc 3/4	38	43	128.5	21	34.6	0.8
25A	Rc 1	43	51.5	144.5	26	53.0	1.1
32A	Rc 1-1/4	50	61.5	181.5	33	93.3	1.8
40A	Rc 1-1/2	60	60	205	41	135.2	2.8
50A	Rc 2	75	76	245.5	51	208.2	4.7



Soft seat is used for the trim parts!

Soft seat (O-ring) is used for the trim parts,
ensuring the reliable airtightness of the valve seat.



AL-150TR

Features

1. Handle type relief valve, pressure can be changed easily.
2. Excellent airtightness ensured by the valve seat incorporating soft seat. Most suitable for applications where valve seat leakage is not tolerated.
3. The trim parts (valve and valve seat) and adjusting spring are made of stainless steel. Used for the trim parts is SCS14A (equivalent to SUS316) with outstanding corrosion resistance.
4. Simple structure and easy to handle.
5. Closed structure prevents fluid leakage.

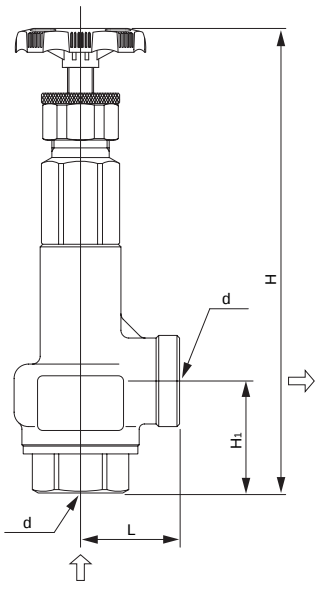
Specifications

Structure		Closed type with a handle
Application		Cold and hot water, Oil, Other non-dangerous fluids *
Working pressure		0.05-1.0 MPa
Maximum temperature		120˚C
Material	Spring case	Cast bronze
	Valve, valve seat	Stainless steel (SCS14A)
	Adjusting spring	Stainless steel
	O-ring	FKM
Connection		JIS Rc screwed

* Please contact us when using for oil.

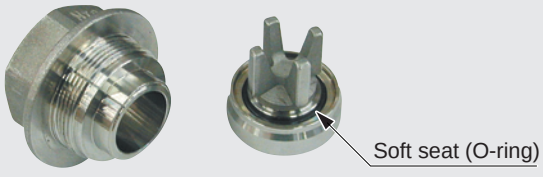
Dimensions and Weights

Nominal size	Dimension (mm)					Flow area $\pi D \ell$ (mm²)	Weight (kg)
	d	L	H_1	H	Seat diameter		
15A	Rc 1/2	34	40	184	16	20.1	1.0
20A	Rc 3/4	38	43	186	21	34.6	1.1
25A	Rc 1	43	51.5	203	26	53.0	1.4
32A	Rc 1-1/4	50	61.5	239	33	93.3	2.1
40A	Rc 1-1/2	60	60	276	41	135.2	3.2
50A	Rc 2	75	76	314	51	208.2	5.1



Soft seat is used for the trim parts!

Soft seat (O-ring) is used for the trim parts,
ensuring the reliable airtightness of the valve seat.



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AL-150TML

Features

1. Lever type safety relief valve. A discharge inspection can be manually performed when the difference between the set pressure and the inlet pressure is as shown in Table 1 below.
2. Excellent airtightness ensured by the valve seat incorporating soft seat. Most suitable for applications where valve seat leakage is not tolerated.
3. The trim parts (valve and valve seat) and adjusting spring are made of stainless steel. Used for the trim parts is SCS14A (equivalent to SUS316) with outstanding corrosion resistance.
4. Simple structure and easy to handle.
5. Closed structure prevents fluid leakage.

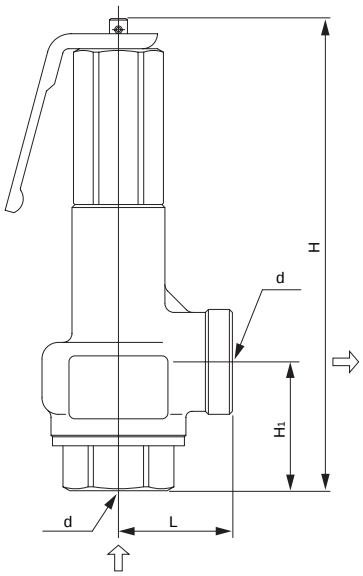
Specifications

Structure		Closed type with a lever
Application		Air, Cold and hot water, Oil, Other non-dangerous fluids *
Working pressure		0.05-1.0 MPa
Maximum temperature		120˚C
Material	Spring case	Cast bronze
	Valve, valve seat	Stainless steel (SCS14A)
	Adjusting spring	Stainless steel
	O-ring	FKM
Connection		JIS Rc screwed

* Please contact us when using for oil.

Dimensions and Weights

Nominal size	Dimension (mm)					Flow area $\pi D \ell$ (mm²)	Weight (kg)
	d	L	H_1	H	Seat diameter		
15A	Rc 1/2	34	40	157	16	20.1	0.8
20A	Rc 3/4	38	43	158	21	34.6	0.9
25A	Rc 1	43	51.5	174	26	53.0	1.3
32A	Rc 1-1/4	50	61.5	212	33	93.3	1.9
40A	Rc 1-1/2	60	60	246	41	135.2	3.0
50A	Rc 2	75	76	286	51	208.2	4.9

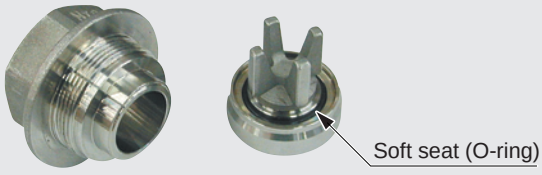


[Table 1] Required differential pressure at a discharge inspection

Nominal size	Difference between set pressure and inlet pressure
15A-25A	1.0 MPa or less
32A, 40A	0.6 MPa or less
50A	0.4 MPa or less

Soft seat is used for the trim parts!

Soft seat (O-ring) is used for the trim parts,
ensuring the reliable airtightness of the valve seat.



Certified Capacity Table

●AL-160・160L for steam (saturation temperature) <Pressure vessel structure standard>

(kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
15A	15	20	29	40	50	60	70	80	90	100	109
20A	27	35	51	69	87	104	121	138	155	172	189
25A	42	54	78	105	133	159	186	212	237	263	289
32A	70	91	132	178	224	268	313	356	400	443	487
40A	105	136	198	266	335	402	468	534	599	664	729
50A	163	211	306	411	518	621	723	824	924	1025	1126

●AL-160・160L・150T・150TML for air (20˚C) <Pressure vessel structure standard>

(kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
15A	25	33	48	65	81	98	114	131	147	164	181
20A	44	57	83	111	140	169	197	226	254	283	311
25A	67	87	127	171	215	258	302	346	390	433	477
32A	113	147	214	288	362	435	509	582	656	730	803
40A	169	221	321	431	542	652	762	872	982	1093	1203
50A	262	341	496	666	836	1006	1176	1346	1516	1687	1857

●AL-160・150T・150TML・150TR for water (accumulation: 25%) <Yoshitake standard>

(m^3/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
15A	0.4	0.5	0.9	1.1	1.3	1.5	1.6	1.8	1.9	2.0	2.1
20A	0.6	0.9	1.6	2.0	2.3	2.6	2.8	3.1	3.3	3.5	3.7
25A	1.0	1.5	2.5	3.1	3.6	4.0	4.4	4.7	5.1	5.4	5.7
32A	1.8	2.6	4.5	5.5	6.3	7.1	7.8	8.4	9.0	9.5	10.0
40A	2.7	3.8	6.5	7.9	9.2	10.3	11.3	12.2	13.0	13.8	14.6
50A	4.1	5.9	10.0	12.3	14.2	15.9	17.4	18.8	20.1	21.3	22.4

・Please contact us for the calculation procedure for nominal size selection.

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AL-150H

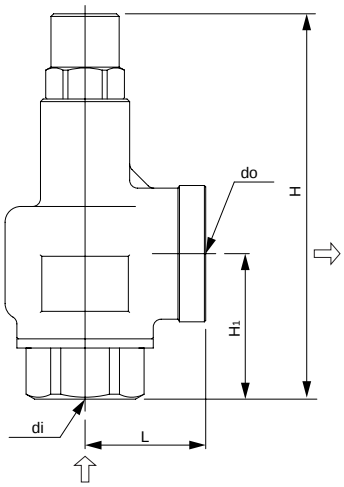
Features

1. Popping structure ensures reliable discharge.
2. Used for the trim parts is SCS14A (equivalent to SUS316) with outstanding corrosion resistance.
3. Simple internal structure facilitates adjustment, maintenance and handling.
4. Closed structure prevents fluid leakage.

Specifications

Structure		Closed type
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids
Working pressure		1.0-1.6 MPa
Maximum temperature		220˚C *
Material	Spring case	Cast bronze
	Valve, valve seat	Cast stainless steel (SCS14A)
Connection		JIS Rc screwed

* The maximum temperature is 150˚C when using for water, oil, or other liquids.



Dimensions and Weights

Nominal size	Dimension (mm)					Flow area πDℓ (mm²)	Weight (kg)
	di x do	L	H1	H	Seat diameter		
15A	Rc 1/2 x Rc 3/4	36	42	126	16	22.9	0.8
20A	Rc 3/4 x Rc 1	38	47	131	21	39.5	0.9
25A	Rc 1 x Rc 1-1/4	46	55.5	147.5	26	60.6	1.3
32A	Rc 1-1/4 x Rc 1-1/2	54	61.5	167.5	33	97.7	1.9
40A	Rc 1-1/2 x Rc 2	63	67	193.5	41	150.8	2.9
50A	Rc 2 x Rc 2-1/2	77	80	241.5	51	233.4	5.0

Certified Capacity Table

●For steam (saturation temperature) <Pressure vessel structure standard>

(kg/h)

Pressure MPa / Nominal size	1.0	1.1	1.2	1.3	1.4	1.5	1.6
15A	115	126	136	146	156	167	177
20A	199	217	235	252	270	288	306
25A	306	333	360	387	415	442	469
32A	493	537	581	625	669	713	757
40A	761	830	897	965	1033	1100	1168
50A	1179	1284	1389	1494	1599	1703	1808

●For air (20˚C) <Pressure vessel structure standard> (kg/h)

Pressure MPa / Nominal size	1.0	1.1	1.2	1.3	1.4	1.5	1.6
15A	190	208	225	243	260	278	295
20A	328	359	389	419	449	479	509
25A	504	550	597	643	689	735	782
32A	813	888	962	1037	1111	1186	1260
40A	1255	1370	1485	1600	1715	1831	1946
50A	1943	2121	2299	2477	2655	2833	3011

●For water (accumulation: 25%) <Yoshitake standard> (m^3/h)

Pressure MPa / Nominal size	1.0	1.1	1.2	1.3	1.4	1.5	1.6
15A	2.4	2.5	2.7	2.8	2.9	3.0	3.1
20A	4.2	4.4	4.6	4.8	5.0	5.2	5.3
25A	6.5	6.8	7.1	7.4	7.7	8.0	8.2
32A	10.5	11.0	11.5	12.0	12.4	12.9	13.3
40A	16.2	17.0	17.8	18.5	19.2	19.9	20.6
50A	25.2	26.4	27.6	28.7	29.8	30.8	31.8

・Please contact us for the calculation procedure for nominal size selection.

AL-140·140H

Features

1. Safety relief valve of all stainless steel made. Used for the trim parts is SCS14A (equivalent to SUS316) with outstanding corrosion resistance.
2. Popping structure ensures reliable discharge.
3. Simple structure and easy to handle.
4. Closed structure prevents fluid leakage.

Specifications

Model		AL-140	AL-140H
Structure		Closed type	
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids	
Working pressure		0.05-1.0 MPa	1.0-2.0 MPa
Maximum temperature		220˚C *	
Material	Spring case	Cast stainless steel	
	Valve, valve seat	Cast stainless steel (SCS14A)	
Connection		JIS Rc screwed	

* The maximum temperature is 150˚C when using for water, oil, or other liquids.

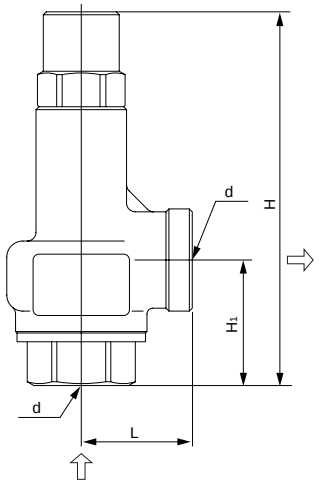
AL-140

AL-140H

Dimensions and Weights

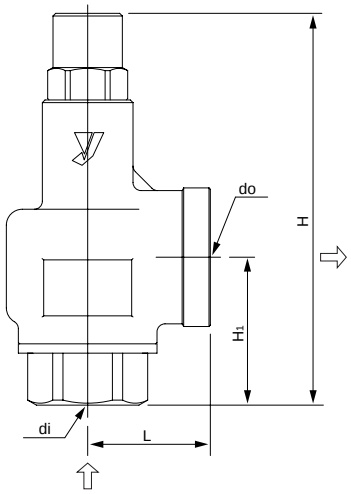
● **AL-140**

Nominal size	Dimension (mm)					Flow area πD ℓ (mm²)	Weight (kg)
	d	L	H1	H	Seat diameter		
15A	Rc 1/2	34	40	128.5	16	20.1	0.7
20A	Rc 3/4	38	42	129	21	34.6	0.8
25A	Rc 1	43	51	148	26	53.0	1.1
32A	Rc 1-1/4	50	61.5	182	33	93.3	2.0
40A	Rc 1-1/2	60	64	206	41	135.2	3.0
50A	Rc 2	75	76	246.5	51	208.2	5.0



● **AL-140H**

Nominal size	Dimension (mm)					Flow area πDℓ (mm²)	Weight (kg)
	di x do	L	H1	H	Seat diameter		
15A	Rc 1/2 x Rc 3/4	36	42	126.5	16	20.1	0.9
20A	Rc 3/4 x Rc 1	38	46	130.5	21	34.6	1.0
25A	Rc 1 x Rc 1-1/4	46	55	150.5	26	53.0	1.5
32A	Rc 1-1/4 x Rc 1-1/2	54	61.5	195	33	93.3	2.5
40A	Rc 1-1/2 x Rc 2	63	67	227.5	41	135.2	4.6
50A	Rc 2 x Rc 2-1/2	77	80	303.5	51	208.2	8.8



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Certified Capacity Table

●For steam (saturation temperature) <Pressure vessel structure standard>

(kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
15A	15	20	29	40	50	60	70	80	90	100	109	109	119	129	139	149	158	168	178	188	198	207
20A	27	35	51	69	87	104	121	138	155	172	189	189	206	222	239	256	273	290	306	324	340	357
25A	42	54	78	105	133	159	186	212	237	263	289	289	315	341	367	393	418	444	470	496	522	547
32A	70	91	132	178	224	268	313	356	400	443	487	487	531	574	617	661	704	747	791	835	878	921
40A	105	136	198	266	335	402	468	534	599	664	729	729	795	860	924	990	1054	1119	1184	1250	1315	1380
50A	163	211	306	411	518	621	723	824	924	1025	1129	1126	1227	1327	1427	1528	1627	1728	1828	1930	2030	2130

●For air (20˚C) <Pressure vessel structure standard>

(kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
15A	25	33	48	65	81	98	114	131	147	164	181	181	197	214	230	247	264	280	297	313	330	347
20A	44	57	83	111	140	169	197	226	254	283	311	311	340	368	397	426	454	483	511	540	568	597
25A	67	87	127	171	215	258	302	346	390	433	477	477	521	565	608	652	696	740	783	827	871	915
32A	113	147	214	288	362	435	509	582	656	730	803	803	877	950	1024	1098	1171	1245	1318	1392	1466	1539
40A	169	221	321	431	542	652	762	872	982	1093	1203	1203	1313	1423	1533	1644	1754	1864	1974	2084	2195	2305
50A	262	341	496	666	836	1006	1176	1346	1516	1687	1857	1857	2027	2197	2367	2537	2707	2877	3047	3217	3388	3558

●For water (accumulation: 25%) <Yoshitake standard>

(m^3/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
15A	0.4	0.5	0.9	1.1	1.3	1.5	1.6	1.8	1.9	2.0	2.1	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.9	3.0
20A	0.6	0.9	1.6	2.0	2.3	2.6	2.8	3.1	3.3	3.5	3.7	3.7	3.9	4.0	4.2	4.4	4.5	4.7	4.8	5.0	5.1	5.2
25A	1.0	1.5	2.5	3.1	3.6	4.0	4.4	4.7	5.1	5.4	5.7	5.7	6.0	6.2	6.5	6.7	7.0	7.2	7.4	7.6	7.8	8.0
32A	1.8	2.6	4.5	5.5	6.3	7.1	7.8	8.4	9.0	9.5	10.0	10.0	10.5	11.0	11.4	11.9	12.3	12.7	13.1	13.5	13.8	14.2
40A	2.7	3.8	6.5	7.9	9.2	10.3	11.3	12.2	13.0	13.8	14.6	14.6	15.3	15.9	16.6	17.2	17.8	18.4	19.0	19.5	20.1	20.6
50A	4.1	5.9	10.0	12.3	14.2	15.9	17.4	18.8	20.1	21.3	22.4	22.4	23.5	24.6	25.6	26.6	27.5	28.4	29.3	30.1	30.9	31.8

- AL-140: 0.05-1.0 MPa
  AL-140H: 1.0-2.0 MPa
- Please contact us for the calculation procedure for nominal size selection.

AL-140T

Features

1. Safety relief valve of all stainless steel made, offering high corrosion resistance and durability in particular.
2. Excellent airtightness ensured by the valve seat incorporating soft seat. Most suitable for applications where valve seat leakage is not tolerated.
3. Closed structure prevents fluid leakage.

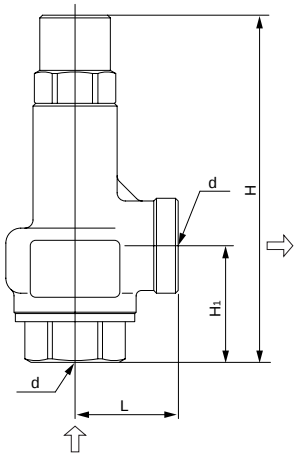
Specifications

Structure		Closed type
Application		Air, Cold and hot water, Oil, Other non-dangerous fluids *
Working pressure		0.05-1.0 MPa
Maximum temperature		120˚C
Material	Spring case	Cast stainless steel
	Valve, valve seat	Cast stainless steel (SCS14A)
	Adjusting spring	Stainless steel
	O-ring	FKM
Connection		JIS Rc screwed

* Please contact us when using for oil.

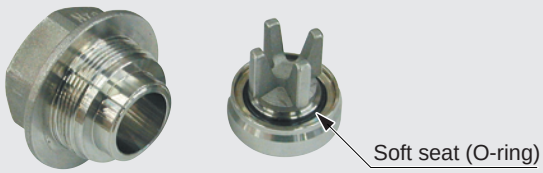
Dimensions and Weights

Nominal size	Dimension (mm)					Flow area	Weight
	d	L	H_1	H	Seat diameter	$\pi D \ell$ (mm²)	(kg)
15A	Rc 1/2	34	40	128	16	20.1	0.7
20A	Rc 3/4	38	42	128.5	21	34.6	0.8
25A	Rc 1	43	51	148	26	53.0	1.1
32A	Rc 1-1/4	50	61.5	181.5	33	93.3	1.8
40A	Rc 1-1/2	60	64	205	41	135.2	2.8
50A	Rc 2	75	76	245.5	51	208.2	4.7



Soft seat is used for the trim parts!

Soft seat (O-ring) is used for the trim parts, ensuring the reliable airtightness of the valve seat.



Certified Capacity Table

●For air (20˚C) <Pressure vessel structure standard> (kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
15A	25	33	48	65	81	98	114	131	147	164	181
20A	44	57	83	111	140	169	197	226	254	283	311
25A	68	87	127	171	215	258	302	346	390	433	477
32A	114	147	214	288	362	435	509	582	656	730	803
40A	171	221	321	431	542	652	762	872	982	1093	1203
50A	264	341	496	666	836	1006	1176	1346	1516	1687	1857

●For water (accumulation: 25%) <Yoshitake standard> (m^3/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
15A	0.4	0.5	0.9	1.1	1.3	1.5	1.6	1.8	1.9	2.0	2.1
20A	0.6	0.9	1.6	2.0	2.3	2.6	2.8	3.1	3.3	3.5	3.7
25A	1.0	1.5	2.5	3.1	3.6	4.0	4.4	4.7	5.1	5.4	5.7
32A	1.8	2.6	4.5	5.5	6.3	7.1	7.8	8.4	9.0	9.5	10.0
40A	2.7	3.8	6.5	7.9	9.2	10.3	11.3	12.2	13.0	13.8	14.6
50A	4.1	5.9	10.0	12.3	14.2	15.9	17.4	18.8	20.1	21.3	22.4

・Please contact us for the calculation procedure for nominal size selection.

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AL-1・1T

AL-1

Features

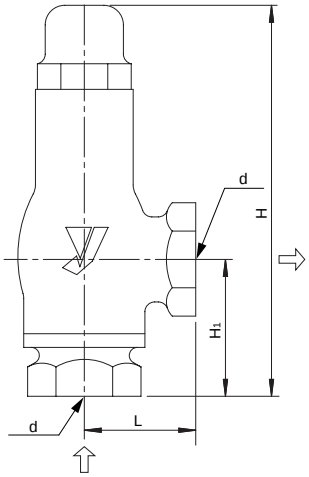
1. Reliable discharge operation minimises downtime and maintenance cost.
2. Simple construction enables easy maintenance.
3. Fluoroplastic disc enables tight shutoff for gas and liquid service (AL-1T).

Specifications

Model		AL-1	AL-1T
Structure		Open type	Closed type
Application		Steam	Air, Cold and hot water, Oil, Other non-dangerous fluids
Working pressure		0.05-1.0 MPa	
Maximum temperature		220˚C	150˚C
Material	Valve case	Cast iron	
	Valve, valve seat	Cast bronze	PTFE・Cast bronze
Connection		JIS Rc screwed	

Dimensions and Weights

Nominal size	Dimension (mm)					Flow area	Weight
	d	L	H_1	H	Seat diameter	$\pi D \ell$ (mm²)	(kg)
15A	Rc 1/2	43	55 (56)	170 (172)	23	41.6	1.3
20A	Rc 3/4	57	70 (71)	200 (202)	25 (29)	49.1 (66.1)	2.2
25A	Rc 1	57	70 (71)	200 (202)	25 (29)	49.1 (66.1)	2.2
32A	Rc 1-1/4	70	82 (83)	266 (268)	37	107.6	4.4
40A	Rc 1-1/2	75	90 (91)	272 (274)	38 (37)	113.5 (107.6)	5.1
50A	Rc 2	82	98 (99)	284 (286)	50	196.4	7.1



・The above values in parentheses are the dimensions of the AL-1T.

Certified Capacity Table

●AL-1 for steam (saturation temperature) <Pressure vessel structure standard> (kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
15A	32	42	59	78	99	118	138	157	176	195	214
20A	38	50	69	93	117	140	162	185	208	230	253
25A	38	50	69	93	117	140	162	185	208	230	253
32A	84	109	152	204	256	306	357	406	455	505	554
40A	89	115	161	215	270	323	376	429	480	532	585
50A	154	200	278	372	468	560	651	742	832	922	1012

●AL-1T for air (20˚C) <Pressure vessel structure standard> (kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
15A	46	65	99	134	168	202	237	271	306	340	374
20A	74	104	158	213	267	322	377	431	486	540	595
25A	74	104	158	213	267	322	377	431	486	540	595
32A	121	169	258	347	436	525	613	702	791	880	969
40A	121	169	258	347	436	525	613	702	791	880	969
50A	221	309	471	634	796	958	1122	1282	1444	1607	1769

●AL-1T for water (accumulation: 25%) <Yoshitake standard> (m^3/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
15A	0.5	0.7	1.0	1.2	1.4	1.6	1.8	1.9	2.0	2.2	2.3
20A	0.8	1.1	1.6	2.0	2.3	2.6	2.8	3.0	3.3	3.5	3.6
25A	0.8	1.1	1.6	2.0	2.3	2.6	2.8	3.0	3.3	3.5	3.6
32A	1.3	1.9	2.6	3.2	3.8	4.2	4.6	5.0	5.3	5.7	6.0
40A	1.3	1.9	2.6	3.2	3.8	4.2	4.6	5.0	5.3	5.7	6.0
50A	2.4	3.4	4.9	6.0	6.9	7.7	8.5	9.1	9.8	10.4	10.9

・Please contact us for the calculation procedure for nominal size selection.

AL-10

Features

1. Compact and lightweight lift safety valve, installation is easy.
2. Simple structure and easy maintenance.
3. Due to lift valve lever mechanism a discharge inspection can be manually performed at more than 75% of the opening pressure (open type with a lever).
4. Blowdown can be adjusted with adjustable ring (seat ring).

Specifications

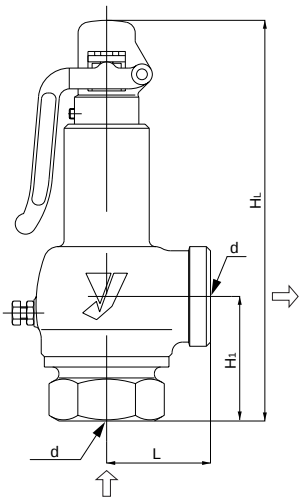
Structure		Open type
Application		Steam
Working pressure		0.05-1.0 MPa
Maximum temperature		220˚C
Material	Spring case	Ductile cast iron
	Valve, valve seat	Cast bronze or stainless steel
Connection		JIS Rc screwed

Open type with a lever

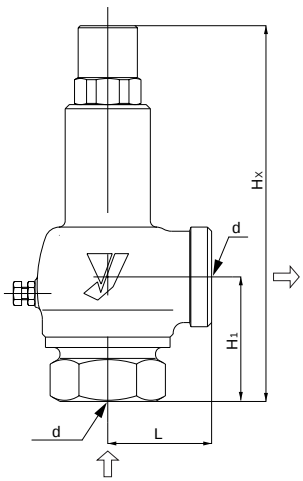
Open type without a lever

Dimensions and Weights

Nominal size	Dimension (mm)						Flow area $\pi D\ell$ (mm^2)	Weight (kg)
	d	L	H_1	H_L	H_X	Seat diameter		
15A	Rc 1/2	40	40	154	142	16	20.1	1.0
20A	Rc 3/4	45	50	173	161	21	34.6	1.5
25A	Rc 1	50	60	193	181	26	53.0	1.8
32A	Rc 1-1/4	60	70	232	219	33	85.5	3.1
40A	Rc 1-1/2	65	75	250	237	41	132.0	4.5
50A	Rc 2	80	85	284	271	51	204.2	6.2



Open type with a lever



Open type without a lever

Certified Capacity Table

●For steam (saturation temperature) <Pressure vessel structure standard>

(kg/h)

Nominal size \ Pressure MPa	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
15A	15	20	29	40	50	60	70	80	90	100	109
20A	27	35	51	69	87	104	121	138	155	172	189
25A	42	54	78	105	133	159	186	212	237	263	289
32A	67	87	127	170	215	257	300	342	383	425	467
40A	104	135	196	263	332	397	463	528	592	656	721
50A	161	209	303	407	513	615	716	817	916	1016	1116

・Please contact us for the calculation procedure for nominal size selection.

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AL-17

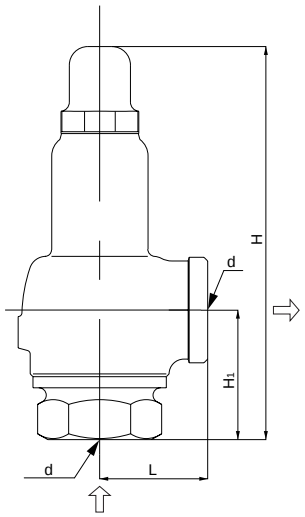
Features

1. Safety relief valve with the trim parts (valve and valve seat) of stainless steel, offering high corrosion resistance and durability in particular.
2. Popping structure ensures reliable discharge.
3. Blowdown can be adjusted with adjustable ring (seat ring).

Specifications

Structure		Closed type
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids
Working pressure		0.05-1.6 MPa
Maximum temperature		220˚C *
Material	Spring case	Ductile cast iron
	Valve, valve seat	Stainless steel
Connection		JIS Rc screwed

* The maximum temperature is 150˚C when using for water, oil, or other liquids.



Dimensions and Weights

Nominal size	Dimension (mm)					Flow area	Weight
	d	L	H1	H	Seat diameter	πD ℓ (mm²)	(kg)
15A	Rc 1/2	40	40	143	16	20.1	0.9
20A	Rc 3/4	45	50	162	21	34.6	1.2
25A	Rc 1	50	60	182	26	53.0	1.7
32A	Rc 1-1/4	60	70	220	33	85.5	2.9
40A	Rc 1-1/2	65	75	238	41	132.0	3.8
50A	Rc 2	80	85	272	51	204.2	6.3

Certified Capacity Table

●For steam (saturation temperature) <Pressure vessel structure standard> (kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6
15A	15	20	29	40	50	60	70	80	90	100	109	119	129	139	149	158	168
20A	27	35	51	69	87	104	121	138	155	172	189	206	222	239	256	273	290
25A	42	54	78	105	133	159	186	212	237	263	289	315	341	367	393	418	444
32A	67	87	127	170	215	257	300	342	383	425	467	509	550	592	634	675	716
40A	104	135	196	263	332	397	463	528	592	656	721	786	850	914	979	1042	1106
50A	161	209	303	407	513	615	716	817	916	1016	1116	1216	1315	1414	1514	1612	1712

● For air (20˚C) <Pressure vessel structure standard> (kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6
15A	25	33	48	65	81	98	114	131	147	164	181	197	214	230	247	264	280
20A	44	57	83	111	140	169	197	226	254	283	311	340	368	397	426	454	483
25A	68	87	127	171	215	258	302	346	390	433	477	521	565	608	652	696	740
32A	108	141	205	276	347	417	488	558	629	699	770	841	911	982	1052	1123	1193
40A	168	218	317	426	535	644	753	862	971	1080	1189	1298	1407	1516	1625	1734	1843
50A	259	338	491	660	828	997	1166	1334	1503	1671	1840	2008	2177	2345	2514	2682	2851

●For water (accumulation: 25%) <Yoshitake standard> (m³/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6
15A	0.2	0.3	0.5	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.4
20A	0.4	0.6	0.8	1.0	1.2	1.3	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.3	2.4
25A	0.6	0.9	1.3	1.6	1.8	2.1	2.3	2.5	2.6	2.8	2.9	3.1	3.2	3.4	3.5	3.6	3.7
32A	1.0	1.5	2.1	2.6	3.0	3.4	3.7	4.0	4.3	4.5	4.8	5.0	5.2	5.5	5.7	5.9	6.1
40A	1.6	2.3	3.3	4.0	4.7	5.2	5.7	6.2	6.6	7.0	7.4	7.8	8.1	8.4	8.8	9.1	9.4
50A	2.5	3.6	5.1	6.3	7.2	8.1	8.9	9.6	10.3	10.9	11.5	12.0	12.6	13.1	13.6	14.1	14.5

・Please contact us for the calculation procedure for nominal size selection.

AL-300·301

Features

1. Safety valve, simple structure and easy maintenance.
2. Easy adjustment.

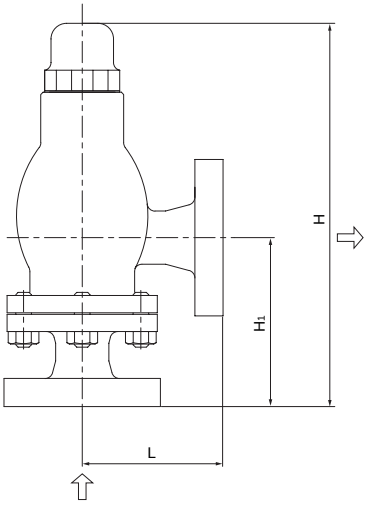
Specifications

Model		AL-300	AL-301
Structure		Closed type	
Application		Steam	
Working pressure		0.05-1.0 MPa	0.05-1.6 MPa
Maximum temperature		220˚C	
Material	Valve case	Ductile cast iron	
	Spring case	Ductile cast iron	
	Valve, valve seat	Cast bronze	Stainless steel
Connection		JIS 10K FF flanged	JIS 10K FF flanged JIS 16K FF flanged *

* JIS 16K FF flanged when working pressure is more than 1.0 MPa.

Dimensions and Weights

Nominal size	Dimension (mm)				Flow area	Weight
	L	H1	H	Seat diameter	πD ℓ (mm²)	(kg)
15A	90	108	245	25	49.1	4.7
20A	90	108	245	25	49.1	5.0
25A	90	108	245	25	49.1	6.2
32A	91	115	285	37	107.6	8.6
40A	91	115	285	38	113.5	8.8
50A	105	132	311	50	196.4	12.6



Certified Capacity Table

●For steam (saturation temperature) <Pressure vessel structure standard> (kg/h)

Nominal size \ Pressure MPa	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6
15A	38	50	73	98	123	148	172	196	220	244	268	292	316	340	364	387	411
20A	38	50	73	98	123	148	172	196	220	244	268	292	316	340	364	387	411
25A	38	50	73	98	123	148	172	196	220	244	268	292	316	340	364	387	411
32A	85	110	160	214	270	324	377	430	482	535	588	640	693	745	798	849	902
40A	89	116	168	226	285	342	398	454	509	564	620	675	731	786	841	896	951
50A	155	201	292	392	494	592	689	785	881	977	1073	1169	1265	1360	1456	1551	1646

- AL-300: 0.05-1.0 MPa
  AL-301: 0.05-1.6 MPa
- Please contact us for the calculation procedure for nominal size selection.

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AL-300T・301T

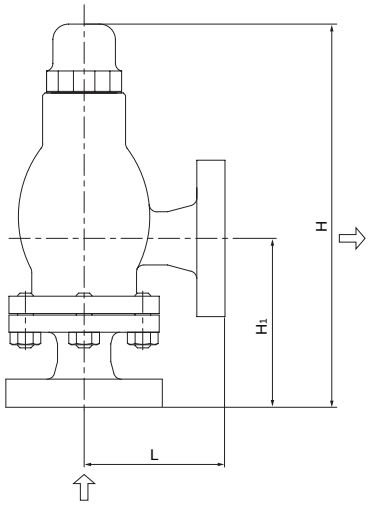
Features

1. Safety relief valve, simple structure and easy maintenance.
2. Easy adjustment.
3. Fluororesin disc ensures reliable seating.

Specifications

Model		AL-300T	AL-301T
Structure		Closed type	
Application		Air, Cold and hot water, Oil, Other non-dangerous fluids	
Working pressure		0.05-1.0 MPa	0.05-1.3 MPa *1
Maximum temperature		150˚C	
Material	Valve case, spring case	Ductile cast iron	
	Valve, valve seat	Cast bronze・PTFE	Stainless steel・PTFE
Connection		JIS 10K FF flanged	JIS 10K FF flanged JIS 16K FF flanged *2

*1 Please contact us if working pressure is between 1.31 MPa and 1.6 MPa.
*2 JIS 16K FF flanged when working pressure is more than 1.0 MPa.



Dimensions and Weights

Nominal size	Dimension (mm)				Flow area πD ℓ (mm²)	Weight (kg)
	L	H1	H	Seat diameter		
15A	90	108	245	29	66.1	4.7
20A	90	108	245	29	66.1	5.0
25A	90	108	245	29	66.1	6.2
32A	91	115	285	37	107.6	8.6
40A	91	115	285	37	107.6	8.8
50A	105	132	311	50	196.4	12.6

Certified Capacity Table

● For air (20˚C) <Pressure vessel structure standard>

(kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6
15A	84	109	159	213	268	322	377	432	486	541	595	650	704	759	604	645	685
20A	84	109	159	213	268	322	377	432	486	541	595	650	704	759	604	645	685
25A	84	109	159	213	268	322	377	432	486	541	595	650	704	759	604	645	685
32A	136	178	259	347	436	525	614	703	792	880	969	1058	1147	1236	1324	1413	1502
40A	136	178	259	347	436	525	614	703	792	880	969	1058	1147	1236	1397	1491	1584
50A	249	325	473	635	797	959	1121	1283	1445	1607	1769	1932	2094	2256	2418	2580	2742

●For water (accumulation: 25%) <Yoshitake standard>

(m³/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6
15A	0.8	1.1	1.6	2.0	2.3	2.6	2.8	3.1	3.3	3.5	3.7	3.9	4.0	4.2	3.2	3.3	3.5
20A	0.8	1.1	1.6	2.0	2.3	2.6	2.8	3.1	3.3	3.5	3.7	3.9	4.0	4.2	3.2	3.3	3.5
25A	0.8	1.1	1.6	2.0	2.3	2.6	2.8	3.1	3.3	3.5	3.7	3.9	4.0	4.2	3.2	3.3	3.5
32A	1.3	1.9	2.7	3.3	3.8	4.2	4.7	5.0	5.4	5.7	6.0	6.3	6.6	6.9	7.1	7.4	7.6
40A	1.3	1.9	2.7	3.3	3.8	4.2	4.7	5.0	5.4	5.7	6.0	6.3	6.6	6.9	7.5	7.8	8.1
50A	2.4	3.5	4.9	6.0	7.0	7.8	8.5	9.2	9.9	10.5	11.0	11.6	12.1	12.6	13.1	13.5	14.0

・AL-300T: 0.05-1.0 MPa
AL-301T: 0.05-1.6 MPa
・Please contact us for the calculation procedure for nominal size selection.

AL-4・4S

Features

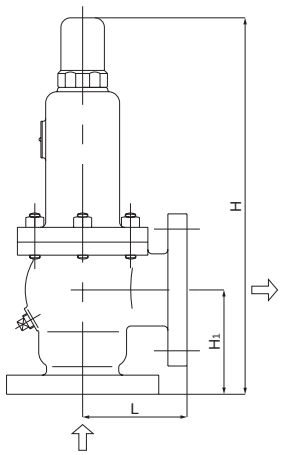
1. Safety valve, simple structure and easy maintenance.
2. Easy adjustment.

Specifications

●AL-4

Structure		Open type
Application		Steam
Working pressure		0.05-1.5 MPa *1
Maximum temperature		220˚C
Material	Valve case	Ductile cast iron
	Spring case	Ductile cast iron
	Valve, valve seat	Stainless steel
Connection		JIS 10K FF flanged JIS 16K FF flanged *2

*1 Maximum working pressure for 150A type is 0.8 MPa (connection: JIS 10K FF flanged).
*2 JIS 16K FF flanged when working pressure is more than 1.0 MPa.



●AL-4S

Structure		Open type
Application		Steam
Working pressure		0.05-2.0 MPa
Maximum temperature		220˚C
Material	Valve case	Ductile cast iron
	Spring case	Ductile cast iron *
	Valve, valve seat	Stainless steel
Connection		JIS 10K FF flanged JIS 16K FF flanged JIS 20K FF flanged

* Available with stainless steel made.

Dimensions and Weights

●AL-4 (JIS 10K)

Nominal size	Dimension (mm)				Flow area	Weight (kg)
	L	H1	H	Seat diameter	πD ℓ (mm²)	
65A	120	120	432	65	331.9	20
80A	130	130	447	75	441.8	22
100A	160	150	595	100	785.4	44
125A	200	205	779	125	1227.2	88
150A	210	215	835	150	1767.2	113

●AL-4S

Nominal size	Dimension (mm)				Flow area
	L	H1	H	Seat diameter	πD ℓ (mm²)
65A	135	125	442	65	331.9
80A	135	135	457	75	441.8
100A	160	150	597	100	785.4

●AL-4 (JIS 16K)

Nominal size	Dimension (mm)				Flow area
	L	H1	H	Seat diameter	πD ℓ (mm²)
65A	120	120	432	65	331.9
80A	132	130	449	75	441.8
100A	162	150	597	100	785.4
125A	202	205	781	125	1227.2

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AL-4T・4ST

Features

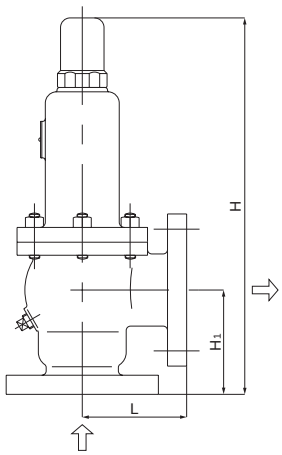
1. Safety relief valve, simple structure and easy maintenance.
2. Easy adjustment.
3. Fluororesin disc ensures reliable seating.

Specifications

●AL-4T

Type		Standard	With SUS trim parts
Structure		Closed type	
Application		Air, Cold and hot water, Oil, Other non-dangerous fluids	
Working pressure		0.05-1.0 MPa *1	0.05-1.5 MPa *1 *2
Maximum temperature		150˚C	
Material	Valve case	Ductile cast iron	
	Spring case	Ductile cast iron	
	Valve, valve seat	Cast bronze (PTFE disc incorporated)	Stainless steel (PTFE disc incorporated)
Connection		JIS 10K FF flanged	JIS 10K FF flanged JIS 16K FF flanged *3

*1 Maximum working pressure for 150A is 0.8 MPa (connection: JIS 10K FF flanged).
*2 When working pressure is more than 1.2 MPa (for 65A and 80A) or 1.0 MPa (for 100A and 125A), a metal-to-metal seating is incorporated in.
*3 JIS 16K FF flanged is used when working pressure is more than 1.0 MPa.



●AL-4ST

Structure		Closed type
Application		Air, Water, Oil, Other non-dangerous fluids
Working pressure		0.05-2.0 MPa *1
Maximum temperature		150˚C
Material	Valve case	Ductile cast iron *2
	Spring case	
	Valve, valve seat	Stainless steel (PTFE disc incorporated)
Connection		JIS 10K FF flanged JIS 16K FF flanged JIS 20K FF flanged

*1 When working pressure is more than 1.2 MPa (for 65A and 80A) or 1.0 MPa (for 100A and 125A), a metal-to-metal seating is incorporated in.
*2 Available with stainless steel made.

Dimensions and Weights

●AL-4T (JIS 10K)

Nominal size	Dimension (mm)				Flow area πD ℓ (mm²)	Weight (kg)
	L	H1	H	Seat diameter		
65A	120	120	434	65	331.9	20
80A	130	130	449	75	441.8	22
100A	160	150	597	100	785.4	44
125A	200	205	781	125	1227.2	88
150A	210	215	837	150	1767.2	113

●AL-4T (JIS 16K)

Nominal size	Dimension (mm)				Flow area πD ℓ (mm²)
	L	H1	H	Seat diameter	
65A	120	120	434	65	331.9
80A	132	130	451	75	441.8
100A	162	150	599	100	785.4
125A	202	205	783	125	1227.2

●AL-4ST

Nominal size	Dimension (mm)				Flow area πD ℓ (mm²)
	L	H1	H	Seat diameter	
65A	135	125	444	65	331.9
80A	135	135	459	75	441.8
100A	160	150	599	100	785.4

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Certified Capacity Table for AL-4·4S

●For steam (saturation temperature) <Pressure vessel structure standard>

(kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
65A	263	340	493	663	834	1000	1165	1328	1489	1651	1814
80A	350	452	657	882	1111	1331	1550	1767	1983	2198	2415
100A	622	804	1168	1569	1975	2367	2756	3142	3525	3908	4294
125A	972	1257	1826	2451	3086	3699	4307	4910	5508	6107	6709
150A	1400	1810	2629	3530	4445	5327	6203	7071	7932	8794	9661

(kg/h)

Pressure MPa / Nominal size	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
65A	1976	2138	2299	2461	2621	2783	2944	3108	3269	3430
80A	2631	2846	3060	3276	3489	3704	3919	4138	4352	4566
100A	4677	5059	5440	5825	6203	6586	6968	7357	7737	8118
125A	7309	7906	8500	9102	9692	10290	10887	11495	12090	12684
150A	10525	11385	12241	13107	13957	14818	15678	16553	17410	18266

・The nominal sizes of the AL-4S are 65A to 100A.

Certified Capacity Table for AL-4T·4ST

●For air (20˚C) <Pressure vessel structure standard>

(kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
65A	422	550	799	1073	1347	1621	1895	2169	2443	2717	2991
80A	562	732	1064	1428	1793	2158	2522	2887	3252	3616	3981
100A	999	1302	1891	2540	3188	3836	4484	5133	5781	6429	7077
125A	1562	2035	2955	3968	4981	5994	7007	8020	9033	10046	11059
150A	2249	2930	4256	5715	7173	8632	10091	11549	13008	14467	15925

(kg/h)

Pressure MPa / Nominal size	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
65A	3264	3538	3812	4086	4360	4364	4908	5182	5456	5730
80A	4346	4710	5075	5440	5804	6169	6534	6898	7263	7628
100A	7726	8374	9022	9671	10319	10967	11615	12264	12912	13560
125A	12072	13085	14098	15111	16124	17136	18149	19162	20175	21188
150A	17384	18843	20301	21760	23219	24677	26136	27594	29053	30512

●For water (accumulation: 25%) <Yoshitake standard>

(m³/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
65A	4.1	5.9	8.3	10.2	11.8	13.2	14.5	15.6	16.7	17.7	18.7
80A	5.5	7.8	11.1	13.6	15.7	17.6	19.3	20.8	22.3	23.6	24.9
100A	9.9	14.0	19.8	24.2	28.0	31.3	34.3	37.0	39.6	42.0	44.3
125A	15.4	21.9	30.9	37.9	43.8	48.9	53.6	57.9	61.9	65.7	69.2
150A	22.3	31.5	44.6	54.6	63.0	70.5	77.2	83.4	89.2	—	—

(kg/h)

Pressure MPa / Nominal size	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
65A	19.6	20.5	21.3	22.1	22.9	23.6	24.4	25.1	25.8	26.4
80A	26.1	27.3	28.4	29.5	30.5	31.5	32.5	33.4	34.3	35.2
100A	46.4	48.5	50.5	52.4	54.2	56.0	57.8	59.4	61.1	62.6
125A	72.6	75.8	78.9	81.9	84.8	—	—	—	—	—
150A	—	—	—	—	—	—	—	—	—	—

・The nominal sizes of the AL-4ST are 65A to 100A.
・Please contact us for the calculation procedure for nominal size selection.

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AL-5

Features

1. Lift safety valve, designed in compliance with JIS B 8210 "Spring loaded safety valves for steam boilers and pressure vessels".
2. Due to lift lever mechanism a discharge inspection can be manually performed at more than 75% of the opening pressure.
3. Blowdown pressure can be adjusted with adjustable ring (seat ring).
4. Restricting structure prevents unnecessary or unintentional pressure adjustment.

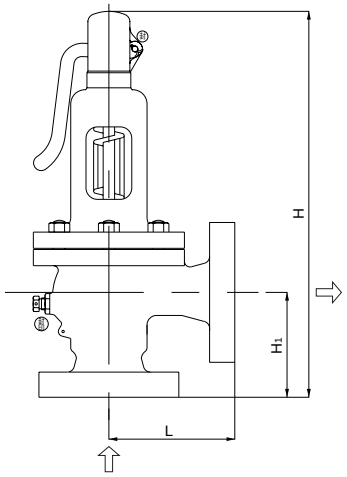
Specifications

Structure		Open type with a lever
Application		Steam
Working pressure		0.05-1.5 MPa
Maximum temperature		220˚C
Material	Valve case	Ductile cast iron
	Spring case	Ductile cast iron
	Valve, valve seat	Stainless steel
Connection		JIS 10K FF flanged JIS 16K FF flanged *

* JIS 16K FF flanged when working pressure is more than 1.0 MPa.

Dimensions

Nominal size	Dimension (mm)				Flow area $\pi D \ell$ (mm²)
	L	H_1	H	Seat diameter	
20A	90	75	276	21	34.6
25A	95	90	295	25	49.1
32A	100	95	331	35	96.2
40A	110	105	347	40	125.6
50A	115	110	388	50	196.4



Certified Capacity Table

● **For steam (saturation temperature) <Pressure vessel structure standard>** (kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
20A	27	35	51	69	87	104	121	138	155	172	189	206	222	239	256	273
25A	38	50	73	98	123	148	172	196	220	244	268	292	316	340	364	387
32A	76	98	143	192	241	290	337	384	431	478	525	572	619	666	713	759
40A	99	128	186	250	315	378	440	502	563	625	686	748	809	870	931	991
50A	155	201	292	392	494	592	689	785	881	977	1073	1169	1265	1360	1456	1551

<Boiler structure standard> (kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
20A	26	34	50	66	83	98	114	130	146	162	178	194	209	225	241	257
25A	37	49	71	94	117	140	163	185	208	230	253	275	297	320	342	365
32A	74	96	140	185	230	274	319	363	407	451	495	539	583	627	671	715
40A	96	125	183	242	301	358	416	474	532	589	647	704	762	819	876	934
50A	151	196	287	378	471	560	652	742	832	921	1012	1102	1191	1280	1371	1461

・Please contact us for the calculation procedure for nominal size selection.

AL-6

Features

1. Lift safety valve, designed in compliance with JIS B 8210 "Spring loaded safety valves for steam boilers and pressure vessels".
2. Due to lift lever mechanism a discharge inspection can be manually performed at more than 75% of the opening pressure.

Specifications

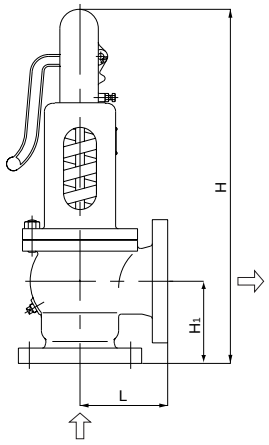
Structure		Open type with a lever
Application		Steam
Working pressure		0.05-1.5 MPa *1
Maximum temperature		220˚C
Material	Valve case	Ductile cast iron
	Spring case	Ductile cast iron
	Valve, valve seat	Cast stainless steel
Connection		JIS 10K FF flanged JIS 16K FF flanged *2

*1 Maximum working pressure for 150A is 0.8 MPa.
*2 JIS 16K FF flanged when working pressure is more than 1.0 MPa.

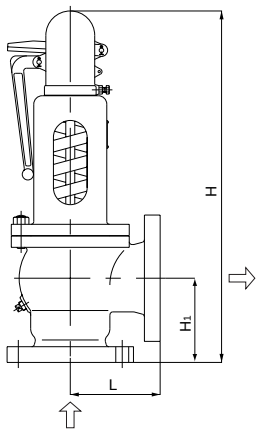
Dimensions and Weights

Nominal size	Dimension (mm)				Flow area	Weight
	L	H1	H	Seat diameter	πD ℓ (mm²)	(kg)
65A	120	120	479	65	331.9	20.2
80A	130	130 (132)	493 (495)	75	441.8	24.0
100A	160	150 (152)	626 (628)	100	785.4	44.0
125A	200	205 (207)	835 (837)	125	1227.2	88.0
150A	210	215 (217)	845 (847)	150	1767.2	113.0

・The values in parentheses are the dimensions of JIS 16K FF flanged.



65A・80A



100A-150A

Certified Capacity Table

● **For steam (saturation temperature) <Pressure vessel structure standard>** (kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
65A	263	340	493	663	834	1000	1165	1328	1489	1651	1814	1976	2138	2299	2461	2621
80A	350	452	657	882	1111	1331	1550	1767	1983	2198	2415	2631	2846	3060	3276	3489
100A	622	804	1168	1569	1975	2367	2756	3142	3525	3908	4294	4677	5059	5440	5825	6203
125A	972	1257	1826	2451	3086	3699	4307	4910	5508	6107	6709	7309	7906	8500	9102	9692
150A	1400	1810	2629	3530	4445	5327	6203	7071	7932	8794	9661	10525	11385	12241	13107	13957

<Boiler structure standard> (kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
65A	255	332	486	640	796	947	1101	1254	1407	1557	1710	1862	2013	2164	2317	2469
80A	339	442	647	851	1059	1261	1466	1670	1873	2073	2276	2479	2680	2881	3084	3286
100A	604	786	1150	1514	1884	2242	2607	2968	3330	3686	4047	4407	4765	5122	5483	5843
125A	944	1228	1797	2366	2944	3504	4074	4638	5204	5760	6324	6886	7446	8003	8567	9129
150A	1359	1769	2588	3407	4239	5046	5866	6680	7494	8295	9107	9917	10723	11525	12337	13147

・Please contact us for the calculation procedure for nominal size selection.

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AL-31・31H

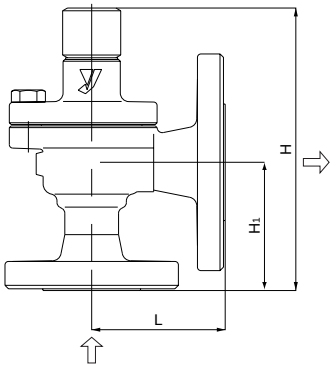
Features

1. Safety relief valve of all stainless steel made, offering high corrosion resistance and durability in particular.
2. Popping structure ensures reliable discharge.

Specifications

Model		AL-31	AL-31H
Structure		Closed type	
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids	
Working pressure		0.05-1.0 MPa	1.0-2.0 MPa
Maximum temperature		220˚C *	
Material	Valve case	Cast stainless steel	
	Spring case	Cast stainless steel	
	Valve, valve seat	Stainless steel	
Connection		JIS 10K RF flanged	JIS 16K RF flanged JIS 20K RF flanged

* The maximum temperature is 150˚C when using for water, oil, or other liquids.



Dimensions and Weights

Nominal size	Dimension (mm)					Flow area πD ℓ (mm²)	Weight (kg)
	Inlet diameter x Outlet diameter	L	H1	H	Seat diameter		
15A	15 x 20	73	72	160	16	20.1	3.4
20A	20 x 25	77	74	163	21	34.6	4.5
25A	25 x 32	91	87	187	26	53.0	6.5
32A	32 x 40	96	92	238	33	85.5	8.1 (8.3)
40A	40 x 50	114	100	277	41	132.0	11.4 (11.7)
50A	50 x 65	116	107	315 (357)	51	204.2	15.0 (18.0)

・The above values in parentheses are the dimensions and weights of JIS 20K RF flanged.

Certified Capacity Table

●For steam (saturation temperature) <Pressure vessel structure standard>

(kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
15A	15	20	29	40	50	60	70	80	90	100	109	109	119	129	139	149	158	168	178	188	198	207
20A	27	35	51	69	87	104	121	138	155	172	189	189	206	222	239	256	273	290	306	324	340	357
25A	42	54	78	105	133	159	186	212	237	263	289	289	315	341	367	393	418	444	470	496	522	547
32A	67	87	127	170	215	257	300	342	383	425	467	467	509	550	592	634	675	716	758	800	842	883
40A	104	135	196	263	332	397	463	528	592	656	721	721	786	850	914	979	1042	1106	1171	1236	1300	1364
50A	161	209	303	407	513	615	716	817	916	1016	1116	1116	1216	1315	1414	1514	1612	1712	1811	1912	2011	2110

●For air (20˚C) <Pressure vessel structure standard>

(kg/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
15A	25	33	48	65	81	98	114	131	147	164	181	181	197	214	230	247	264	280	297	313	330	347
20A	44	57	83	111	140	169	197	226	254	283	311	311	340	368	397	426	454	483	511	540	568	597
25A	67	87	127	171	215	258	302	346	390	433	477	477	521	565	608	652	696	740	783	827	871	915
32A	108	141	205	276	347	417	488	558	629	699	770	770	841	911	982	1052	1123	1193	1264	1335	1405	1476
40A	168	218	317	426	535	644	753	862	971	1080	1189	1189	1298	1407	1516	1625	1734	1843	1952	2061	2170	2279
50A	259	338	491	660	828	997	1166	1334	1503	1671	1840	1840	2008	2177	2345	2514	2682	2851	3020	3188	3357	3525

●For water (accumulation: 25%) <Internal standard>

(m³/h)

Pressure MPa / Nominal size	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
15A	0.2	0.3	0.5	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.4	1.5	1.5	1.6
20A	0.4	0.6	0.8	1.0	1.2	1.3	1.5	1.6	1.7	1.8	1.9	1.9	2.0	2.1	2.2	2.3	2.3	2.4	2.5	2.6	2.6	2.7
25A	0.6	0.9	1.3	1.6	1.8	2.1	2.3	2.5	2.6	2.8	2.9	2.9	3.1	3.2	3.4	3.5	3.6	3.7	3.9	4.0	4.1	4.2
32A	1.0	1.5	2.1	2.6	3.0	3.4	3.7	4.0	4.3	4.5	4.8	4.8	5.0	5.2	5.5	5.7	5.9	6.1	6.2	6.4	6.6	6.8
40A	1.6	2.3	3.3	4.0	4.7	5.2	5.7	6.2	6.6	7.0	7.4	7.4	7.8	8.1	8.4	8.8	9.1	9.4	9.7	9.9	10.0	10.5
50A	2.5	3.6	5.1	6.3	7.2	8.1	8.9	9.6	10.3	10.9	11.5	11.5	12.0	12.6	13.1	13.6	14.1	14.5	15.0	15.4	15.8	16.3

・AL-31: 0.05-1.0 MPa AL-31H: 1.0-2.0 MPa
・Please contact us for the calculation procedure for nominal size selection.

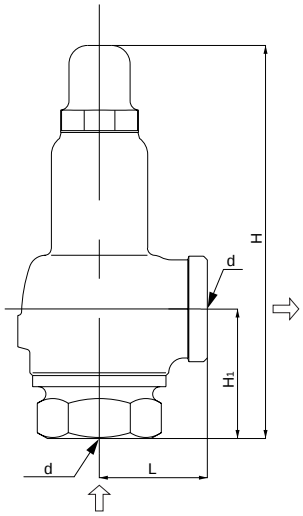
AL-27

Features

1. Relief valve, designed for pressure up to 1.6 MPa.
2. Remarkably effective for lines of heavy pulsation or considerable pressure fluctuation due to unique valve structure. Prevents chattering and hunting.
3. Stable operation can be maintained against back pressure changes produced in continuous blow.

Specifications

Structure		Closed type
Application		Cold and hot water, Oil, Other non-dangerous fluids
Working pressure		0.05-1.6 MPa
Maximum temperature		120˚C
Material	Valve case	Ductile cast iron
	Spring case	Ductile cast iron
	Valve, valve seat	Stainless steel
Connection		JIS Rc screwed



Dimensions and Weights

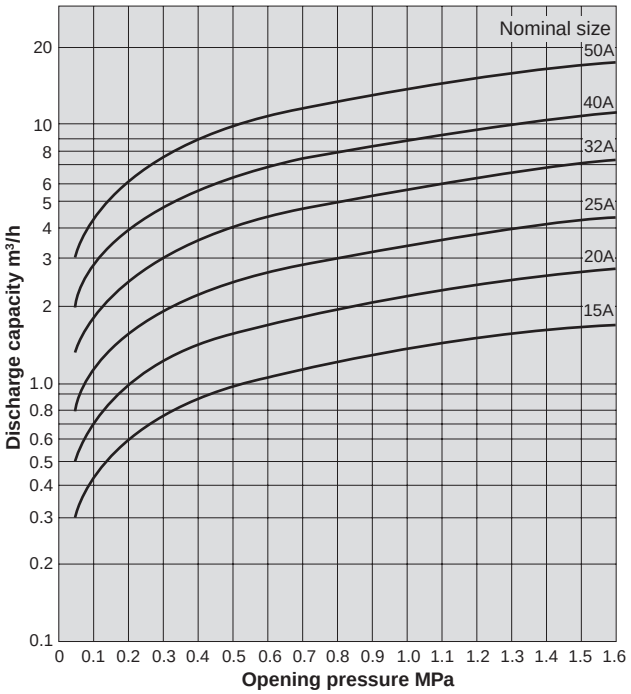
(mm)

Nominal size	d	L	H1	H	Weight (kg)
15A	Rc 1/2	40	40	143	0.9
20A	Rc 3/4	45	50	162	1.3
25A	Rc 1	50	60	182	1.7
32A	Rc 1-1/4	60	70	220	2.9
40A	Rc 1-1/2	65	75	238	3.9
50A	Rc 2	80	85	272	6.4

Dashpot structure

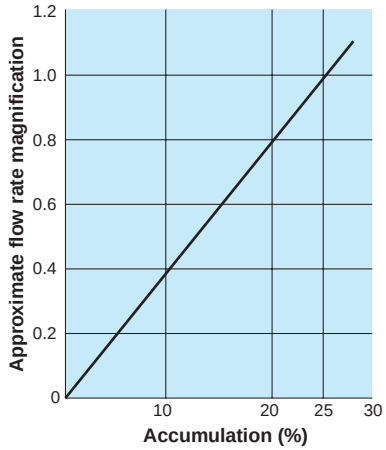
Flow Rate Chart [water]

Shown in the chart is the flow rate at 25% accumulation.
For flow rates at other accumulation levels, use the approximate flow rate magnification chart.



●Approximate flow rate magnification chart

When the accumulation is not 25%, select an approximate flow rate magnification matching the accumulation based on this chart, and multiply the flow rate at 25% accumulation by the selected magnification.



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AL-260・260R

Features

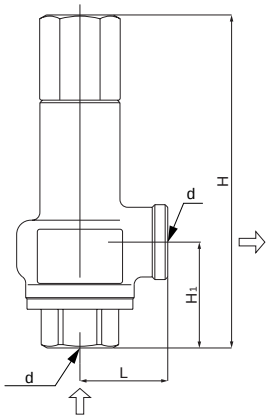
1. Stainless steel is used for the trim parts, and corrosion-resistant material for all wetted parts.
2. Remarkably effective for lines of heavy pulsation or considerable pressure fluctuation due to unique valve structure. Prevents chattering and hunting.
3. Stable operation can be maintained against back pressure changes produced in continuous blow.
4. Simple structure, easy to handle.
5. Since the AL-260R is equipped with a handle, pressure change is easy.

AL-260

AL-260R

Specifications

Model		AL-260	AL-260R
Structure		Closed type	Closed type with a handle
Application		Cold and hot water, Oil, Other non-dangerous fluids	
Working pressure		0.05-1.0 MPa	
Maximum temperature		120˚C	
Material	Valve case	Cast bronze	
	Spring case	Cast bronze	
	Valve, valve seat	Stainless steel	
Connection		JIS Rc screwed	



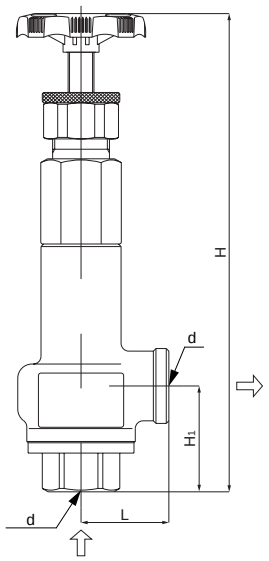
AL-260

Dimensions and Weights

(mm)

Nominal size	d	L	H1	H	Weight (kg)
15A	Rc 1/2	34	41.0	129 (185)	0.7 (1.0)
20A	Rc 3/4	38	45.0	131 (187)	0.9 (1.2)
25A	Rc 1	43	51.5	145 (200)	1.2 (1.5)
32A	Rc 1-1/4	50	63.5	184 (241)	1.9 (2.2)
40A	Rc 1-1/2	60	68.5	210 (278)	2.8 (3.2)
50A	Rc 2	75	80.0	250 (314)	4.9 (5.3)

・The values in parentheses are the dimensions and weights of the AL-260R.



AL-260R

Dashpot structure

AL-250・250R

Features

1. Relief valve of stainless steel made, offering high corrosion resistance and durability in particular.
2. Remarkably effective for lines of heavy pulsation or considerable pressure fluctuation due to unique valve structure. Prevents chattering and hunting.
3. Stable operation can be maintained against back pressure changes produced in continuous blow.
4. Simple structure, easy to handle.
5. Since the AL-250R is equipped with a handle, pressure change is easy.

AL-250 AL-250R

Specifications

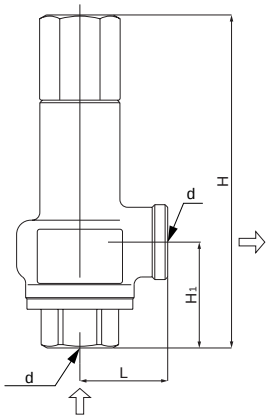
Model		AL-250	AL-250R
Structure		Closed type	Closed type with a handle
Application		Cold and hot water, Oil, Other non-dangerous fluids	
Working pressure		0.05-1.0 MPa	
Maximum temperature		120˚C	
Material	Spring case	Cast stainless steel	
	Valve, valve seat	Stainless steel	
Connection		JIS Rc screwed	

Dimensions and Weights

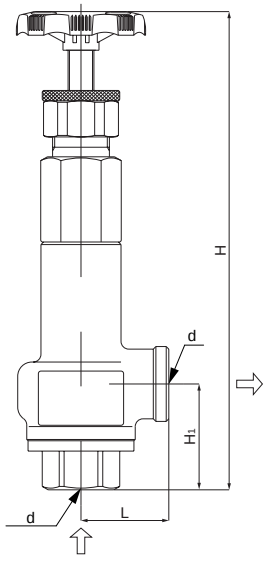
(mm)

Nominal size	d	L	H_1	H	Weight (kg)
15A	Rc 1/2	34	41.0	129 (185)	0.7 (0.9)
20A	Rc 3/4	38	45.0	132 (188)	0.9 (1.1)
25A	Rc 1	43	51.5	148 (203)	1.2 (1.4)
32A	Rc 1-1/4	50	63.5	184 (241)	2.2 (2.5)
40A	Rc 1-1/2	60	68.5	210 (278)	3.2 (3.7)
50A	Rc 2	75	80.0	250 (314)	5.6 (6.0)

・The values in parentheses are the dimensions and weights of the AL-250R.



AL-250



AL-250R

Dashpot structure

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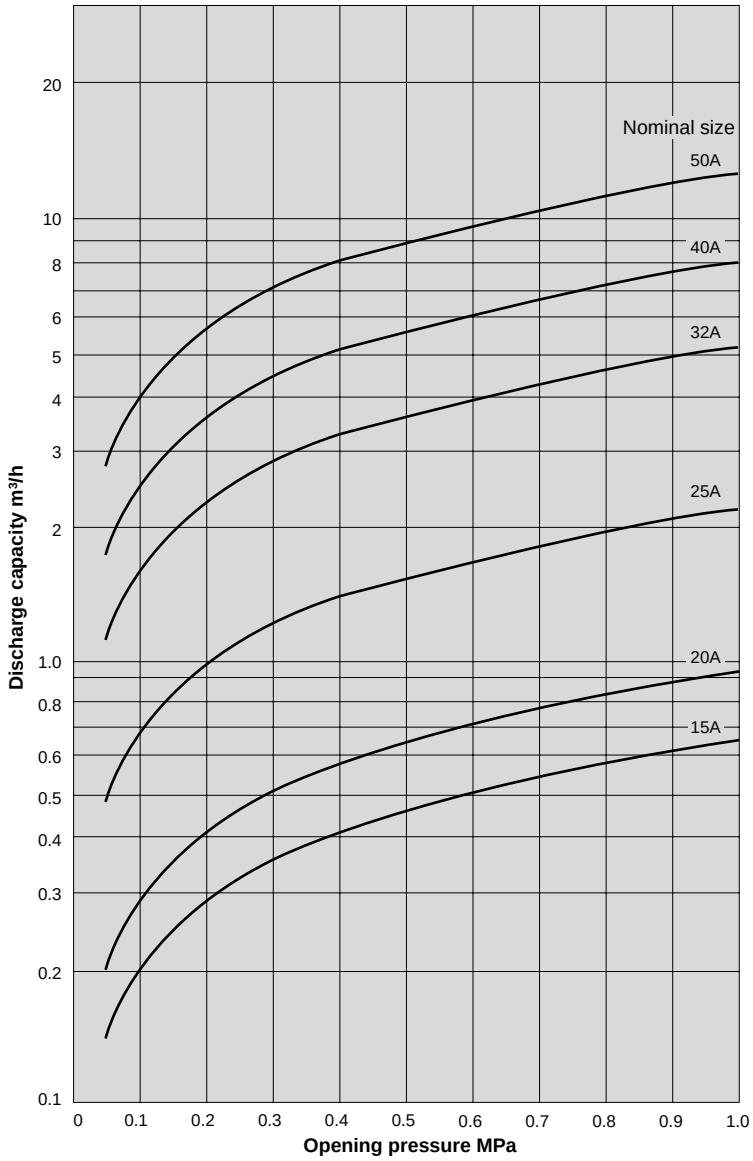
Table for Selecting AL-250·250R·260·260R Relief Valve Nominal Sizes

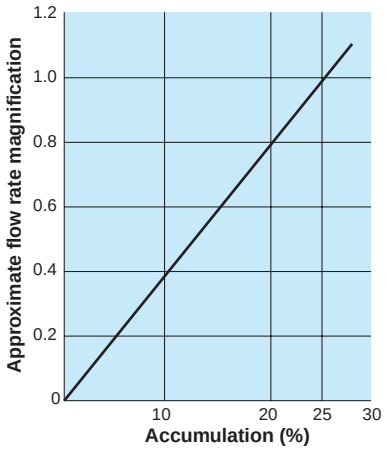
●Flow rate chart [water] (AL-250·250R·260·260R)

Shown in the chart is the flow rate at 25% accumulation.
For flow rates at other accumulation levels, use the approximate flow rate magnification chart.



●Approximate flow rate magnification chart

When the accumulation is not 25%, select an approximate flow rate magnification matching the accumulation based on this chart, and multiply the flow rate at 25% accumulation by the selected magnification.



●Discharge capacity (accumulation: 25%)

(m³/h)

Nominal size	Opening pressure (MPa)										
	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
15A	0.14	0.20	0.29	0.35	0.41	0.46	0.50	0.54	0.58	0.62	0.65
20A	0.20	0.29	0.41	0.51	0.59	0.66	0.72	0.78	0.83	0.88	0.93
25A	0.49	0.69	0.98	1.20	1.38	1.54	1.69	1.83	1.96	2.07	2.19
32A	1.14	1.62	2.29	2.81	3.24	3.63	3.97	4.29	4.59	4.87	5.13
40A	1.79	2.53	3.58	4.39	5.07	5.67	6.21	6.71	7.17	7.61	8.02
50A	2.80	3.96	5.60	6.86	7.92	8.86	9.71	10.49	11.21	11.89	12.53

AL-280

Features

1. Relief valve, exclusive for the pressure control of pumps with high pulsation pressure or large pressure fluctuation.
2. The trim parts (valve and valve seat) are designed to continuously discharge fluid against its set pressure change without popping (patent pending), preventing chattering and hunting.
3. Stainless steel with excellent corrosion resistance is used for the adjusting spring.

Specifications

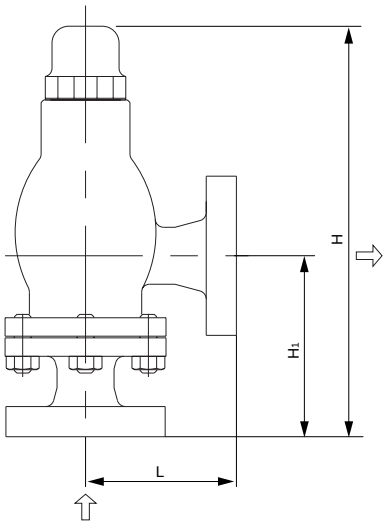
Structure		Closed type
Application		Cold and hot water, Oil (heavy oil A, heavy oil B, kerosene)
Working pressure		0.05-1.0 MPa
Maximum temperature		120˚C
Material	Valve case	Ductile cast iron
	Spring case	Ductile cast iron
	Valve, valve seat	Stainless steel
	Adjusting spring	Stainless steel
Connection		JIS 10K FF flanged

Dashpot structure

Dimensions and Weights

(mm)

Nominal size	L	H	H_1	Weight (kg)
15A	90	245	108	4.7
20A	90	245	108	5.0
25A	90	245	108	6.2
32A	91	285	115	8.6
40A	91	285	115	8.8
50A	105	331	132	13.0



Relief Valve Discharge Piping

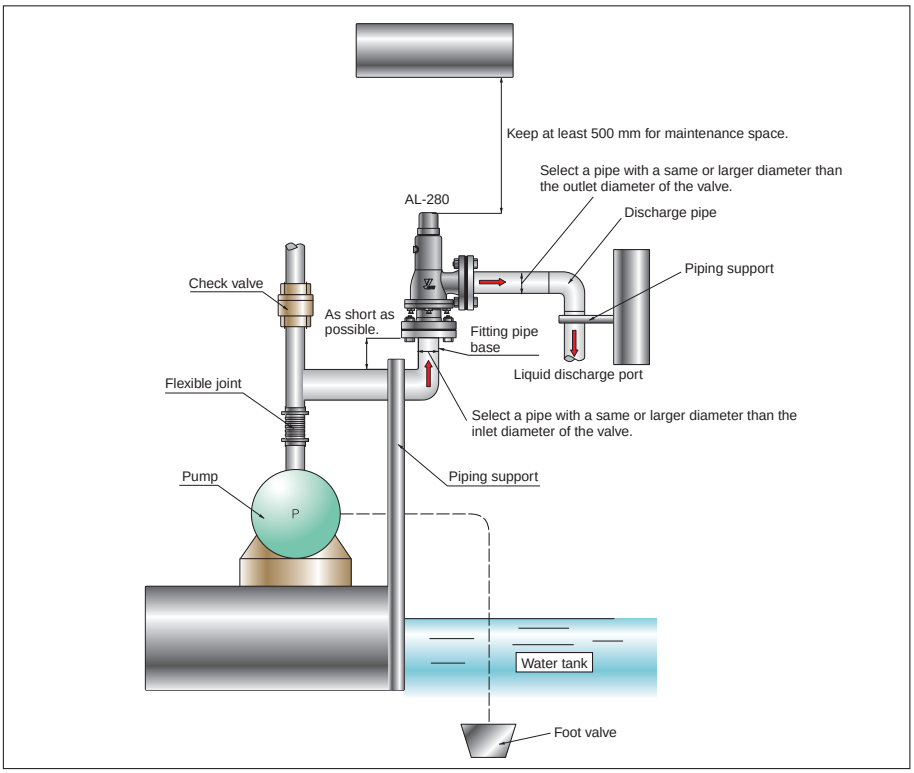


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Table for Selecting Nominal Sizes

●Flow rate chart

The flow rate to each nominal size when the accumulation (overpressure to the set pressure) is 25% is as shown in Fig. 1.
See Fig. 2 when the accumulation is less than 25%.

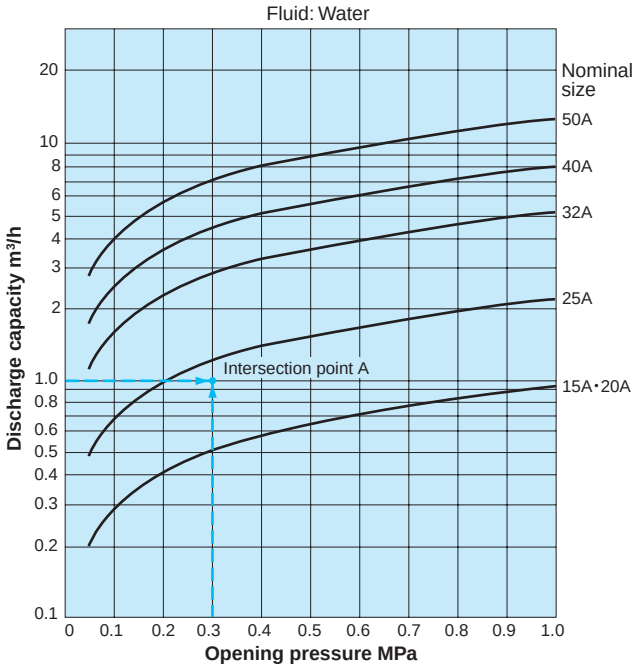
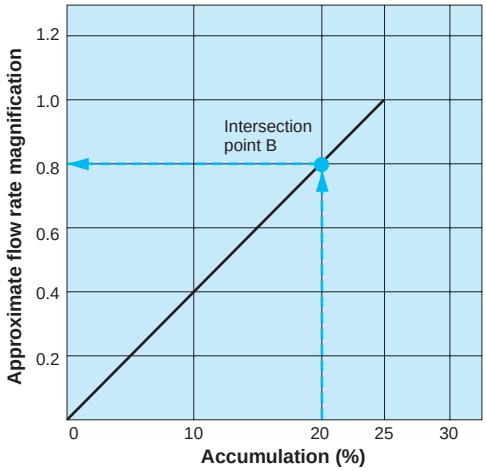


Fig. 1: Nominal size selection chart

[Example]
To select a nominal size when the working conditions are pressure: 0.3 MPa and discharge capacity: 1.0 m³/h, first find intersection point A of the pressure of 0.3 MPa on the horizontal axis and the discharge capacity of 1.0 m³/h on the vertical axis in Fig. 1.
Since intersection point A lies between the curve of nominal sizes 15A・25A and the curve of nominal size 25A, select the larger one, 25A.



When the accumulation is less than 25%, select an approximate flow rate magnification matching the accumulation based on this chart, and multiply the flow rate at 25% accumulation by the selected magnification.

Fig. 2: Approximate flow rate magnification

[Example]
To obtain the flow rate when the working conditions are nominal size: 25A, setting pressure: 0.1 MPa, and accumulation: 20%, first find the flow rate at an accumulation of 25% in Fig. 1. Then, mark intersection point B of the accumulation of 20% and the diagonal straight line in Fig. 2. Trace horizontally to the left from this intersection point B, and reach the point of 0.8 on the axis of approximate flow rate magnification.

●Discharge capacity (reference) (accumulation: 25%)

(m³/h)

Nominal size	Flow area (mm²)	Opening pressure (MPa)										
		0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
15A·20A	16.7	0.20	0.29	0.41	0.51	0.59	0.66	0.72	0.78	0.83	0.88	0.93
25A	36.2	0.49	0.69	0.98	1.20	1.38	1.54	1.69	1.83	1.96	2.07	2.19
32A	91.9	1.14	1.62	2.29	2.81	3.24	3.63	3.97	4.29	4.59	4.87	5.13
40A	143.6	1.79	2.53	3.58	4.39	5.07	5.67	6.21	6.71	7.17	7.61	8.02
50A	224.3	2.80	3.96	5.60	6.86	7.92	8.86	9.71	10.49	11.21	11.89	12.53

●Set pressure range for each model

(MPa)

Model	Size	A	B	C	D	E	F	G	H
AL-1・1T	15A	0.05-0.25	0.26-0.4	0.41-0.75	0.76-1.0				
	20A-50A	0.05-0.25	0.26-0.5	0.51-0.75	0.76-1.0				
AL-160 AL-160L	15A-50A	0.05-0.2	0.21-0.4	0.41-0.7	0.66-1.0				
AL-150 AL-150L AL-140	15A	0.05-0.2	B1: 0.21-0.3 B2: 0.31-0.4	0.41-0.55	0.56-0.75	0.76-1.0			
	20A	0.05-0.2	0.21-0.35	0.36-0.45	0.46-0.6	0.61-0.75	0.76-1.0		
	25A	0.05-0.2	0.21-0.35	0.36-0.45	0.46-0.55	0.56-0.8	0.81-1.0		
	32A	0.05-0.2	B1: 0.21-0.3 B2: 0.31-0.4	0.41-0.65	0.66-1.0				
	40A・50A	0.05-0.2	B1: 0.21-0.3 B2: 0.31-0.4	0.41-0.65	0.66-0.8	0.81-1.0			
AL-150H・150HL	15A						1.0-1.6		
	20A・25A							1.0-1.6	
	32A					1.0-1.6			
	40A・50A						1.0-1.6		
AL-140H	15A						1.0-1.3	1.31-2.0	
	20A・25A							1.0-1.6	1.61-2.0
	32A					1.0-1.6	1.61-2.0		
	40A						1.0-1.6	1.61-2.0	
AL-150T・150TR AL-150TML AL-140T AL-250・250R AL-260・260R	15A	0.05-0.2	0.21-0.4	0.41-0.55	0.56-0.75	0.76-1.0			
	20A	0.05-0.2	0.21-0.35	0.36-0.45	0.46-0.6	0.61-0.75	0.76-1.0		
	25A	0.05-0.2	0.21-0.35	0.36-0.45	0.46-0.55	0.56-0.8	0.81-1.0		
	32A	0.05-0.2	0.21-0.4	0.41-0.65	0.66-1.0				
	40A・50A	0.05-0.2	0.21-0.4	0.41-0.65	0.66-0.8	0.81-1.0			
AL-17・27	15A-50A	0.05-0.2	0.21-0.4	0.41-0.65	0.66-1.0	1.01-1.6			
AL-10	15A-40A	0.05-0.2	0.21-0.4	0.41-0.65	0.66-1.0				
	50A	0.05-0.1							
		0.11-0.2							
AL-31・31H	15A	0.05-0.15	0.16-0.25	0.36-0.45	0.56-0.65	0.76-0.85	1.0-1.3	1.31-1.6	
			0.26-0.35	0.46-0.55	0.66-0.75	0.86-1.0		1.61-2.0	
	20A	0.05-0.2	0.21-0.3		0.31-0.4	0.51-0.7	0.71-1.0	1.0-1.3	1.61-2.0
					0.41-0.5			1.31-1.6	
	25A	0.05-0.2	0.21-0.3	0.31-0.45	0.46-0.55	0.56-0.65	0.81-1.0	1.0-1.6	1.61-2.0
						0.66-0.8			
	32A-50A	0.05-0.2	0.21-0.3	0.31-0.5	0.51-0.65	0.66-0.8	0.81-1.0	1.0-1.6	1.61-2.0
AL-300・301	15A-50A	0.05-0.25	0.26-0.5	0.51-0.75	0.76-1.5				
AL-300T・301T	15A-50A	0.05-0.25	0.26-0.5	0.51-0.75	0.76-1.3				
AL-280	15A	0.05-0.2	0.21-0.35	0.36-0.45	0.46-0.6	0.61-0.75	0.76-1.0		
	20A	0.05-0.2	0.21-0.35	0.36-0.45	0.46-0.6	0.61-0.75	0.76-1.0		
	25A	0.05-0.2	0.21-0.35	0.36-0.45	0.46-0.55	0.56-0.8	0.81-1.0		
	32A	0.05-0.2	0.21-0.4	0.41-0.65	0.66-1.0				
	40A-50A	0.05-0.2	0.21-0.4	0.41-0.65	0.66-0.8	0.81-1.0			
AL-4・4T・6	65A	0.05-0.1	0.11-0.25	0.26-0.55	0.56-1.0	1.01-1.5			
	80A-125A	0.05-0.1	0.11-0.2	0.21-0.4	0.41-0.8	0.81-1.5			
	150A	0.05-0.1	0.11-0.2	0.21-0.4	0.41-0.8				
AL-4S・4ST	65A	0.05-0.1	0.11-0.25	0.26-0.55	0.56-1.0	1.01-2.0			
	80A・100A	0.05-0.1	0.11-0.2	0.21-0.4	0.41-0.8	0.81-1.6	1.61-2.0		
AL-5	20A	0.05-0.12	0.13-0.21	0.22-0.35	0.36-0.63	0.64-1.0		1.01-1.5	
	25A	0.05-0.08	0.09-0.15	0.16-0.25	0.26-0.45	0.46-0.75	0.76-1.0	1.01-1.1	1.11-1.5
	32A	0.05-0.08	0.09-0.17	0.18-0.25	0.26-0.45	0.46-0.75	0.76-1.0	1.01-1.1	1.11-1.5
	40A	0.05-0.08	0.09-0.15	0.16-0.4	0.41-0.7	0.71-1.0		1.01-1.1	1.11-1.5
	50A	0.05-0.09	0.1-0.25	0.26-0.5	0.51-0.7	0.71-1.0	1.11-1.5		
						1.01-1.1			

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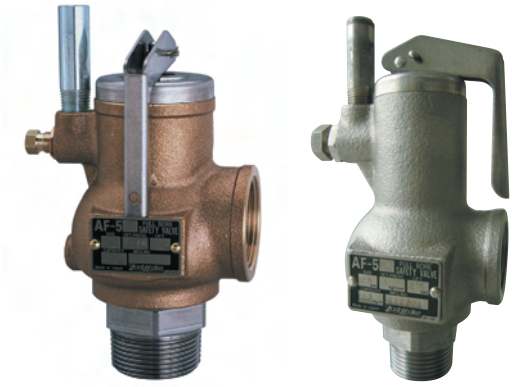
AF-5・5S

Features

1. Full bore safety valve with increased safety. Compact and lightweight (about half size of the conventional full bore type safety valve).
2. Popping structure ensures reliable discharge.
3. A material of excellent quality is used for the trim parts. High performance is maintained by precision processing and heat treatment.
4. Corrosion-free due to corrosion-resistant material (the AF-5S is all stainless made, offering high corrosion resistance and durability).
5. Due to lift lever mechanism a discharge inspection can be manually performed at more than 75% of the opening pressure.



AF-5 AF-5S

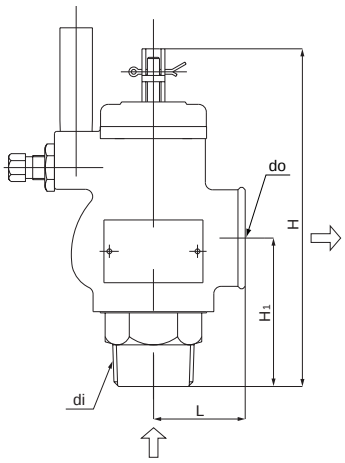
Specifications

Model		AF-5		AF-5S
Structure		Open type with a lever		
Application		Steam	Air, Other non-dangerous fluids	Steam, Air, Other non-dangerous fluids
Working pressure		0.1-1.6 MPa	0.1-1.0 MPa	0.1-1.0 MPa
Maximum temperature		220˚C		
Material	Spring case	Cast bronze		Cast stainless steel
	Valve, valve seat	Stainless steel		
Connection		Inlet: JIS R screwed Outlet: JIS Rc screwed		

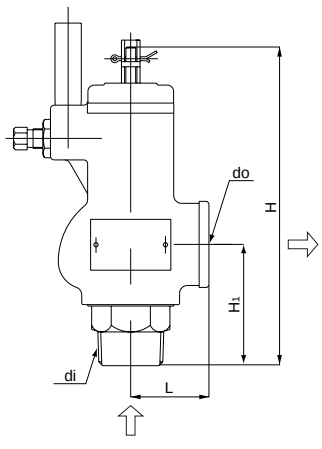
Dimensions and Weights

Nominal size	di x Throat diameter x do	Flow area $\frac{\pi}{4}dt^2$ (mm²)	Lift ℓ (mm)	Dimension(mm)			Plug	Weight (kg)
				L	H1	H		
20A	R 1 x 15 x Rc 1	176.6	3.3	38 (40)	61 (62)	136 (163)	R 1/8	1.24 (1.65)
25A	R 1-1/4 x 19 x Rc 1-1/4	283.3	4.4	45 (47)	70 (70)	157 (190)	R 1/8	1.88 (2.35)
32A	R 1-1/2 x 24 x Rc 1-1/2	452.1	5.5	52 (52)	80 (79)	183 (208)	R 1/8	2.62 (2.90)
40A	R 2 x 30 x Rc 2	706.5	6.8	65 (65)	98 (98)	216 (248)	R 1/4	5.10 (5.30)
50A	R 2-1/2 x 38 x Rc 2-1/2	1133.5	8.7	77 (77)	121 (121)	262 (315)	R 1/4	8.40 (9.20)

・The nominal size and the connection size are different.
・The values in parentheses are the dimensions and weights of the AF-5S.



AF-5



AF-5S

Certified Capacity Table

●For steam (saturation temperature) <Pressure vessel structure standard>

(kg/h)

Nominal size \ Pressure MPa	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6
20A	159	231	310	390	468	545	621	697	773	849	925	1001	1076	1152	1227	1303
25A	255	370	498	627	751	875	997	1118	1240	1362	1484	1606	1726	1849	1968	2090
32A	407	591	794	1000	1199	1396	1591	1785	1979	2175	2369	2562	2755	2950	3142	3336
40A	636	925	1242	1563	1874	2182	2487	2790	3093	3398	3702	4005	4306	4611	4910	5213
50A	1021	1484	1992	2508	3007	3501	3991	4477	4963	5453	5940	6425	6909	7398	7877	8364

・AF-5: 0.1 MPa to 1.6 MPa　AF-5S: 0.1 MPa to 1.0 MPa

<Boiler structure standard>

(kg/h)

Nominal size \ Pressure MPa	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6
20A	155	227	299	372	443	515	587	659	729	800	872	942	1013	1084	1156	1227
25A	249	365	480	598	711	827	942	1057	1170	1284	1398	1512	1625	1740	1854	1968
32A	398	582	767	954	1136	1320	1503	1687	1867	2050	2232	2413	2594	2777	2959	3141
40A	622	910	1198	1491	1775	2063	2350	2636	2918	3204	3488	3772	4054	4340	4625	4909
50A	998	1461	1923	2393	2848	3311	3770	4229	4681	5140	5597	6052	6505	6963	7420	7876

●For air (20˚C) <Pressure vessel structure standard>

(kg/h)

Nominal size \ Pressure MPa	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
20A	257	374	502	630	759	887	1015	1143	1272	1400
25A	413	600	806	1011	1217	1423	1629	1835	2040	2246
32A	659	958	1286	1614	1943	2271	2600	2928	3256	3585
40A	1030	1497	2010	2523	3036	3550	4063	4576	5089	5602
50A	1654	2402	3225	4049	4872	5695	6518	7342	8165	8988

・Please contact us for the calculation procedure for nominal size selection.

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AF-4・4M

Features

1. Lift safety valve, designed in compliance with JIS B 8210 "Spring loaded safety valves for steam boilers and pressure vessels".
2. Larger discharge capacity than lift type.
3. Due to lift lever mechanism a discharge inspection can be manually performed at more than 75% of the opening pressure (AF-4).
4. Blowdown pressure can be adjusted with a back pressure throttle valve.
5. A material of excellent quality is used for the trim parts. High performance is maintained by precision processing and heat treatment.

AF-4

Specifications

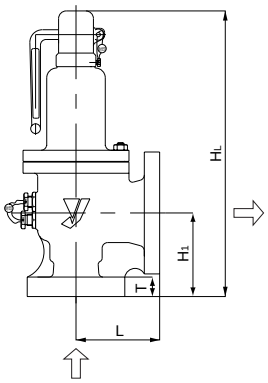
Structure		Open type
Application		Steam, Air, Other non-dangerous fluids
Working pressure		0.1-1.0 MPa
Maximum temperature		220˚C
Material	Valve case	Ductile cast iron
	Spring case	Ductile cast iron
	Valve, valve seat	Stainless steel *
Connection		JIS 10K FF flanged

* Stellite overlaid stainless steel for 80A or larger in nominal size.

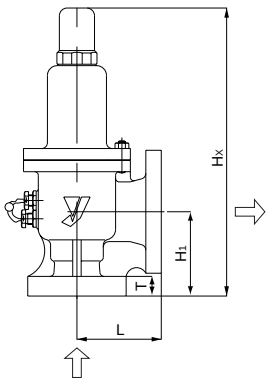
Dimensions and Weights

Nominal size	Inlet diameter x Throat diameter x Outlet diameter	Flow area $\frac{\pi}{4}dt^2$ (mm²)	Lift ℓ (mm)	Dimension (mm)				Flange			Weight (kg)
				L	H_1	H_L	H_X	Inlet	T (mm)	Outlet	
25A	25 x 16 x 40	200.9	3.7	100	100	356	335	25A	26	40A	12
40A	40 x 26 x 65	530.6	6.0	120	120	410	408	40A	28	65A	21
50A	50 x 30 x 75	706.5	6.8	130	130	458	453	50A	30	80A	27
65A	65 x 40 x 100	1256.0	9.0	150	150	514	537	65A	32	100A	41
80A	80 x 49 x 125	1884.7	11.1	165	160	677	648	80A	32	125A	41
100A	100 x 76 x 150	4534.1	16.8	215	200	799	779	100A	32	150A	115
125A	125 x 84 x 200	5538.9	19.1	220	210	858	835	125A	36	200A	135
150A	150 x 100 x 200	7850.0	22.7	250	230	1006	966	150A	38	200A	203

・The connection flange standard is JIS B 2239 10K FF.



AF-4 (open type with a lever)



AF-4M (open type without a lever)

Certified Capacity Table

●For steam (saturation temperature) <Pressure vessel structure standard>

(kg/h)

Nominal size \ Pressure MPa	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
25A	181	263	353	444	532	620	707	793	879	966
40A	478	694	932	1174	1407	1638	1868	2095	2323	2552
50A	636	925	1242	1563	1874	2182	2487	2790	3093	3398
65A	1132	1644	2208	2780	3332	3879	4422	4960	5500	6042
80A	1699	2467	3313	4171	4999	5821	6636	7444	8253	9067
100A	4087	5937	7971	10036	12028	14004	15964	17908	19855	21813
125A	4993	7252	9738	12260	14694	17108	19502	21877	24256	26647
150A	7076	10279	13801	17375	20825	24246	27640	31005	34377	37766

<Boiler structure standard>

(kg/h)

Nominal size \ Pressure MPa	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
25A	177	258	340	424	504	586	668	749	829	911
40A	467	683	900	1120	1333	1550	1764	1980	2191	2406
50A	622	910	1198	1491	1775	2063	2350	2636	2918	3204
65A	1106	1619	2131	2651	3156	3669	4177	4687	5187	5696
80A	1660	2429	3198	3978	4735	5505	6269	7033	7784	8547
100A	3995	5844	7694	9572	11393	13245	15081	16920	18728	20563
125A	4880	7139	9399	11693	13918	16180	18424	20670	22878	25120
150A	6916	10118	13321	16572	19725	22931	26111	29294	32424	35601

●For air (20˚C) <Pressure vessel structure standard>

(kg/h)

Nominal size \ Pressure MPa	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
25A	293	425	571	717	863	1009	1155	1301	1447	1593
40A	774	1124	1510	1895	2280	2666	3051	3436	3822	4207
50A	1030	1497	2010	2523	3036	3550	4063	4576	5089	5602
65A	1832	2662	3574	4486	5398	6311	7223	8135	9047	9960
80A	2750	3994	5363	6732	8101	9470	10839	12207	13576	14945
100A	6616	9610	12903	16196	19489	22782	26076	29369	32662	35955
125A	8082	11739	15762	19785	23808	27831	31854	35877	39900	43923
150A	11454	16638	22339	28041	33742	39444	45146	50847	56549	62250

・Please contact us for the calculation procedure for nominal size selection.

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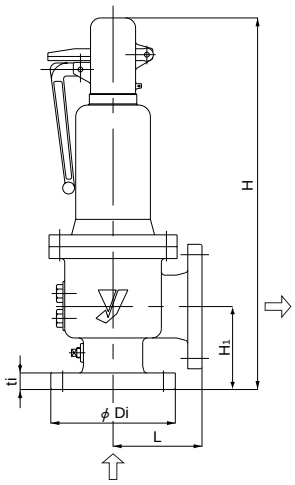
AF-2

Features

1. Lift safety valve, designed in compliance with JIS B 8210 "Spring loaded safety valves for steam boilers and pressure vessels".
2. Larger discharge capacity than lift type.
3. Due to lift lever mechanism a discharge inspection can be manually performed at more than 75% of the opening pressure.
4. Blowdown pressure can be adjusted with a back pressure throttle valve.
5. A material of excellent quality is used for the trim parts. High performance is maintained by precision processing and heat treatment.



Specifications

Structure		Open type with a lever
Application		Steam
Working pressure		0.18-1.6 MPa
Maximum temperature		220˚C
Material	Valve case	Ductile cast iron
	Spring case	Ductile cast iron
	Valve, valve seat	Stainless steel
Connection		Inlet: JIS B 8210 10K RF flanged * Outlet: JIS B 2239 10K FF flanged

* JIS B 8210 20K RF flanged when working pressure is more than 1.0 MPa.

Dimensions and Weights

Nominal size	Inlet diameter x Throat diameter x Outlet diameter	Flow area $\frac{\pi}{4}dt^2$ (mm²)	Lift ℓ (mm)	Dimension (mm)			Connection (mm)						Outlet	Weight (kg)
				L	H1	H	Inlet: JIS B 8210 10K							
							Di	Ci	gi	ti	fi	ni x hi		
65A	65 x 49 x 90	1884.7	11.1	150	142	630	200	160	105	30	2	8 x 23	100A	50.0
80A	75 x 57 x 100	2550.7	13.0	165	160	682	210	170	125	32	2	8 x 23		62.3

Certified Capacity Table

●For steam (saturation temperature) <Pressure vessel structure standard> (kg/h)

Pressure MPa / Nominal size	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6
65A	2467	3313	4171	4999	5821	6636	7444	8253	9067	9877	10684	11488	12300	13098	13907
80A	3339	4484	5645	6766	7878	8981	10074	11170	12271	13368	14460	15547	16647	17727	18821

<Boiler structure standard> (kg/h)

Pressure MPa / Nominal size	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6
65A	2429	3198	3978	4735	5505	6269	7033	7784	8547	9306	10063	10816	11578	12338	13096
80A	3287	4328	5385	6409	7451	8484	9518	10535	11567	12595	13619	14638	15669	16698	17725

・Please contact us for the calculation procedure for nominal size selection.

Feature		Lift type / Closed type	Lift type / Lever type	
Model		AL-150	AL-150L	AL-150HL
Picture			 AL-150L	
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids	Steam, Air	
Working pressure		0.05-1.0 MPa	0.05-1.0 MPa	1.0-1.6 MPa
Max. temperature		220˚C *	220˚C	
Connection		JIS Rc screwed	JIS Rc screwed	
Material	Spring case	Cast bronze	Cast bronze	
	Valve	Stainless steel (SCS14A)	Stainless steel (SCS14A)	
	Valve seat	Stainless steel (SCS14A)	Stainless steel (SCS14A)	
Size		15A-50A	15A-50A	
Others		* The maximum temperature is 150˚C when using for water, oil or other liquids.	—	

Feature		Relief valve / Diaphragm type	Full bore / SCPH	Full bore / SCS
Model		AL-24	AF-6H	AF-6HS
Picture			 AF-6H	
Application		Cold and hot water	Air, Other non-dangerous fluids	
Working pressure		0.1-0.7 MPa *1	0.1-1.96 MPa	
Max. temperature		60˚C	250˚C *1	
Connection		JIS Rc screwed	Inlet: JIS 20K RF flanged Outlet: JIS 10K FF flanged *2	
Material	Valve case	Cast bronze *2	Cast carbon steel	Cast stainless steel
	Valve	NBR *3	Stellite overlaid stainless steel	
	Valve seat	Stainless steel	Stellite overlaid stainless steel	
	Diaphragm	NBR (heat-resistant nylon contained)	—	
Size		15A-25A	25A-100A	
Others		*1 Available with working pressure between 0.05 MPa and 0.1 MPa. *2 Available with NPb-treated. *3 Available with FKM (AL-24F).	*1 It may change depending on fluid and pressure. *2 The inlet flange is thicker than JIS standard value.	

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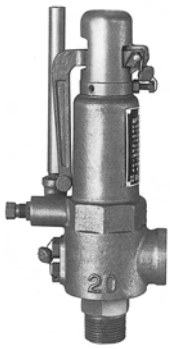
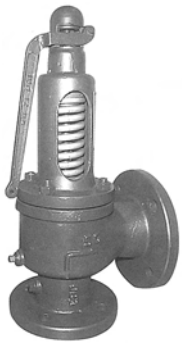
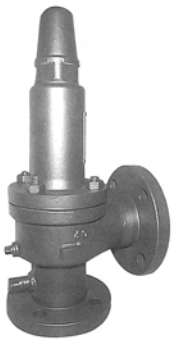
Feature		Full bore / Screwed	Full bore / Lever, SCPH	Full bore / Closed, SCPH
Model		**AF-1**	**AF-7**	**AF-7M**
Picture				
Application		**Steam**	**Steam, Air, Other non-dangerous fluids**	**Air, Other non-dangerous fluids**
Working pressure		0.18-1.6 MPa	0.1-1.0 MPa *	
Max. temperature		220˚C	350˚C	300˚C
Connection		Inlet: JIS R screwed Outlet: JIS Rp screwed	Inlet: JIS 10K RF flanged Outlet: JIS 10K FF flanged	
Material	Valve case	Ductile cast iron	Cast carbon steel	
	Valve	Stainless steel	Stainless steel	
	Valve seat	Stainless steel	Stainless steel	
Size		20A-50A	25A-100A	
Others		—	* Available with working pressure between 1.0 MPa and 1.6 MPa (Inlet: JIS 20K RF flanged).	

Strainer

Strainer Selection

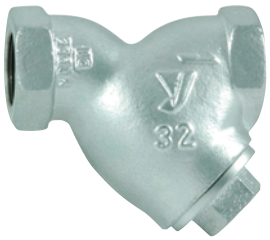
Application				Max. Pressure (MPa)	Material				Max. Temperature (˚C)	Model	Type			Page
Steam	Air	Water	Oil		Ductile Cast Iron	Stainless Steel	Bronze	Carbon Steel			Y Type	Basket	Duplex	
●	●	●		1.0	●				220	SY-40	●			152
●	●	●	●			●			150	SY-8	●			154
●	●	●	●			●				SY-38	●			154
●	●	●	●			●			220	SY-13SS	●			156
●	●	●	●					●		SY-13	●			156
●	●	●						●	260	SY-20-10	●			162
●	●	●	●	1.3			●		220	SY-6	●			150
●	●	●		2.0	●				220	SY-5	●			149
●	●	●			●					SY-40EN	●			153
●	●	●			●					SY-40H	●			153
●	●	●	●			●			150	SY-17	●			151
●	●	●	●			●				SY-37	●			151
●	●	●						●	260	SY-20-20	●			162
●	●	●		3.0				●	260	SY-10-30	●			162
●	●	●						●	350	SY-10H	●			162
●	●	●				●				SY-10HS	●			163
	●	●		1.0	●				60	SY-40C	●			152
	●	●			●				80	SY-9	●			162
		●	●	1.0	●				60	SU-20C		●		158
		●	●		●					SU-20S		●		158
		●	●		●				80	SW-10			●	161
		●	●		●					SW-10S			●	161
		●	●		●				220	SU-20		●		158
		●	●			●			80	SU-10S		●		163
		●	●			●			120	SU-6SS		●		160
		●	●			●			220	SU-10		●		163
		●	●					●	120	SU-6		●		160
		●	●		●				5-80	SU-50S		●		157
		●	●		●					SU-50SS		●		157
		●		1.2			●		60	SU-55F		●		163
		●		1.3			●		80	SY-6-N	●			150
		●		1.6			●		80	SY-24	●			162
		●					●			SY-24-N	●			162
		●	●	2.0				●	260	SU-12		●		163
		●	●		●				80	SU-20H		●		159
		●	●		●				5-80	SU-50H		●		157
●	●	●		4.0		●			220	ST-1 Corn Type Temporary				163

Selection of Strainer

What is a Strainer ??

A strainer catches foreign substances inside of piping and prevents them to flow inside of the piping for steam, air, water, and oil systems for a factory or plant, as well as problems or damage to devices attributable to the ingress of foreign substances.

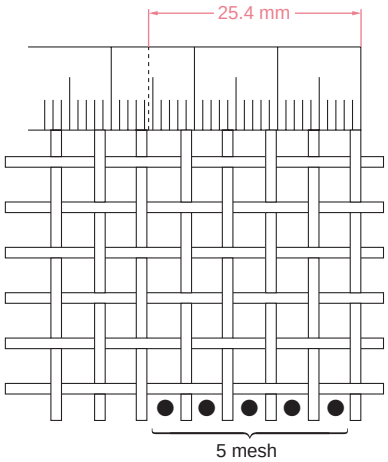
Applications	Y type strainer	Basket strainer	Duplex strainer	Temporary strainer
	A compact type strainer with low fluid resistance and requiring less installation space.	A basket strainer is suitable for liquid, equipped with a larger filtration area than Y type strainer.	The screen can be washed without stopping the fluid because the fluid passage can be switched.	A piping flushing type strainer to be used prior to operation.

Major Products	SY-5	SU-20	SW-10	ST-1
				

Meshes

What is the mesh size?

The mesh size is the number of meshes in 25.4 mm (1 inch).
Example: In the right figure, the mesh size is five.



	Specification for Japanese government	Yoshitake standard
For water	40 mesh or more (80 mesh or more when installed before a solenoid valve)	40・60 mesh
For steam	80 mesh or more	80 mesh

●Table of standard mesh per model

Standard meshes	Model
40 mesh	SU-6・6SS
60 mesh	SY-40C, SY-24・24-N, SY-6-N, SY-9, SU-10・10S, SU-20・20S・20C・20H, SU-12, SU-50H・50S・50SS, SW-10・10S, SU-55F
80 mesh	SY-5, SY-40・40EN・40H, SY-6, SY-17, SY-8, SY-10-30, SY-10H・10HS, SY-20-10・20, SY-13・13SS, ST-1

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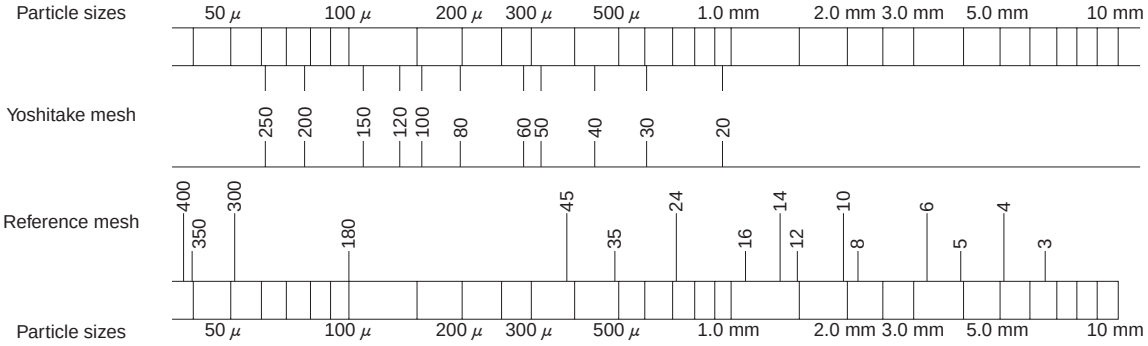
Meshes

Comparison of Meshes and Particle Sizes



- Note that because of the structure, the capability to catch foreign substances equivalent to standard meshes may not be guaranteed. Please contact us when the passing of foreign substances is not permissible.

Porosity of Screen

●Porosity of perforation

Hole diameter (mm) ——— No. of hole (holes/cm²)	Porosity (%)
ϕ 1.2 ——— 23.8	26.98
ϕ 1.3 ——— 16.2	21.59
ϕ 1.5 ——— 11.2	19.96
ϕ 2.5 ——— 7.21	35.42
ϕ 6 ——— 1.42	40.30
ϕ 6 ——— 1.80	50.63
ϕ 8 ——— 0.954	47.96
ϕ 10 ——— 0.739	58.04

●Screen porosity table

(%)

	Meshes										
Model	20	30	40	50	60	80	100	120	150	200	250
SY-5・6・9・10・17・20・24・37・38 SY-40・40EN・40H, SU-10・10S・12 SU-20・20S・20H・50H・50S・50SS SW-10・10S	59.5	49.6	51.3	41.6	44.8	38.6	36.7	38.6	41.6	36.7	36.7
SY-8 (15A-100A)	59.5	49.6	51.3	41.6	44.8	38.6	36.7	—	—	—	—
SY-8 (125A-150A)	52.5	43.2									
SY-13・13SS, SU-6・6SS	53.6	49.6	46.9	41.6	44.7	38.6	36.7	38.6	41.6	36.7	36.7
ST-1	52.5	46.4	40.7	39.2	41.7	38.7	36.8	38.6	38	36.8	36.8

How to Calculate the Filtration Area and Filtration Area Ratio of a Strainer

Calculate the filtration area ratio of a strainer to the bore as shown below.

Filtration area of Y type strainer = Surface area of screen (π・ds・ℓs) x porosity of perforated sheet x porosity of mesh screen

Filtration area of basket type and duplex type strainers =

Surface area of screen $(\pi \cdot ds \cdot \ell s + \frac{\pi \cdot ds^2}{4})$ x porosity of perforated sheet x porosity of mesh screen

$$\text{Filtration area ratio to bore} = \frac{\text{Filtration area of strainer}}{\text{Inside cross sectional area of piping } \left(\frac{\pi \cdot D^2}{4}\right)} \quad \text{(D: Bore)}$$

<Calculation example>

Calculate the filtration area of an 80A SY-8 strainer with a 40 mesh screen

(ds = ϕ 88, ℓs = 130, perforated sheet ϕ 2.5-7.21 holes/cm²).

Filtration area of strainer = (π x 88 x 130) x 0.3542 x 0.513 ≒ 6530 (mm²)

Inside cross sectional area of piping = $\frac{\pi \times 80.7^2}{4}$ ≒ 5114 (mm²) (Assuming that the bore is ϕ 80.7)

Consequently,

Filtration area ratio to bore = $\frac{6530}{5114}$ ≒ 1.27 (times)

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Features of Y Type Strainer

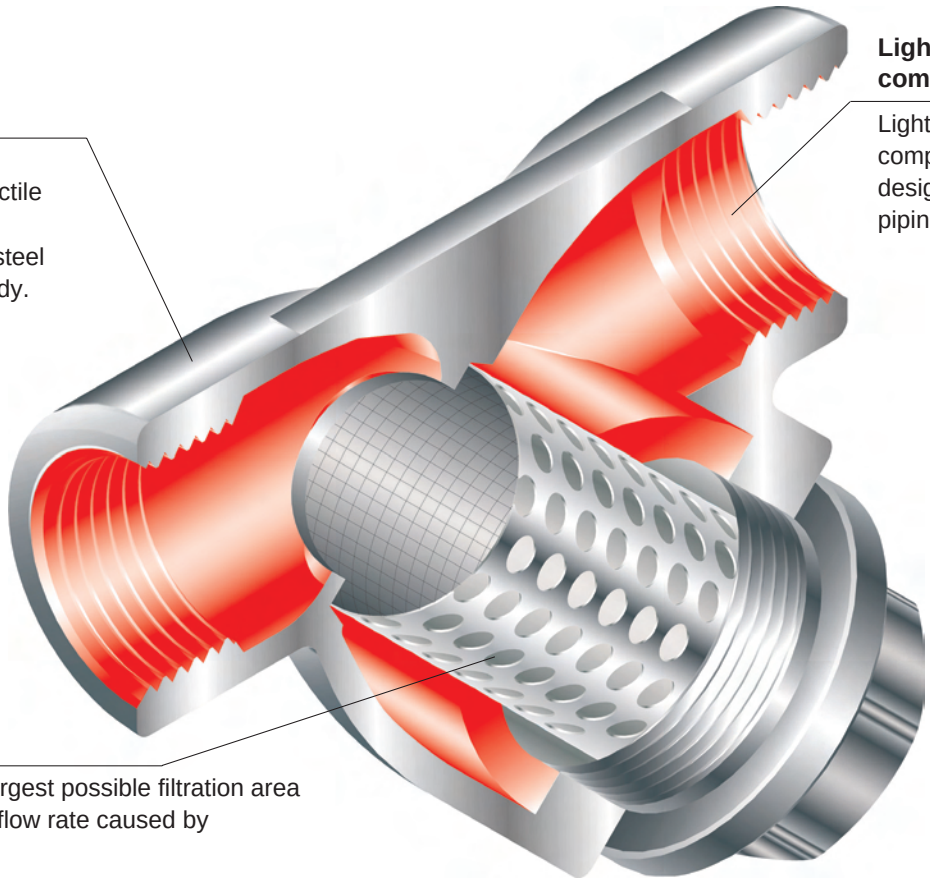
Use this strainer for applications such as:

Mainly for removing dirt and dust from steam or air piping and for protecting control valves.

The Y type strainer can be widely used for removing dirt and dust from pipelines. Lightweight and compact, the Y type strainer comes in a wide variety of structures, shapes, and mesh types.

Selectable materials

Available with various materials, including ductile cast iron, carbon steel, bronze, and stainless steel as materials for the body.



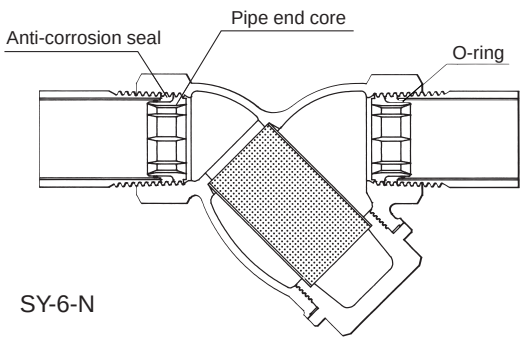
Lightweight and compact

Lightweight, compact, and designed for easy piping.

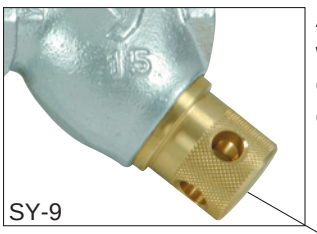
Large filtration area

Marine type with the largest possible filtration area in view of decrease in flow rate caused by clogging.

Available with pipe end core.



SY-6-N



SY-9

Available with "easy plug" which makes the removal and cleaning of the internal screen easy (SY-9).

Easy plug

SY-5

SY-40

SY-8

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Features of Basket Strainer

Use this strainer for applications such as:

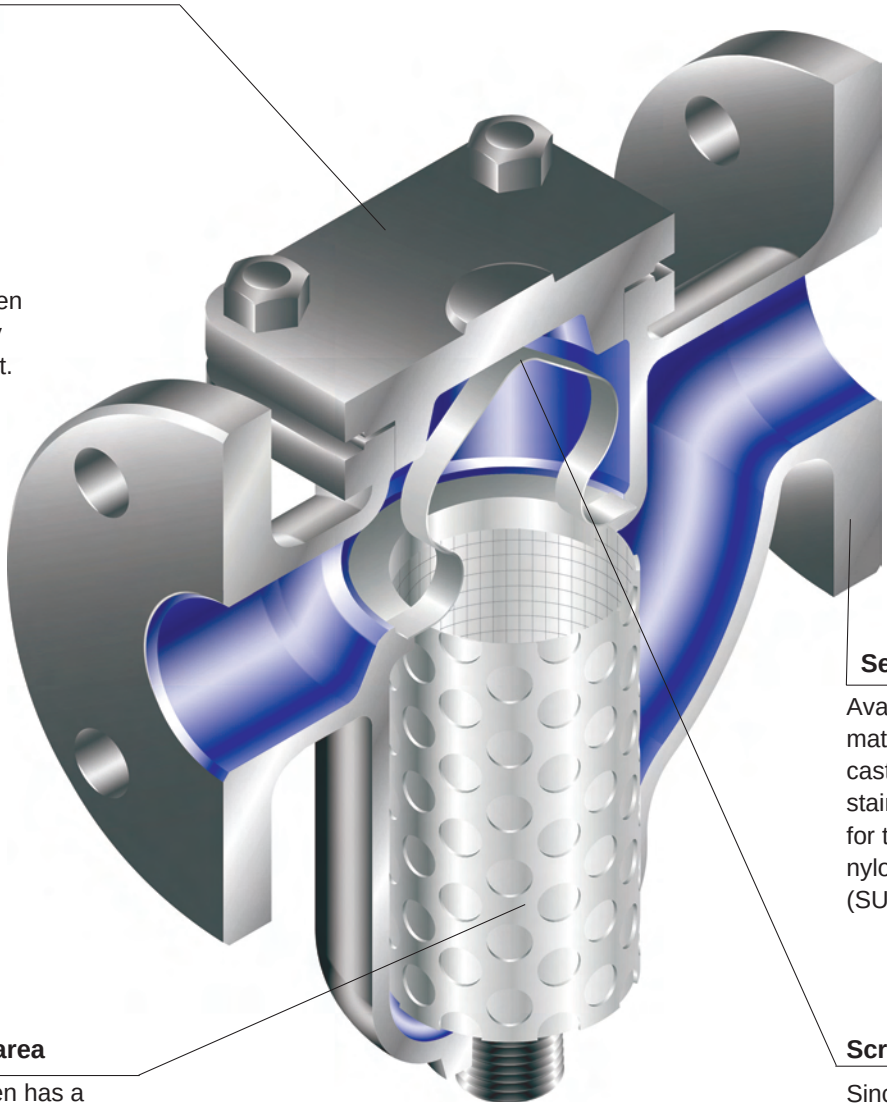
- For industrial water
- For combustion oil for boilers, etc.

The basket strainer can be widely used mainly for removing dirt and dust from pipelines for liquids.

SU-20S

Available with one-touch type allowing the screen to be removed by unfastening a bolt.

One-touch cover



Selectable materials

Available with various materials, including ductile cast iron, carbon steel and stainless steel as materials for the body. Available with nylon-coated basket strainer (SU-20C).

Large filtration area

The internal screen has a large surface area (1.5 times to twice that of other structures), which helps reduce pressure loss due to clogging.

Screen with a handle

Since the screen is provided with a handle, it is possible to remove it with user's hands kept clean.

SU-20

SU-10S

Features of Duplex strainer

Use this strainer for applications such as:

Systems that must keep the fluid flowing, such as fuel supply lines.

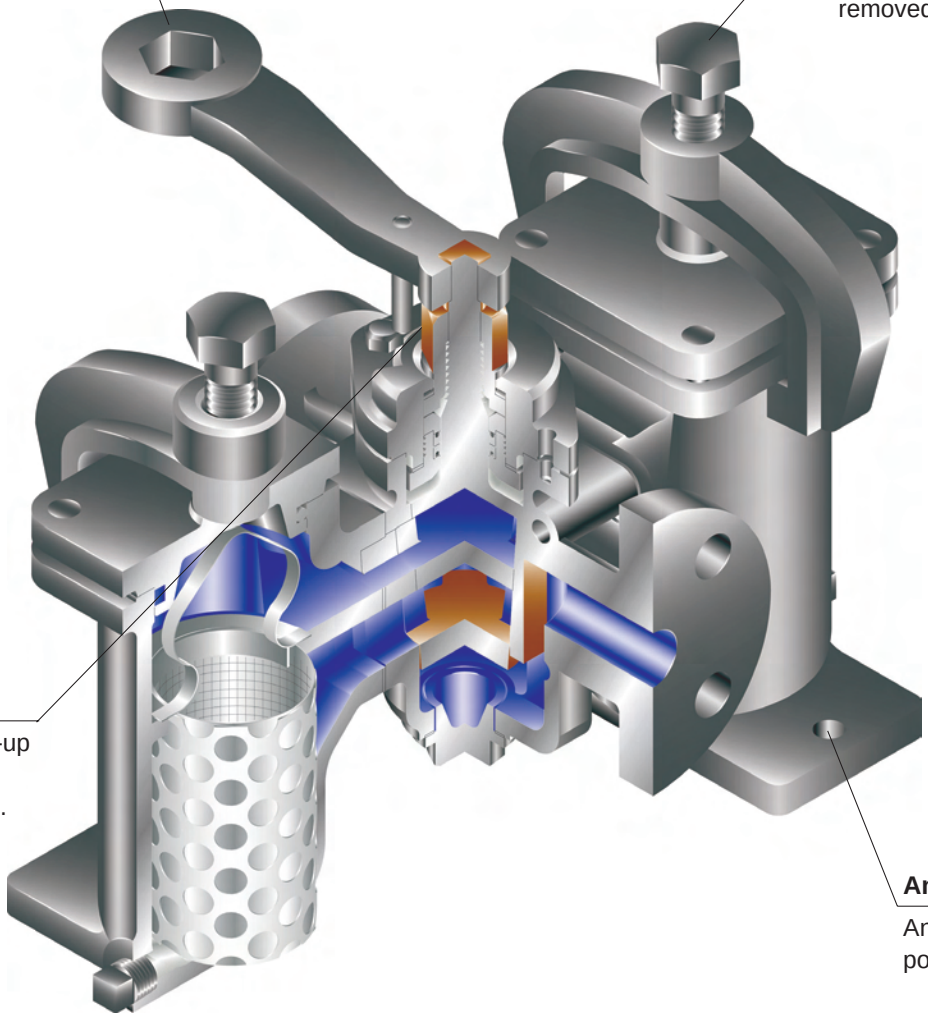
The duplex strainer can be widely used for removing dirt and dust from pipelines for water and oil. By switching the right or left passage to the other, the screen can be washed without stopping the fluid.

No other tools required

Switching can be performed with the attached tool.

One-touch operation

The SW-10S strainer is a one-touch type strainer whose screen can be easily removed.



Pull-up cock

The handle of a pull-up cock type can be effortlessly operated.

Anchor base

Anchor fixing is possible.

The screen can be removed and cleaned without stopping the fluid (system). It is not necessary to install bypass piping.

SW-10

SW-10S

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How to Select a Nominal Size

A strainer can work most effectively and completely fulfill working conditions if the following are taken into account:

■ Selecting a nominal size

Select a strainer of the same nominal size as that of the piping to which it will be connected (nominal size of piping = nominal size of strainer). Please remember that using a strainer of a smaller nominal size increases the pressure loss of the strainer and may disable it from keeping specified pressure at the inlet of a device.

<Standard flow velocity of fluids>

Fluid	Remarks	Standard flow velocity
Saturated steam	Auxiliary piping for vacuum or small-diameter piping	15 m/s (10-20)
	Large-diameter piping	30 m/s (20-40)
Superheated vapor	Piping diameter: Approx. ϕ 75-ϕ 250	40 m/s (30-50)
	Piping of high-grade material	70 m/s (65-80)
Inlet of steam coil	0.3-0.7 MPa	30 m/s (25-30)
Air	High pressure: 1.0 MPa	20 m/s (20-25)
	Low pressure	15 m/s (5-15)
	Extremely low pressure: 0.1 MPa	10 m/s (3-10)
Water, oil		2 m/s (2- 4)

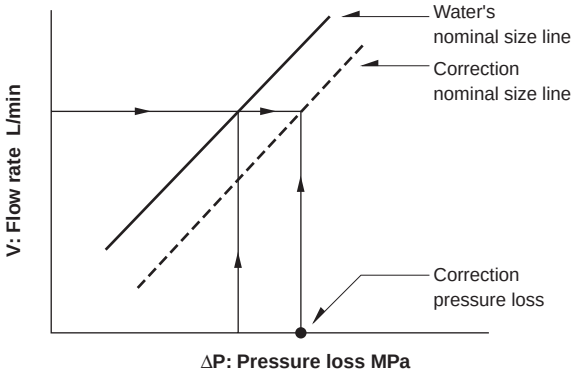
・This table shows the standard flow velocity of each fluid based on the flow velocities specified in JIS F 7101 (Shipbuilding -- Pipes of machinery -- Standard velocity of flow).

■ Selecting a piping nominal size

Selecting as large a piping nominal size as possible is an ideal way to reduce pressure loss inside piping. On the other hand, the smaller the piping nominal size, the better in view of piping and equipment costs. Additionally, heat loss rises with an increase in piping nominal size. In selecting a piping nominal size, determine permissible pressure loss based on the application, and find the smallest piping nominal size that can keep actual pressure loss within the determined range. However, an excessively high flow velocity accelerates wear in piping and may cause vibration. In general, the standard flow velocity of a fluid is set according to the application and based on the type and properties of the fluid and the piping nominal size.

How to Read a Pressure Loss Chart

1. When water or a fluid close to water in viscosity and specific gravity is used:
   Find the intersection point of the flow rate V L/min and the pressure loss ΔP MPa (usually 0.02 MPa to 0.03 MPa) on the pressure loss chart for the strainer. The nominal size line above the intersection point represents the required nominal size.
2. When the fluid to be used is different from water in viscosity and specific gravity:
   Take any of each nominal size from pressure loss chart (for water) in each product, and calculate the pressure loss at that point using the expression shown below. Draw a line of the same gradient as water's nominal size line. Then, find the required nominal size as described in 1.
3. When the filter element and the filter screen are different:
   Pressure loss seldom changes even if our perforated sheet and filter screen are replaced. However, fine ones and coarse ones are different in the state and progression of clogging. Set a higher safety factor for a finer one.
4. How to calculate the pressure loss of a strainer:
   Find the intersection point of the nominal size line and the flow rate on the chart. The ΔP value at the intersection point is the pressure loss of the strainer.
   ・Use the expression shown below to calculate pressure loss when a fluid other than water is used and its weight volume ratio and kinetic viscosity coefficient are different from those of water.



<Calculation formula>

$$\Delta P = \Delta Pw \frac{r}{rw}(0.00379v + 1)$$

ΔP	: Pressure loss when the fluid is flowing [MPa]
ΔPw	: Pressure loss when water is flowing [MPa]
r	: Weight volume ratio of the fluid [kg/m³]
rw	: Weight volume ratio of water [kg/m³]
v	: Kinetic viscosity coefficient [cSt]

<Calculation example>

Calculate the pressure loss of an 80A SU-20 strainer when a lubricating oil (weight volume ratio: 900 kg/m³, kinetic viscosity coefficient: 200 cSt) flows at a rate of 300 L/min. Calculate the pressure loss of water from the chart.

$$\Delta Pw = 0.004 \text{ MPa}$$

$$\Delta P = 0.004 \times \frac{900}{1000} \times (0.00379 \times 200 + 1)$$

$$\fallingdotseq 0.007 \text{ MPa}$$

Guidelines for the Installation of a Strainer

- Use a strainer under a maximum pressure loss of 0.1 MPa or less.
- Whether a strainer is clogged can be checked by installing a pressure gauge before and after it.
- When installing a strainer, prepare space for removing the screen from it.
- Do not apply back pressure from the outlet of a strainer because the filter screen may separate from the perforated sheet.

Guidelines for Y type strainer

Install the Y type strainer with the cap down. Remove the drain plug, and attach a blow valve. The dirt accumulating in the lower portion of the strainer can be discharged (see Fig.1).

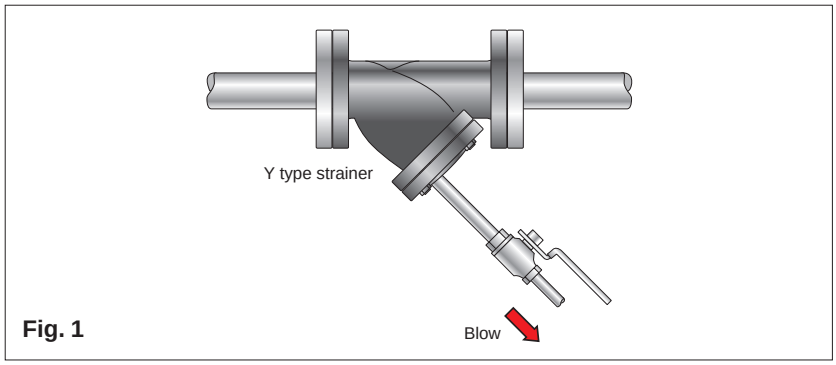


Fig. 1

When the fluid is steam, connect piping so that the cap faces sideways in order to minimize the pooling of drain (see Fig. 2).

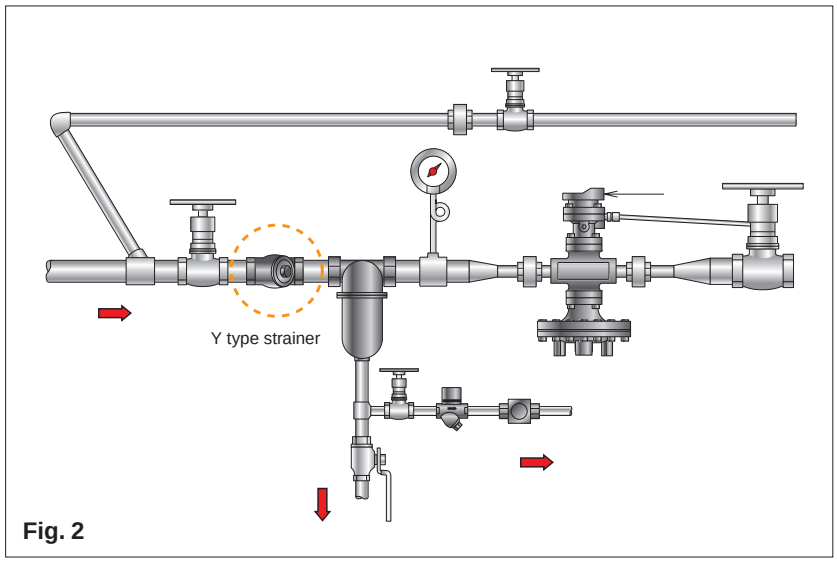
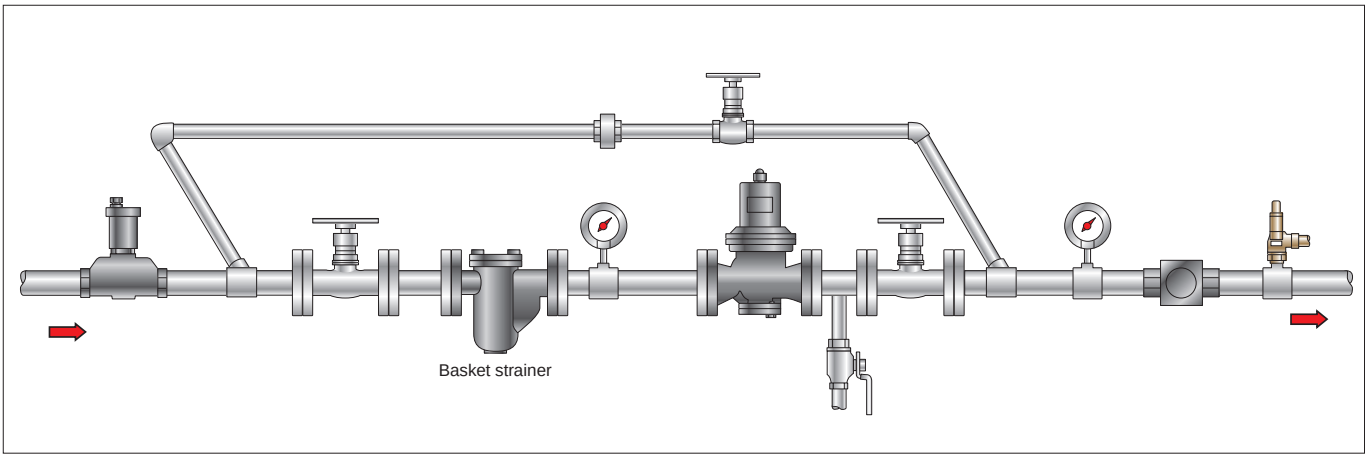


Fig. 2

Guidelines for Basket Strainer

Connect the basket strainer to piping with the mounting cover up.



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Guidelines for the Installation of a Strainer

Duplex strainer

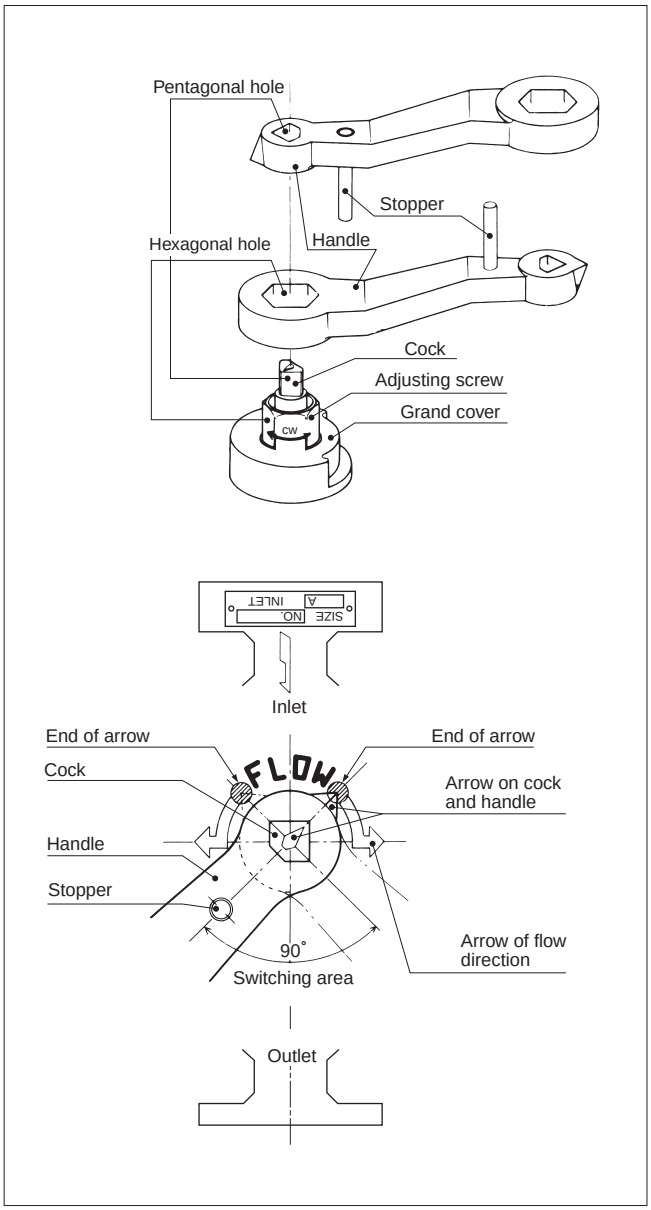
Switch the cock according to the operation procedure described below (the cock will get damaged if switching is carried out without pulling up the cock).

●Operation procedure

1: Slide the handle's head with the hexagonal hole over the adjusting screw, and give the screw one or two clockwise turns (the cock rises).
2: Slide the handle's head with the pentagonal hole over the cock (with the stopper down), switch the cock to the right or left.
3: Align the arrow marked on each of the cock and the handle with the end ● mark of the arrow on the screen.
4: After the cock is switched, turn the adjusting screw counterclockwise, the opposite direction of the operation in (1). If the cock and the adjusting screw simultaneously turn, hold either of them with a wrench, etc. The adjusting screw must be tightened with the attached handle.
5: After switching, clean the strainer opposite to the direction of flow.

●Precautions

1: The pressure loss during switching reaches a maximum value when the angle at the time of the change of the direction of flow of the fluid is 45˚.
2: Keep the fluid flowing when turning the handle (otherwise, the strainer body and the cock may be galled).
3: The cock will get damaged if switching is carried out without pulling up the cock.
4: If the cock and the adjusting screw simultaneously turn, lightly hold either of them with a wrench, etc.
5: Do not tighten the adjusting screw to an excessive torque.



<Adjusting the direction of flow>
Align the arrow marked on each of the cock and the handle with the end ● mark of the arrow on the screen used (the position at which the handle no longer turns by the handle).

SY-5

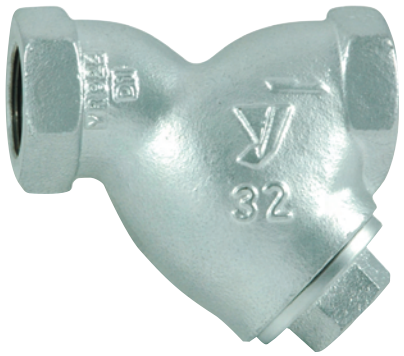
Features

1. Versatile, compact, lightweight and economical.
2. High-flow-rate marine type with the largest possible filtration area in view of decrease in flow rate caused by clogging.

Specifications

Application		Steam, Air, Cold and hot water, Other non-dangerous fluids
Maximum pressure		2.0 MPa
Maximum temperature		220˚C
Material	Body	Ductile cast iron
	Screen	Stainless steel
Screen	Perforation	ϕ 2.5-7.21 holes/cm^2
	Mesh	Standard 80 mesh
Connection		JIS Rc screwed

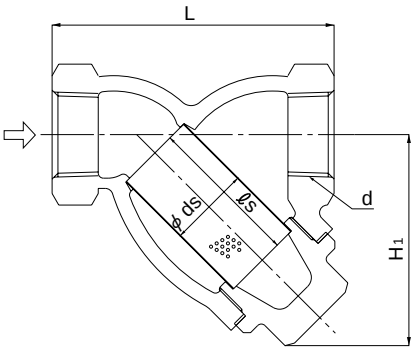
- Available with 20 to 100 mesh screen (perforation: ϕ 2.5-7.21 holes/cm^2) or only with perforation (ϕ 1.2-23.8 holes/cm^2) on request.
- Available with 10A to 32A attached with a plug (material: S15C).
- Available with a brass plug.



10A-32A

Dimensions (mm) and Weights (kg)

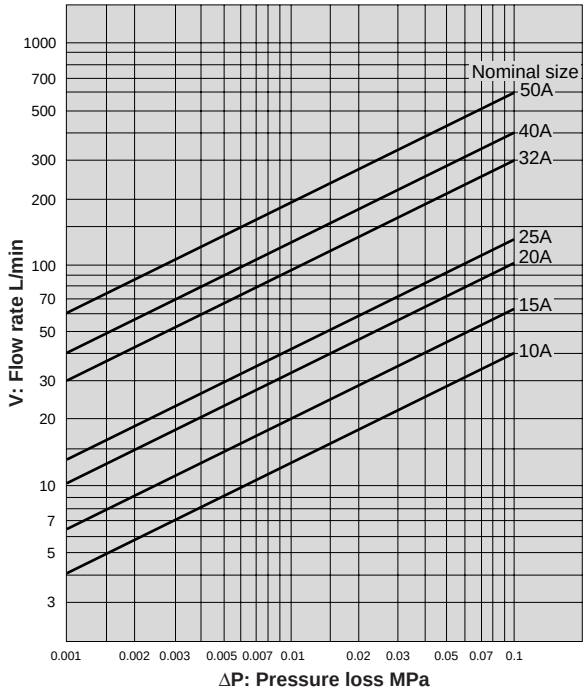
Nominal size	d	L	H$_1$	ds	ℓs	Plug	Weight
10A	Rc 3/8	65	50	18	32	(R 1/4)	0.4
15A	Rc 1/2	75	55	20	35	(R 1/4)	0.6
20A	Rc 3/4	90	70	25	50	(R 3/8)	0.9
25A	Rc 1	110	85	32	60	(R 3/8)	1.4
32A	Rc 1-1/4	135	95	40	70	(R 3/8)	2.2
40A	Rc 1-1/2	145	105	45	75	R 3/8	3.4
50A	Rc 2	170	120	56	90	R 3/8	4.5

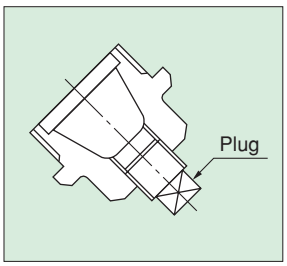


10A-32A

Pressure Loss Chart (For Water)

● Screen: Perforation = ϕ 2.5-7.21 holes/cm^2, Mesh = 80 mesh





40A-50A

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SY-6・6-N

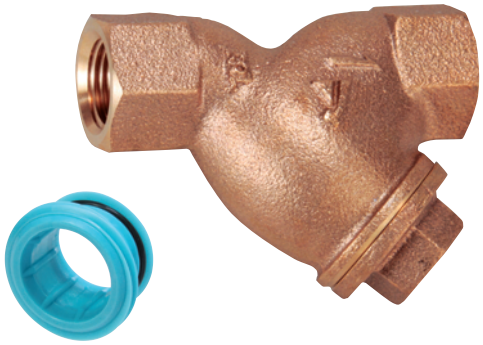
Features

1. Outstanding corrosion resistance offered by bronze body.
2. Corrosive portions, such as the end faces of lining steel piping or threads, are isolated from fluid by a pipe end core, stopping ingress of rust (SY-6L and SY-6L-N).
3. Easy plumbing and cost reduction are ensured since any piping joints, such as bronze nipples and corrosion-resistant sockets, are not needed.
4. Since an integral core is built-in, failure to insert the core no longer occurs (SY-6L and SY-6L-N).
5. The core has an O-ring structure and maintains a high degree of air-tightness (SY-6L and SY-6L-N).

Specifications

Model		SY-6	SY-6-N	SY-6L	SY-6L-N
Type		For general piping		Common core	
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids	Cold and hot water		
Maximum pressure		1.3 MPa		1.0 MPa	
Maximum temperature		220˚C	80˚C	40˚C	
Material	Body	Cast bronze	Cast bronze (NPb-treated)	Cast bronze	Cast bronze (NPb-treated)
	Screen	Stainless steel			
Screen	Perforation	ϕ 2.5-7.21 holes/cm^2			
	Mesh	Standard 80 mesh	Standard 60 mesh		
Connection		JIS Rc screwed			

・Available with 20 to 100 mesh screen.
・Available with 10A to 32A attached with a plug.

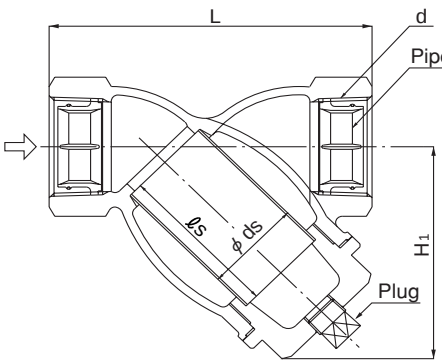


▲Pipe end core

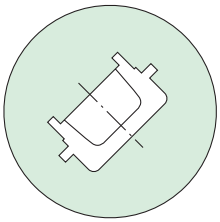
●What is a pipe end core?
An integral core brings the lining steel piping and the core into close contact with each other and stops the inflow of water into threaded portion for rust prevention.

Dimensions (mm) and Weights (kg)

Nominal size	d	L	H$_1$	ds	ℓs	Plug	Weight
15A	Rc 1/2	86	55	20	35	(R 1/4)	0.5
20A	Rc 3/4	98	70	25	50	(R 3/8)	0.8
25A	Rc 1	117	80	32	60	(R 3/8)	1.1
32A	Rc 1-1/4	145	92	40	70	(R 3/8)	1.9
40A	Rc 1-1/2	148	105	45	75	R 3/8	2.6
50A	Rc 2	178	122	56	90	R 3/8	3.8



40A-50A



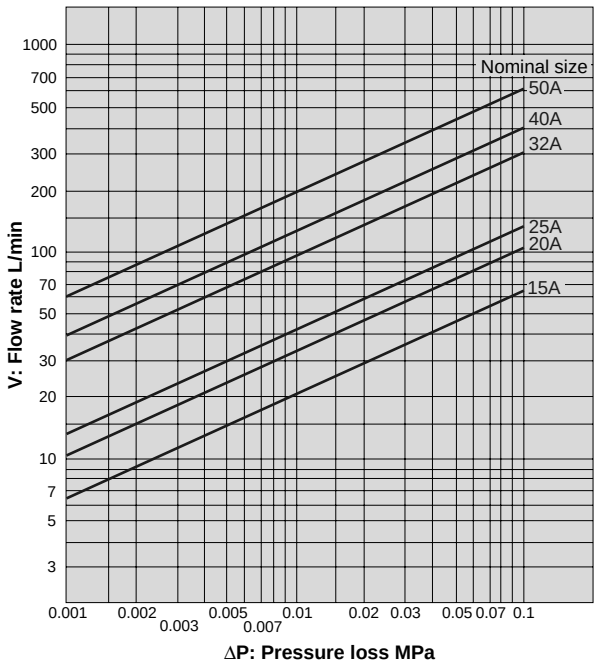
15-32A

Precautions about Installation

Follow the instructions below to maintain the anti-corrosion characteristic of the pipe end core.
1. Use a steel pipe complying with the JIS standard.
2. Cut threads on the pipe according to the JIS standard.

Pressure Loss Chart (For Water)

● Screen: Perforation = ϕ 2.5-7.21 holes/cm^2, Mesh = 60 mesh



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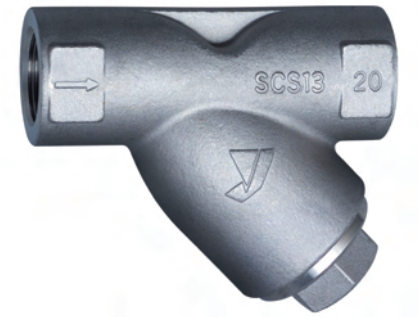
SY-17・37

Features

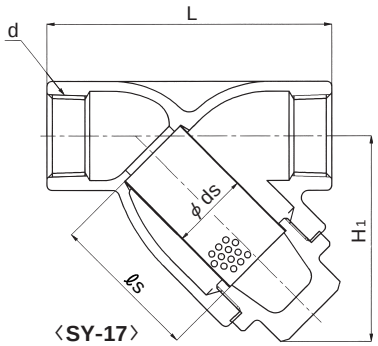
1. Stainless cast steel body is rustless, available for a wide variety of applications ranging from food, chemical industry to oil piping.
2. High-flow-rate marine type with the largest possible filtration area in view of decrease in flow rate caused by clogging.



Specifications

Model		SY-17	SY-37 (strainer with fine mesh)
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids	
Maximum pressure		2.0 MPa	
Maximum temperature		150˚C (250˚C)	
Material	Body	Cast stainless steel	
	Screen	Stainless steel	
Screen	Perforation	ϕ 2.5-7.21 holes/cm^2	
	Mesh	Standard 80 mesh	120 to 200 mesh
Gasket		PTFE *	
Connection		JIS Rc screwed	

* If the temperature is more than 150˚C, another material is used for the gasket. Please contact us.
・Available with 20 to 100 mesh screen (SY-17).

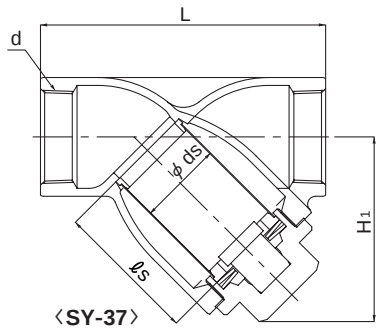


〈SY-17〉

Dimensions (mm) and Weights (kg)

Nominal size	d	L	H1	ds	ℓs	Weight
15A	Rc 1/2	85	55	20 (18)	35	0.40 (0.4)
20A	Rc 3/4	100	69	25 (23)	50	0.68 (0.7)
25A	Rc 1	115	83	32 (30)	60	1.01 (1.1)
32A	Rc 1-1/4	135	92	40 (38)	70	1.48 (1.6)
40A	Rc 1-1/2	150	102	45 (43)	75	1.88 (2.0)
50A	Rc 2	180	117	56 (54)	90	3.34 (3.6)

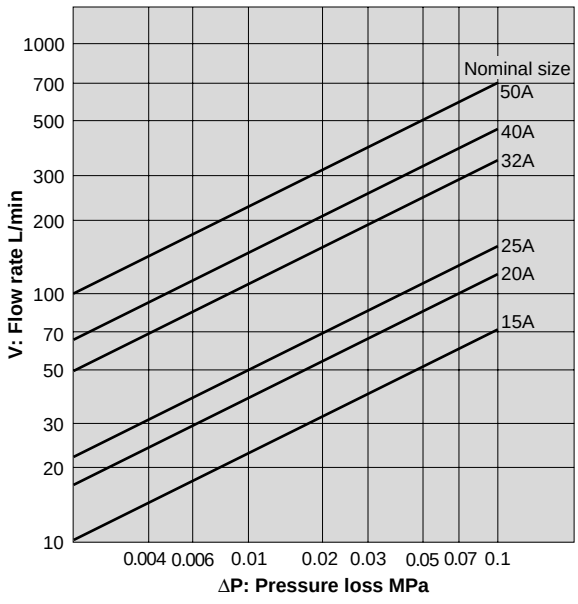
・The above values in parentheses are the dimensions and weights of the SY-37.



〈SY-37〉

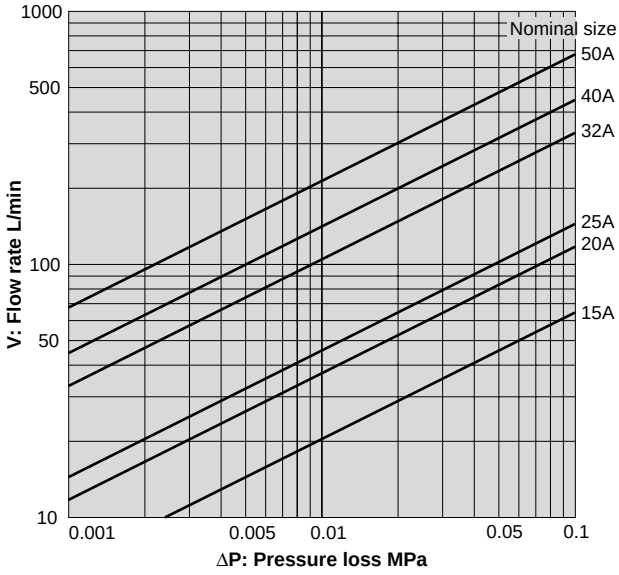
SY-17 Strainer Pressure Loss Chart (For Water)

● Screen: Perforation = ϕ 2.5-7.21 holes/cm^2, Mesh = 80 mesh



SY-37 Strainer Pressure Loss Chart (For Water)

● Screen: Perforation = ϕ 2.5-7.21 holes/cm^2, Mesh = 120 mesh



Strainer

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SY-40·40C

Features

1. High-flow-rate marine type with the largest possible filtration area in view of decrease in flow rate caused by clogging.
2. 65A or more (in nominal size) is designed as compact as possible and reduced in weight, making plumbing easy.
3. The SY-40C (15A to 200A) offers excellent corrosion resistance since its inner and outer surfaces are coated with Nylon 11.

SY-40

Specifications

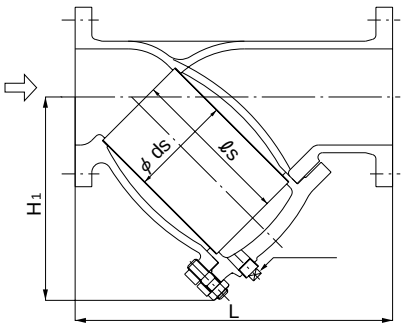
Model		SY-40	SY-40C
Application		Steam, Air, Cold and hot water, Other non-dangerous fluids	Air, Cold and hot water, Other non-dangerous fluids
Maximum pressure		1.0 MPa	
Maximum temperature		220˚C	60˚C
Material	Body	Ductile cast iron	
	Screen	Stainless steel	
Screen	Perforation	ϕ 2.5-7.21 holes/cm^2	
	Mesh	Standard 80 mesh	Standard 60 mesh
Connection		JIS 10K FF flanged	

- Available with 20 to 100 mesh screen (perforation: ϕ 2.5-7.21 holes/cm^2) or only perforation (15A to 80A: ϕ 1.3-16.2 holes/cm^2, 100A or more: ϕ 1.5-11.2 holes/cm^2) on request.
- Available with a brass plug (the standard is S15C or FCMB310).
- Available with rust-proof (65A or more).
- The SY-40C of 250A and 300A is coated with Nylon 12.

Dimensions (mm) and Weights (kg)

Nominal size	L	H1	ds	ℓs	Plug	Weight
15A	130	61	22	40	—	1.9
20A	140	75	27	56	—	2.5
25A	160	88	34	66	—	4.0
32A	175	104	43	76	—	5.2
40A	190	115	50	85	R 1/2	6.7
50A	225	140	61	107	R 1/2	10.2
65A	255	167	73	125	R 1/2	14.5
80A	330	190	88	130	R 1/2	18.3
100A	370	225	108	180	R 3/4	29.7
125A	415	263	136	200	R 3/4	40.5
150A	495	315	160	250	R 3/4	66.0
200A	565	385	210	300	R 3/4	95.8
250A	690	460	260	370	R 3/4	167.5
300A	840	556	315	442	R 3/4	286.0

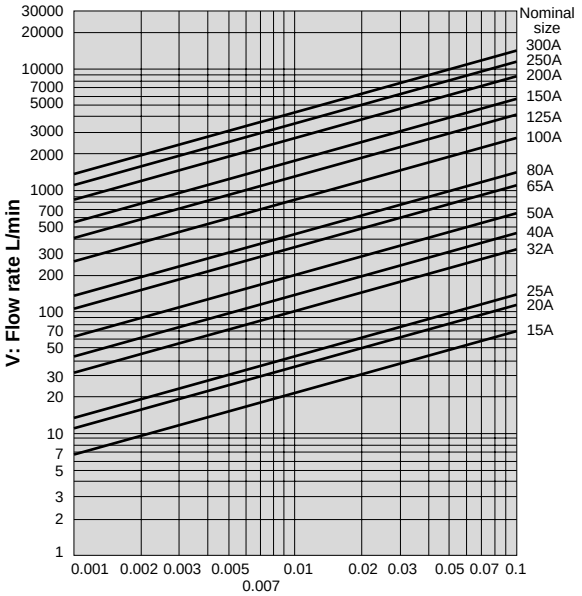
- A screwed cap is applied to 50A or less.



The shape of 15A to 50A is slightly different.

Pressure Loss Chart (For Water)

● Screen: Perforation = ϕ 2.5-7.21 holes/cm^2, Mesh = 80 mesh



ΔP: Pressure loss MPa

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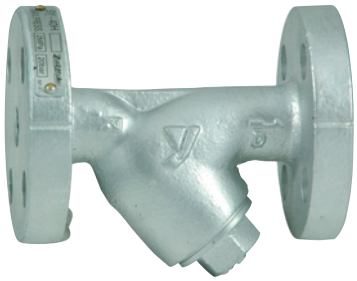
SY-40EN・40H

Features

1. The SY-40EN strainer can be replaced easily from existing strainer because it complies with face-to-face dimensions of the EN standard.
2. High-flow-rate marine type provided with the largest possible filtration area as a contermeasure against the decreasing in the flow rate caused by clogging.
3. 65A or more (in nominal size) is designed as compact as possible and reduced in weight, making plumbing easy.

Specifications

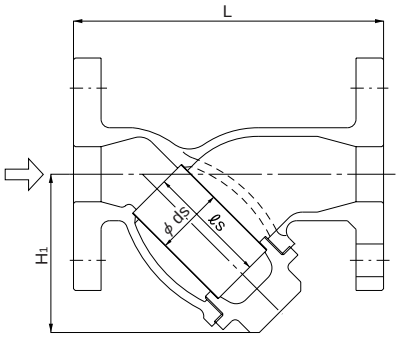
Model		SY-40EN	SY-40H
Application		Steam, Air, Cold and hot water, Other non-dangerous fluids	
Maximum pressure		2.0 MPa	
Maximum temperature		220˚C	
Material	Body	Ductile cast iron	
	Screen	Stainless steel	
Screen	Perforation	ϕ 2.5-7.21 holes/cm^2	
	Mesh	Standard 80 mesh	
Connection		EN1092 PN25	JIS 20K FF flanged ASME Class 300 flanged



・Available with 20 to 100 mesh screen (perforation: ϕ 2.5-7.21 holes/cm^2) or only with perforation (15A to 80A: ϕ 1.3-16.2 holes/cm^2, 100A or more: ϕ 1.5-11.2 holes/cm^2).
・Available with a brass plug (the standard is S15C or FCMB310).

Dimensions (mm) and Weights (kg)

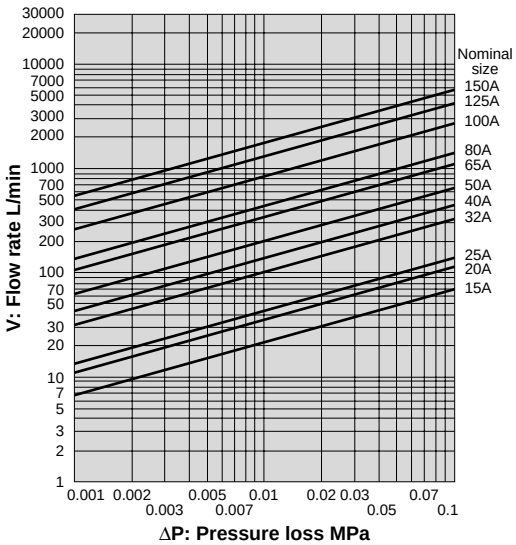
Nominal size	L		H_1	ds	ℓs	Plug	Weight	
	SY-40EN	SY-40H					SY-40EN	SY-40H
15A	130	130 (—)	61	22	40	—	2.0	1.9 (—)
20A	150	140 (—)	75	27	56	—	3.0	2.5 (—)
25A	160	160 (160)	88	34	66	—	4.5	4.0 (4.5)
32A	180	175 (180)	104	43	76	—	5.5	5.2 (6.0)
40A	200	190 (200)	115	50	85	R 1/2	8.0	6.7 (8.5)
50A	230	233 (230)	140	61	107	R 1/2	10.5	10.2 (11.0)
65A	290	290 (302)	167	73	125	R 1/2	14.0	15.0 (15.0)
80A	310	316 (330)	190	88	130	R 1/2	18.0	19.0 (20.0)
100A	350	360 (370)	225	108	180	R 3/4	27.0	28.0 (30.0)
125A	400	415 (440)	263	136	200	R 3/4	40.0	42.0 (43.0)
150A	480	495 (520)	315	160	250	R 3/4	66.0	68.0 (71.0)



The shape of 65A or more is slightly different.

・The values in parentheses are the dimensions and weights of ASME Class 300 flanged.

Pressure Loss Chart (For Water)



● Screen: Perforation = ϕ 2.5-7.21 holes/cm^2, Mesh = 80 mesh

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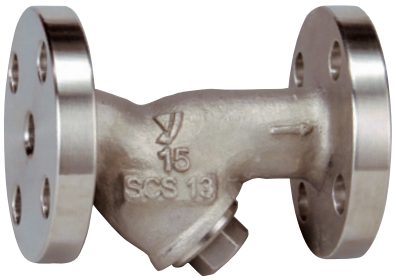
SY-8・38

Features

1. Stainless cast steel body is rustless, available for a wide variety of applications ranging from food, chemical industry to oil piping.
2. High-flow-rate marine type with the largest possible filtration area in view of decrease in flow rate caused by clogging.

Specifications

Model		SY-8	SY-38 (strainer with fine mesh)
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids	
Maximum pressure		1.0 MPa	
Maximum temperature		150˚C (250˚C)	
Material	Body	Cast stainless steel	
	Screen	Stainless steel	
Screen	Perforation	15A to 100A = ϕ 2.5-7.21 holes/cm^2 125A to 150A = ϕ 6-2.05 holes/cm^2	15A to 100A = ϕ 2.5-7.21 holes/cm^2 125A to 150A = ϕ 6-1.80 holes/cm^2
	Mesh	Standard 80 mesh	120 to 200 mesh
Gasket		PTFE *	
Connection		JIS 10K FF flanged	



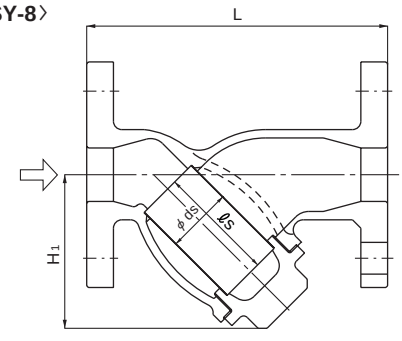
* If the temperature is over 150˚C, another material is used for the gasket. Please contact us.
・Available with the SY-8 made of SCS14.
・Available with JIS 20K flanged (up to 50A).
・Available with 20 to 100 mesh screen (SY-8).

Dimensions (mm) and Weights (kg)

Nominal size	L	H1	ds	ℓs	Plug	Weight
15A	125	54	20 (18)	35	—	1.8 (1.8)
20A	140	68	25 (23)	50	—	2.4 (2.4)
25A	160	81	32 (30)	60	—	3.7 (3.8)
32A	180	92	40 (38)	70	—	4.2 (4.2)
40A	190	104	45 (43)	75	—	5.9 (6.1)
50A	220	117	56 (54)	90	—	8.1 (8.3)
65A	270	162	73 (70)	125 (132)	R 1/2	13.2 (13.7)
80A	290	185	88 (85)	130 (134)	R 1/2	17.2 (18.0)
100A	350	222	108 (105)	180 (187)	R 1/2	26.0 (27.0)
125A	390	280	140 (137)	200 (207)	R 1/2	34.0 (40.0)
150A	440	318 (319)	160 (147)	225	R 1/2	60.0 (64.0)

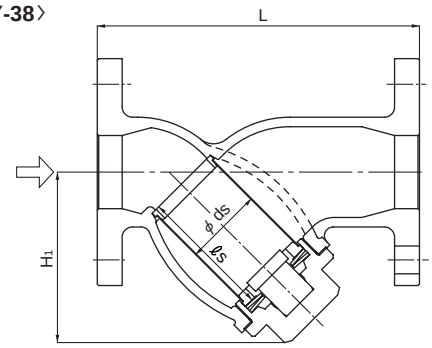
・The values in parentheses are the dimensions and weights of the SY-38.

〈SY-8〉



15A-50A

〈SY-38〉



15A-50A

The shape of 65A or more is slightly different.

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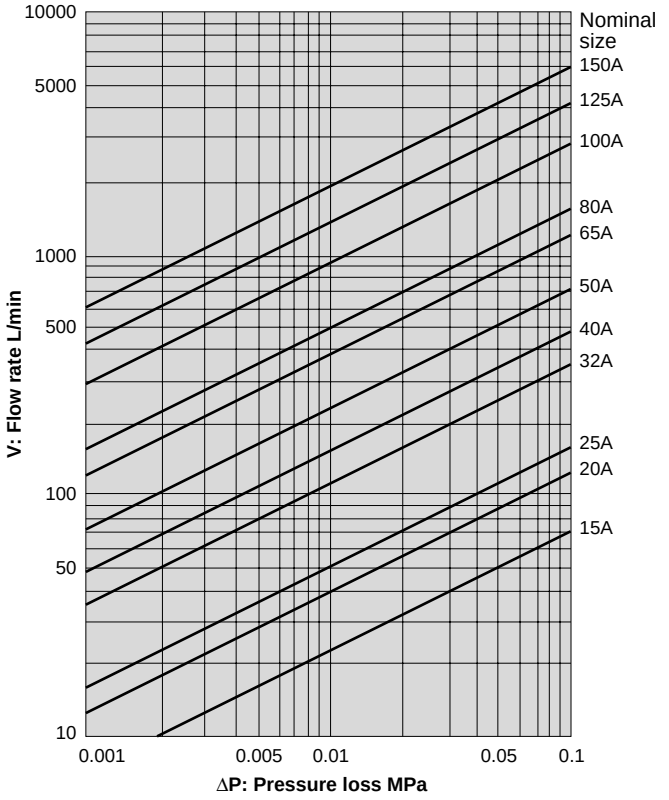
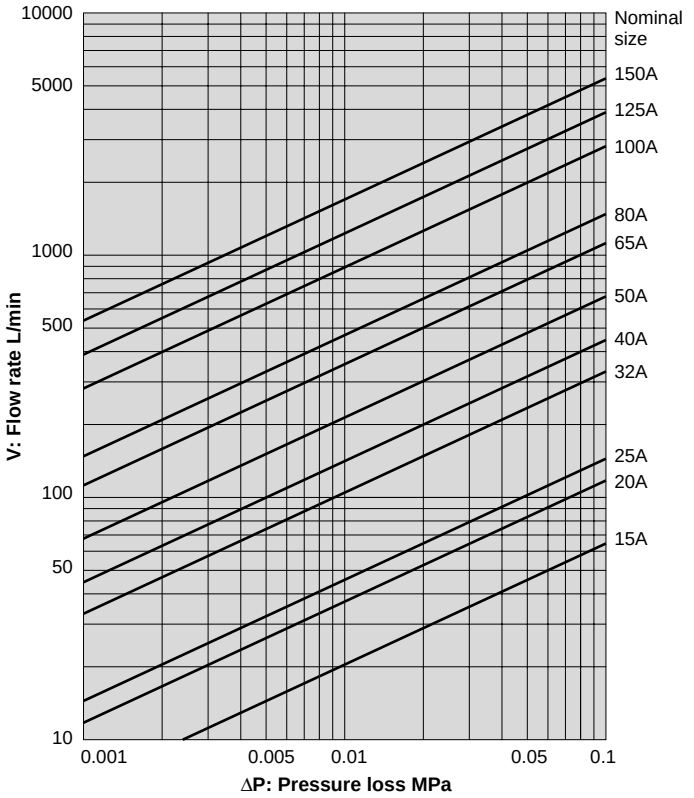
SY-8 Strainer Pressure Loss Chart (For Water)

● Screen: 15A to 100A: Perforation = ϕ 2.5-7.21 holes/cm², Mesh = 80 mesh
125A and 150A: Perforation = ϕ 6-2.05 holes/cm², Mesh = 80 mesh



SY-38 Strainer Pressure Loss Chart (For Water)

● Screen: 15A to 100A: Perforation = ϕ 2.5-7.21 holes/cm², Mesh = 120 mesh
125A and 150A: Perforation = ϕ 6-1.80 holes/cm², Mesh = 120 mesh



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SY-13・13SS

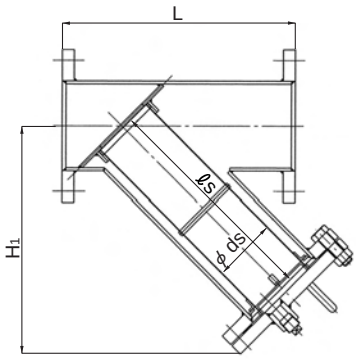
Features

1. Designed for large-diameter piping and lighter than cast iron strainer.

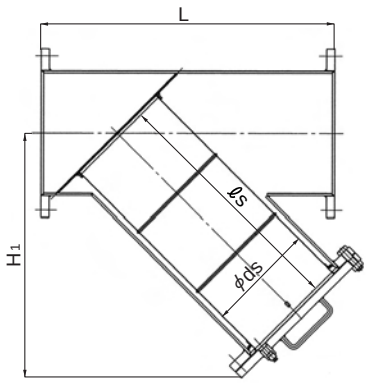
Specifications

Model		SY-13
Nominal size		200A-600A
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids
Maximum pressure		1.0 MPa
Maximum temperature		220˚C
Material	Body	Carbon steel pipes for pressure service and rolled steels for general structure
	Screen	Stainless steel
Screen	Perforation	ϕ 6-1.80 holes/cm^2
	Mesh	Standard 80 mesh
Connection		JIS 10K FF flanged

- Available with 20 to 100 mesh screen (perforation: ϕ 6.0-1.80 holes/cm^2) or only perforation (ϕ 1.5-11.2 holes/cm^2) on request.
- Available with rust-proof (hot-dip zinc coating).
- Available with stainless wetted parts (SY-13SS).
- Available with hinge attachment for screen cover.
- Available with JIS 20K flanged.



200A-250A



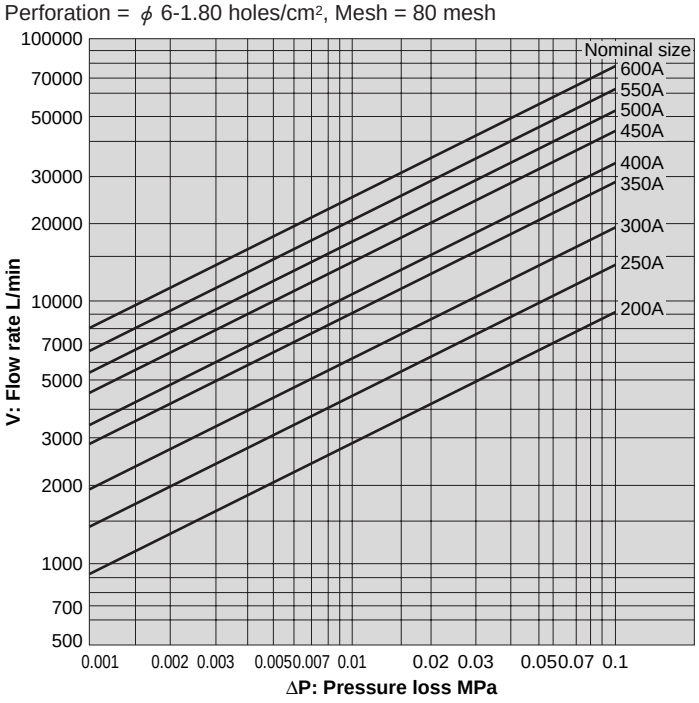
300A-600A

Dimensions (mm) and Weights (kg)

Nominal size	L	H1	ds	ℓs	Plug	Weight
200A	580	500	170	510	R 3/4	75
250A	680	565	220	570	R 3/4	115
300A	800	660	250	680	R 3/4	145
350A	930	745	300	776	R 3/4	210
400A	1000	845	340	876	R 3/4	270
450A	1080	890	400	926	R 3/4	400
500A	1200	1045	450	1100	R 1	460
550A	1300	1175	500	1250	R 1	625
600A	1500	1260	550	1340	R 1	820

Pressure Loss Chart (For Water)

● Screen: Perforation = ϕ 6-1.80 holes/cm^2, Mesh = 80 mesh



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SU-50H・50S・50SS

Features

1. Standard 316 stainless steel ensures excellent rust-proof performance.
2. Cover with O-ring ensures superior sealing.
3. Quick-open type, disassembly and screen cleaning are easy (SU-50S and SU-50SS).
4. Ductile cast iron body, the maximum pressure is 2.0 MPa (SU-50H).

Specifications

Model		SU-50H	SU-50S	SU-50SS
Application		Water, Oil		Water, Oil, Flushing water
Nominal size		50A, 65A, 80A, 100A, 150A		
Maximum pressure		2.0 MPa	1.0 MPa	
Maximum temperature		80˚C		
Material	Body	Ductile cast iron *		Ductile cast iron with Epoxy Coating
	Cover	Ductile cast iron	Carbon steel	Stainless steel
	O-ring	NBR		
	Screen	Stainless steel (SUS316)		
Screen	Perforation	ϕ 2.5-7.21 holes/cm^2		
	Mesh	Standard 60 mesh		
Connection		JIS 20K RF flanged or BS4504 PN16 flanged		

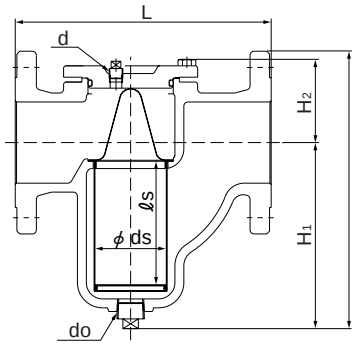
* Available with Epoxy Coating for flushing water.
・Available with 20 to 100 mesh screen.

SU-50H

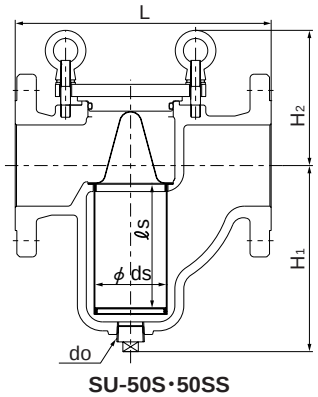
SU-50S・50SS

Dimensions (mm) and Weights (kg)

Size	L	H_1	H_2			ds	ℓ s	d	do	Weight	
			SU-50H	SU-50S	SU-50SS					SU-50H	SU-50S・50SS
50A	243	166	88	140	144	64.5	108	R 1/4	R 3/4	13.0	13.0
65A	254	166	88	140	144	64.5	108	R 1/4	R 3/4	15.0	15.0
80A	300	204	98	163	165.5	77	140	R 3/8	R 1	20.0	20.0
100A	315	230	103	166.5	169	90	160	R 3/8	R 1	29.0	28.0
150A	455	385	137	211	214	140	270	R 3/8	R 1-1/2	73.5	72.0



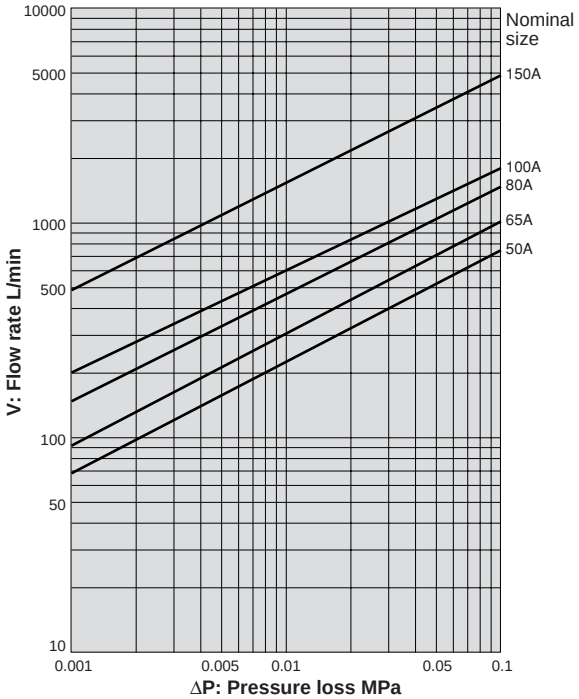
SU-50H



SU-50S・50SS

Pressure Loss Chart (For Water)

● Screen: Perforation = ϕ 2.5-7.21 holes/cm^2, Mesh = 60 mesh



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SU-20・20S・20C

Features

1. The largest possible filtration area in view of flow rate decrease caused by clogging.
2. Disassembling and cleaning are easy due to a simply structured cover that can be fixed and removed simply by tightening or unfastening a single bolt.
3. Excellent corrosion resistance due to the inner and outer surface coated with Nylon 11 (SU-20C).

Specifications

Model		SU-20・20C	SU-20S		
Application		Cold and hot water, Oil, Other non-dangerous fluids			
Nominal size		20A-150A	20A-100A	125A	150A
Maximum pressure		1.0 MPa	1.0 MPa	0.7 MPa	0.5 MPa
Maximum temperature		220˚C (60˚C in the case of the SU-20C)	80˚C		
Material	Body	Ductile cast iron			
	O-ring	—	NBR		
	Screen	Stainless steel			
Screen	Perforation	ϕ 6-1.42 holes/cm^2			
	Mesh	Standard 60 mesh			
Connection		JIS 10K FF flanged			

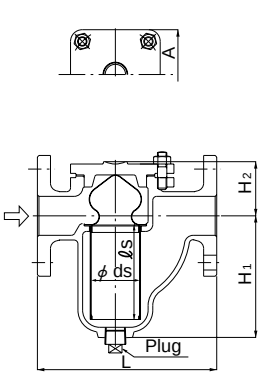
・Available with rust-proof (SU-20).
・Available with 20 to 250 mesh screen.

SU-20

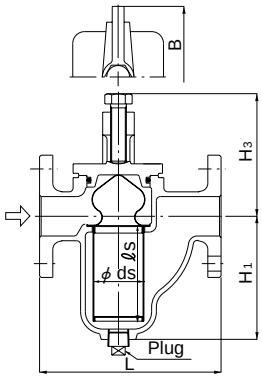
SU-20S

Dimensions (mm) and Weights (kg)

Size	L	H1	H2	H3	A	B	ds	ℓs	Plug	Weight	
										SU-20	SU-20S
20A	175	97.5	54	107.5	87	131	40	70	R 3/8	5.0	5.6
25A	175	97.5	54	107.5	87	131	40	70	R 3/8	6.1	6.7
32A	230	146	67.5	151	115	179	64.5	108	R 3/4	11.1	12.5
40A	230	146	67.5	151	115	179	64.5	108	R 3/4	11.8	13.2
50A	230	156	69.5	153	115	179	64.5	120	R 3/4	12.4	13.8
65A	290	182	70	153.5	134	208	77	140	R 1	18.7	20.8
80A	300	197.5	88.5	189	185	249	90	160	R 1	23.8	27.1
100A	365	262	118.5	253	220	334	120	210	R 1-1/4	41.3	48.6
125A	425	340.5	134.5	269	248	362	140	270	R 1-1/2	61.4	69.4
150A	505	378	158.5	293	305	414	175	300	R 2	98.4	108.3



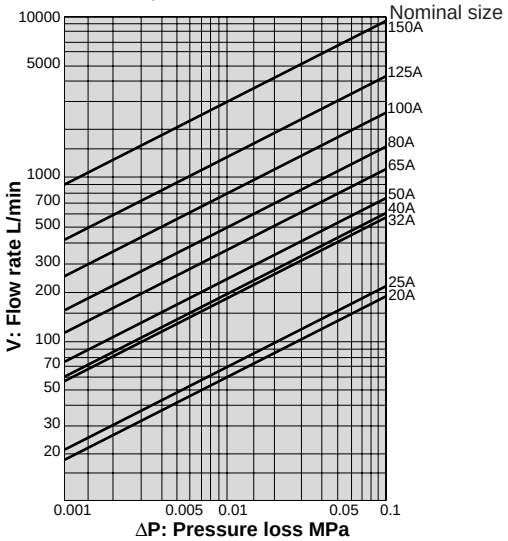
SU-20・20C



SU-20S

Pressure Loss Chart (For Water)

● Screen: Perforation = ϕ 6-1.42 holes/cm^2, Mesh = 60 mesh



SU-20H

Features

1. The largest possible filtration area in view of flow rate decrease caused by clogging.
2. Equipped with eyebolts and anchoring leg for safety on installation.

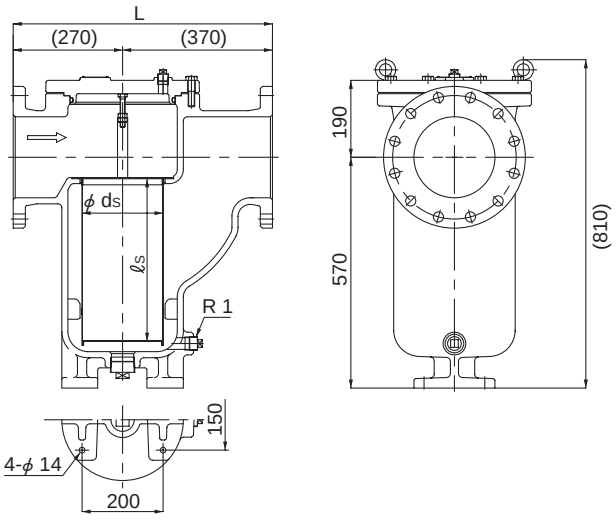
Specifications

Nominal size		200A	
Application		Cold and hot water, Oil	
Maximum working pressure		1.0 MPa	2.0 MPa
Maximum temperature		80˚C	
Material	Body	Ductile cast iron	
	Screen	Stainless steel	
Screen	Perforation	ϕ 6-1.42 holes/cm^2	
	Mesh	Standard 60 mesh	
Connection		JIS 10K FF flanged	JIS 20K RF flanged

・Available with 20 to 100 mesh or only with perforation (when only with perforation, perforation of ϕ 2.5-7.21 holes/cm^2 is used).

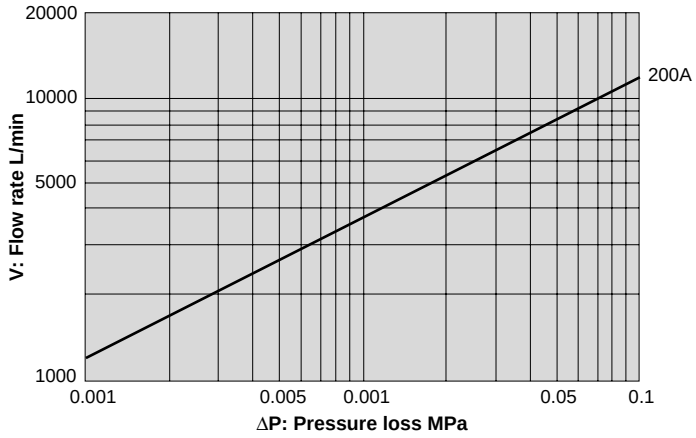
Dimensions (mm) and Weights (kg)

Connection flange	L	Screen		Weight
		ds	ℓs	
JIS 10K FF	640	200	400	167
JIS 20K RF	640	200	400	170



Pressure Loss Chart (For Water)

● Screen: Perforation = ϕ 6-1.42 holes/cm^2, Mesh = 60 mesh



Strainer

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SU-6•6SS•6AS

Features

1. Used mainly for cooling water and industrial water for dust prevention.
2. Designed for large-diameter piping and lighter than cast iron strainer.

Specifications

Application		Cold and hot water, Oil, Other non-dangerous fluids
Nominal size		200A-650A
Maximum pressure		1.0 MPa
Maximum temperature		120˚C
Material	Body	Rolled steel for carbon steel piping and general structural rolled steel
	Screen	Stainless steel
Screen	Perforation	ϕ 10-0.8 holes/cm^2
	Mesh	Standard 40 mesh
Connection		JIS 10K FF flanged

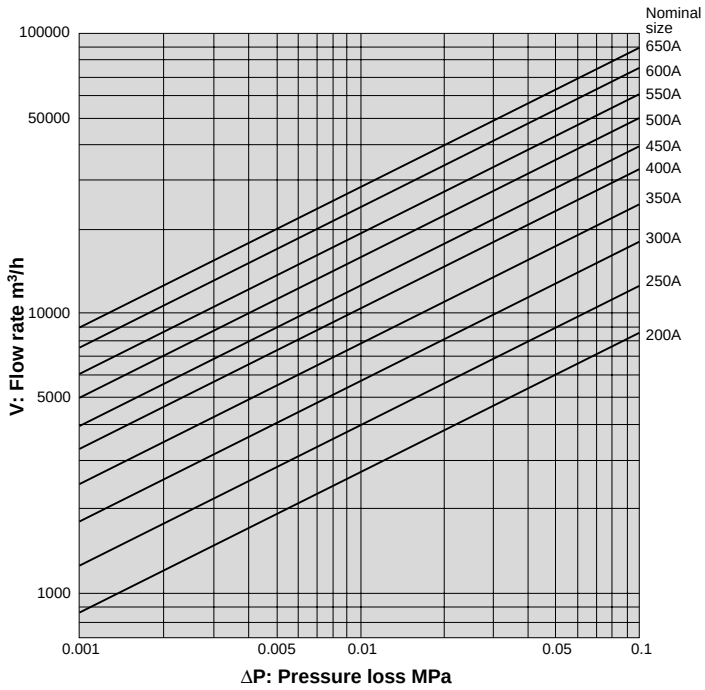
- Available with 20 to 100 mesh screen.
- Available with rust-proof (hot-dip zinc coating).
- Available with stainless steel wetted parts (SU-6SS).
- Available with all stainless steel made (SU-6AS).

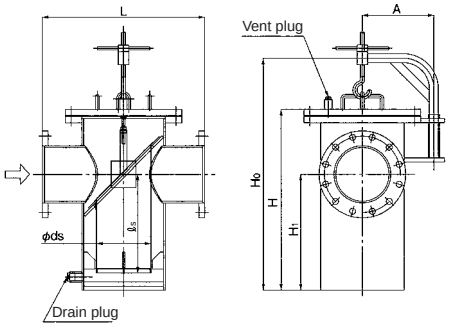
Dimensions (mm) and Weights (kg)

Nominal size	L	A	H_0	H	H_1	C	h_1	ds	ℓs	Drain plug	Vent plug
200A	620	273	882	687	440	—	—	210	375	R 1	R 1/2
250A	660	295	1062	867	570	—	—	240	505	R 1	R 1/2
300A	710	330	1218	1021	670	—	—	290	600	R 1	R 1/2
350A	760	350	1306	1103	710	—	—	340	640	R 1	R 3/4
400A	810	400	1492	1253	810	—	—	390	740	R 1	R 3/4
450A	860	430	1655	1405	910	—	—	440	835	R 1	R 3/4
500A	910	455	2195	1945	1400	800	19	490	930	R 1	R 3/4
550A	960	480	2353	2107	1510	840	23	540	1030	R 1	R 3/4
600A	1010	510	2538	2237	1590	920	27	590	1100	R 1-1/2	R 1
650A	1060	545	2716	2419	1720	970	27	630	1220	R 1-1/2	R 1

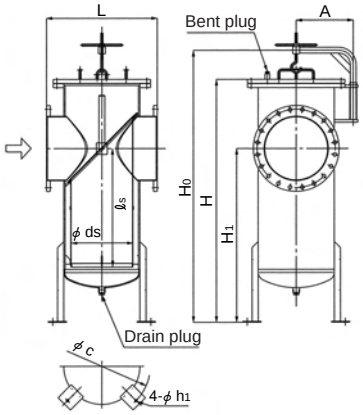
Pressure Loss Chart (For Water)

● Screen: Perforation = ϕ 10-0.8 holes/cm^2, Mesh = 40 mesh





SU-6 200A-450A



SU-6 500A-650A

SW-10・10S

Features

1. Cleanable without stopping the filtrated fluid by switching the left and right units.
2. Cock lifting mechanism (switching by lifting the cock) makes handle operation easy.
3. Since there is no need to install a bypass, piping space can be minimized (SW-10 and SW-10S).
4. Disassembling and cleaning are easy due to a simply structured cover that can be fixed and removed simply by tightening or unfastening a single bolt (SW-10S).

SW-10

SW-10S

Specifications

Application		Cold and hot water, Oil, Other non-dangerous fluids
Maximum pressure		1.0 MPa
Maximum temperature		80˚C
Material	Body	Ductile cast iron
	Cock	Cast bronze
	Screen	Stainless steel
Screen	Perforation	ϕ 6-1.42 holes/cm^2
	Mesh	Standard 60 mesh
Connection		JIS 10K FF flanged

・Available with stainless steel (SCS13) made.
・Available with 20 to 250 mesh screen.

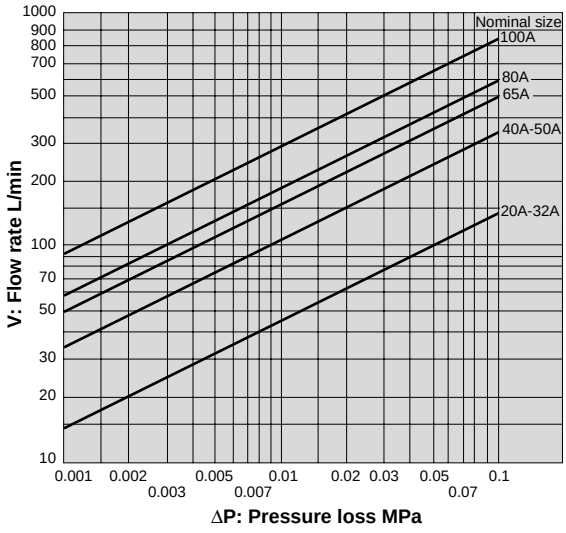
Dimensions (mm) and Weights (kg)

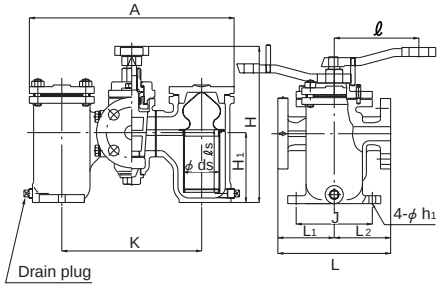
Nominal size	L	L_1	L_2	H_1	H	Ha	A	ℓ	ds	ℓs	Anchor space			Drain plug	Weight	
											J	K	h_1		SW-10	SW-10S
20A	200	100	100	126	280	292	363	180	64.5	108	135	248	12	R 1	23.9	26.7
25A	200	100	100	126	280	292	363	180	64.5	108	135	248	12	R 1	25.1	27.9
32A	205	102.5	102.5	126	280	292	363	180	64.5	108	135	248	12	R 1	26.1	28.9
40A	245	122.5	122.5	134	306	316	390	180	64.5	120	135	275	12	R 1	34.0	36.8
50A	245	122.5	122.5	134	306	316	390	180	64.5	120	135	275	12	R 1	35.9	38.7
65A	285	130	155	155	356	345	450	240	77	140	160	311	15	R 1	52.5	54.6
80A	285	130	155	155	356	345	450	240	77	140	160	311	15	R 1	53.0	55.1
100A	385	175	210	230	482	509	644	340	120	210	225	430	19	R 1	117.0	124.3

・Dimensions H_1, H, K, and A are reference values.
・The values of H_1 and H are different from those of stainless steel made.
・Plugs of R 3/4 are used for stainless steel strainers of all sizes.

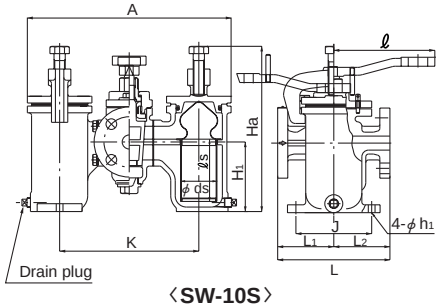
Pressure Loss Chart (For Water)

● Screen: Perforation = ϕ 6-1.42 holes/cm^2, Mesh = 60 mesh





〈SW-10〉



〈SW-10S〉

Strainer

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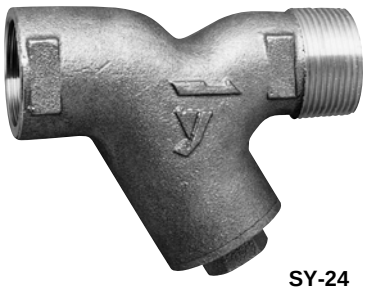
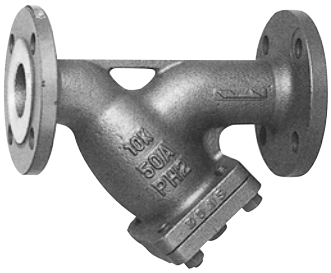
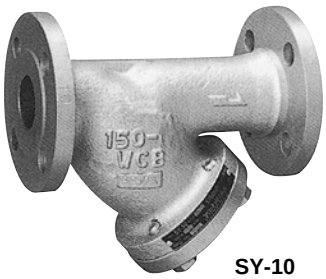
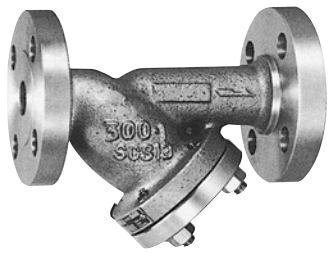
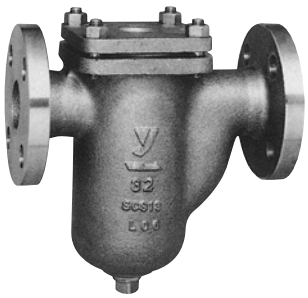
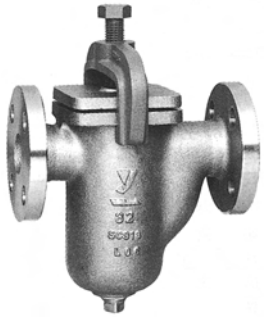
Feature		Y type screwed / Easy plug	Y type screwed / Bronze	Leadless bronze
Model		SY-9	SY-24	SY-24-N
Picture			 SY-24	
Application		Air, Cold and hot water, Other non-dangerous fluids	Cold and hot water	
Max. pressure		1.0 MPa	1.6 MPa	
Max. temperature		80˚C	80˚C	
Connection		JIS Rc screwed	Inlet: JIS Rc screwed Outlet: JIS R screwed	
Material	Body	Ductile cast iron	Cast bronze	Cast bronze (NPb-treated)
	Screen	Stainless steel	Stainless steel	
Standard screen		60 mesh (ϕ 2.5-7.21 holes/cm^2)	60 mesh (ϕ2.5-7.21 holes/cm^2)	
Available screen		20-100 mesh (ϕ 2.5-7.21 holes/cm^2)	20-100 mesh (ϕ 2.5-7.21 holes/cm^2)	
Size		15A-50A	15A-50A	
Others		—	—	—

Feature		Y type flanged / Carbon steel	Y type flanged / Carbon steel	
Model		SY-20	SY-10	SY-10H
Picture			 SY-10	
Application		Steam, Air, Cold and hot water, Other non-dangerous fluids	Steam, Air, Cold and hot water, Other non-dangerous fluids	High-pressure gas, Steam, Cold and hot water, Other non-dangerous fluids
Max. pressure		1.0 or 2.0 MPa	3.0 MPa	1.0, 2.0 or 3.0 MPa
Max. temperature		260˚C	260˚C *	350˚C *
Connection		JIS 10K RF flanged JIS 20K RF flanged	JIS 30K RF flanged	JIS 10K RF flanged JIS 20K RF flanged JIS 30K RF flanged
Material	Body	Cast carbon steel	Cast carbon steel	
	Screen	Stainless steel	Stainless steel	
Standard screen		80 mesh (ϕ 6-1.80 holes/cm^2)	80 mesh (ϕ 6-1.80 holes/cm^2)	
Available screen		20-60 mesh (ϕ 6-1.80 holes/cm^2)	20-100 mesh (ϕ 6-1.80 holes/cm^2)	
Size		15A-150A	15A-250A	15A-100A
Others		—	* If the temperature is more than 260˚C, please contact us.	* For SY-10H-30, 350˚C for working pressure up to 2.0 MPa, and 300˚C for more than 2.0 MPa.

Feature		Y type flanged / Stainless steel	Basket / Stainless steel	One-touch / Stainless steel		
Model		SY-10HS	SU-10	SU-10S		
Picture						
Application		High-pressure gas, Steam, Cold and hot water, Other non-dangerous fluids	Cold and hot water, Oil, Other non-dangerous fluids			
Max. pressure		1.0, 2.0 or 3.0 MPa	1.0 MPa	1.0 MPa	0.7 MPa	0.5 MPa
Max. temperature		350˚C *	220˚C	80˚C		
Connection		JIS 10K RF flanged JIS 20K RF flanged JIS 30K RF flanged	JIS 10K FF flanged			
Material	Body	Cast stainless steel	Cast stainless steel			
	Screen	Stainless steel	Stainless steel			
Standard screen		80 mesh (ϕ 6-1.80 holes/cm^2)	60 mesh (ϕ 6-1.42 holes/cm^2)			
Available screen		20-100 mesh (ϕ 6-1.80 holes/cm^2)	20-250 mesh (ϕ 6-1.42 holes/cm^2)			
Size		15A-100A	20A-150A	20A-100A	125A	150A
Others		* For SY-10HS-30, 350˚C for working pressure up to 2.0 MPa, and 300˚C for more than 2.0 MPa.	—	—		

Feature		Basket flanged / CS	Small type / Bronze	Corn type / Temporary
Model		SU-12	SU-55F	ST-1
Picture				
Application		Cold and hot water, Oil, Other non-dangerous fluids	Cold and hot water	Stem, Air, Cold and hot water, Other non-dangerous fluids
Max. pressure		1.0, 1.6 or 2.0 MPa	1.2 MPa	1.0, 2.0, 3.0 or 4.0 MPa
Max. temperature		260˚C *	60˚C	220˚C
Connection		JIS 10K RF flanged JIS 16K RF flanged JIS 20K RF flanged ASME Class 150 flanged ASME Class 300 flanged	JIS Rc screwed	JIS 10K flanged JIS 20K flanged JIS 30K flanged JIS 40K flanged
Material	Body	Cast carbon steel	Cast bronze	—
	Screen	Stainless steel	Stainless steel	Stainless steel
Standard screen		60 mesh (ϕ 6-1.42 holes/cm^2)	60 mesh	80 mesh (ϕ 8-0.954 holes/cm^2)
Available screen		20-250 mesh (ϕ 6-1.42 holes/cm^2)	—	20-250 mesh (ϕ 8-0.954 holes/cm^2)
Size		20A-150A	15A	25A-300A
Others		* If the temperature is more than 260˚C, please contact us.	—	—

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Solenoid Valve

Motor Valve
Air Operated Valve
Emergency Shutoff System

Solenoid Valve Selection

Application						Working Pressure (MPa)	Max. Temperature (˚C)	Model	Type			Page
Steam	Air	Water	Oil	Nitrogen Gas	Heavy Oil A / Light Oil				Piston	Diaphragm	Direct Acting	
●						0-0.12	120	DD-1S			●	188
●	●	●	●	●		0-0.15	175	DD-2			●	187
●						0-0.5	160	DD-1S-5			●	188
●	●	●	●			0-0.7	170	DD-1S-7			●	188
●	●	●	●	●		0-0.8	175	DD-2-8			●	187
●	●	●	●			0-1.0	180	DP-100	●			175
●	●	●	●					DP-100F	●			175
●	●	●	●			0.05-1.0		DP-10	●			178
●	●	●	●					DP-13	●			178
	●	●	●			0-0.12	120	DD-1W			●	188
	●	●	●	●		0-0.15	100	DD-3			●	187
	●	●	●			0-0.5	120	DD-1W-5			●	188
	●	●	●			0-0.7		DD-1W-7			●	188
	●	●	●	●		0-0.8	100	DD-3-8			●	187
	●	●	●			0-1.0	60	DP-12		●		181
	●	●	●					DP-12-N		●		181
	●	●	●					DP-14		●		181
	●	●	●					DP-14-N		●		181
	●	●	●					DP-16		●		182
	●	●	●					DP-18		●		182
	●	●		●	●	0.05-1.6		DP-34	●			197

Motor Valve Selection

Application				Working Pressure (MPa)	Max. Temperature (˚C)	Model	Type		Page
Steam	Air	Water	Oil				Two Way Type	Three Way Type	
●				0-0.6	160	MD-54	●		190
	●	●		0-1.0	80	MD-35R		●	197
	●	●				MD-36R	●		191
	●	●				MD-53	●		197
	●	●				MD-55	●		197
	●	●				MD-61	●		197
	●	●			120	MD-54	●		190

Air Operated Valve Selection

Application				Working Pressure (MPa)	Max. Temperature (˚C)	Model	Type	Page
Steam	Air	Water	Oil				Diaphragm	
●	●	●	●	0-1.0	180	PD-1	●	192
●	●	●	●			PD-2	●	192

Selection of Solenoid Valve

What is a Solenoid Valve ??

A solenoid valve opens/closes by moving a piece of steel called “plunger” by magnetic force of solenoid, and is applied to the flow control (on-off control) in the piping for fluids. The solenoid valve opens/closes more quickly than a motor valve.

Applications	・Water supply and drainage for general households ・Plant facilities ・Industrial machine	・Air-conditioning facilities ・Building facilities ・Plant facilities	・Air-conditioning facilities ・Building facilities ・Plant facilities
Types	**Direct acting type** Directly opens/closes the valve disc by attraction effect of electromagnet.	**Pilot operated type** Opens/closes the valve disc by opening/closing its pilot valve by attraction effect of electromagnet.	
		Piston type Piston works as the main valve.	**Diaphragm type** Diaphragm works as the main valve.
	Features wide application for fluids such as air, water, oil, steam, etc. and reliable operation by simple structure.	The DP-10 Series meets the demands for high reliability of automatic control devices as the automation of process grows in various industrial fields. The series has a wide variety of compact pilot operated types and satisfies each purpose and application.	
Major Products	**DD-1 Series**  Compact, lightweight and space-saving	**DP-10 Series**  ・Applicable to all kinds of fluid ・Easy to maintain	**DP-12 Series**  ・Actuates with no differential pressure ・No leakage

Best Selection Chart

Requirement		1st recommendation	2nd recommendation
High-speed response	Steam	DP-100・100F	DP-10 Series
	Cold and hot water	DP-12 Series	PD Series
Water hammer prevention	Steam	MD-54	
	Cold and hot water	MD Series	PD Series + speed controller
No rubber material (Stainless steel, PTFE)		DP-100・100F	MD Series
Easy maintenance		DP・DD Series	
Manual operation		MD Series	
On/Off switch		MD Series	
Usable in explosion-proof area		DP-34	PD Series
Less scale problems		PD Series	MD Series
Lightweight, compact and space-saving		DD Series	DP Series

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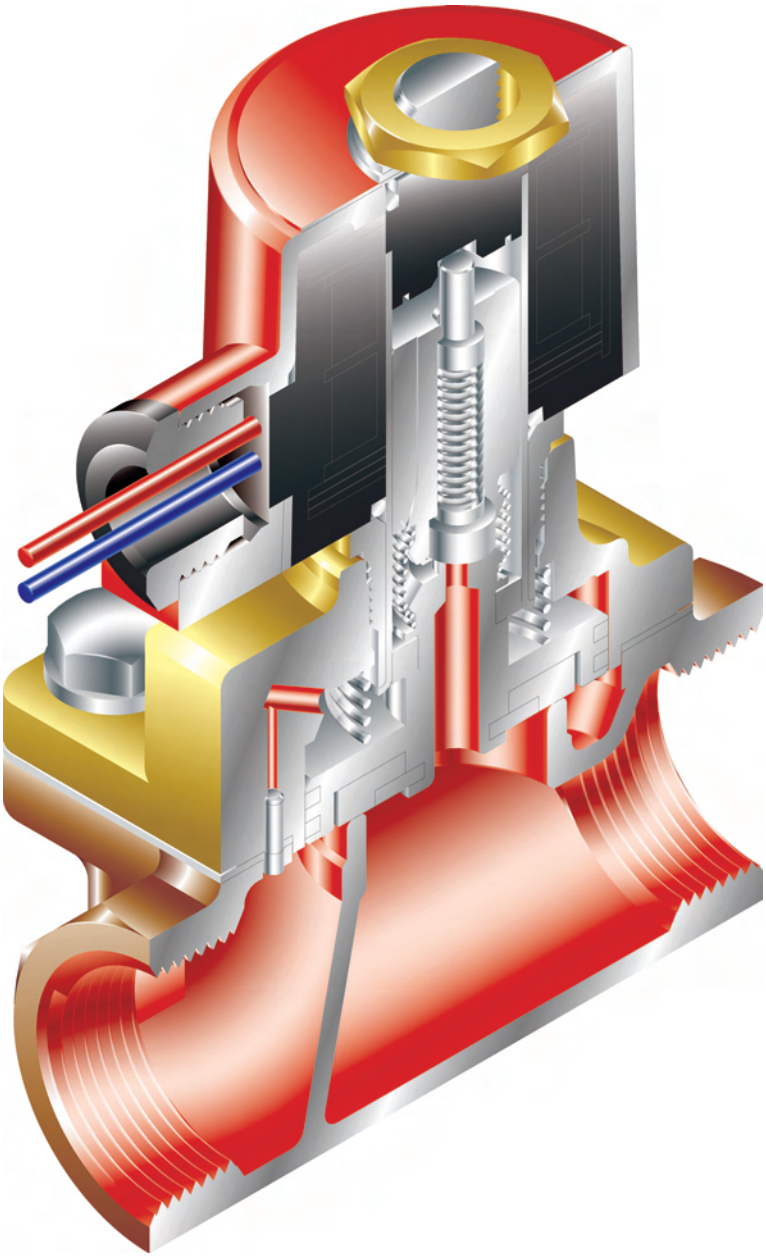
Features of Pilot Operated Piston Type ＜DP-10 Series＞



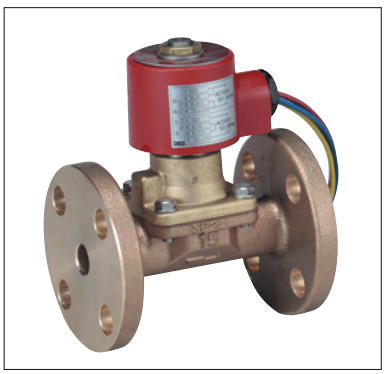
1: Ass'y Plunger
Plunger, spring, disc and etc. are combined in one unit, resulting in easy maintenance.

2: Double piston ring
Excellent sliding motion and tight sealing are achieved by double piston ring.

3: Molded coil
- The coil protective structure complies with splashproof requirements of JIS C 0920.
- Class H molded coil provides excellent insulation from high temperature.

4: Trim parts made of stainless steel
All of major internal parts such as valve disc, plunger, spring, and etc. are made of stainless steel or PTFE and is excellent in corrosion resistance.

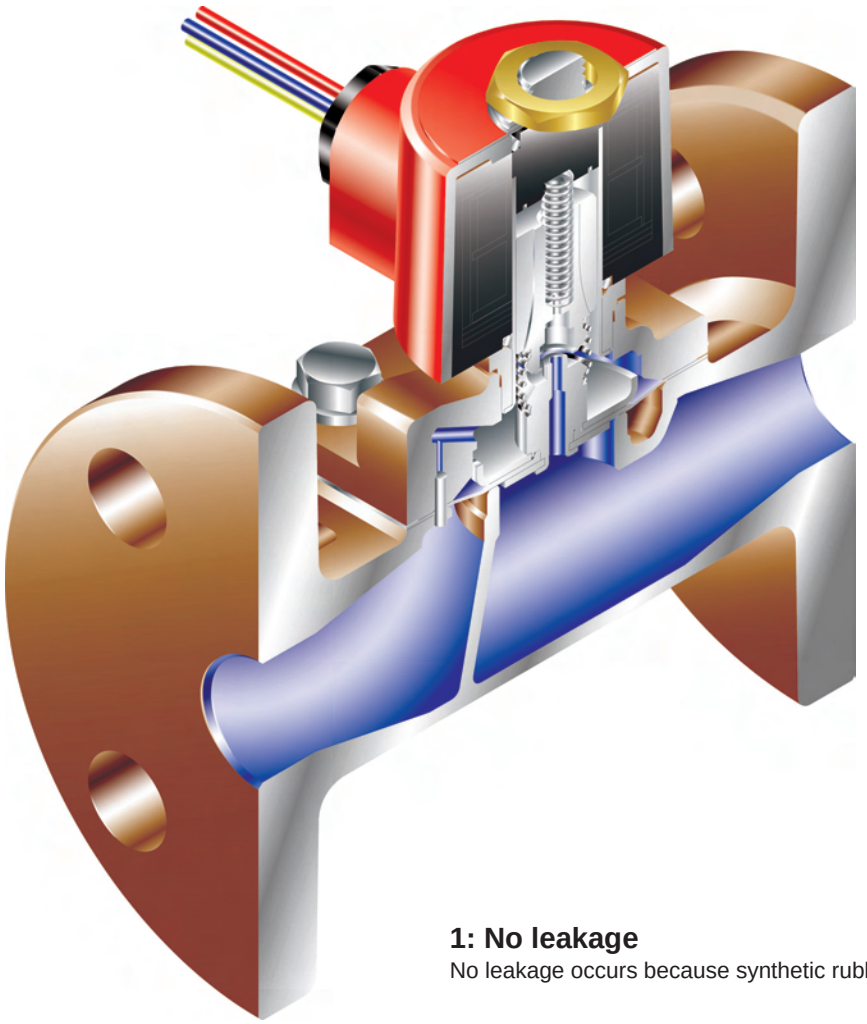
5: Variations



DP-13

DP-10C

Features of Pilot Operated Diaphragm Type ＜DP-12 Series＞



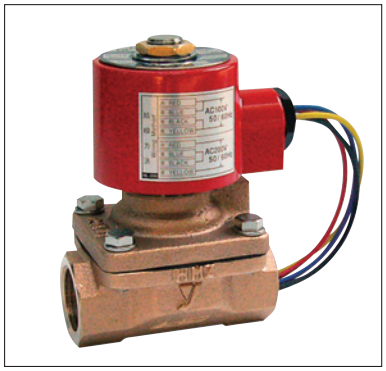
1: No leakage
No leakage occurs because synthetic rubber valve is used.

2: Less scale problems
Less scale problems occurs because the valve opens/closes by diaphragm and has no sliding parts.

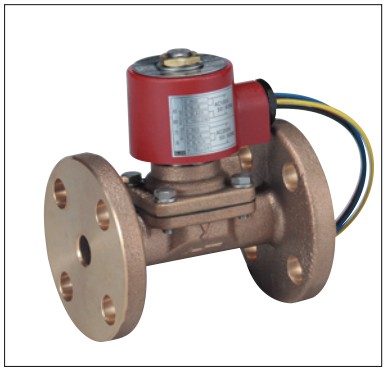
3: Horizontal or vertical installation as desired

4: Anti-water hammer
Available with anti-water hammer structure on request.

5: Variations



DP-12



DP-14

DP-16

7-3, Futano-cho, Mizuho-ku, Nagoya, 467-0861, Japan Phone: 81-52-881-7199 Fax: 81-52-881-7201
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Codes for Solenoid Valve

IP Codes

IEC 529 outlines an international classification system for the sealing effectiveness of enclosure of Electrical equipment against the intrusion into equipment of foreign bodies and moisture.
This classification system utilities the letter "IP" (Ingress Protection) followed by two digits.

- **First character**
  The first character of the IP code indicates the degree of protection against the ingress of solid foreign objects.
- **Second character**
  The second character indicates the degree of protection against the ingress of water with harmful effects.

1st character	Degrees of Protection Against Solid Foreign Objects Entering the Enclosure
0	Not protected
1	Protected against solid foreign objects larger than 50 mm in diameter
2	Protected against solid foreign objects larger than 12.5 mm in diameter
3	Protected against solid foreign objects larger than 2.5 mm in diameter
4	Protected against solid foreign objects larger than 1 mm in diameter
5	Dust protected
6	Dust tight

2nd character	Degrees of Protection Against Water	JIS C0920
0	Not protected	—
1	Protected against vertically falling water drops	Drip-proof I
2	Protected against vertically falling water drops when enclosure is tilted us at a 15 degree angle	Drip-proof II
3	Protected against water sprayed at up to a 60 degree angle	Rain-proof
4	Protected against splashing water from any directions	Splash-proof
5	Protected against water jets from any directions	Water jets-proof
6	Protected against powerful water jets from any directions	Heavy water jets-proof
7	Protected against temporary immersion in water	Emersion-proof
8	Protected against submersion	Submersible type

Description of Pressure- and Explosion-proof Code

d 2 G4

Degree of ignition
G1: Ignition temperature of more than 450˚C
G2: Ignition temperature of more than 300˚C up to 450˚C
G3: Ignition temperature of more than 200˚C up to 300˚C
G4: Ignition temperature of more than 135˚C up to 200˚C
G5: Ignition temperature of more than 100˚C up to 135˚C
G6: Ignition temperature of more than 85˚C up to 100˚C

Explosion class
Minimum value of clearance with the depth of 25 mm, which causes the transmission of flame
1: More than 0.6 mm (Ex. Propane gas)
2: More than 0.4 mm up to 0.6 mm (Ex. Ethylene)
3: 0.4 mm or less (Ex. Hydrogen (3a))

Type of explosion-proof structure
d: Pressure- and explosion-proof structure (Zone 1, 2)
e: Explosion-proof structure for increased safety structure (Zone 2)
i : Explosion-proof structure for intrinsic safety (Zone 0)

Types of Zone where Explosion-proof Solenoid Valve is Used

Zone 0
Ignitable concentrations present continuously or for long periods of time
Ex.) Vicinity of the surface of combustible liquid

Zone 1
Ignitable concentrations likely to exist under normal operations
Ex.) Vicinity of the opening which often emits combustible gas while inspection or repair work of products

Zone 2
Ignitable concentrations not likely to exist under normal operations, or may exist for a short time only (twice or three times per year)
Ex.) A place where combustible gas may ingress due to corrosion or deterioration of a vessel , or vicinity of rupture disk

Nominal Size Selection for Solenoid Valve

Calculation Formula for Cv Value

(1) For steam

When $P_2 > \frac{P_1}{2}$ $\quad Cv = \frac{Wk}{138\sqrt{\Delta P\,(P_1 + P_2)}}$

When $P_2 \leqq \frac{P_1}{2}$ $\quad Cv = \frac{Wk}{120P_1}$

(2) For gas

When $P_2 > \frac{P_1}{2}$ $\quad Cv = \frac{Q}{2940}\sqrt{\frac{(273 + t)\,G}{\Delta P\,(P_1 + P_2)}}$

When $P_2 \leqq \frac{P_1}{2}$ $\quad Cv = \frac{Q\sqrt{(273 + t)\,G}}{2560P_1}$

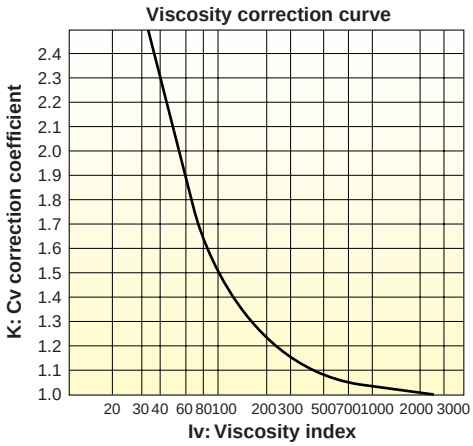
(3) For liquid

$Cv = \frac{0.365V\sqrt{G}}{\sqrt{\Delta P}}$

W: Max. steam flow rate [kg/h]
P_1: Inlet pressure [MPa・A]
P_2: Outlet pressure [MPa・A]
ΔP: $P_1 - P_2$ [MPa]
k : 1 + 0.0013 x {superheated steam temp. [˚C] – saturated steam temp. [˚C] }
Q : Max. gas flow rate [m³/h (standard condition)]
G : Specific gravity (relative to air for gas, or relative to water for liquid)
t : Fluid temperature [˚C]
V : Max. liquid flow rate [m³/h]
Cv: Cv value of each nominal size
Iv : Viscosity index
Mcst: Viscosity [cSt]

Formula for Correction of Viscosity

$Iv = \frac{72780}{Mcst}\left(\frac{\Delta P}{G}\right)^{\frac{1}{4}} V^{\frac{1}{2}}$



Cv Value Table

Model \ Nominal size	10A	15A	20A	25A	32A	40A	50A	65A
DP-100	3	4.5	7.5	12	17.7	25	33.6	
DP-100F		4.5	7.5	12	17.7	25	33.6	33.6
DP-10・13	3.1	4.9	8.2	12.4	17.7	25.0	33.6	33.6
DP-12・12-N・14・14-N・16・18	3.0	4.4	8.1	11.5	17.0	23.3	30.5	
DP-34		4.5	8.6	12.6				
DD-1S・1W・2・3	1.7	1.7	1.7					
DD-1S-5・1W-5	0.75	0.75	0.75					
DD-1S-7・1W-7・2-8・3-8	0.55	0.55	0.55					
MD-35R		3	6	8				
MD-36R		6	11	15				
MD-53		12	16	28	47	83	123	
MD-54		9	13	24	44	80	120	
PD-1・2		5	7	11	16	24	40	

Terminal Box (Made of Plastics)

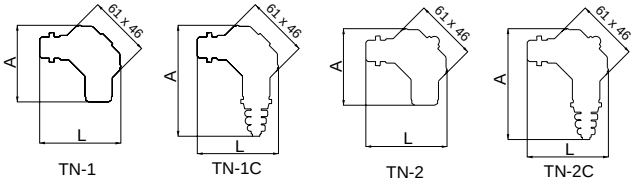
The terminal box is for both indoor and outdoor, and can be attached to DP-100・10 Series.


TN-1


TN-1C


TN-2


TN-2C



Model	Specifications	IP Code	Dimensions L x A mm
TN-1	Standard terminal box	Rain-proof (IP 03)	80 x 76
TN-1C	With cab tire cable	Splash-proof (IP 54)	80 x 110
TN-2	With indication light	Rain-proof (IP 03)	80 x 76
TN2C	With indication light and cab tire cable	Splash-proof (IP 54)	80 x 110

・Please specify the rated voltage (AC 100 V or AC 200 V) when ordering terminal box.
・The TN-2 and TN-2C cannot be used for DC voltage.

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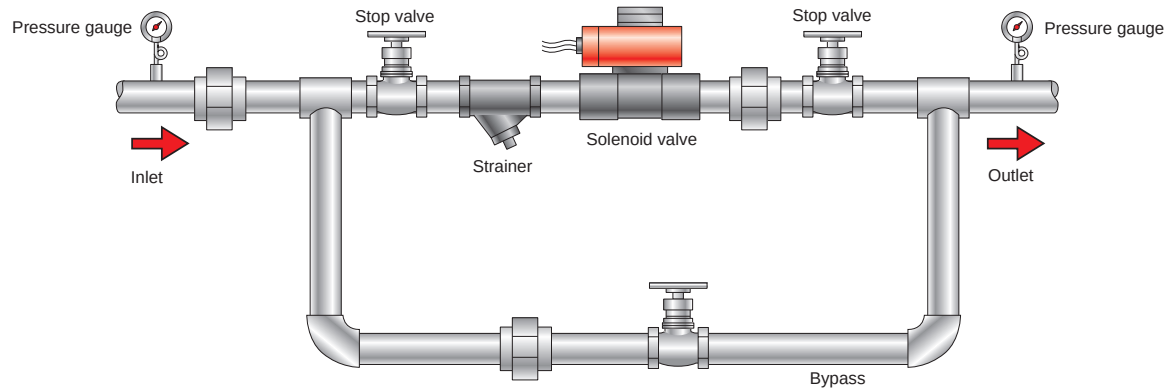
Guidelines for Installing Solenoid Valve

Piping Example



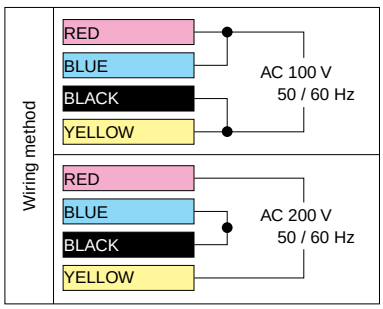
- Vertical or horizontal installation is possible including the intermediates between vertical and horizontal positions, however, do not install it upside-down.
- When used at less than 0.1 MPa pressure, the valve should be installed horizontally with the coil up. The vertical installation is limited to the condition that the differential pressure between the inlet and outlet sides is 0.1 MPa or more.

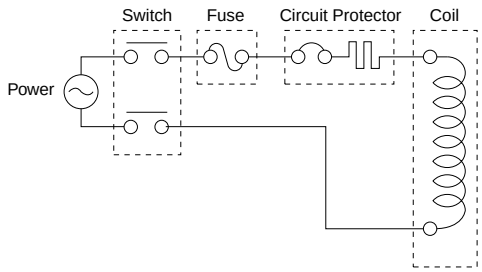
⚠ Warning and caution for installation

1. Before connecting the product to piping, remove foreign substances and scales inside the piping. Note that the seal material must not flow into the inside of the product.
2. When installation, check the direction of the product so that the fluid flowing and the arrow marked on the product are in the same direction.
3. As shown in the above figure, it is recommended that stop valves, strainers, pressure gauges and bypass line be installed to the piping. For screwed valve, a union joint is recommended to install for easy maintenance and inspection.
4. Make sure to install a strainer with the mesh size 80-100 at the inlet side of the product.
5. Avoid over-tightening of screw and excessive stress imposed from the piping in order to prevent malfunction due to the distortion of the body.
6. Vertical or horizontal installation is possible, however, the coil must be installed above the horizontal level.
7. Secure a space required for disassembly or removal of the product at the time of maintenance and inspection.
8. Solenoid valve and motor valve are not explosion-proof. Do not use them in the area or ambience where explosive gasses accumulate.
9. When using at the outdoor, set eaves to avoid direct rain.

Wiring Method (DP-10 Series)

AC coil





DC coil

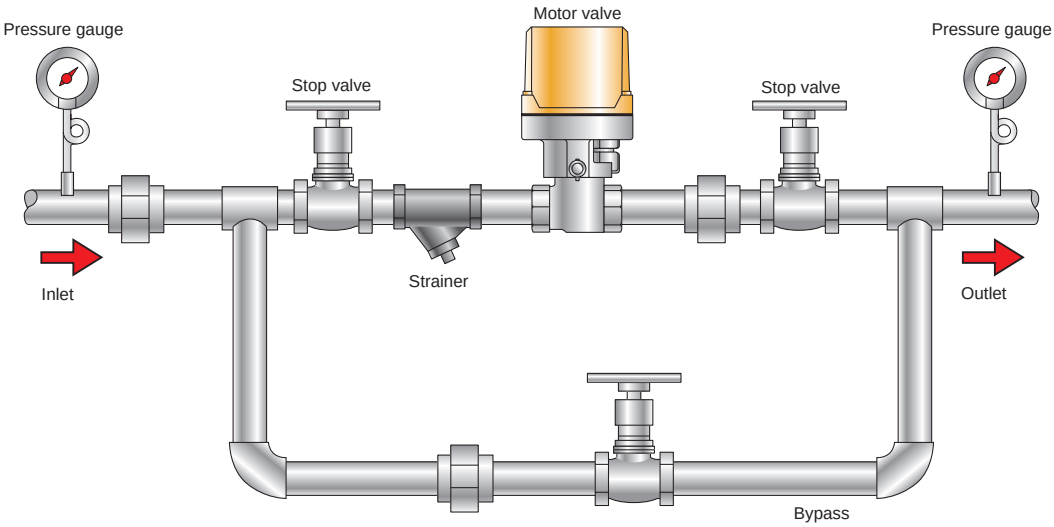
- DC coil has two lead wires (red and black). Connect each of them to + and – (the correspondence relation is undecided).

1. Method of wire binding differs between the voltages AC 100 V and AC 200 V. Bind the lead wires of the coil according to the instruction label attached on the side of the coil. In order to prevent faulty or erroneous wiring when in a dark or narrow space, it is recommended that each of the lead wires be clearly identified with different colors that can be easily recognized.
2. In order to prevent disconnection or insulation failure, do not pull the lead wires or subject them to an excessive load while binding or using them.
3. Use an electric wire with wire core of 0.75 mm^2 or more.
4. Install a fuse (2-3A) to protect the electric circuit. Additionally, if the product is used in a fuel supply system, install a circuit protector of a rated ampere shown below.

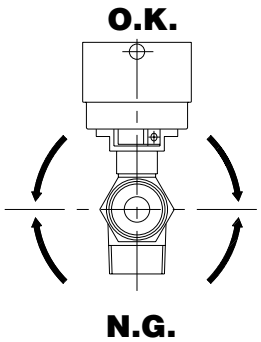
Rated voltage 100 / 110 V: 0.5A (10A to 25A), 0.75A (32A to 65A)
Rated voltage 200 / 220 V: 0.3A (10A to 25A), 0.5A (32A to 65A)

Guidelines for Installing Motor Valve

Piping Example



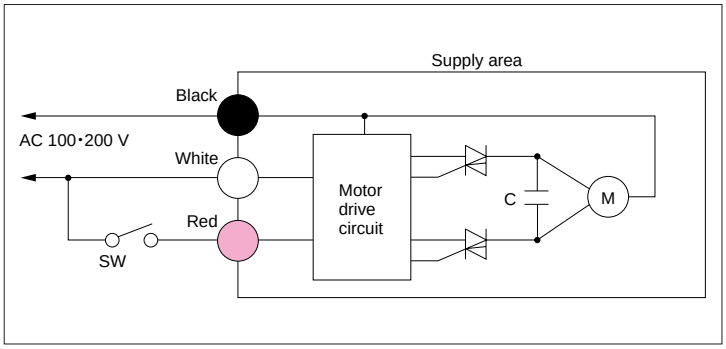
Installation posture



⚠ Warning and caution for installation

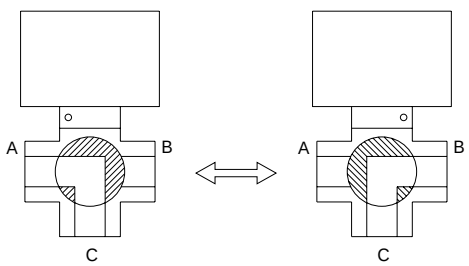
1. Before connecting the product to piping, remove foreign substances and scales inside the piping. Note that the seal material must not flow into the inside of the product.
2. When installation, check the direction of the product so that the fluid flowing and the arrow marked on the product are in the same direction.
3. As shown in the above figure, it is recommended that stop valves, strainers, pressure gauges and bypass line be installed to the piping. For screwed valve, a union joint is recommended to install for easy maintenance and inspection.
4. Make sure to install a strainer with the mesh size 80-100 at the inlet side of the product.
5. Avoid over-tightening of screw and excessive stress imposed from the piping in order to prevent malfunction due to the distortion of the body.
6. Vertical or horizontal installation is possible, however, the coil must be installed above the horizontal level.
7. Secure a space required for disassembly or removal of the product at the time of maintenance and inspection.
8. Solenoid valve and motor valve are not explosion-proof. Do not use them in the area or ambience where explosive gasses accumulate.
9. When using at the outdoor, set eaves to avoid direct rain.

Wiring Method (MD-35R･36R)



- MD-36R: Valve closes when SW is OFF.
  Valve opens when SW is ON.
- MD-35R: Passage is from A to C when SW is OFF.
  Passage is from B to C when SW is On.

[Switch direction (MD-35R)]



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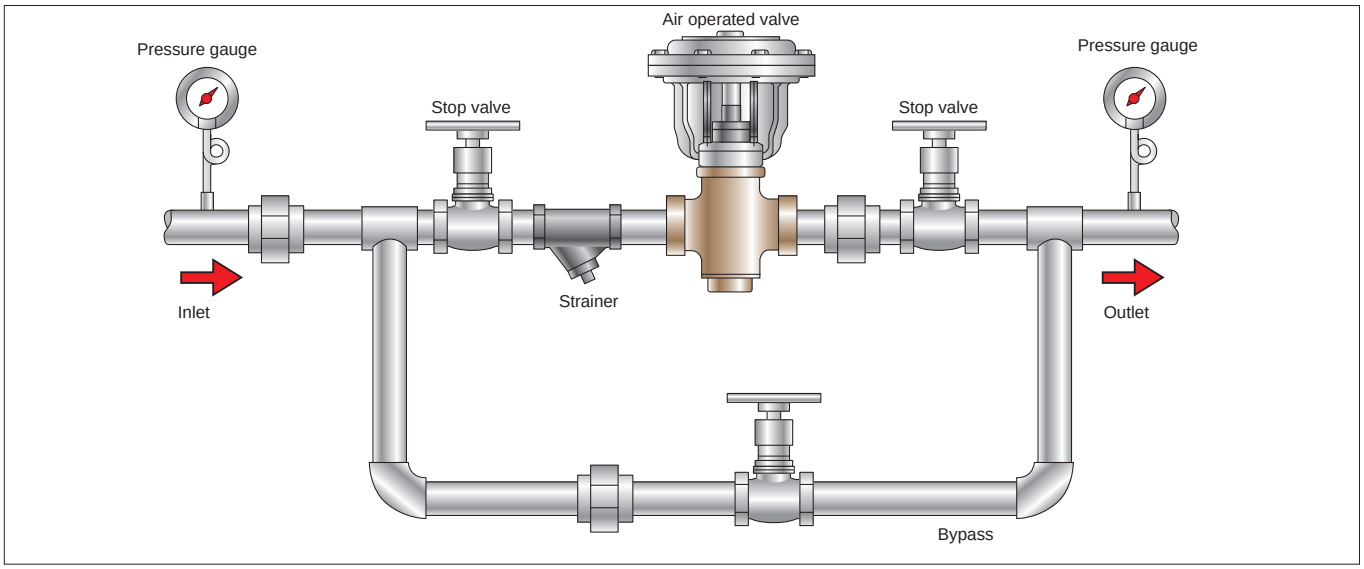
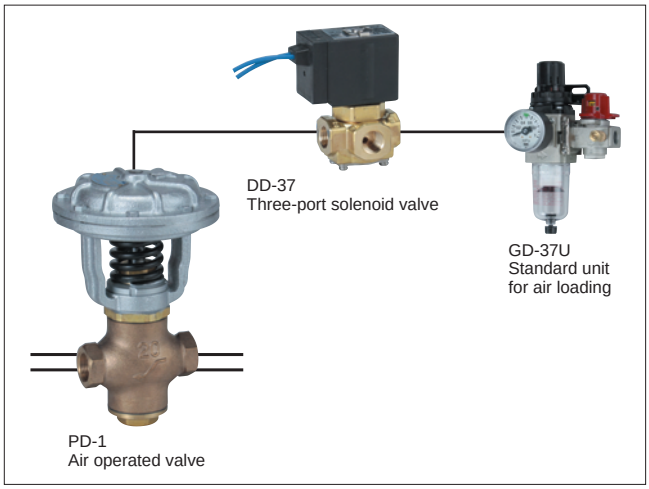
Guidelines for Installing Air Operated Valve

Piping Example

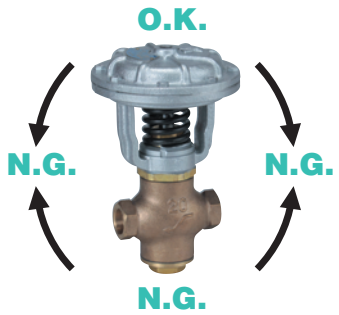


⚠ Warning and caution for installation

1. Before connecting the product to piping, remove foreign substances and scales inside the piping. Note that the seal material must not flow into the inside of the product.
2. When installation, check the direction of the product so that the fluid flowing and the arrow marked on the product are in the same direction.
3. As shown in the above figure, it is recommended that stop valves, strainers, pressure gauges and bypass line be installed to the piping. For screwed valve, a union joint is recommended to install for easy maintenance and inspection.
4. Make sure to install a strainer with the mesh size 80-100 at the inlet side of the product.
5. Avoid over-tightening of screw and excessive stress imposed from the piping in order to prevent malfunction due to the distortion of the body.
6. Secure a space required for disassembly or removal of the product at the time of maintenance and inspection.



●Installation posture



Install the air operated valve vertically (the air pressure inlet port must be faced upward).

DP-100・100F

DP-100 <10A-25A>

DP-100 <32A-50A>

DP-100F <15A-25A>

DP-100F <32A-65A>

Features

1. Ultra-high performance technology gives high precision in performance.
2. Three-times more durability than our conventional models.
3. ASM (Anti-Sticking Mechanism) for three-times more scale resistance.
4. Body and main parts made of stainless steel give higher corrosion resistance, making usable for clean fluid.
5. A combined internal component enables easy cartridge replacement with this product installed.

Specifications

Model		DP-100	DP-100F
Application		Steam, Air, Cold and hot water, N_2 gas, CO_2 gas (dry), Ar gas, Oil (20 cSt or less)	
Working pressure		0-1.0 MPa (unusable under vacuum)	
Min. differential pressure		0 MPa (0.03 MPa or more is required for vertical installation)	
Allowable valve seat leakage		50 mL/min under standard conditions (at air pressure of 0.6 MPa)	
Temperature range		5-180˚C (no freeze condition)	
Operation		Normally closed	
Material	Body	Cast stainless steel (SCS14A)	
	Piston	Stainless steel (SCS14A)	
	Valve disc	PTFE	
Connection		JIS Rc screwed	JIS 10K FF flanged
Size		10A-50A	15A-65A

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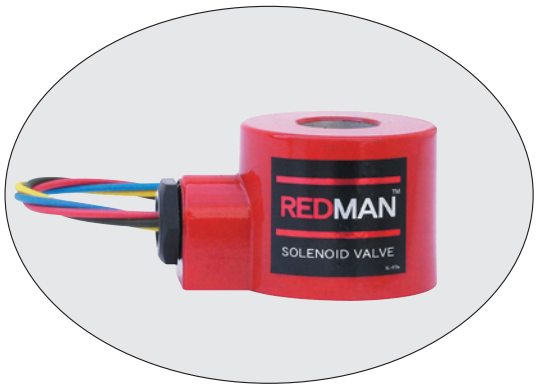
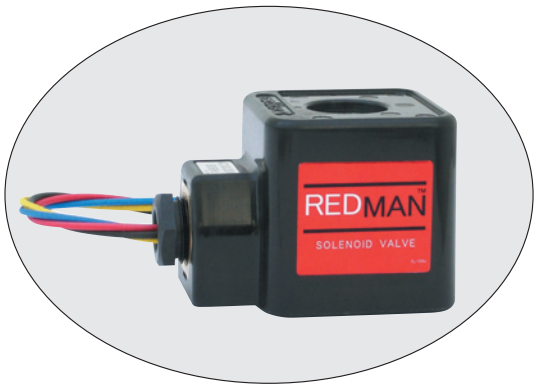
Specifications of Coil

Rated voltage	AC 100 / 200 V selective type		AC 110 / 220 V selective type	
	50 / 60 Hz common			
Nominal size	10-25A	32-65A	10-25A	32-65A
Allowable fluctuation	Reted voltage –5% to + 10%			
Rated current	0.34 / 0.17 A	0.46 / 0.23 A	0.32 / 0.16 A	0.42 / 0.21 A
Starting current	1.64 / 0.82 A	1.90 / 0.95 A	1.48 / 0.74 A	1.80 / 0.90 A
Insulation class	Insulation class H			
Protective structure	Dust tight, Splash proof			
Ingress protection code	IP64 (JIS C0920)			
Insulation resistance	50 MΩ and more / 500 V megger			
Withstand voltage test	1500 V/min			



10A-25A

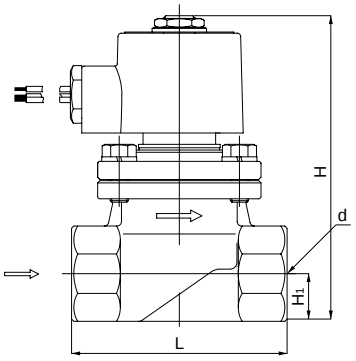


32A-50A

Dimensions (mm) and Weights (kg)

●DP-100

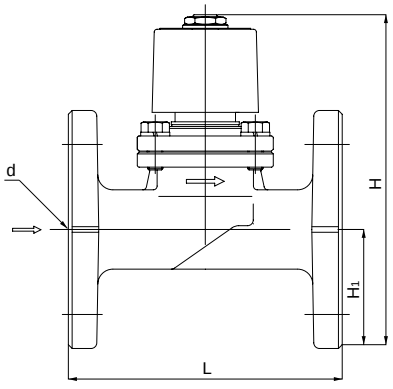
Nominal size	d	L	H	H_1	Weight
10A	Rc 3/8	70	127	14.5	1.4
15A	Rc 1/2	70	127	14.5	1.4
20A	Rc 3/4	80	131	17.5	1.5
25A	Rc 1	95	135	21.0	1.9
32A	Rc 1-1/4	110	172	26.0	3.1
40A	Rc 1-1/2	120	178	29.5	4.0
50A	Rc 2	140	187	36.5	5.6



DP-100

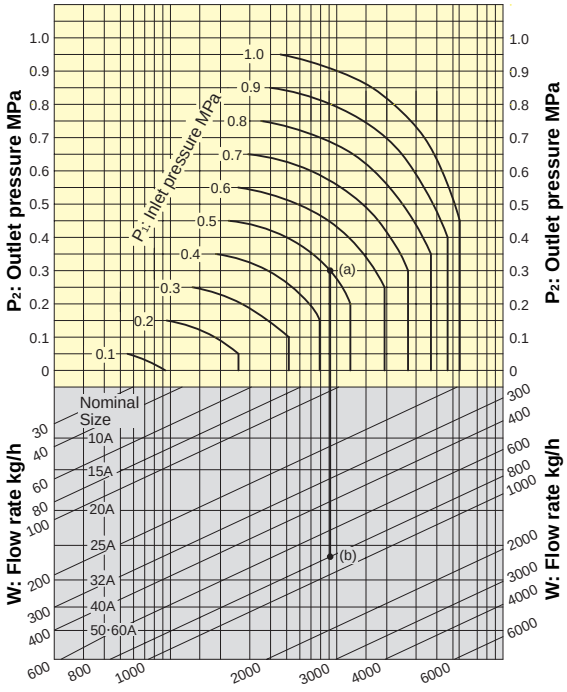
●DP-100F

Nominal size	d	L	H	H_1	Weight
15A	15	120	161	47.5	2.7
20A	20	130	164	50.0	3.2
25A	25	145	177	62.5	4.5
32A	32	160	213	67.5	6.9
40A	40	170	219	70.0	8.0
50A	50	195	228	77.5	10.5
65A	65	198	238	87.5	12.3



DP-100F

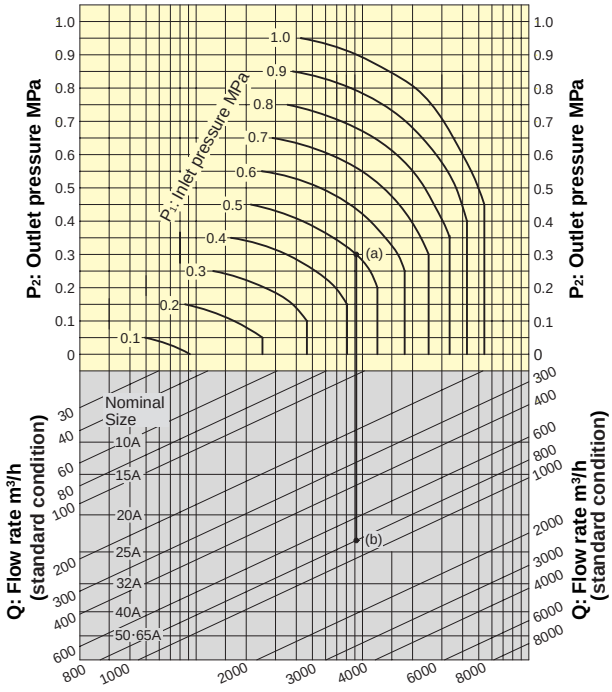
Nominal Size Selection Chart (For Steam)



How to use the chart

When selecting the nominal size of a solenoid valve whose inlet pressure (P_1), outlet pressure (P_2), and steam (saturated steam) flow rate (W) are 0.5 MPa, 0.3 MPa, and 800 kg/h, respectively, first find intersection point (a) of P_1 = 0.5 MPa and P_2 = 0.3 MPa. Trace down vertically from this intersection point (a) to find intersection point (b) with W = 800 kg/h. Since this intersection point (b) lies between nominal sizes 25A and 32A, select the larger one, 32A.

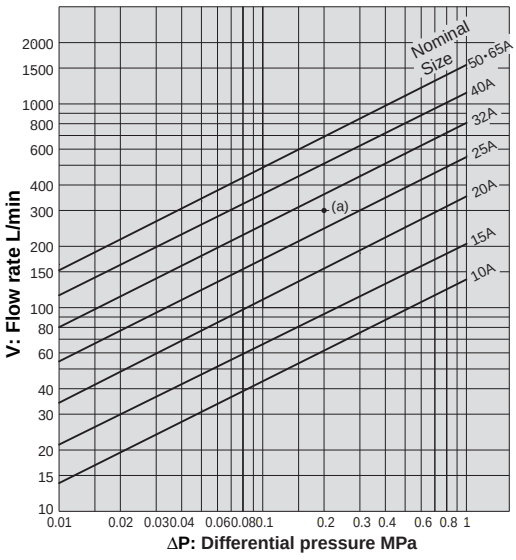
Nominal Size Selection Chart (For Air)



How to use the chart

When selecting the nominal size of a solenoid valve whose inlet pressure (P_1), outlet pressure (P_2), and air (20˚C) flow rate (Q) are 0.5 MPa, 0.3 MPa, and 800 m³/h (standard condition), respectively, first find intersection point (a) of P_1 = 0.5 MPa and P_2 = 0.3 MPa. Trace down vertically from this intersection point (a) to find intersection point (b) with Q = 800 m³/h (standard condition). Since this intersection point (b) lies between nominal sizes 20A and 25A, secect the larger one, 25A.

Nominal Size Selection Chart (For Water)



How to use the chart

When selecting the nominal size of a solenoid valve whose inlet pressure (P_1), outlet pressure (P_2), and flow rate (V) are 0.5 MPa, 0.3 MPa, and 300 L/min, respectively, first find intersection point (a) of the differential pressure before and after the valve [ΔP = 0.5 – 0.3 = 0.2 MPa] and V = 300 L/min. Since this intersection point (a) lies between nominal sizes 25A and 32A, select the larger one, 32A.

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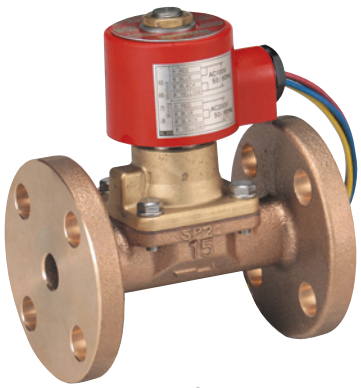
DP-10·13 Series

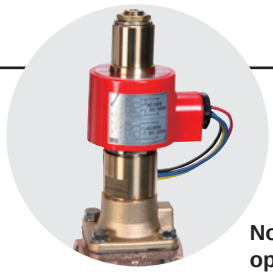
Features

1. Excellent performance on fluid control, mainly used for steam.
2. Compact, lightweight and large capacity.
3. Horizontal and vertical installation.

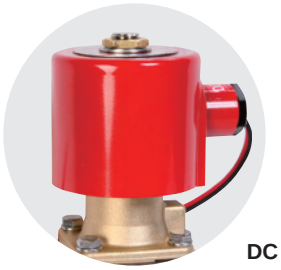
DP-10



DP-13



Normally opened type



DC coil type

●Piston Type Solenoid Valves Variation

Voltage and operation	AC voltage		DC voltage	
	Normally closed	Normally opened	Normally closed	Normally opened
Screwed type	DP-10	DP-10C	DP-10D	DP-10CD
Flanged type	DP-13	DP-13C	DP-13D	DP-13CD

Specifications

Model	AC coil	**DP-10**	**DP-13**	**DP-10C**	**DP-13C**
	DC coil	**DP-10D**	**DP-13D**	**DP-10CD**	**DP-13CD**
Application		Steam, Air, Cold and hot water, Oil (20 cSt or less)			
Working pressure		0.05-1.0 MPa (unusable under vacuum)			
Min. differential pressure		0.05 MPa (0.1 MPa or more is required for vertical installation)			
Valve seat leakage		50 mL/min (at the time of air pressure 0.6 MPa)			
Max. temperature		180˚C			
Operation		Normally closed		Normally opened	
Material	Body	Cast bronze			
	Piston	Stainless steel			
	Valve disc	PTFE			
Connection		JIS Rc screwed	JIS 10K FF flanged	JIS Rc screwed	JIS 10K FF flanged

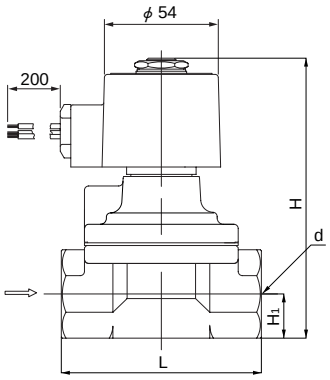
・Available with working pressure of 0 to 0.10 MPa (DP-□□L (D)).

Dimensions (mm) and Weights (kg)

●DP-10

Nominal size	d	L	H	H_1	Weight
10A	Rc 3/8	70	119	14.5	1.2
15A	Rc 1/2	70	119	14.5	1.2
20A	Rc 3/4	80	126	17.5	1.4
25A	Rc 1	95	133	21.0	1.8
32A	Rc 1-1/4	110	155	26.0	2.6
40A	Rc 1-1/2	120	162	29.5	3.2
50A	Rc 2	140	177	36.5	5.1

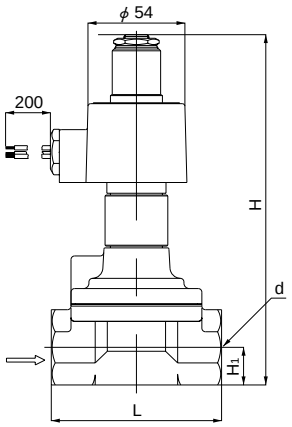
DP-10



●DP-10C

Nominal size	d	L	H	H_1	Weight
10A	Rc 3/8	70	182	14.5	1.5
15A	Rc 1/2	70	182	14.5	1.5
20A	Rc 3/4	80	189	17.5	1.7
25A	Rc 1	95	196	21.0	2.1
32A	Rc 1-1/4	110	218	26.0	2.9
40A	Rc 1-1/2	120	225	29.5	3.5
50A	Rc 2	140	239	36.5	5.4

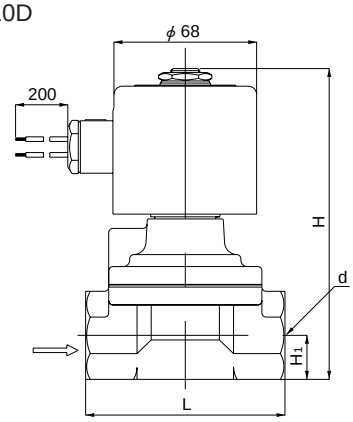
DP-10C



●DP-10D

Nominal size	d	L	H	H_1	Weight
10A	Rc 3/8	70	134	14.5	2.0
15A	Rc 1/2	70	134	14.5	2.0
20A	Rc 3/4	80	141	17.5	2.2
25A	Rc 1	95	148	21.0	2.6
32A	Rc 1-1/4	110	170	26.0	3.4
40A	Rc 1-1/2	120	177	29.5	4.0
50A	Rc 2	140	192	36.5	5.9

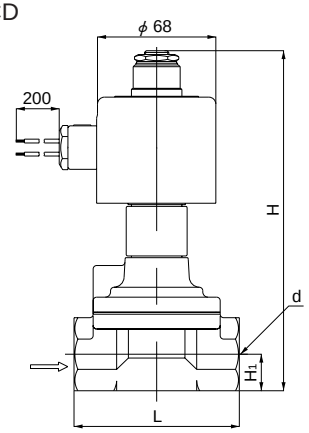
DP-10D



●DP-10CD

Nominal size	d	L	H	H_1	Weight
10A	Rc 3/8	70	182	14.5	2.2
15A	Rc 1/2	70	182	14.5	2.2
20A	Rc 3/4	80	189	17.5	2.4
25A	Rc 1	95	196	21.0	2.8
32A	Rc 1-1/4	110	218	26.0	3.6
40A	Rc 1-1/2	120	225	29.5	4.5
50A	Rc 2	140	239	36.5	6.1

DP-10CD



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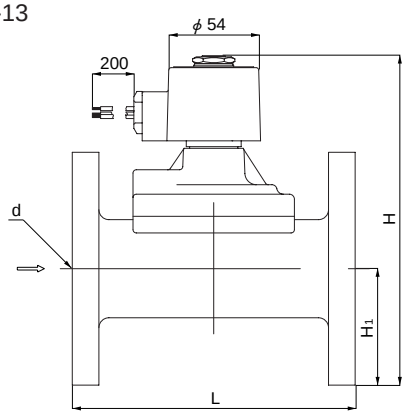
●DP-13

Nominal size	d	L	H	H1	Weight
15A	15	120	152.0	47.5	2.7
20A	20	130	158.5	50.0	3.3
25A	25	145	174.5	62.5	4.8
32A	32	160	196.5	67.5	6.6
40A	40	170	202.5	70.0	7.3
50A	50	195	217.5	77.5	10.0
65A	50	198	227.5	87.5	13.5

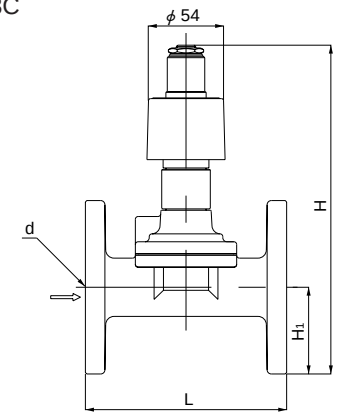
DP-13



●DP-13C

Nominal size	d	L	H	H1	Weight
15A	15	120	215	47.5	3.0
20A	20	130	221	50.0	3.6
25A	25	145	237	62.5	5.1
32A	32	160	259	67.5	6.9
40A	40	170	265	70.0	7.6
50A	50	195	280	77.5	10.3

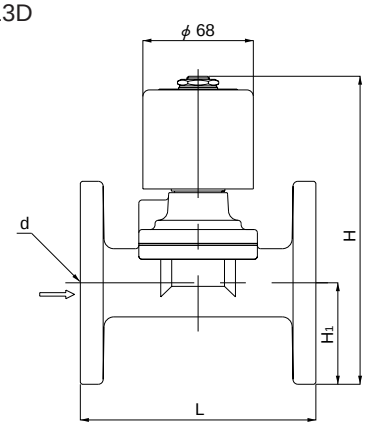
DP-13C



●DP-13D

Nominal size	d	L	H	H1	Weight
15A	15	120	167	47.5	3.5
20A	20	130	174	50.0	4.1
25A	25	145	190	62.5	5.6
32A	32	160	212	67.5	7.4
40A	40	170	218	70.0	8.1
50A	50	195	233	77.5	10.8

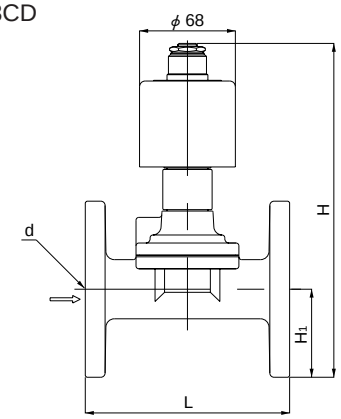
DP-13D



●DP-13CD

Nominal size	d	L	H	H1	Weight
15A	15	120	215	47.5	3.7
20A	20	130	221	50.0	4.3
25A	25	145	237	62.5	5.8
32A	32	160	259	67.5	7.6
40A	40	170	265	70.0	8.3
50A	50	195	280	77.5	11.0

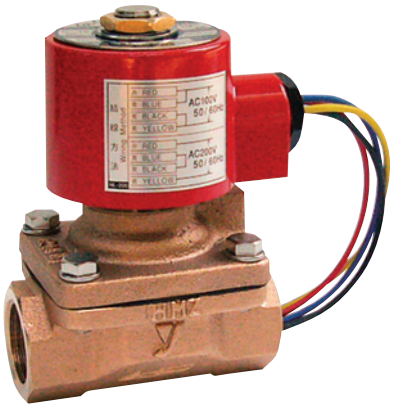
DP-13CD



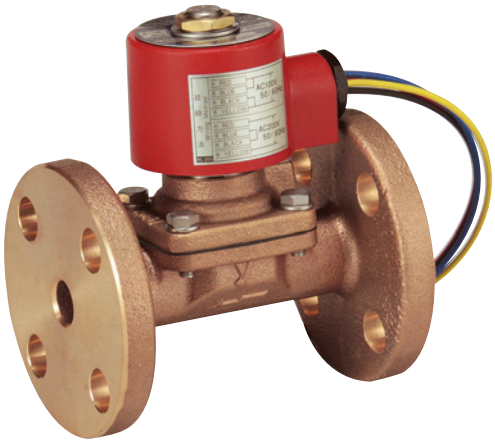
DP-12·12-N
DP-14·14-N Series

Features

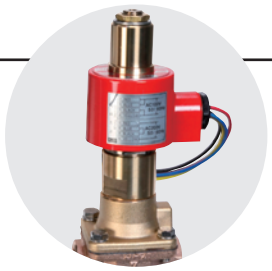
1. Zero working pressure, mainly used for gas and liquid.
2. Zero leakage due to synthetic rubber used for valve part.
3. Horizontal and vertical installation.



DP-12
DP-12-N



DP-14
DP-14-N



Normally opened type

DC coil type

●Diaphragm type Solenoid Valve

Voltage and operation	AC voltage		DC voltage	
	Normally closed	Normally opened	Normally closed	Normally opened
Screwed type	DP-12·12-N	DP-12C	DP-12D	DP-12CD
Flanged type	DP-14·14-N	DP-14C	DP-14D	DP-14CD

Specifications

Model	AC coil	**DP-12·12-N**	**DP-14·14-N**	**DP-12C**	**DP-14C**
	DC coil	**DP-12D**	**DP-14D**	**DP-12CD**	**DP-14CD**
Application		Air, Cold and hot water, Oil (20 cSt or less)			
Working pressure		0-1.0 MPa (unusable under vacuum)			
Min. differential pressure		0 MPa (0.1 MPa or more is required for vertical installation)			
Valve seat leakage		No leakage at the pressure gauge			
Max. temperature		60˚C			
Operation		Normally closed		Normally opened	
Material	Body	Cast bronze *			
	Valve	NBR (diaphragm)			
Connection		JIS Rc screwed	JIS 10K FF flanged	JIS Rc screwed	JIS 10K FF flanged

* Available with leadless bronze (Non-Pb surface treatment) as the DP-12-N and DP-14-N.
・Available with FKM.
・Available with a terminal box (made of plastic).

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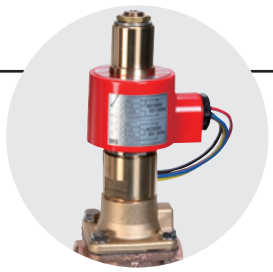
DP-16·18 Series

Features

1. Outstanding corrosion resistance ensured by stainless steel wetted parts.
2. High reliability for fluid.
3. Horizontal and vertical installation.
4. Compact, lightweight and large capacity.

DP-16

DP-18



Normally opened type

DC coil type

●Diaphragm type Solenoid Valve

Voltage and operation	AC voltage		DC voltage	
	Normally closed	Normally opened	Normally closed	Normally opened
Screwed type	DP-16	DP-16C	DP-16D	DP-16CD
Flanged type	DP-18	DP-18C	DP-18D	DP-18CD

Specifications

Model	AC coil	DP-16	DP-18	DP-16C	DP-18C
	DC coil	DP-16D	DP-18D	DP-16CD	DP-18CD
Application		Air, Cold and hot water, Oil (20 cSt or less)			
Working pressure		0-1.0 MPa (unusable under vacuum)			
Min. differential pressure		0 MPa (0.1 MPa or more is required for vertical installation)			
Valve seat leakage		No leakage at the pressure gauge			
Max. temperature		60˚C			
Operation		Normally closed		Normally opened	
Material	Body	Cast stainless steel			
	Valve	NBR (diaphragm)			
Connection		JIS Rc screwed	JIS 10K FF flanged	JIS Rc screwed	JIS 10K FF flanged

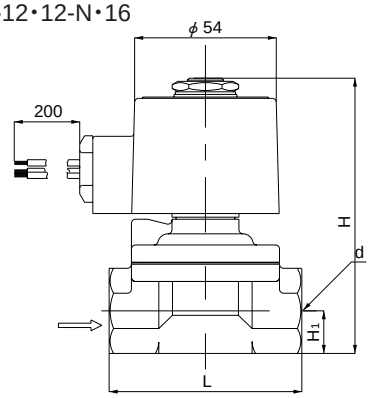
- Available with FKM.
- Available with a terminal box (made of plastic).

Dimensions (mm) and Weights (kg)

●DP-12・12-N・16 (DP-16: 15A-50A)

Nominal size	d	L	H	H_1	Weight
10A	Rc 3/8	70	109.5	14.5	1.1
15A	Rc 1/2	70	109.5	14.5	1.1
20A	Rc 3/4	80	116.5	17.5	1.3
25A	Rc 1	95	123.5	21.0	1.7
32A	Rc 1-1/4	110	150.5	26.0	2.5
40A	Rc 1-1/2	120	157.5	29.5	3.1
50A	Rc 2	140	172.5	36.5	5.0

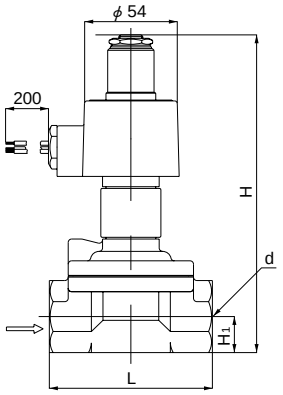
DP-12・12-N・16



●DP-12C・16C (DP-16C: 15A-50A)

Nominal size	d	L	H	H_1	Weight
10A	Rc 3/8	70	172	14.5	1.4
15A	Rc 1/2	70	172	14.5	1.4
20A	Rc 3/4	80	179	17.5	1.6
25A	Rc 1	95	186	21.0	2.0
32A	Rc 1-1/4	110	213	26.0	2.8
40A	Rc 1-1/2	120	220	29.5	3.4
50A	Rc 2	140	235	36.5	5.3

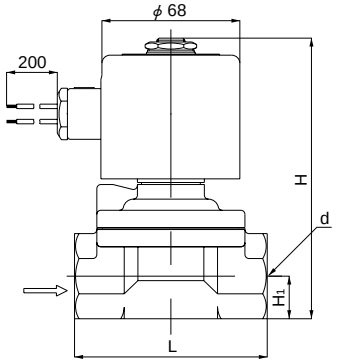
DP-12C・16C



●DP-12D・16D (DP-16D: 15A-50A)

Nominal size	d	L	H	H_1	Weight
10A	Rc 3/8	70	124	14.5	1.9
15A	Rc 1/2	70	124	14.5	1.9
20A	Rc 3/4	80	131	17.5	2.1
25A	Rc 1	95	138	21.0	2.5
32A	Rc 1-1/4	110	166	26.0	3.3
40A	Rc 1-1/2	120	173	29.5	3.9
50A	Rc 2	140	187	36.5	5.8

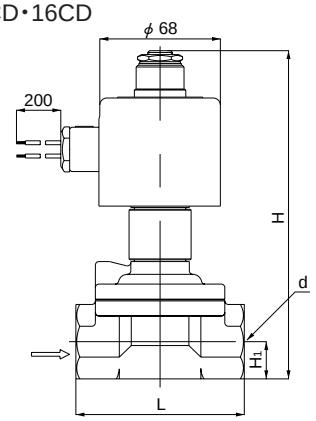
DP-12D・16D



●DP-12CD・16CD (DP-16CD: 15A-50A)

Nominal size	d	L	H	H_1	Weight
10A	Rc 3/8	70	172	14.5	2.1
15A	Rc 1/2	70	172	14.5	2.1
20A	Rc 3/4	80	179	17.5	2.3
25A	Rc 1	95	186	21.0	2.7
32A	Rc 1-1/4	110	213	26.0	3.5
40A	Rc 1-1/2	120	220	29.5	4.1
50A	Rc 2	140	235	36.5	6.0

DP-12CD・16CD



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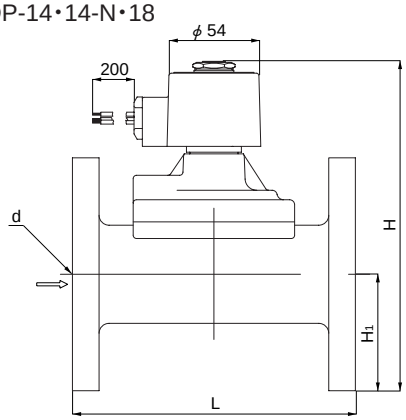
●DP-14・14-N・18

Nominal size	d	L	H	H1	Weight
15A	15	120	142.5	47.5	2.6
20A	20	130	149.0	50.0	3.2
25A	25	145	165.0	62.5	4.7
32A	32	160	192.0	67.5	6.5
40A	40	170	198.0	70.0	7.2
50A	50	195	213.0	77.5	9.9

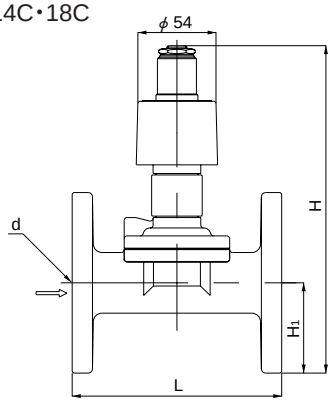
DP-14・14-N・18



●DP-14C・18C

Nominal size	d	L	H	H1	Weight
15A	15	120	205	47.5	2.9
20A	20	130	212	50.0	3.5
25A	25	145	228	62.5	5.0
32A	32	160	255	67.5	6.8
40A	40	170	261	70.0	7.5
50A	50	195	276	77.5	10.2

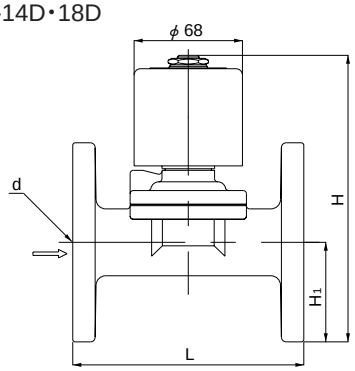
DP-14C・18C



●DP-14D・18D

Nominal size	d	L	H	H1	Weight
15A	15	120	157	47.5	3.4
20A	20	130	164	50.0	4.0
25A	25	145	180	62.5	5.5
32A	32	160	207	67.5	7.3
40A	40	170	213	70.0	8.0
50A	50	195	228	77.5	10.7

DP-14D・18D

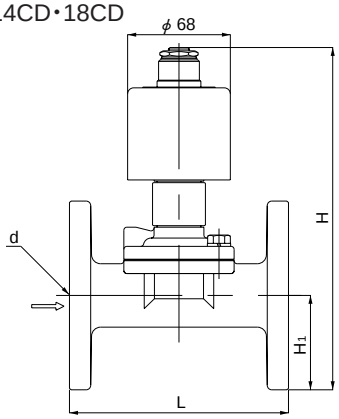


●DP-14CD・18CD

Nominal size	d	L	H	H1	Weight
15A	15	120	205	47.5	3.6
20A	20	130	212	50.0	4.2
25A	25	145	228	62.5	5.7
32A	32	160	255	67.5	7.5
40A	40	170	261	70.0	8.2
50A	50	195	276	77.5	10.9

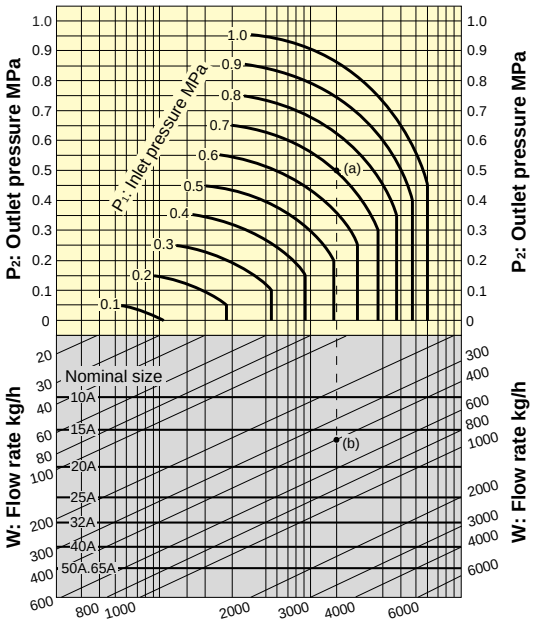
・The DP-18 Series is slightly heavier.

DP-14CD・18CD



・The DP-18 Series adopts a welded flange structure.

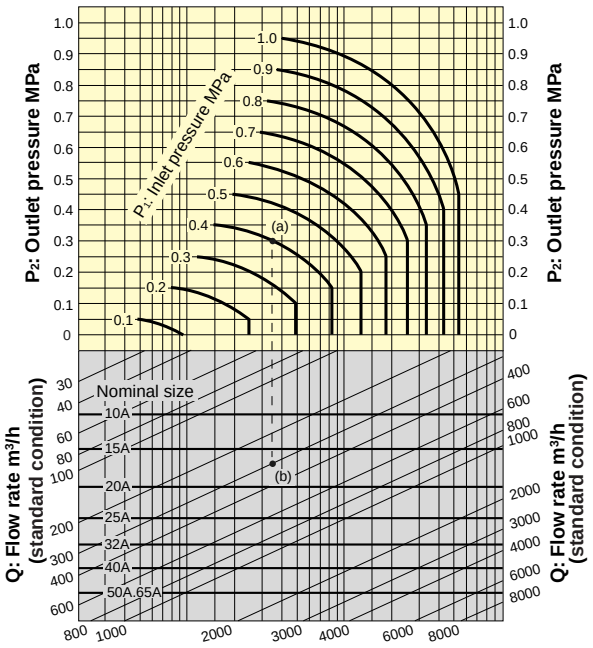
Nominal Size Selection Chart (For Steam)



How to use the chart

When selecting the nominal size of a solenoid valve whose inlet pressure (P_1), outlet pressure (P_2), and steam (saturated steam) flow rate (W) are 0.7 MPa, 0.5 MPa, and 400 kg/h, respectively, first find intersection point (a) of P_1 = 0.7 MPa and P_2 = 0.5 MPa. Trace down vertically from this intersection point (a) to find intersection point (b) with W = 400 kg/h. Since this intersection point (b) lies between nominal sizes 15A and 20A, select the larger one, 20A.

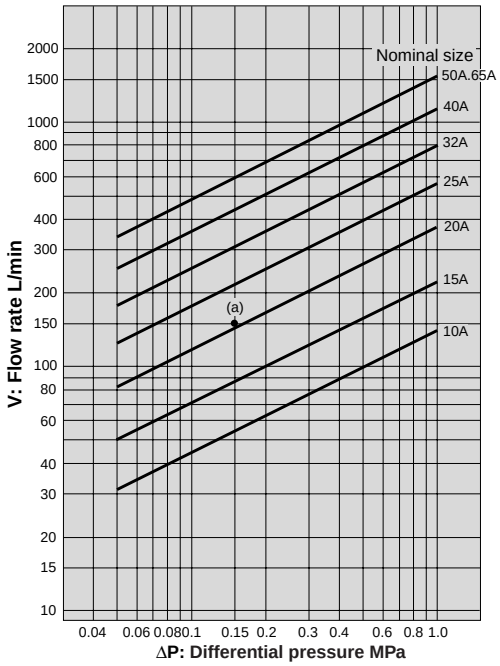
Nominal Size Selection Chart (For Air)



How to use the chart

When selecting the nominal size of a solenoid valve whose inlet pressure (P_1), outlet pressure (P_2), and air (20˚C) flow rate (Q) are 0.4 MPa, 0.3 MPa, and 300 m³/h (standard condition), respectively, first find intersection point (a) of P_1 = 0.4 MPa and P_2 = 0.3 MPa. Trace down vertically from this intersection point (a) to find intersection point (b) with Q = 300 m³/h (standard condition). Since this intersection point (b) lies between nominal sizes 15A and 20A, select the larger one, 20A.

Nominal Size Selection Chart (For Water)



How to use the chart

When selecting the nominal size of a solenoid valve whose inlet pressure (P_1), outlet pressure (P_2), and flow rate (V) are 0.5 MPa, 0.35 MPa, and 150 L/min, respectively, first find intersection point (a) of the differential pressure before and after the valve [ΔP = 0.5 – 0.35 = 0.15 MPa] and V = 150 L/min. Since this intersection point (a) lies between nominal sizes 20A and 25A, select the larger one, 25A.

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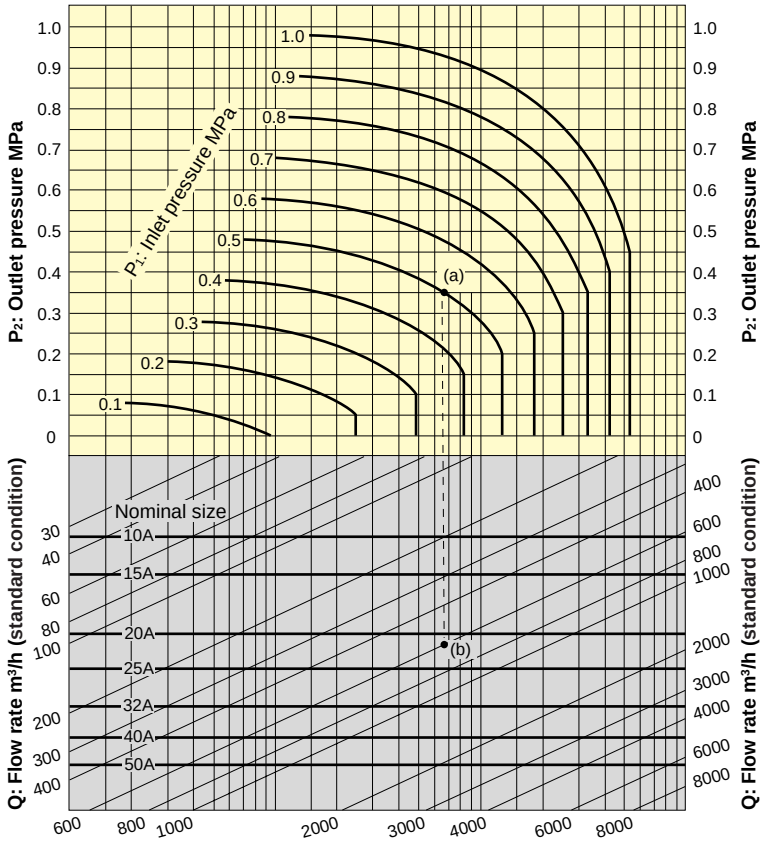
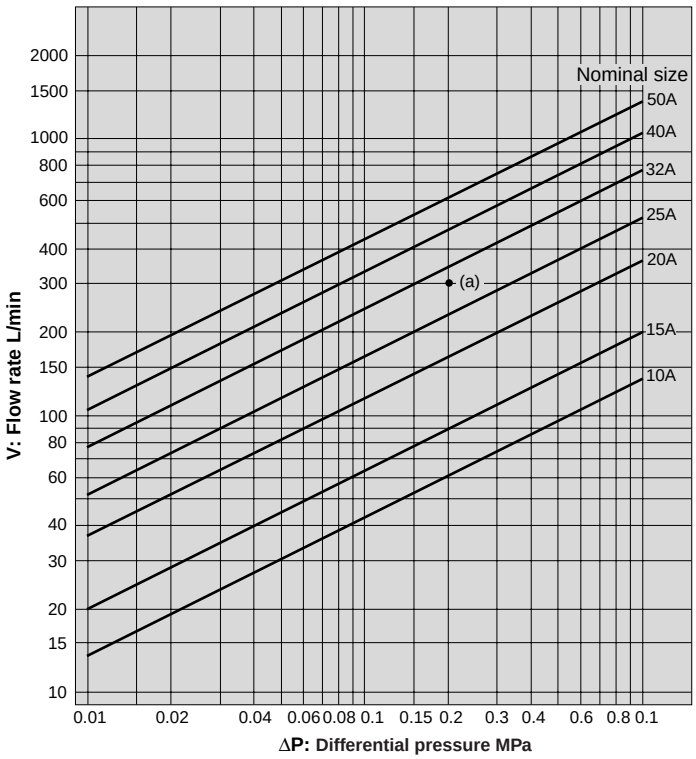
Nominal Size Selection Chart (For Air)



How to use the chart
When selecting the nominal size of a solenoid valve whose inlet pressure (P_1), outlet pressure (P_2), and air (20˚C) flow rate (Q) are 0.5 MPa, 0.35 MPa, and 600 m³/h (standard condition), respectively, first find intersection point (a) of P_1 = 0.5 MPa and P_2 = 0.35 MPa. Trace down vertically from this intersection point (a) to find intersection point (b) with Q = 600 m³/h (standard condition). Since this intersection point (b) lies between nominal sizes 20A and 25A, select the larger one, 25A.

Nominal Size Selection Chart (For Water)



How to use the chart
When selecting the nominal size of a solenoid valve whose inlet pressure (P_1), outlet pressure (P_2), and flow rate (V) are 0.7 MPa, 0.5 MPa, and 300 L/min, respectively, first find intersection point (a) of the differential pressure before and after the valve [ΔP = 0.7 – 0.5 = 0.2 MPa] and V = 300 L/min. Since this intersection point (a) lies between nominal sizes 25A and 32A, select the larger one, 32A.

DD-2・3

Features

1. Outstanding corrosion resistance achieved by adopting stainless steel for major parts and body.
2. Significantly improved corrosion resistance with stainless steel made body and trim parts.
3. Easy maintenance due to gasket made of PTFE.
4. RoHS-compliant product.
5. Various installation postures: Vertical or horizontal including intermediates.
6. Equipped with coil of AC 100 / 200 V selective and common for 50 Hz / 60 Hz.

Specifications

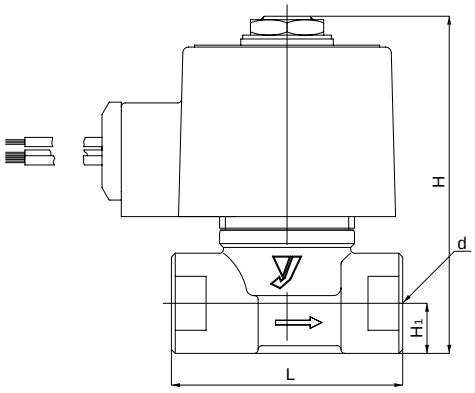
Model		DD-2	DD-2-8	DD-3	DD-3-8
Application		Steam, Air, Cold and hot water, N_2 gas, CO_2 gas (dry), Ar gas, Oil		Air, Cold and hot water, N_2 gas, CO_2 gas (dry), Ar gas, Oil	
Fluid viscosity		20 cSt or less			
Working pressure		0-0.15 MPa	0-0.8 MPa	0-0.15 MPa	0-0.8 MPa
Orifice (mm)		9.5	4.0	9.5	4.0
Cv value		1.7	0.55	1.7	0.55
Allowable valve seat leakage		50 mL/min under standard conditions		No leakage at the pressure gauge	
Max. temperatue		175˚C		100˚C	
Operation		Normally closed			
Material	Body	Cast stainless steel (SCS14A)			
	Plunger	Stainless steel			
	Valve disc	PTFE		FKM	
Connection		JIS Rc screwed			

Specification of Coil

Rated voltage	AC 100 / 200 V selective type	AC 110 / 220 V selective type
	50 / 60 Hz common	
Allowable fluctuation	Rated voltage ± 10%	
Rated current	0.42 / 0.21 A	0.38 / 0.19 A
Starting current	1.10 / 0.55 A	1.00 / 0.50 A
Insulation class	Insulation class H	
Protective structure	Dust proof, Splash proof	
Ingress protection code	IP64 (JIS C0920)	
Insulation resistance	500 MΩ and more / 500V megger	
Withstand voltage test	1500 V/min	

Dimensions (mm) and Weights (kg)

Nominal size	d	L	H	H_1	Weight
10A	Rc 3/8	50	85.5	12	0.66
15A	Rc 1/2	60	87.5	13	0.69
20A	Rc 3/4	65	91	16.5	0.74



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DD-1S·1W

Features

1. Usable for air, water, oil (viscosity: up to 20 cSt) and steam.
2. Horizontal and vertical installation.
3. Large orifice diameter provides a high flow rate (Cv value).
4. Coil protective structure complies with the splashproof requirements specified in JIS C 0920.
5. Available with AC 100V 50/60 Hz (selective) type and AC 200V 50/60 Hz (selective) type.

Specification of coil

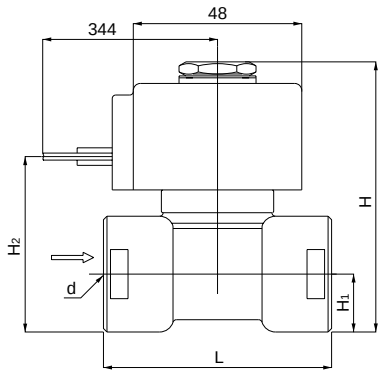
Rated voltage	AC 100 V 50 / 60 Hz Selective	AC 200 V 50 / 60 Hz Selective
Allowable fluctuation	Rated voltage ± 10%	
Rated current	0.22 / 0.26 A	0.11 / 0.13 A
Starting current	0.56 / 0.67 A	0.27 / 0.32 A
Insulation class	Insulation class H	
Protective structure	Dust proof, Splash proof	
Insulation resistance	500 MΩ and more / 500 V megger	
Withstand voltage test	1500 V/min	

Specifications

Model	DD-1S	DD-1S-5	DD-1S-7	DD-1W	DD-1W-5	DD-1W-7
Application	Steam			Air, Cold and hot water, Oil		
Fluid viscosity	20 cSt or less					
Working pressure	0-0.12 MPa	0-0.5 MPa	0-0.7 MPa	0-0.12 MPa	0-0.5 MPa	0-0.7 MPa
Orifice (mm)	9.5	5.0	4.0	9.5	5.0	4.0
Flow rate coefficient (Cv)	1.7	0.75	0.55	1.7	0.75	0.55
Max. temperature	120˚C	160˚C	170˚C	120˚C		
Rated voltage	AC 100 V 50 / 60 Hz·AC 200 V 50 / 60 Hz Selective					
Operation	Normally closed					
Material – Body	Cast bronze					
Material – Plunger	Stainless steel					
Material – Valve disc	PTFE			FKM		
Connection	JIS Rc screwed					

Dimensions (mm) and Weights (kg)

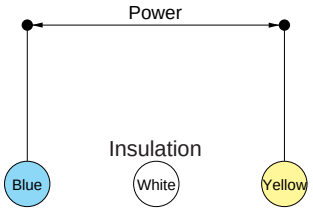
Nominal size	d	L	H	H_1	H_2	Weight
10A	Rc 3/8	50	70	11	41	0.45
15A	Rc 1/2	55	74	13	45	0.48
20A	Rc 3/4	65	80	16.5	51	0.53



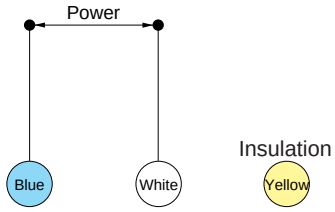
Wire Connecting Method

Wire connecting method differs between the 50 Hz and 60 Hz types. Connect the wires of the coil as specified below.

For 100 / 200V 50Hz
Connect the "blue" and "yellow" wires to the power supply. Insulate the "white" wire (by taping or fixing it to the terminal, etc.).

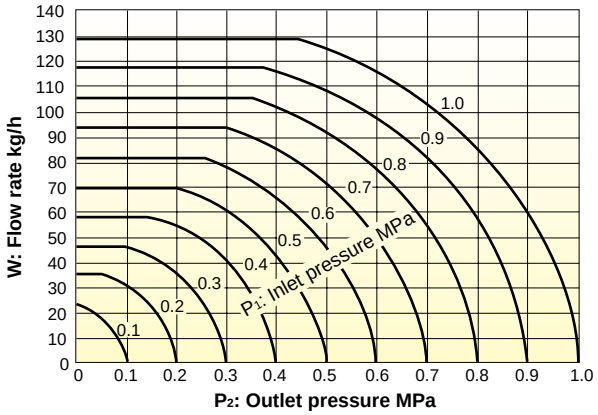


For 100 / 200V 60Hz
Connect the "blue" and "white" wires to the power supply. Insulate the "yellow" wire (by taping or fixing it to the terminal, etc.).

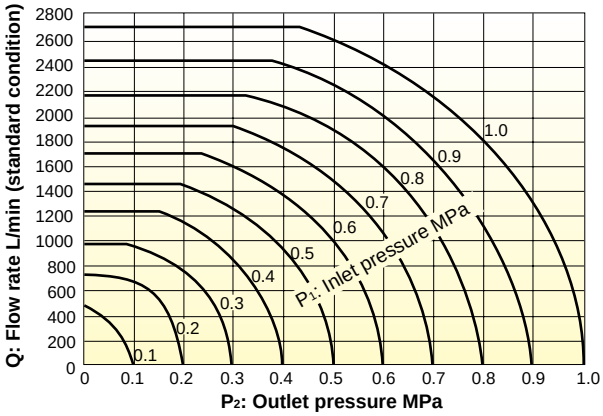


Nominal Size Selection Chart

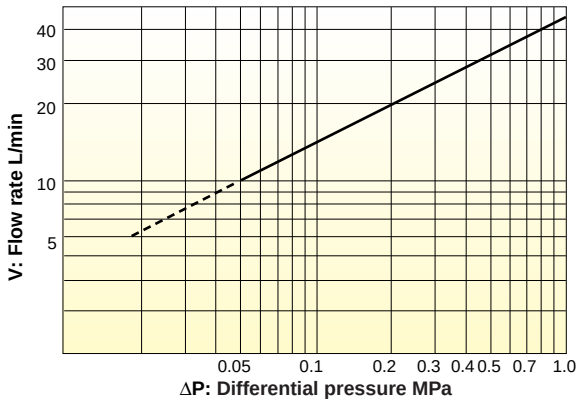
●Fluid: Saturated steam (Cv: 1)



●Fluid: Air (Cv: 1)



●Fluid: Water (Cv: 1)



How to calculate the flow rate
The steam, air, and water flow rate charts show the flow rates when Cv = 1. To calculate the flow rate of each model, multiply the value by the Cv value of the model.
(Example)
Calculating the amount of water when a DD-1W-5 20A valve is used and its inlet and outlet pressures are 0.4 MPa and 0.3 MPa. When the differential pressure before and after the valve is [ΔP = 0.4 – 0.3 = 0.1 MPa], the amount of water is 15 L/min as shown in the left figure.
15 L/min (from the chart of water) x 0.75 (Cv value) = 11.25 L/min

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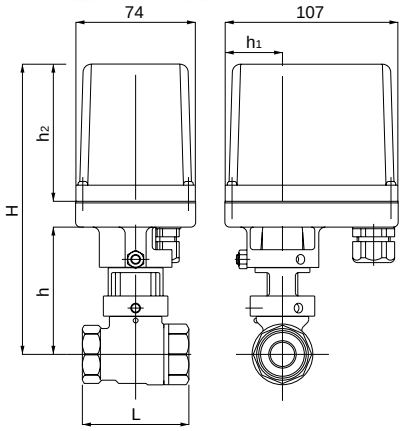
MD-54

Features

1. IP65 dust and water proof structure (JIS C 0920).
2. Excellent durability by built-in thermal protector (no motor burnout).
3. Quickly accurate starting/stopping operation. The indication of the working position can be checked.
4. Valve disc smoothly opens and closes, preventing water hammer and ensuring complete sealing.
5. Manually operable.
6. Equipped with opening-closing indicator lamp circuit.
7. Incorporated space heater for dew condensation prevention (1W).

Specifications

Application	Steam, Air, Cold and hot water			
Working pressure	Steam: 0-0.6 MPa Air, Cold and hot water: 0-1.0 MPa			
Application temperature	Steam: Max. 160˚C Air: Max. 120˚C Cold and hot water: Max. 100˚C			
Ambient temperature	−15 − 55℃			
Rated voltage	AC 100 / 110 V 50 / 60 Hz common AC 200 / 220 V 50 / 60 Hz common			
Power consumption	Nominal size 15A-32A	Nominal size 40A･50A		
	16 VA	19 VA		
Operation	ON-OFF			
Operation angle	90˚			
Opening and closing time	Nominal size 15A･20A	Nominal size 25A･32A	Nominal size 40A･50A	
	5.4 sec. (50 Hz) 4.5 sec (60 Hz)	15.5 sec. (50 Hz) 13 sec. (60 Hz)	16 sec. (50 Hz) 13.5 sec. (60 Hz)	
Percentage duty cycle	20% 15 min.			
Manual operation	Possible			
Overcurrent protection	Built-in thermal protector			
Indicator lamp circuit	Built-in			
Protective structure	IP65 dust and water proof structure (JIS C 0920)			
Valve shape	Reduced bore			
Material	Body	Cast stainless steel		
	Ball	Stainless steel		
	Seat	Reinforced fluorine resin for high temperature		
Connection	JIS Rc screwed			



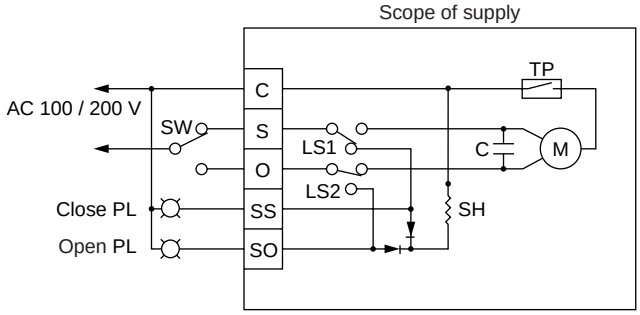
Dimensions (mm) and Weights (kg)

Nominal size	L	H	h	h_1	h_2	Bore	Weight
15A	59	178	52	36	85	13	1.4
20A	66	180	54	36	85	15	1.5
25A	78	187	61	36	85	20	1.7
32A	87	197	71	36	85	25	2.0
40A	95	218	77	53	85	32	2.8
50A	109	224	83	53	85	40	3.3

●Cv value

Nominal size	Cv value
15A	9
20A	13
25A	24
32A	44
40A	80
50A	120

Circuit of Motor Operation



LS1: Close-limit SW LS2: Open-limit SW SH: Space heater
TP: Thermal protector C: Condenser M: Motor

MD-36R

Features

1. Outdoor, rainproof structure (IP64 specified in JIS C 0920).
2. Starts and stops are quick and accurate, and the indication of the working position can be checked.
3. Smoothly opens and closes, preventing water hammer by the fluid and ensuring complete sealing.
4. Manually operable.
5. A space heater is incorporated to prevent dew condensation (0.5 W).
6. Superior in durability: no motor burnout by function of the timer for motor protection.

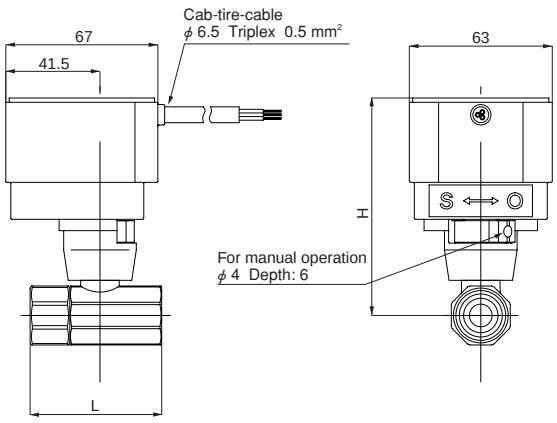
Specifications

Application		Air, Cold and hot water
Working pressure		0-1.0 MPa
Application temperature		–10 – 80˚C (no freeze condition)
Ambient temperature		–20 – 50 (60) ˚C *
Rated voltage		AC 100 / 110 V 50 / 60 Hz common AC 200 / 220 V 50 / 60 Hz common
Power consumption		8 VA
Operation		ON-OFF
Operation angle		90-degree positive, inverse rotation
Opening and closing time		About 6-8 seconds
Percentage duty cycle		20% 15 min.
Manual operation		Possible
Protective structure		Rainproof structure at the outdoor
Valve shape		Reduced bore
Material	Body	Brass
	Ball	Brass (HCr plating)
	Seat	PTFE
Connection		JIS Rc screwed

* The ambient temperature of 60˚C depends on the frequency of operation and the temperature of the fluid. Please contact us.

Dimensions (mm) and Weights (kg)

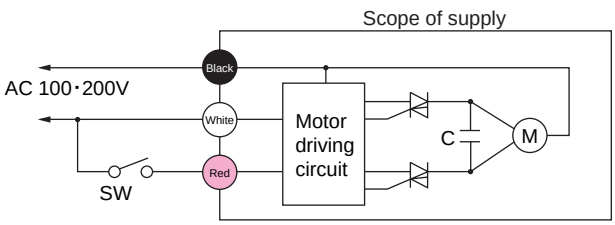
Nominal size	L	H	Bore	Weight
15A	58	96	10	1.1
20A	63	98	12.5	1.1
25A	71	102	15	1.2



●Cv value

Nominal size	Cv value
15A	6
20A	11
25A	15

Connecting Diagram



When SW is OFF, the valve closes.
When SW is ON, the valve opens.
Note) This valve may not be available if the switch is semiconductor such as triac.

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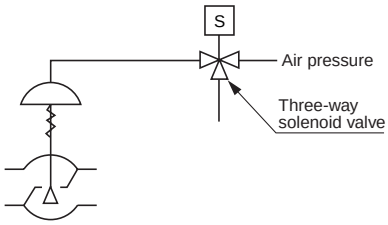
PD-1・2

Features

1. Usable for air, water, oil and steam.
2. No chattering due to closing action against the flow direction of fluid.
3. Excellent durability of stainless steel valve seat.
4. Excellent durability of synthetic rubber diaphragm.



PD-1

Specifications

Model		PD-1	PD-2
Application		Steam, Air, Cold and hot water, Other non-dangerous fluids	
Working pressure		0-1.0 MPa	
Max.temperature		180˚C	
Operation		Air-to-open	
Operation pressure		0.2-0.25 MPa	
Material	Body	Cast bronze	Cast iron
	Valve	Stainless steel	
	Valve seat	Stainless steel	
Connection		JIS Rc screwed	JIS 10K FF flanged

・Available with air-to-close operation type.

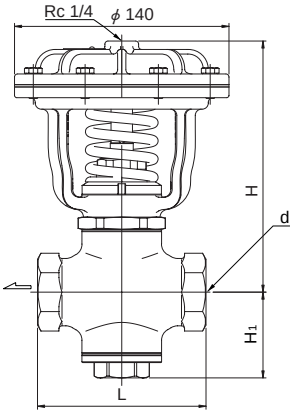
Dimensions (mm) and Weights (kg)

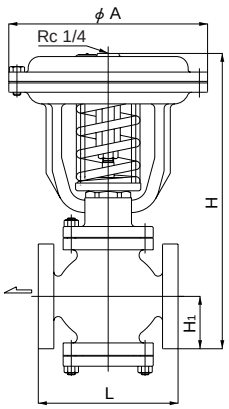
●PD-1

Nominal size	d	L	H	H_1	Cv value	Weight
15A	Rc 1/2	90	210	50	5	4
20A	Rc 3/4	100	221	56	7	4.4
25A	Rc 1	110	221	56	11	4.7

●PD-2

Nominal size	L	H	H_1	ϕ A	Cv value	Weight
15A	120	210	50	140	5	5.9
20A	130	221	56	140	7	6.6
25A	140	221	56	140	11	8.1
32A	180	412	100	256	16	28.5
40A	180	412	100	256	24	29.0
50A	180	422	105	256	40	30.0





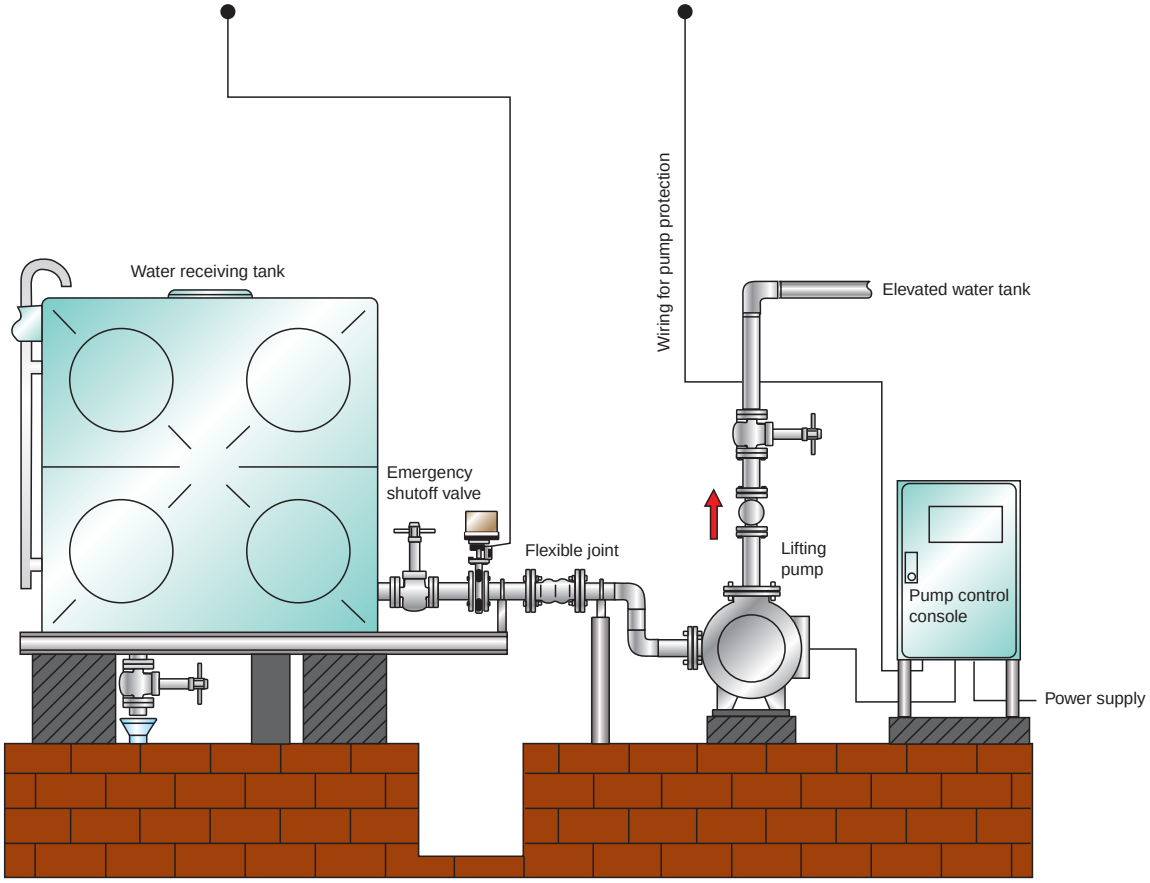
MD-71・KS-5

What is an Emergency Shutoff System?

If a piping system is damaged by a big earthquake, important water for living stored in a water receiving tank or gravity water tank will be lost. It is, therefore, necessary to prevent the interruption of lifelines and reserve water for living after the disaster. Additionally, national standards and guidelines stress the necessity of “emergency shutoff valves” for the purpose of preserving water. Yoshitake's emergency shutoff system comprises an “emergency shutoff valve” and an “emergency shutoff valve control console” and is designed to automatically close the valve when the earthquake sensor inside the control console works. It is capable of supplying water for living reserved in the water receiving tank or gravity water tank even after a disaster.

MD-71 Emergency shutoff valve

KS-5 Emergency shutoff valve control console



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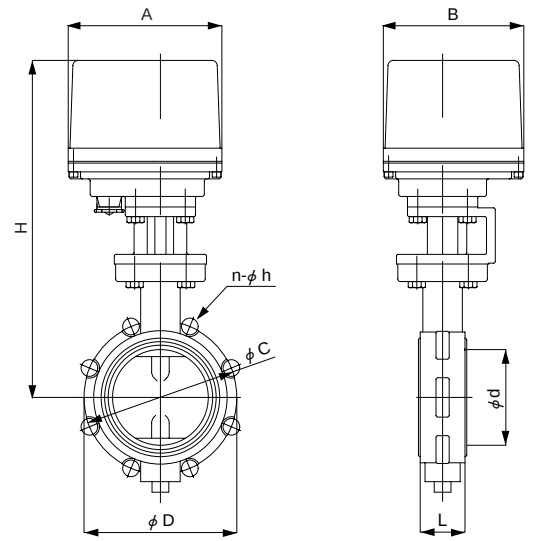
Specifications and Structure of MD-71

Model		MD-71 (butterfly valve)
Application		City water
Applicable pressure		0-1.0 MPa
Applicable fluid temperature		5-60˚C
Installation posture		Can be installed in any posture, from upright to sideways to horizontal piping.
Opening-closing time		50A and 65A: 4 or fewer seconds, 80A and 100A: 10 or fewer seconds, 125A and 150A: 15 or fewer seconds, 200A: 45 or fewer seconds
Actuator	Rated voltage	24 V DC
	Power consumption	50-100A: MAX. 80 VA 125-200A: MAX.120 VA
	Ambient temperature	–20 – 55˚C (no freeze condition)
	Measure against dew condensation	Space heater contained
	Manual operation	Manual operation mechanism provided
	Protective structure	Outdoor rainproof structure (JIS C 0920 IP65)
	Wire lead-in port	G 1/2
Material	Body	Cast iron (FC 300)
	Valve	Stainless steel
	Seat	FKM
Connection		JIS 10K flanged

・Please contact us when using for fluid other than city water.

Dimensions (mm) and Weights (kg)

Nominal size	d	L	H	D	A	B	JIS 10K flanged		Weight
							C	n-h	
50A	52	41	332	115	175	160	120	4-19	7.7
65A	64	44	349	135	175	160	140	4-19	9.2
80A	78	44	356	145	175	160	150	8-19	9.7
100A	103	51	384	175	175	160	175	8-19	12
125A	129	54	406	206	175	160	210	8-23	15
150A	154	54	419	231	175	160	240	8-23	16
200A	205	64	501	290	217.5	175	290	12-23	30



・The shape of the 200A is partly different from the figure.

Cv Value and Calculation Formula

50A	65A	80A	100A	125A	150A	200A
159	266	457	860	1320	2020	3540

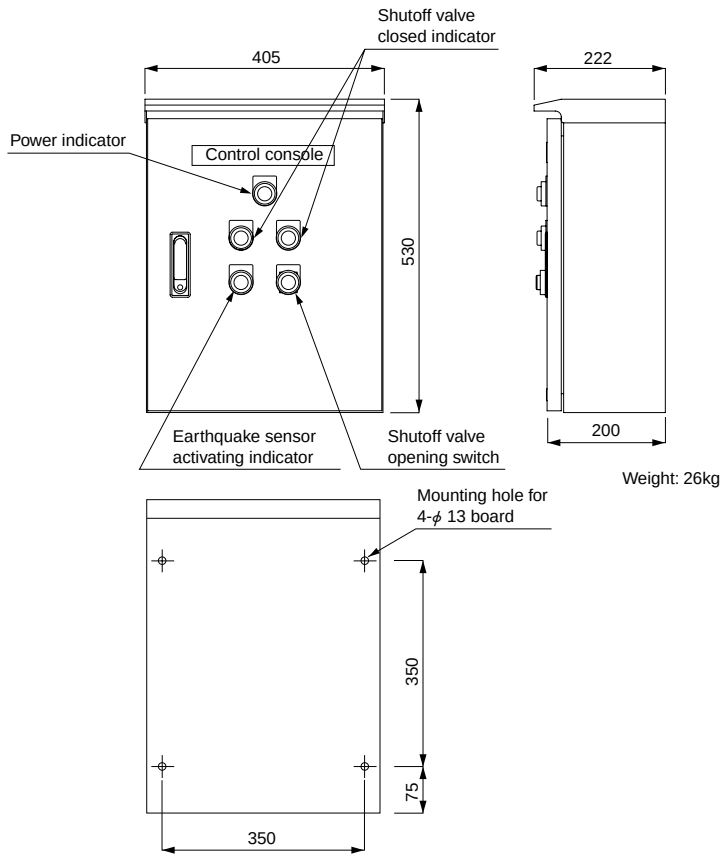
$$Cv = \frac{0.365\,V\sqrt{G}}{\sqrt{\Delta P}}$$

P_1: Inlet pressure [MPa・A]
P_2: Outlet pressure [MPa・A]
ΔP: $P_1 - P_2$ [MPa]
G : Specific gravity (against water)
V : Max. flow rate of fluids
Cv: Cv value of each nominal size

Specifications and Structure of KS-5

Model		KS-5
Number of emergency shutoff valves to be controlled		2 *1
Supply power source		85-240 V AC, 50 / 60 Hz
Ambient temperature		–10 – 50˚C
Backup power source		24 V DC
Backup time		Approx. 5 hours
Storage battery		Storage battery manufactured by Japan Storage Battery (PE 12 V 2.2)
Charging method		Constant charging method (float charging)
Measure against lightning		Surge absorber provided
Output terminal	For emergency shutoff valve control	24 V DC
	For pump protection	No-voltage c-contact (one c-contact) *2
	For earthquake sensor external warning	No-voltage a-contact (one a-contact) (ON contact when the earthquake sensor is working)
	For power external warning	No-voltage a-contact (one a-contact) (ON contact when the power inside the control console unusually drops)
Shutoff valve opening switch		Pushbutton switch for resetting provided
Earthquake sensor	Detection direction	All horizontal directions
	Set acceleration	200 Gal (equal to 5 upper in Japan Meteorological Agency's seismic intensity)
Installation location		Indoor and outdoor (equal to JIS C 0920 IP44)
Installation method		Wall-hung type

*1 Available with for controlling one, three or four emergency shutoff valve(s).
*2 It is different when controlling three or four emergency shutoff valves.



・The figure shown above is a control console for controlling two emergency shutoff valves. The shapes of control consoles for controlling one, three, and four emergency shutoff valves are slightly different.

Reference **What is Gal ...?**

One Gal is defined as an acceleration of 1 centimeter per second (1 cm/s) per second. That is, the gal can also be expressed as 1 centimeter per second squared (1 cm/s^2). In the International System of Units (SI), the unit of acceleration is meter per second squared (m/s^2), and 1 Gal is equal to 0.01 m/s^2.
Although the gal is a non-SI unit, Japan's Measurement Law permits the use of Gal and Milligal (mGal) only for the measurement of gravitational acceleration as well as vibration acceleration regarding earthquakes.

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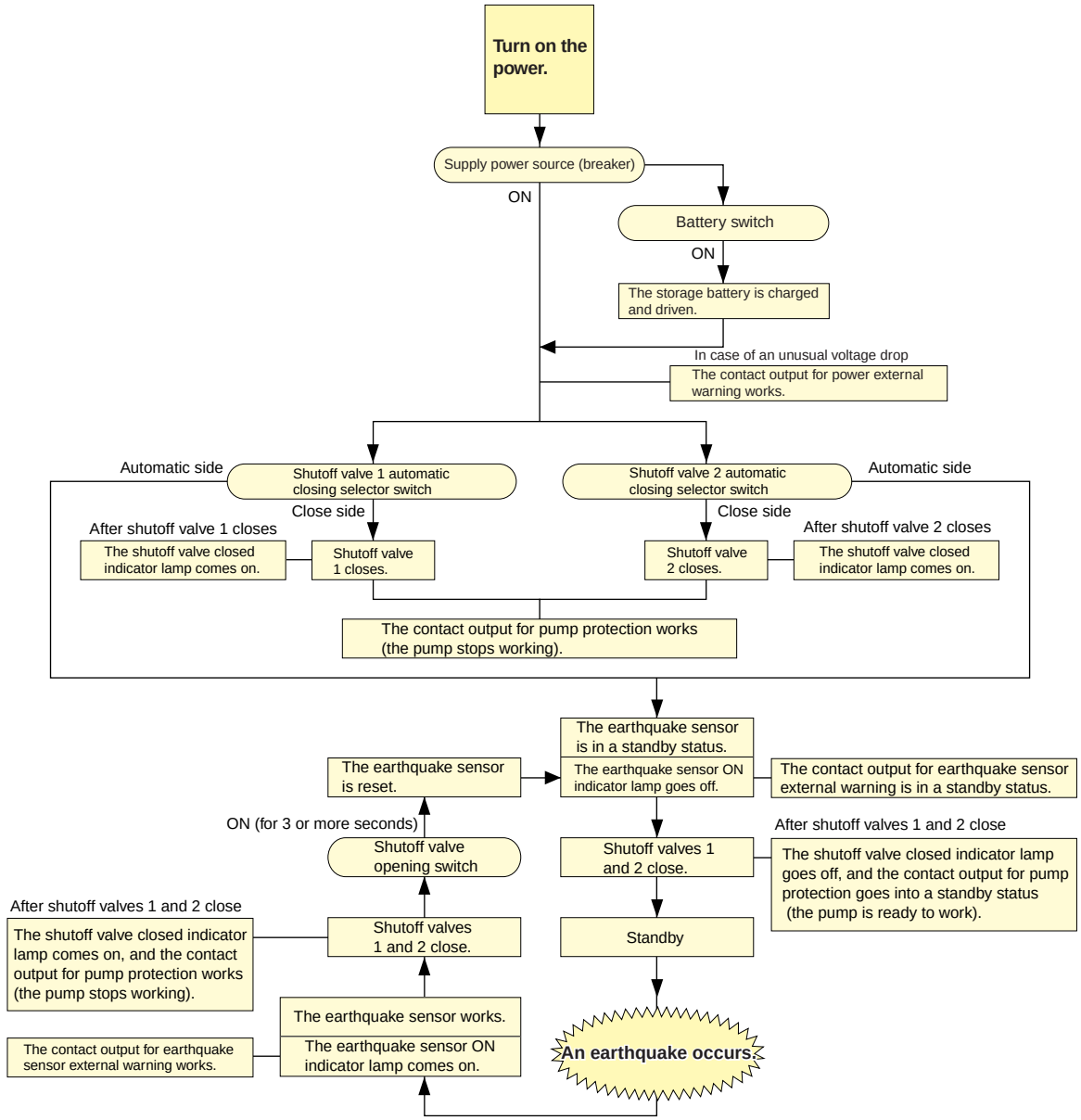
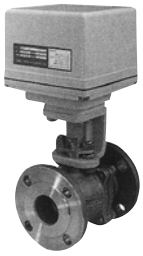
Operation Flowchart (for Controlling Two Shutoff Valves)



Features

1. An earthquake sensor (acceleration: 200 Gal) is installed inside the control console that automatically works in case of an earthquake (the shutoff valves close in intensity 5 upper).
2. The control console properly works with the backup power source even in case of a power failure.
3. The pump instantly stops when the shutoff valves close (this requires wiring between the interlock terminal of the emergency shutoff valve control console and that of the pump control console).
4. Resetting after a shutoff is easy just by pressing the shutoff valve opening switch.
5. The control console can be manually operated.

Feature		Pressure & flame proof solenoid valve		Motor valve / Screwed, 2 way
Model		**DP-34**		**MD-53**
Picture				
Application		**Air, Nitrogen gas**	**Cold and hot water, Heavy oil A, Light oil**	**Air, Cold and hot water**
Working pressure		0.05-0.9 MPa (unusable under vacuum)	0.05-1.6 MPa (unusable under vacuum)	0-1.0 MPa
Min. differential pressure		0.05 MPa		—
Application temperature		5-60˚C		–15 – 80˚C (no freeze condition)
Ambient temperature		5-60˚C		–15 – 55˚C
Rated voltage		AC 100 V 50 / 60 Hz common AC 200 V 50 / 60 Hz common		AC 100 / 110 V 50 / 60 Hz common AC 200 / 220 V 50 / 60 Hz common
Operation		Normally closed		ON-OFF
Connection		JIS Rc screwed		JIS Rc screwed
Material	Body	Brass (C3771)		Cast stainless steel
	Main valve	Brass (C3604)		—
	Valve disc	Fluororubber (FKM)		—
	Ball	—		Stainless steel
	Seat	—		PTFE
Size		15A-25A		15A-50A
Others		—		—

Feature		Motor valve / Screwed, 3 way	Motor valve / Flanged, 2 way	Motor valve / Stainless steel, 2 way
Model		**MD-35R**	**MD-55**	**MD-61**
Picture				
Application		**Air, Cold and hot water**	**Air, Cold and hot water**	**Air, Cold and hot water**
Working pressure		0-1.0 MPa	0-1.0 MPa	0-1.0 MPa
Min. differential pressure		—	—	—
Application temperature		–10 – 80˚C (no freeze condition)	0-80˚C	0-80˚C
Ambient temperature		–20 – 50 (60)˚C *	–20 – 50˚C	–20 – 50˚C
Rated voltage		AC 100 / 110 V 50 / 60 Hz common AC 200 / 220 V 50 / 60 Hz common	AC 100 / 110 V 50 / 60 Hz common AC 200 / 220 V 50 / 60 Hz common	AC 100 / 110 V 50 / 60 Hz common AC 200 / 220 V 50 / 60 Hz common
Operation		Diverting	ON-OFF	ON-OFF
Connection		A・B: JIS Rc screwed C: JIS R screwed	JIS 10K RF flanged	JIS 10K RF flanged
Material	Body	Brass	Ductile cast iron	Cast stainless steel
	Ball	Brass (HCr plating)	Stainless steel	Stainless steel
	Seat	PTFE	PTFE	PTFE
Size		15A-25A	65A-150A	65A-125A
Others		* The ambient temperature of 60˚C depends on the frequency of operation and the temperature of the fluid. Please contact us.	—	—

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Temperature Regulator

Temperature Regulator Selection

Application				Heating/ Cooling Fluid Max. Pressure (MPa)	Heated/Cooled Temperature Range (˚C)	Model	Type		Page
Steam	Hot Water	Cold Water	Refrigerant				External Pressure Type	Internal Pressure Type	
●	●			0.2-0.7	40-120	OB-2		●	216
●	●				15-100	OB-2G	●		216
●	●			0.5	40-120	OB-5		●	218
●	●					OB-6		●	218
●	●			0.7	40-120	OB-1		●	214
●	●				15-100	OB-1G	●		214
●				1.0	0-150	OB-30	●		210
●						OB-30U	●		210
●				2.0	-8-183	OB-2000	●		212
	●			1.7	0-150	OB-30	●		210
	●					OB-30U	●		210
		●	●	0.2-0.7	40-120	OB-4		●	218
		●	●		15-100	OB-4G	●		218
		●	●	0.7	40-120	OB-3		●	218
		●	●		15-100	OB-3G	●		218
		●	●	1.7	0-100	OB-31	●		210
		●	●			OB-31U	●		210

Selection of Temperature Regulator

What is a Temperature Regulator??

A temperature regulator, that is self-acting, automatically controls the steam/liquid flow, in response to the temperature changes in the cooled/heated media, and keeps the cooled/heated fluid temperature at a constant level.

Applications

Heating	Heating or Cooling

Types

Pilot type	Direct acting type
Recommended to be used when higher accuracy, larger capacity for steam, and wider temp. control range is required.	Applied to various temperature control applications with gradually changing continuous loads. Available with two types of valves — single and double. Single valve provides tight shutoff and double valves allow higher capacity as providing two flow paths.

External pressure bellows	Internal pressure bellows
Insusceptible to the ambient temperature and usable even at a place where the difference between the set temperature and the ambient temperature is 30˚C or less.	Recommended to be used at a place where the difference between the set temp. and the ambient temp. is 30˚C or more.

Major Products

OB-2000	OB-30・31	OB-1 Series
		
CP-2005		
		

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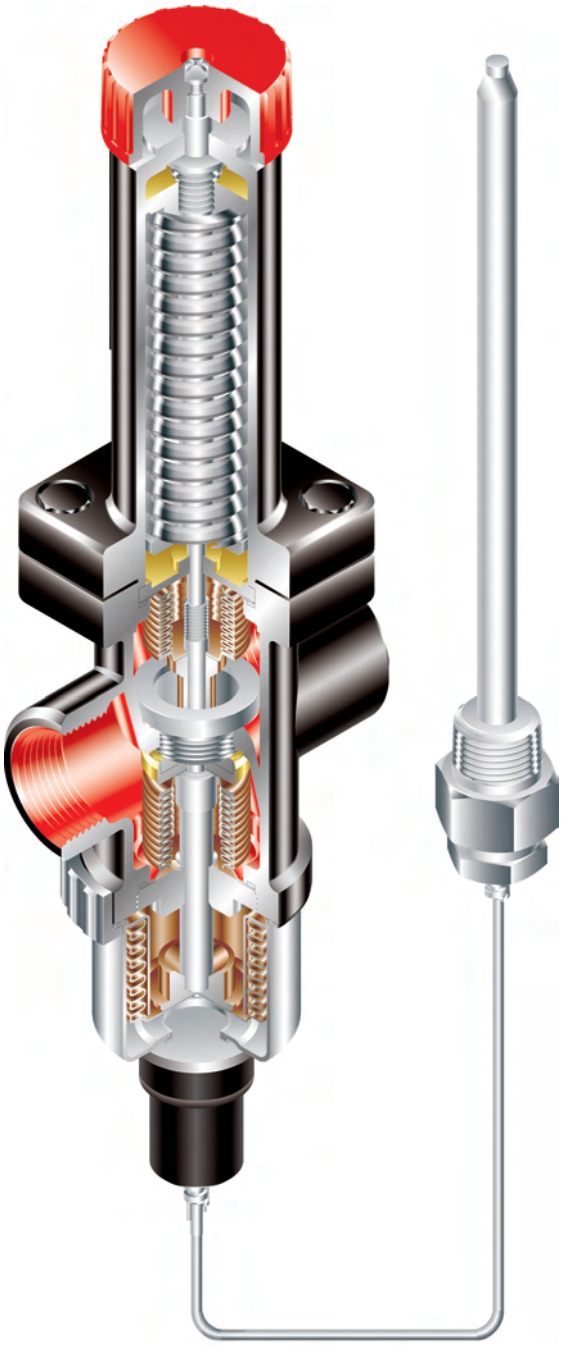
Features of Direct Acting Type <OB-30>

1. Pressure balancing mechanism
Equipped with two bellows called balance bellows which ensure stable temperature regulation, the OB-30 is not affected by inlet pressure fluctuation.

2. Thermal bulb
Thermal bulb can be installed in any position because the temperature is sensed by sealing gas which will not be mixed with fluid in case of breakage. It is especially recommended to the food processing industry.

3. High durability and sealing function
Stainless steel and PTFE materials are used for the valve disc, which ensures high durability and sealing function.



4: Variations

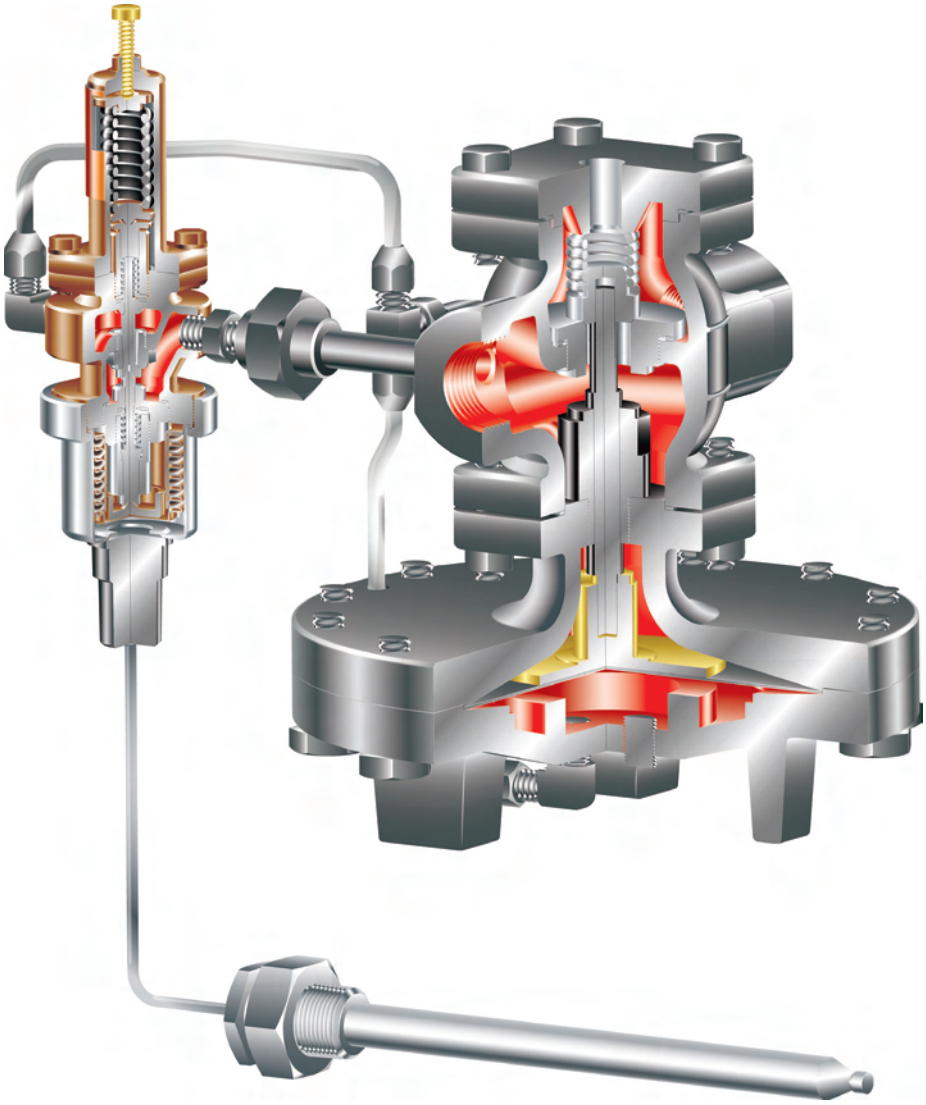

OB-30


OB-30U


OB-31


OB-31U

Features of Pilot Operated Type <OB-2000>



1. Great accuracy

Temperature pilot controls steam pressure to main diaphragm which forces to open main valve. Large diaphragm can sense and respond even with small changes in steam load. Adoption of this mechanism gives great accuracy even under fluctuation of temperature or wide range of steam loads.

2. Fast response

Thermal bulb is aimed at cooperating quick response and accurate temperature sensing. Hence, thermal bulb is filled with gas and designed as small as possible. This unique design allows fast response in controlling temperature differences.

3. Variations

By installing a pressure pilot, it can be used for applications requiring pressure and temperature control (CP-2005). Refer to advantage of the CP-2005 on page 29 and 204.

CP-2005

Pressure & temperature control

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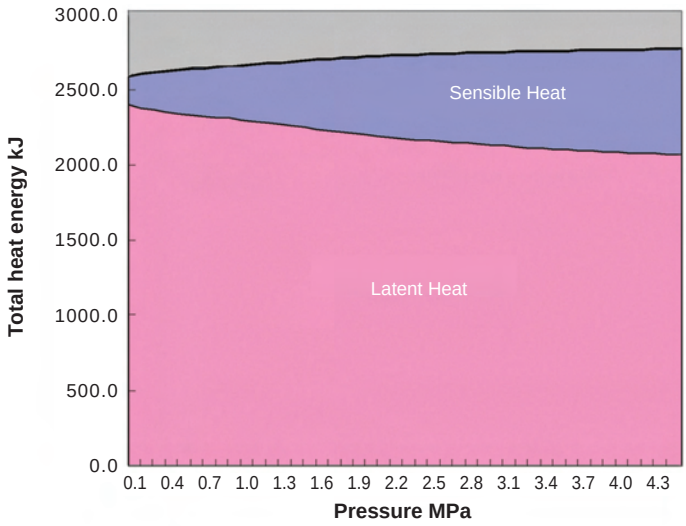
Advantage of YOSHITAKE Product: CP-2005

Energy saving is a critical issue that all of us must be conscious of in daily life. Using a temperature regulating valve with pressure control pilot guides your activity to the energy saving.

Beneficial Use of Latent Heat Energy

As the pressure of saturated steam decreases, sensible heat falls while latent heat rises. Latent heat is considered as useful heat energy for steam, and lower pressure provides a greater amount of latent heat.

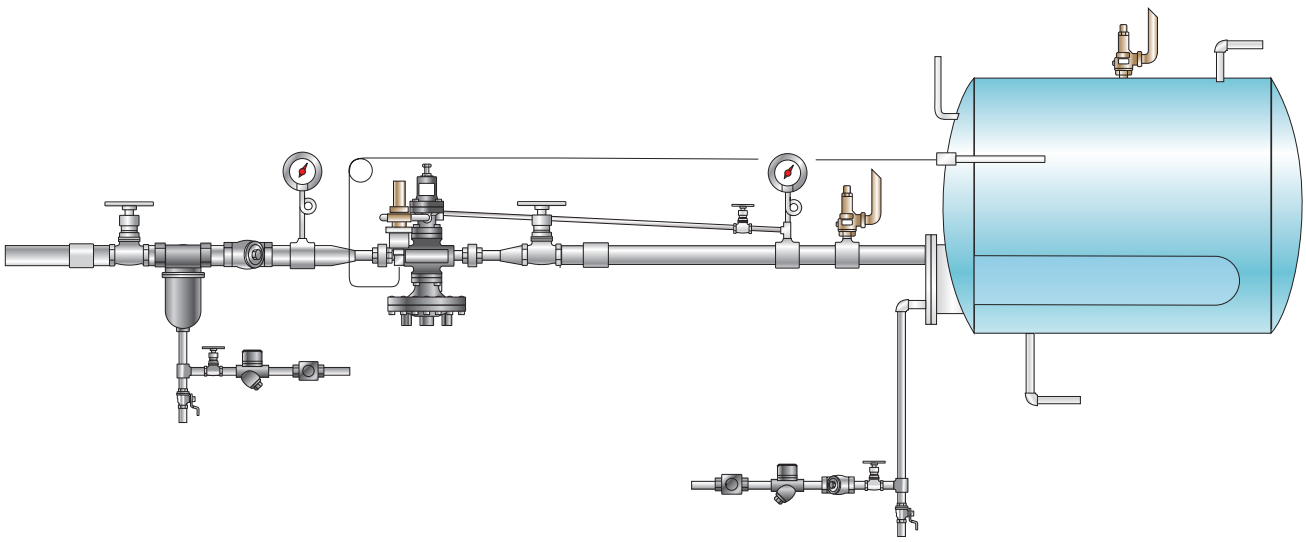


Benefit from Combination Valve CP-2005

The CP-2005 is combination of main body and both temperature & pressure pilot.
Self-acting temperature and pressure pilots control the main valve operation.

Advantages of the CP-2005

- Controlling and reducing pressure to maximise latent heat.
- Providing accurate operation that responds to the changes in steam loads with wide range ability.
- Applicable to dead-end service.



Calculation Formula for Cv Value

〈For steam〉

When $P_2 > \frac{P_1}{2}$

$$Cv = \frac{Wk}{138\sqrt{\Delta P\,(P_1 + P_2)}}$$

When $P_2 = \leqq \frac{P_1}{2}$

$$Cv = \frac{Wk}{120P_1}$$

〈For liquid〉

$$Cv = \frac{0.365V\sqrt{G}}{\sqrt{\Delta P}}$$

W: Max. flow rate of steam [kg/h]
P_1: Inlet pressure [MPa・A]
P_2: Outlet pressure [MPa・A]
ΔP: $P_1 - P_2$ [MPa]
k : 1 + 0.0013 x {superheated steam temperature [˚C] – saturated steam temperature [˚C]}
G : Specific gravity (against water in the case of fluid)
V : Max. flow rate of fluid [m^3/h]
Cv: Cv value of each nominal size

Cv Value Table

Model \ Nominal size	15A	20A	25A	32A	40A	50A	65A	80A	100A	125A	150A
OB-30・31	0.8	1	1.2	—	—	—	—	—	—	—	—
OB-2000	5.0	7.2	10.9	14.3	18.8	32	60	78	120	—	—
OB-1・1G	2	2	4	7	10	—	—	—	—	—	—
OB-2・2G	2	2	4	7	10	14	21	27	42	72	94
OB-3・3G	2	2	4	7	10	—	—	—	—	—	—
OB-4・4G	2	2	4	7	10	14	21	27	42	72	94
OB-5	1	1	2	—	—	—	—	—	—	—	—
OB-6	1	1	2	—	—	—	—	—	—	—	—

Point to Remember when Selecting the Size

- If system has small capacity and seat leakage become a problem, select single valve type such as the OB-30 Series, OB-5 or OB-6.
- Differential pressure between inlet and outlet of temperature regulator should be 0.05 MPa in principle.
- It is recommended that inlet pressure be 0.2-0.3 MPa to obtain the best performance of the temperature regulator and its longer product life.

Formula for Calculating Necessary Steam Volume

<Calculation formula>
The quantity of steam required to increase the temperature of Q kg of water by B˚C in time A (h) is:

$$W = \frac{B \times Q}{500 \times A}$$

Select a nominal size by applying the calculated quantity of steam W and the steam pressure P to the flow rate chart for nominal size selection.

<Calculation example>
When increasing the temperature of 7000 kg of water from 20˚C to 60˚C in an hour with 0.5 MPa steam

$$W = \frac{(60 - 20) \times 7000}{500 \times 1} = 560\ (kg/h)$$

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Guidelines for Temperature Regulator OB-30 Series

Precautions during Installation

●Installation of body

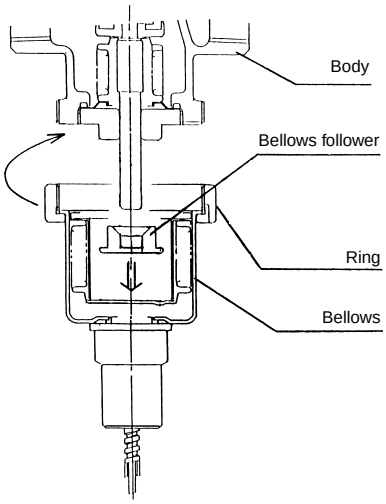
1. Be sure not to lose the bellows follower (attached component).
2. Install the temperature regulator perpendicularly to horizontal piping with the handle facing upward.
3. Check the direction of the temperature regulator so that the fluid flowing and the arrow marked on the body are in the same direction.
4. Be sure to install pressure gauge, strainer and bypass line to the piping (see "Piping Example" below).
5. The pressure of heating or cooling fluid should be reduced with a reducing valve if it exceeds the maximum pressure.
6. Completely discharge the fluid inside the piping and close the stop valves installed at before and after the temperature regulator before stopping operation of the product for an extended period.
7. Be sure to remove foreign matter from the piping through the bypass line at the starting before operating the temperature regulator.

●Installation of thermal bulb

1. Although the thermal bulb can be mounted in any posture, make sure that more than 3/4 of its total length is in direct contact with the fluid to be heated or cooled.
2. Screw on bushing first, then use washer of packing to secure the thermal bulb.
3. The bend radius of the capillary tube should be more than 40 mm. Avoid bending at a sharp angle, twisting or pulling it with force.
4. Install the thermometer close to the thermal bulb.
5. When inserting the thermal bulb into the piping for temperature detection, it should be installed at a point where the circulation is best.

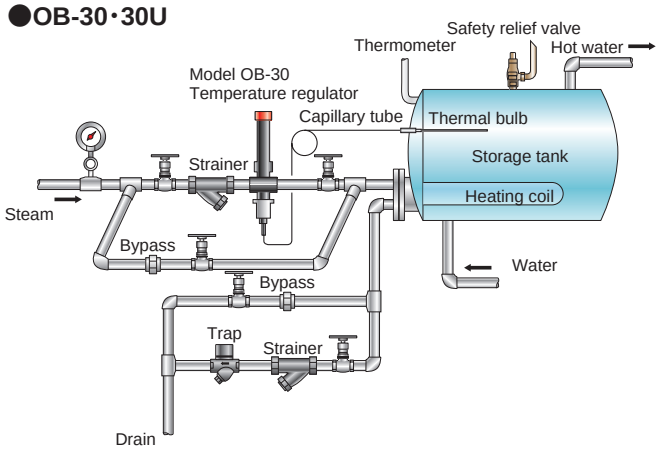
●Assembly of body and thermal bulb

Install the bellows follower into the bellows at thermal bulb with its flat surface facing downward and then screw it into the lower surface of the body by the ring. During the assembly, it makes assembly easy to loosen the handle to direction of the "Low" position.

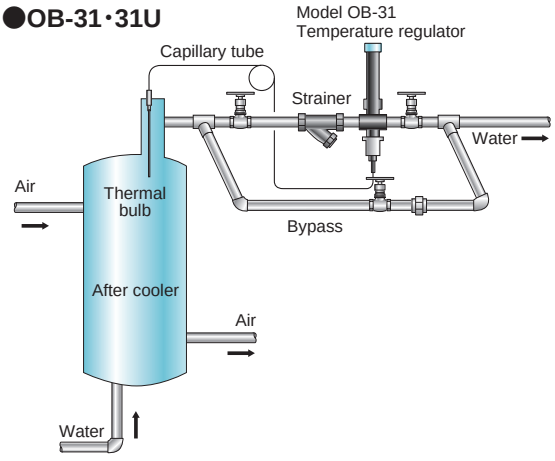


Piping Example

●OB-30・30U



●OB-31・31U



Guidelines for Temperature Regulator OB-2000 Series

Precautions during Installation

●Installation of main valve

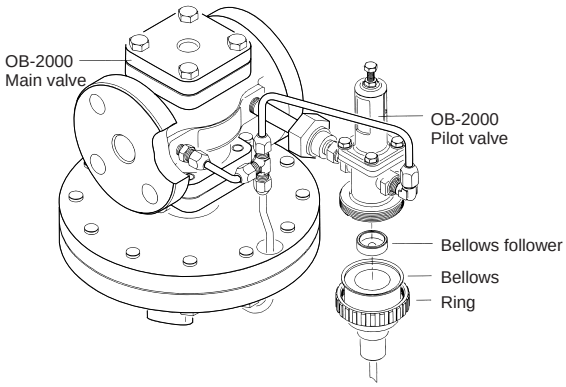
1. Be sure that there are no foreign matters or scales inside the piping before plumbing.
2. Install the temperature regulator perpendicularly to horizontal piping with the handle facing upward.
3. Check the direction of the temperature regulator so that the fluid flowing and the arrow marked on the body are in the same direction.
4. Be sure to install pressure gauge, strainer and bypass line to the piping (see "Piping Example" below).
5. The pressure of heating or cooling fluid should be reduced with a reducing valve if it exceeds the maximum pressure.
6. Completely discharge the fluid inside the piping and close the stop valves installed at before and after the temperature regulator before stopping operation of the product for an extended period.
7. Be sure to remove foreign matter from the piping through the bypass line at the starting before operating the temperature regulator.

●Installation of thermal bulb

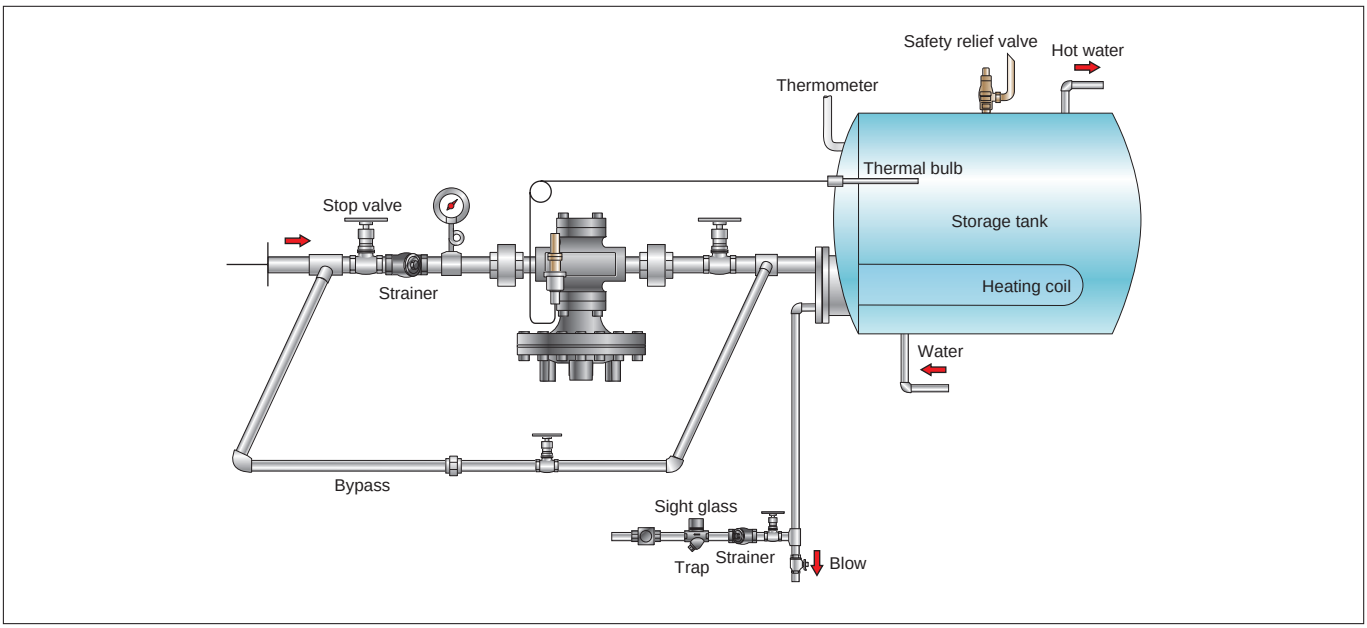
1. Although the thermal bulb can be mounted in any posture, make sure that more than 3/4 of its total length is in direct contact with the fluid to be heated.
2. Screw on bushing first, then use washer of packing to secure the thermal bulb.
3. The bend radius of the capillary tube should be more than 40 mm. Avoid bending at a sharp angle, twisting or pulling it with force.
4. Install the thermometer close to the thermal bulb.
5. When inserting the thermal bulb into the piping for temperature detection, it should be installed at a point where the circulation is best.

●Assembly of pilot valve body and thermal bulb

Install the bellows follower into the bellows at thermal bulb with its flat surface facing downward and then screw the ring to assemble the bellows follower.



Piping Example



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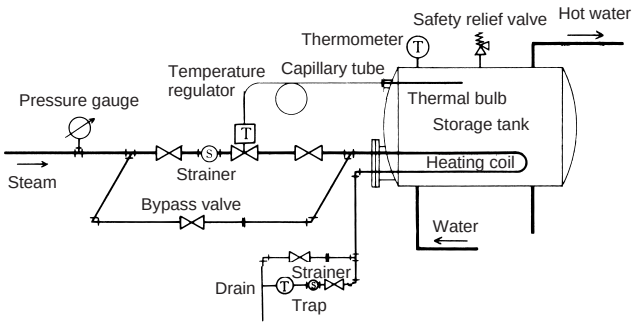
Guidelines for Temperature Regulator OB-1 to 6 Series

●Installation of body

1. Install the temperature regulator vertically to horizontal piping with the frame facing upward.
2. Be sure to install the temperature regulator on the place below the preset temperature. If the ambient temperature exceeds the preset temperature, it leads to the product malfunction.
3. Be sure to install pressure gauge, strainer and bypass line to the piping (see Fig. 1 below).
4. The pressure of heating or cooling fluid should be reduced with a reducing valve if it exceeds the maximum pressure.
5. Do not apply an excessive load, torque or vibration to the product during plumbing.
6. Completely discharge the fluid inside the piping and close the stop valves installed at before and after the temperature regulator before stopping operation of the product for an extended period.
7. Be sure to remove foreign matter from the piping through the bypass line at the ventilation before opening the temperature regulator circuit.

〈For liquid〉



〈For air〉

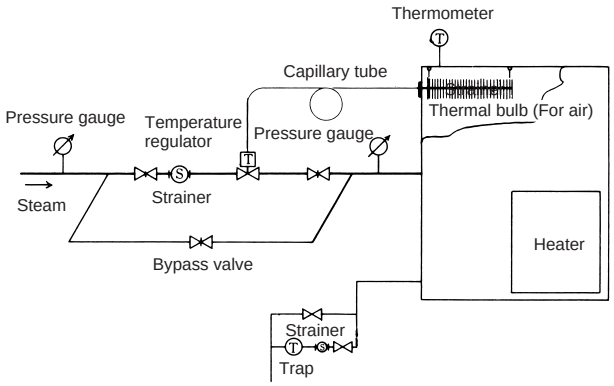
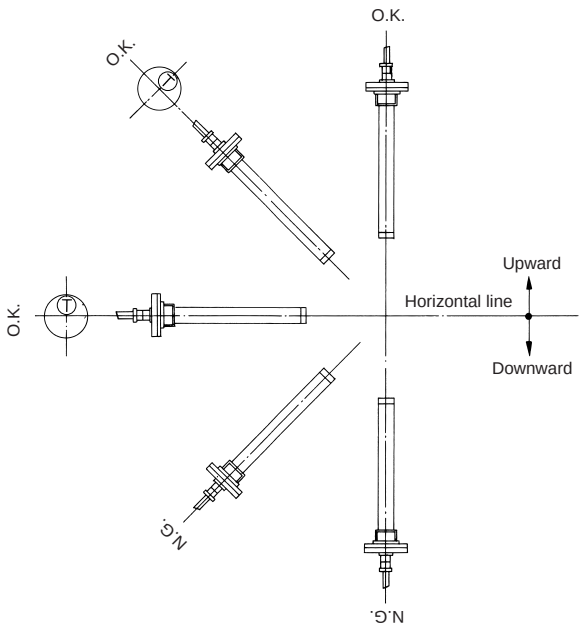


Fig. 1 Piping example

●Installation of thermal bulb

1. Avoid bending the capillary tube at a sharp angle, twisting or entangling.
2. Make sure that more than 3/4 of the thermal bulb's total length is in direct contact with the fluid to be heated or cooled.
3. Install the thermometer close to the thermal bulb.
4. Install the thermal bulb on the place where temperature detection is needed.
5. When plumbing, make sure that the connecting part of the thermal bulb is faced downward and (T) position at the flange or the joint nut section is located at uppermost part (see Fig. 2).
6. Remove the companion flange bolts from attaching part of the thermal bulb. Then screw the flange and insert the bulb to align holes of companion flange, tighten the bolts uniformly. Do not twist conduit pipe (except for the OB-5・6).

Fig. 2 Mounting postures of thermal bulb



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Guidelines for Temperature Regulator OB-1 to 6 Series

Errors of Set Temperature

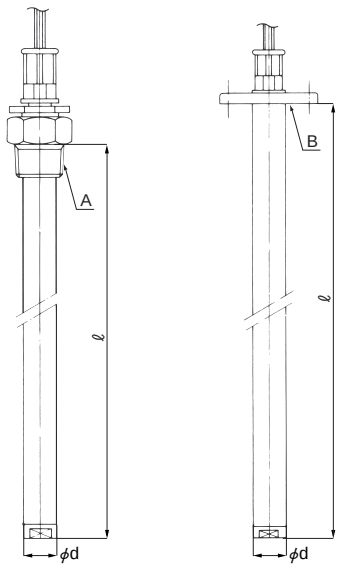
●Errors of set temperature varies on model, thermal bulb and capillary length as shown in the following chart.

Model	OB-1, 2, 3, 4, 5 and 6		OB-1G, 2G, 3G and 4G
Capillary length \ Application	For liquid	For gas	For liquid and gas
2 m	± 2˚C	± 3˚C	± 3.5˚C
2-3.5 m	± 2.5˚C	± 3.5˚C	± 4˚C
3.5-5 m	± 3˚C	± 4˚C	± 4.5˚C

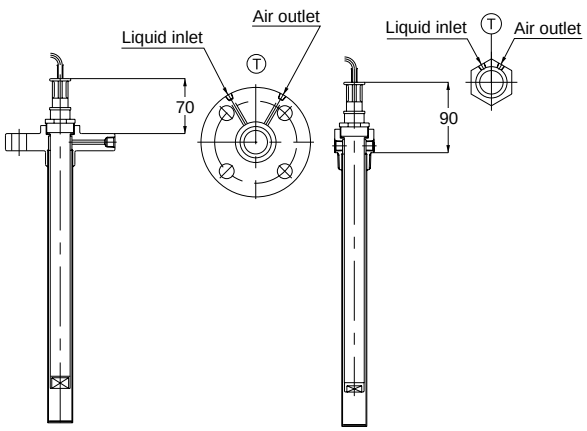
* If set temperature exceeds 100˚C, add ±1.0˚C to the above values.
* Errors of set temperature means values of maximum temperature range between closing and opening of valves, not those of controlled temperature range.

Special Specification of Thermal Bulb

〈For liquid〉



●Thermal bulb with thermal well



●List of minimum length (ℓ) for internal pressure type thermal bulb (mm)

A / B / d \ Nominal size	R 3/4	R1	R 1-1/4
B	20A or more	25A or more	32A or more
d	19	25	32
15-25A	300	200	200
32-40A	300	250	200
50A	350	300	200
65A	550	350	250
80A	650	350	300
100A	–	600	350
125A	–	600	440
150A	–	–	440

●List of minimum length (ℓ) for external pressure type thermal bulb (mm)

A / B / d \ Nominal size	R 3/4	R1	R 1-1/4
B	20A or more	25A or more	32A or more
d	19	25	32
15-25A	750	400	350
32-40A	750	400	350
50A	750	400	350
65A	750	400	350
80A	750	400	350
100A	–	600	440
125A	–	600	440
150A	–	–	–

●List of minimum length (ℓ) for internal high pressure type thermal bulb (mm)

A / B / d \ Nominal size	R 3/4	R1	R 1-1/4
B	20A or more	25A or more	32A or more
d	19	25	32
15-25A	350	200	200
32-40A	450	250	200
50A	550	300	200
65A	550	300	250
80A	–	550	300
100A	–	600	350
125A	–	–	440
150A	–	–	440

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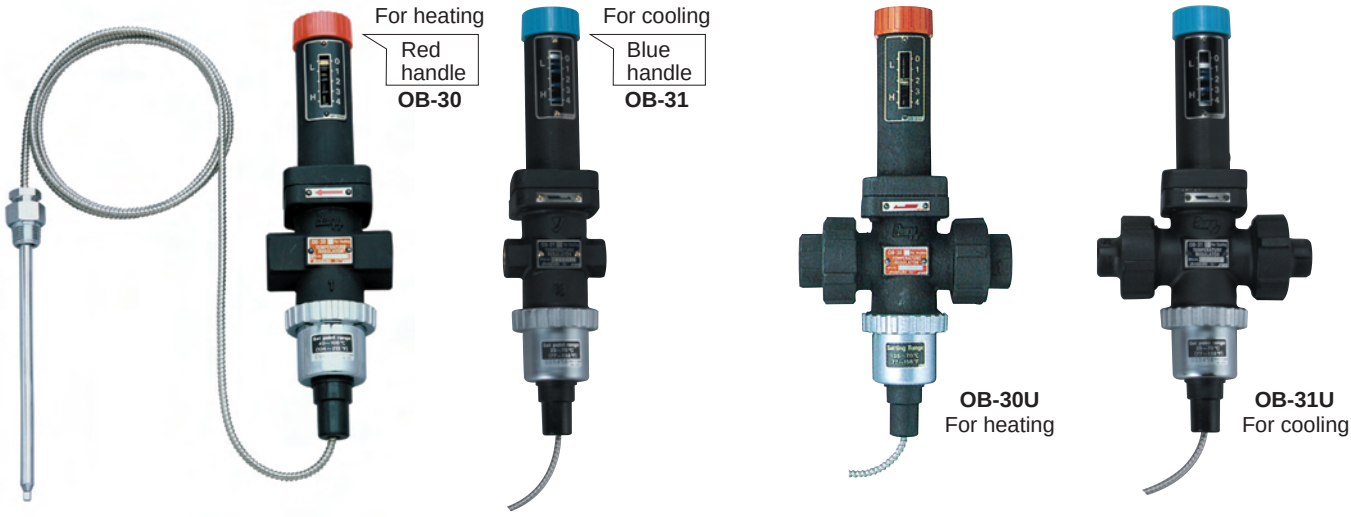
OB-30 Series



Features

1. Red handle type is for heating and blue handle type for cooling. It is possible to identify their application at a glance.
2. Excellent durability and high sealability ensured by valve part of stainless steel and fluororesin.
3. Single valve and balance bellows structure offers stable temperature control without being affected by inlet pressure fluctuations.
4. Easy changeable thermal specification by easy attachment and detachment of the body and thermal bulb.
5. Wide temperature adjusting range, applicable to wide variety of applications.
6. The thermal bulb is usable for heating and cooling, which is common for all sizes (15 to 25A). It is possible to select models considering the temperature adjusting range only.
7. Easy setting of the initial temperature by handle operation.

Specifications

●Body

Model		OB-30	OB-30U	OB-31	OB-31U
Purpose		For heating		For cooling	
Application		Steam, Hot water		Cold water, Refrigerant	
Maximum pressure		1.0 MPa〔1.7 MPa for hot water〕		1.7 MPa	
Max. differential pressure		1.0 MPa			
Valve seat leakage		0.05% or less of rated flow rate			
Max. temperature		185˚C			
Material	Body	Cast bronze			
	Valve disc	PTFE			
	Valve seat	Stainless steel			
Connection		JIS Rc screwed	JIS Rc screwed (union joint)	JIS Rc screwed	JIS Rc screwed (union joint)

●Sensor

Heated fluid		Cold and hot water, Oil, Liquid
Cooled fluid		
Maximum pressure		1.0 MPa
Material	Thermal bulb	Copper pipe (nickel chrome plated)
	Capillary	Copper pipe
	Capillary tube	Stainless steel
Standard capillary length		2 m
Connection		JIS Rc screwed

・Available with thermal well (stainless steel made).
・Available with capillary of 3 or 5 meter.

Temperature Adjusting Range

Temperature adjusting range (˚C)	Withstand temperature (˚C)
0-35	75
25-70	110
40-100	140
60-130	170
70-150	190

- The term "withstand temperature" means the temperature from pressure resistance of the bellows.
- The maximum temperature of the thermal bulb for cooling is 100˚C.

Dimensions (mm) and Weights (kg)

●Body (OB-30・31)

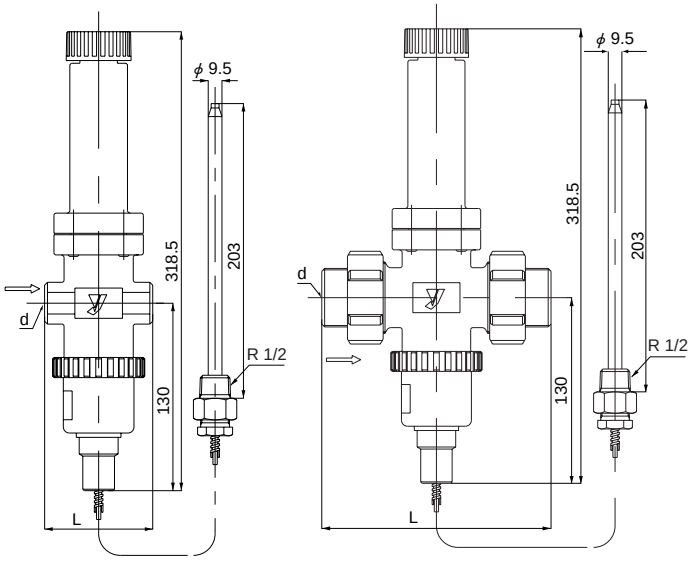
Nominal size	d	OB-30・31	
		L	Body weight
15A	Rc 1/2	75	2.1
20A	Rc 3/4	80	2.2
25A	Rc 1	90	2.4

●Body (OB-30U・31U)

Nominal size	d	OB-30U・31U	
		L	Body weight
15A	Rc 1/2	160	3.1
20A	Rc 3/4	160	3.1
25A	Rc 1	160	3.1

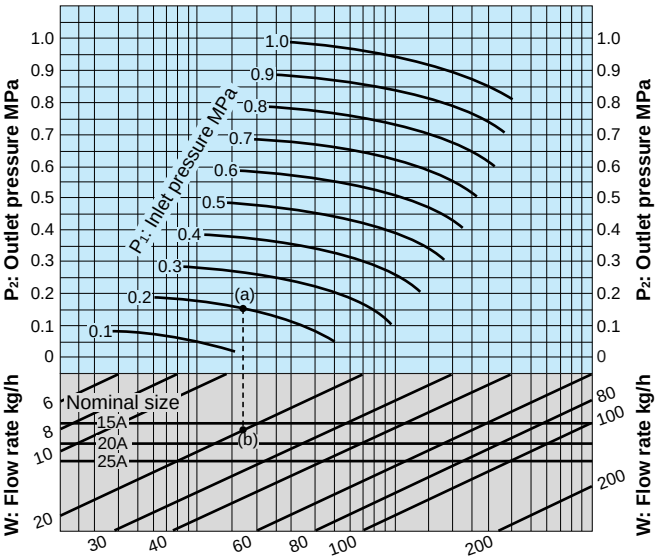
●Sensor (Common to OB-30・31・30U・31U)

Capillary length	2 m
Weight	0.6 kg



OB-30 OB-30U

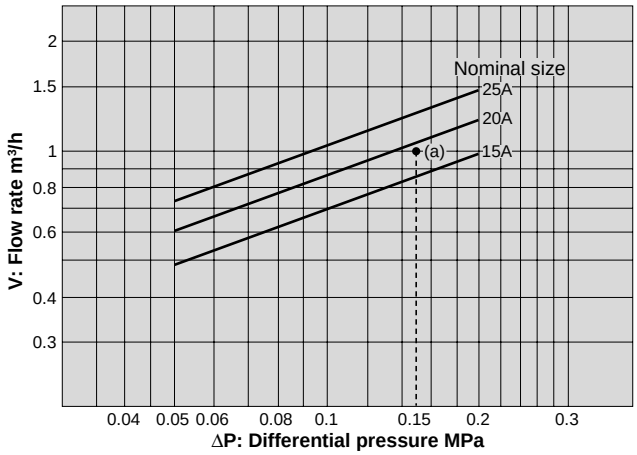
OB-30・30U Nominal Size Selection Chart (For Steam)



How to use the chart

When selecting the nominal size of a temperature regulator whose inlet pressure (P_1), outlet pressure (P_2), and steam flow rate are 0.2 MPa, 0.15 MPa, and 20 kg/h, respectively, first find intersection point (a) of the inlet pressure of 0.2 MPa and the outlet pressure of 0.15 MPa. Trace down vertically from this intersection point (a) to find intersection point (b) with the flow rate of 20 kg/h. Since this intersection point (b) lies between nominal sizes 15A and 20A, select the larger one, 20A.

OB-31・31U Nominal Size Selection Chart (For Water)



How to use the chart

When selecting the nominal size of a temperature regulator whose inlet pressure, outlet pressure, and flow rate are 0.3 MPa, 0.15 MPa, and 1 m³/h, respectively, first find intersection point (a) of the differential pressure (ΔP) of 0.15 MPa (0.3 MPa − 0.15 MPa) before and after the valve and the flow rate of 1 m³/h. Since this intersection point (a) lies between nominal sizes 15A and 20A, select the larger one, 20A.

- When the OB-30 or OB-30U is used and the fluid is hot water, use the selection chart shown above.

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OB-2000

Features

1. Large capacity.
2. Excellent sealability ensured by the spherical valve.
3. Wide temperature adjusting range. The thermal bulb can be installed in any direction.
4. Since the body and the thermal bulb are easy to attach and detach, they can be replaced easily for thermal specification change.

OB-2000 Flanged type

Specifications

Model		OB-2000	
Application	Heating	Steam	
	Heated	Cold and hot water, Oil, Non-dangerous fluids	
Maximum Pressure	Body	2.0 MPa *1	
	Thermal bulb	1.0 MPa	
Minimum differential pressure		0.05 MPa	
Max. temperature		220˚C	
Temperature adjusting range		-8 - 183˚C	
Valve seat leakage		0.01% or less of rated flow rate	
Material	Body	Ductile cast iron	
	Main valve, valve seat	Stainless steel	
	Diaphragm	Stainless steel	
	Pilot valve	Stainless steel	
	Pilot valve seat	Stainless steel	
	Thermal bulb	Copper pipe (nickel chrome plated)	
Standard capillary length		2 m	
Connection		JIS Rc screwed	JIS 10K FF, 20K RF flanged

*1 Maximum pressure of JIS 10K FF flanged is 1.0 MPa.
- Available with thermal well (stainless steel made).
- Available with capillary of 3 or 5 meter.

Temperature Adjusting Range

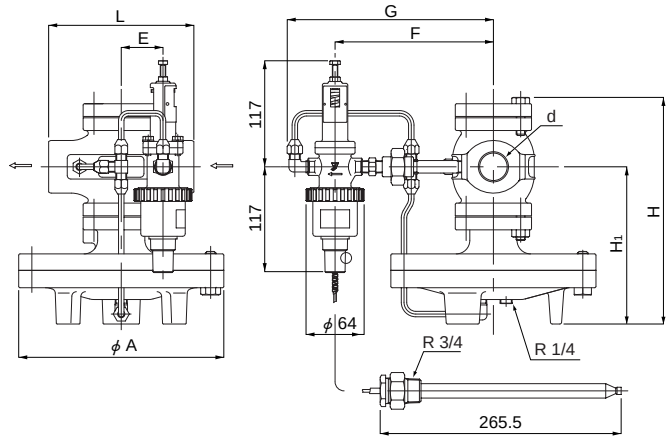
Temperature adjusting range (˚C)	Withstand temperature (˚C)
-8 - 15	35
10-36	56
30-62	82
55-94	114
80-127	147
115-183	203

- The term "withstand temperature" means the temperature from pressure resistance of the bellows.

Dimensions (mm) and Weights (kg)

●OB-2000 Screwed type

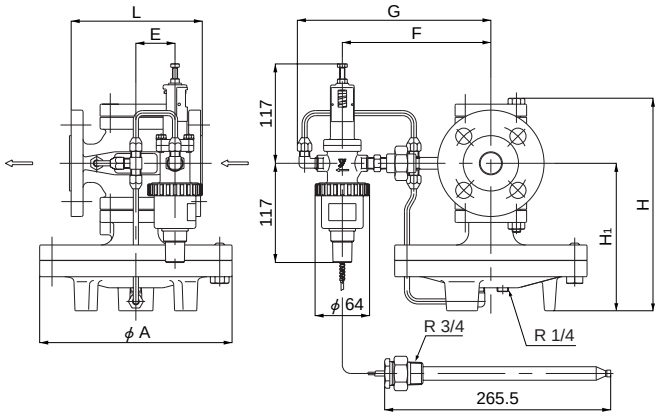
Nominal size	d	L	H_1	H	A	E	F	G	Weight
15A	Rc 1/2	150	170	244	200	45	169	222	14.1
20A	Rc 3/4	150	170	244	200	45	169	222	14.1
25A	Rc 1	160	175	251	226	46	174	227	18.1
32A	Rc 1-1/4	180	192	282	226	55	182	235	21.6
40A	Rc 1-1/2	180	192	282	226	55	182	235	21.6
50A	Rc 2	230	216	319	276	60	189	242	32.7



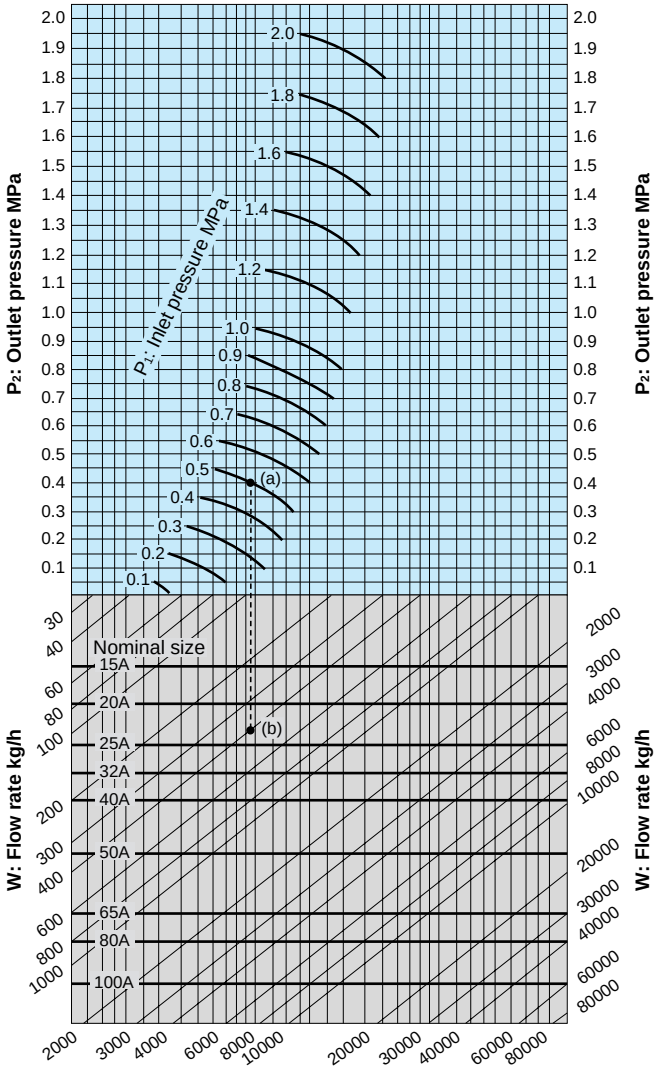
●OB-2000 Flanged type

Nominal size	L	H_1	H	A	E	F	G	Weight
15A	146 (142)	170	244	200	45	169	222	15.6 (15.4)
20A	146 (142)	170	244	200	45	169	222	16.1 (15.9)
25A	156 (152)	175	251	226	46	174	227	21.1 (20.7)
32A	176 (172)	192	282	226	55	182	235	24.1 (23.7)
40A	196 (192)	192	282	226	55	182	235	24.6 (24.2)
50A	222 (218)	216	319	276	60	189	242	35.7 (35.5)
65A	282 (278)	251	373	352	75	206	259	63.3 (63.0)
80A	302 (294)	265	399	352	80	217	270	70.3 (68.1)
100A	342 (330)	321	488	401	105	234	287	110.0 (106.4)

・The above values within parentheses are JIS 10K FF flanged.



Nominal Size Selection Chart (For Steam)



[Example]
When selecting the nominal size of a temperature regulator whose inlet pressure (P_1), outlet pressure (P_2), and steam flow rate are 0.5 MPa, 0.4 MPa, and 400 kg/h, respectively, first find intersection point (a) of the inlet pressure of 0.5 MPa and the outlet pressure of 0.4 MPa. Trace down vertically from this intersection point (a) to find intersection point (b) with the flow rate of 400 kg/h. Since this intersection point (b) lies between nominal sizes 20A and 25A, select the larger one, 25A.

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OB-1・1G

Features

1. Easy plumbing due to union type connection screw.
2. No need for adjusting tool due to the attached adjusting handle, making adjustment easy.
3. Double valve structure offers larger flow late than single valve type.
4. Excellent accuracy since special packing is used for spindle gland packing which affects opening/closing operation of the valve.
5. The OB-1G ensures distinguished temperature resistance due to external pressure type bellows.

Specifications

Model		OB-1	OB-1G
Application	Heating	Steam, Hot water	
	Heated	Cold and hot water, Oil, Non-dangerous fluids	
Maximum pressure	Body	0.7 MPa	
	Thermal bulb	1.0 MPa	
Max. temperature		180˚C	
Temperature adjusting range	For liquid	40-120˚C	15-100˚C
	For air	40-120˚C	15-100˚C
Ambient temperature		Set temperature -10˚C or less	Set temperature +30˚C or less
Material	Body	Cast bronze	
	Valve	Phosphor bronze	
	Valve spindle	Stainless steel	
	Bellows	Phosphor bronze	
	Thermal bulb	Stainless steel	
Standard capillary length		2 m	
Connection		JIS Rc screwed (union joint)	

- If the ambient temperature is higher than the set pressure or the set temperature is less than 40˚C, use the OB-1G (with external pressure type bellows).
- Available with capillary of up to 5 meter.
- Available with thermal well (SUS304 made or with a PTFE cap) for liquid.

Temperature Adjusting Range

●OB-1

Temperature adjusting range (˚C)		Withstand temperature (˚C)
For liquid	For air	
40-60	40-60	70
50-70	50-70	80
60-80	60-80	90
80-100	80-100	110
100-120	100-120	130

- The term "withstand temperature" means the temperature from pressure resistance of the bellows.
- Available with temperature adjusting range of 30˚C (the OB-1 only).

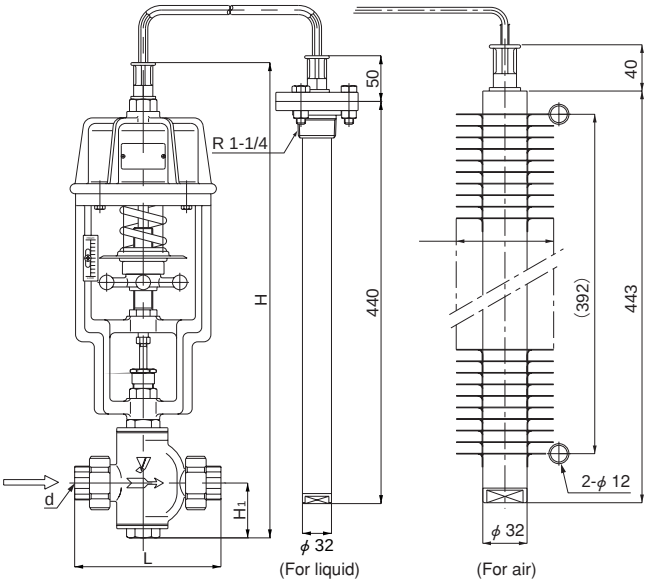
●OB-1G

Temperature adjusting range (˚C)		Withstand temperature (˚C)
For liquid	For air	
15-35	15-35	50
20-40	20-40	50
35-55	35-55	70
40-60	40-60	90
50-70	50-70	100
60-80	60-80	110
70-90	70-90	120
80-100	80-100	130

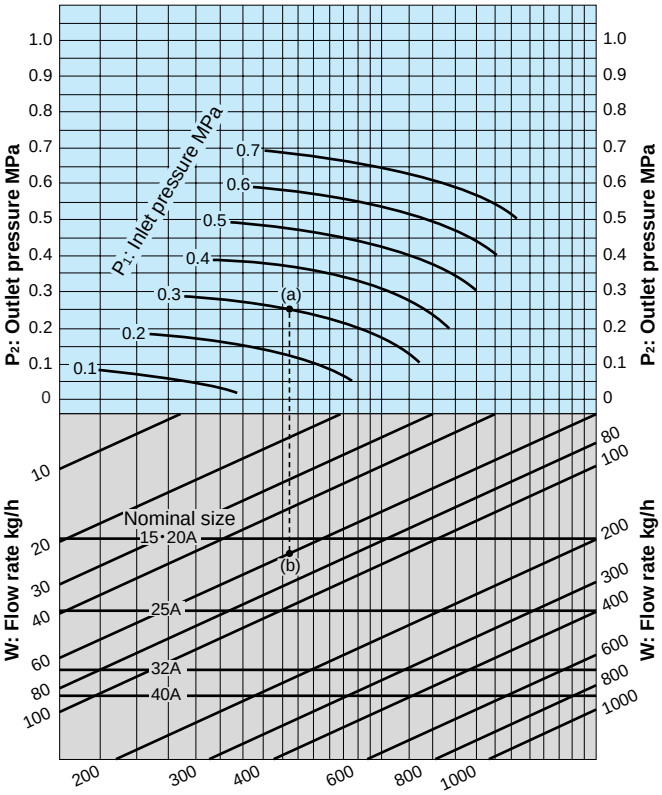
- The term "withstand temperature" means the temperature from pressure resistance of the bellows.

Dimensions (mm) and Weights (kg)

Nominal size	d	L	H_1	H	Weight
15A	Rc 1/2	148	55	510	11
20A	Rc 3/4	148	55	510	11
25A	Rc 1	160	60	520	12
32A	Rc 1-1/4	195	60	520	12
40A	Rc 1-1/2	210	65	530	13



Nominal Size Selection Chart (For Steam)



How to use the chart

When selecting the nominal size of a temperature regulator whose inlet pressure (P_1), outlet pressure (P_2), and steam flow rate are 0.3 MPa, 0.25 MPa, and 60 kg/h, respectively, first find intersection point (a) of the inlet pressure of 0.3 MPa and the outlet pressure of 0.25 MPa. Trace down vertically from this intersection point (a) to find intersection point (b) with the flow rate of 60 kg/h. Since this intersection point (b) lies between nominal sizes 15A or 20A and 25A, select the larger one, 25A.

Valve Seat Leakage

Unit: steam (kg/h), water (ℓ/h)

15A	20A	25A	32A	40A	50A	65A	80A	100A	125A	150A
1.5	1.5	1.8	2.4	3.0	3.6	4.8	6.0	7.2	9.0	10.8

* The values in the table above are max. valve seat leakage observed under the conditions of 0.5 MPa or max. pressure and set temperature + 5˚C (– 5˚C for cooling).

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OB-2·2G

Features

1. No need for adjusting tool due to the attached adjusting handle, making adjustment easy.
2. Double valve structure offers larger flow rate than single valve type.
3. Excellent accuracy since special packing is used for spindle gland packing which affects opening/closing operation of the valve.
4. The OB-2G ensures distinguished temperature resistance due to an external pressure type bellows.

Specifications

Model		OB-2	OB-2G
Application	Heating	Steam, Hot water	
	Heated	Cold and hot water, Oil, Non-dangerous fluids	
Maximum pressure	Body	15A-40A: 0.7 MPa〔1.0 MPa〕 50A: 0.5 MPa〔0.7 MPa〕 65A: 0.5 MPa〔0.7 MPa〕 80A: 0.4 MPa〔0.5 MPa〕 100A: 0.4 MPa 125A: 0.2 MPa〔0.35 MPa〕 150A: 0.2 MPa	
	Thermal bulb	1.0 MPa	
Max. temperature		180˚C	
Temperature adjusting range	For liquid	40-120˚C	15-100˚C
	For air	40-120˚C	15-100˚C
Ambient temperature		Set temperature -10˚C or less	Set temperature +30˚C or less
Material	Body	Cast iron	
	Valve, valve seat	Phosphor bronze (stainless steel)	
	Valve spindle	Stainless steel	
	Bellows	Phosphor bronze	
	Thermal bulb	Stainless steel	
Standard capillary length		15A-80A: 2 m 100A-150A: 3 m	
Connection		JIS 10K FF flanged	

- If the ambient temperature is higher than the set pressure or the set temperature is less than 40˚C, use the OB-2G (with external pressure type bellows).
- If using at a pressure higher than 0.5 MPa, with stainless steel trim parts is recommended.
- Available with capillary of up to 5 meter.
- Available with of the values in the above parentheses.
- Available with thermal well (SUS304 made or with a PTFE cap) for liquid.

Temperature Adjusting Range

●OB-2

Temperature adjusting (˚C)		Withstand temperature (˚C)
For liquid	For air	
40-60	40-60	70
50-70	50-70	80
60-80	60-80	90
80-100	80-100	110
100-120	100-120	130

- The term "withstand temperature" means the temperature from pressure resistance of the bellows.
- Available with temperature adjusting range of 30˚C (the OB-2 only).

●OB-2G

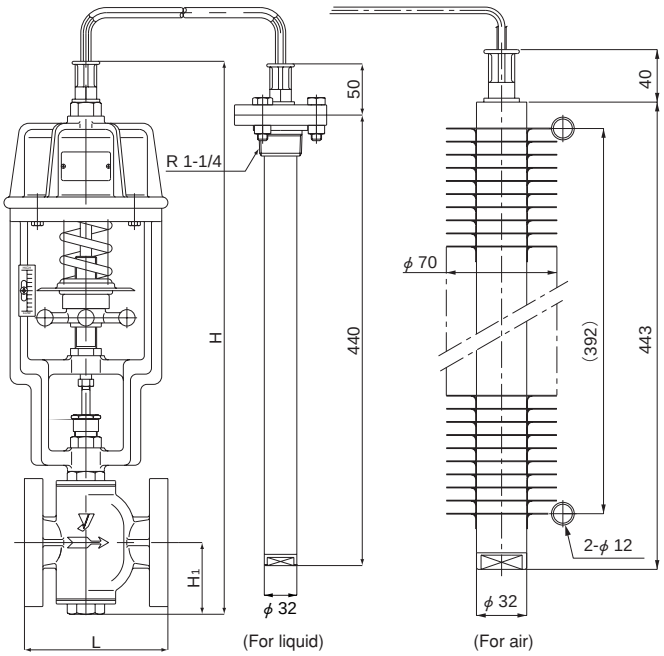
Temperature adjusting (˚C)		Withstand temperature (˚C)
For liquid	For air	
15-35	15-35	50
20-40	20-40	50
35-55	35-55	70
40-60	40-60	90
50-70	50-70	100
60-80	60-80	110
70-90	70-90	120
80-100	80-100	130

- The term "withstand temperature" means the temperature from pressure resistance of the bellows.

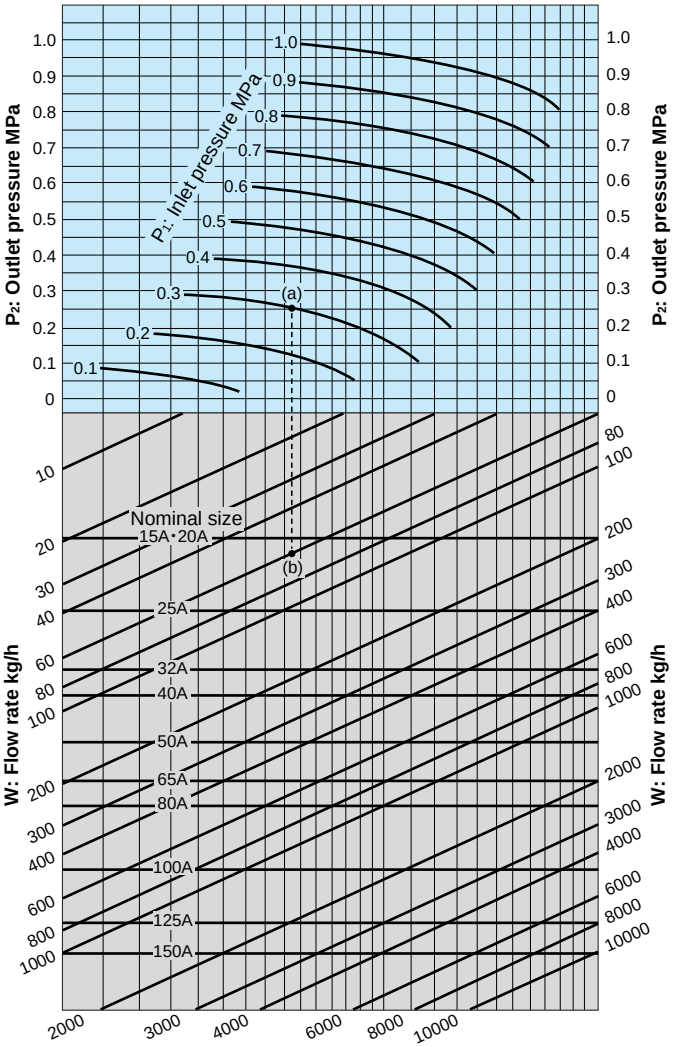
Dimensions (mm) and Weights (kg)

Nominal size	L	H_1	H	Weight
15A	126	60	520	15
20A	130	60	520	16
25A	140	70	540	18
32A	150	75	550	21
40A	160	75	550	23
50A	180	110	620	29
65A	215	125	650	38
80A	260	135	700	48
100A	300	160	750	58
125A	360	190	810	76
150A	382	220	980	125

・The OB-2G comes in nominal size up to 125A.



Nominal Size Selection Chart (For Steam)



How to use the chart

When selecting the nominal size of a temperature regulator whose inlet pressure (P_1), outlet pressure (P_2), and steam flow rate are 0.3 MPa, 0.25 MPa, and 60 kg/h, respectively, first find intersection point (a) of the inlet pressure of 0.3 MPa and the outlet pressure of 0.25 MPa. Trace down vertically from this intersection point (a) to find intersection point (b) with the flow rate of 60 kg/h. Since this intersection point (b) lies between nominal sizes 15A or 20A and 25A, select the larger one, 25A.

Valve Seat Leakage

Unit: steam (kg/h), water (ℓ/h)

15A	20A	25A	32A	40A	50A	65A	80A	100A	125A	150A
1.5	1.5	1.8	2.4	3.0	3.6	4.8	6.0	7.2	9.0	10.8

* The values in the table above are max. valve seat leakage observed under the conditions of 0.5 MPa or max. pressure and set temperature + 5˚C (– 5˚C for cooling).

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Feature		For cooling / Screwed	For cooling / External pressurized	For cooling / Flanged
Model		OB-3	OB-3G	OB-4
Picture				
Application	Cooling/Heating	Cold water, Refrigerant		Cold water, Refrigerant
	Cooled/Heated	Cold and hot water, Oil, Non-dangerous fluids		Cold and hot water, Oil, Non-dangerous fluids
Max. pressure	Body	0.7 MPa		0.2-0.7 MPa *
	Thermal bulb	1.0 MPa		1.0 MPa
Body max. temperature		180˚C		180˚C
Temperature adjusting range		4-120˚C	15-100˚C	4-120˚C
Ambient temperature		Set temp. –10˚C or less	Set temp. +30˚C or less	Set temp. –10˚C or less
Connection		JIS Rc screwed (union joint)		JIS 10K FF flanged
Material	Body	Cast bronze		Cast iron
	Valve	Phosphor bronze		Phosphor bronze (stainless steel)
	Valve seat	Phosphor bronze		Phosphor bronze (stainless steel)
	Valve spindle	Stainless steel		Stainless steel
	Bellows	Phosphor bronze		Phosphor bronze
	Thermal bulb	Stainless steel		Stainless steel
Standared capillary length		2 m		15A-80A: 2 m 100A-150A: 3 m
Size		15A-40A		15A-150A
Others		・If the ambient temperature is higher than the set pressure or the set temperature is less than 40˚C, use the OB-3G (with external pressure type bellows). ・Available with capillary of up to 5 meter. ・Available with thermal well (SUS304 made or with a PTFE cap) for liquid.	・Available with capillary of up to 5 meter. ・Available with thermal well (SUS304 made or with a PTFE cap) for liquid.	* Maximum pressure varies on the nominal size. ・If the ambient temperature is higher than the set pressure or the set temperature is less than 40˚C, use the OB-4G (with external pressure type bellows). ・Available with capillary of up to 5 meter. ・Available with thermal well (SUS304 made or with a PTFE cap) for liquid.

Feature		For cooling / External pressurized	For heating / Screwed	For heating / Flanged
Model		OB-4G	OB-5	OB-6
Picture				
Application	Cooling/Heating	Cold water, Refrigerant	Steam, Hot water	Steam, Hot water
	Cooled/Heated	Cold and hot water, Oil, Non-dangerous fluids	Cold and hot water, Oil, Non-dangerous fluids	Cold and hot water, Oil, Non-dangerous fluids
Max. pressure	Body	0.2-0.7 MPa *	0.5 MPa	0.5 MPa
	Thermal bulb	1.0 MPa	1.0 MPa	1.0 MPa
Body max. temperature		180˚C	180˚C	180˚C
Temperature adjusting range		15-100˚C	4-120˚C	4-120˚C
Ambient temperature		Set temp. +30˚C or less	Set temp. –10˚C or less	Set temp. –10˚C or less
Connection		JIS 10K FF flanged	JIS Rc screwed (union joint)	JIS 10K FF flanged
Material	Body	Cast iron	Cast bronze	Cast iron
	Valve	Phosphor bronze (stainless steel)	Stainless steel	Stainless steel
	Valve seat	Phosphor bronze (stainless steel)	Stainless steel	Stainless steel
	Valve spindle	Stainless steel	Stainless steel	Stainless steel
	Bellows	Phosphor bronze	Phosphor bronze	Phosphor bronze
	Thermal bulb	Stainless steel	Stainless steel	Stainless steel
Standared capillary length		15A-80A: 2 m 100A-150A: 3 m	2 m	2 m
Size		15A-150A	15A-25A	15A-25A
Others		* Maximum pressure varies on the nominal size. ・Available with capillary of up to 5 meter. ・Available with thermal well (SUS304 made or with a PTFE cap) for liquid.	・Available with capillary of up to 5 meter. ・Available with the OB-5G for low-temperature heating (15-35˚C, 20-40˚C, 35-55˚C). ・Available with thermal well (SUS304 made or with a PTFE cap) for liquid.	・Available with capillary of up to 5 meter. ・Available with the OB-6G for low-temperature heating (15-35˚C, 20-40˚C, 35-55˚C). ・Available with thermal well (SUS304 made or with a PTFE cap) for liquid.

Steam Trap

Assist Trap
Radiator Trap
Radiator Valve

Steam Trap/Assist Trap Selection

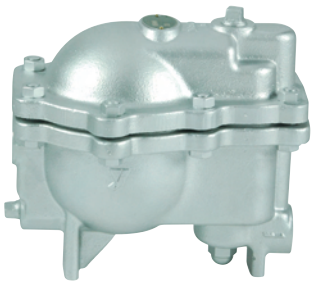
Installing Direction		Max. Pressure (MPa)	Max. Temperature (˚C)	Model	Type				Page
Horizontal	Vertical & Horizontal				Bucket	Float	Thermostatic	Disc	
●		0.3	150	TF-1		●			231
●		0.5	160	TFA-2000		●			232
●		0.7	170	TF-2		●			231
●		1.0	220	TB-5	●				233
	●	1.0	183	TSD-7				●	228
	●			TSD-7F				●	228
	●			TS-7			●		229
	●			TS-8			●		229
	●	2.0	220	TD-10NA				●	227
	●			TD-30NA				●	227
	●	4.2	425	TSD-42				●	226

Radiator Trap/Valve Selection

Application			Max. Pressure (MPa)	Max. Temperature (˚C)	Model	Type						Page
Steam	Condensate	Hot Water				Bellows	Wax	Manual	Angle	Straight	Horizontal Angle	
●			0.05	110	118 Series	●	●		●	●	●	238
		●	1.0	120		●	●		●	●	●	238
●		●	0.3	150	FV-2A			●	●			237
●		●			FV-2S			●		●		237
	●		0.1	120	TS-1A	●			●			234
	●				TS-1S	●				●		234
	●		0.2	135	TS-3A	●			●			235
	●				TS-3S	●				●		235
	●		0.35	150	TS-4A		●		●			236
	●				TS-4S		●			●		236
		●	0.6	120	HV-3A			●	●			238
		●			HV-3S			●		●		238
		●	1.0	120	109 Series			●	●	●		238

Selection of Steam Trap

If steam gives heat to an object and loses quantity of heat, it will condense and will return to warm water. This condensation water is called condensate. In steam transportation piping and the apparatus which uses steam, this condensate becomes obstructive existence and causes water hammer or decreases in thermal efficiency. In such steam systems, steam trap only discharges the unncessary condensate.

Applications	Steam transport pipe, Heat exchanger, Air-heater, Process heater	Heat exchanger, Air-heater, Process heater	Steam transport pipe, Radiator for heating
Types	Thermodynamics type	Mechanical type	Thermostatic type
	Actuates by the thermodynamic characteristics of steam and condensate.	Actuates by the specific gravity difference between steam and condensate.	Actuates by the temperature difference between steam and condensate.
Operations	Intermittent	Continuously	Intermittent
Air discharge	Excellent	Excellent	Excellent
Allowable back pressure	—	Excellent	Excellent
Tolerence of water hammer	Excellent	—	—
Installation	Free	Horizontal	Free
Weight and dimension	Small	Large	Small
Heat loss	Small	Large	Large
Action at failure	Valve open	Close valve	Close valve
Safety factor	4 or more	3 or more	3 or more
Major Products	 **TD-10NA**	 **TF-2**	 **TS-7**

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Note for Selecting Steam Trap

There are various kinds of steam trap classified by operation, discharge capacity, etc. In order to obtain the full benefit from the traps, selecting proper trap size and pressure is essential. The followings are considerations to select the proper traps.

1: Service point

Each service point has each requirements for steam traps. Please consider the following points to select the proper traps.

Steam piping / Header

・Not affected by outside temperature ・Air discharge at the starting system ・Small steam loss

At the end of piping

・Discharges mass volume at the starting ・Continuous blow ・Air discharge at the starting system

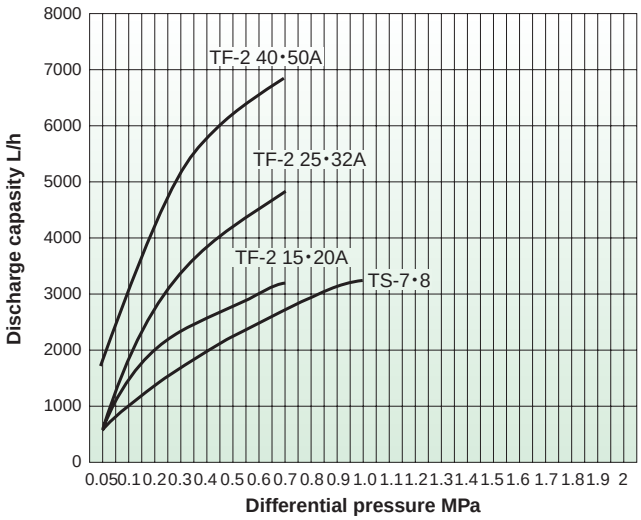
Equipment / process

・Operates under fluctuation of condensate volume ・High back pressure operation

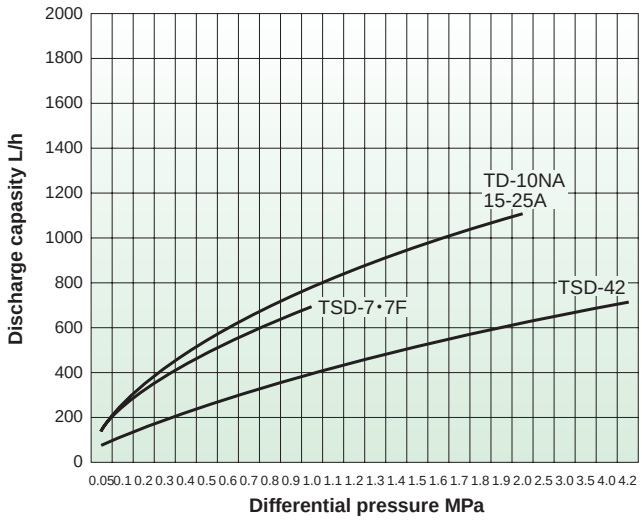
・Air discharge at the starting system ・No accumulation of condensate at the time of failure

2: Discharge capacity

●TS-7・8, TF-2



●TSD-42, TD-10NA, TSD-7・7F



3: Safety factor

The graph for discharge capacity is showing the capacity of discharging continuously. The trap requires the allowance to cover the amount of condensate fluctuation. Such allowance is the safety factor of steam trap.

For instance, safety factor 3 means that the steam trap discharging 900 kg/h is required to discharge condensation amount 300 kg/h.

Type	Thermodynamics			Mechanical	Thermostatics
Model	TSD-42	TD-10NA	TSD-7・7F	TF-2	TS-7
Safety factor	4 or more			3 or more	3 or more

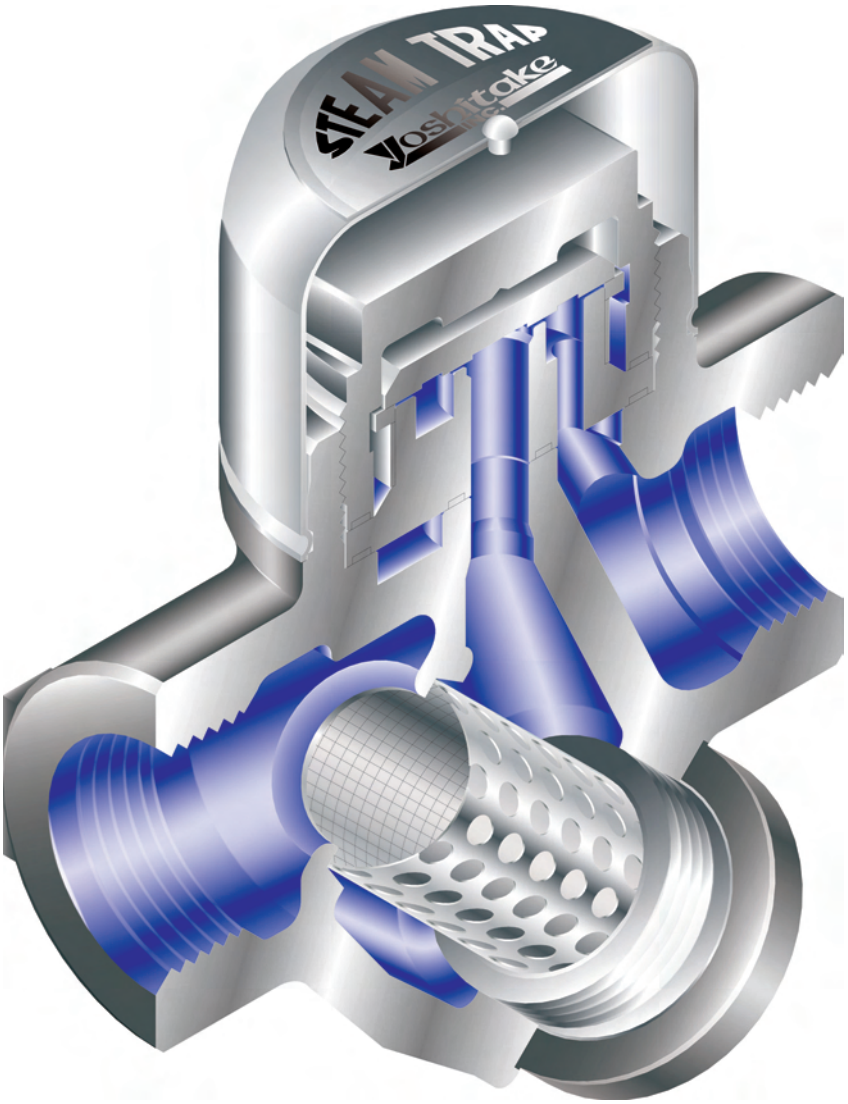
4: Differential pressure

Because of operation, allowable back pressure is less than 50% of inlet pressure for thermodynamics type. On thermostatic and float type, back pressure has no adverse effect on operation, but as back pressure approaches to inlet pressure, discharge becomes less since differential pressure will be low.

Features of Thermodynamics Type ＜TD-10NA＞

1: Bi-metal ring

If the inlet pressure rise up too fast in the starting time, due to high-speed air, a trap will be closed by the same principle as steam, and an “air-binding” will occur. This is cancelled with the bi-metal ring which starts to expand only by the temperature. Such function enables prompt discharge of cold water and air off at starting, and also results in efficient start-up of steam apparatus.



2: Insulation cover

When installed under cold ambient conditions, steam in chamber condensates faster than usual. This could make life of disc and valve seat shortened, due to too much wear by frequent on-off. To avoid this, the insulation cover prolongs condensation time of steam in chamber, and the frequent on-off operation of a disc is suppressed, and long durability is maintained. In addition, stable operation is obtained despite a drop in outside temperature.

3: Advantages

- Small, lightweight
- Installable in any direction
- Applicable on super heated steam

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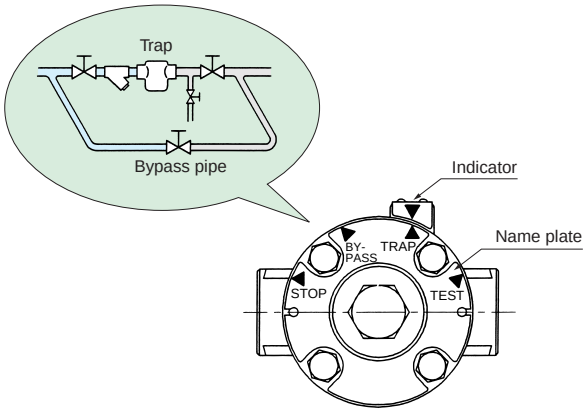
Features of Thermostatic Type ＜TS-7＞

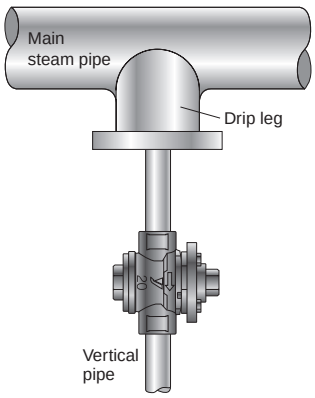
1: All-in-one

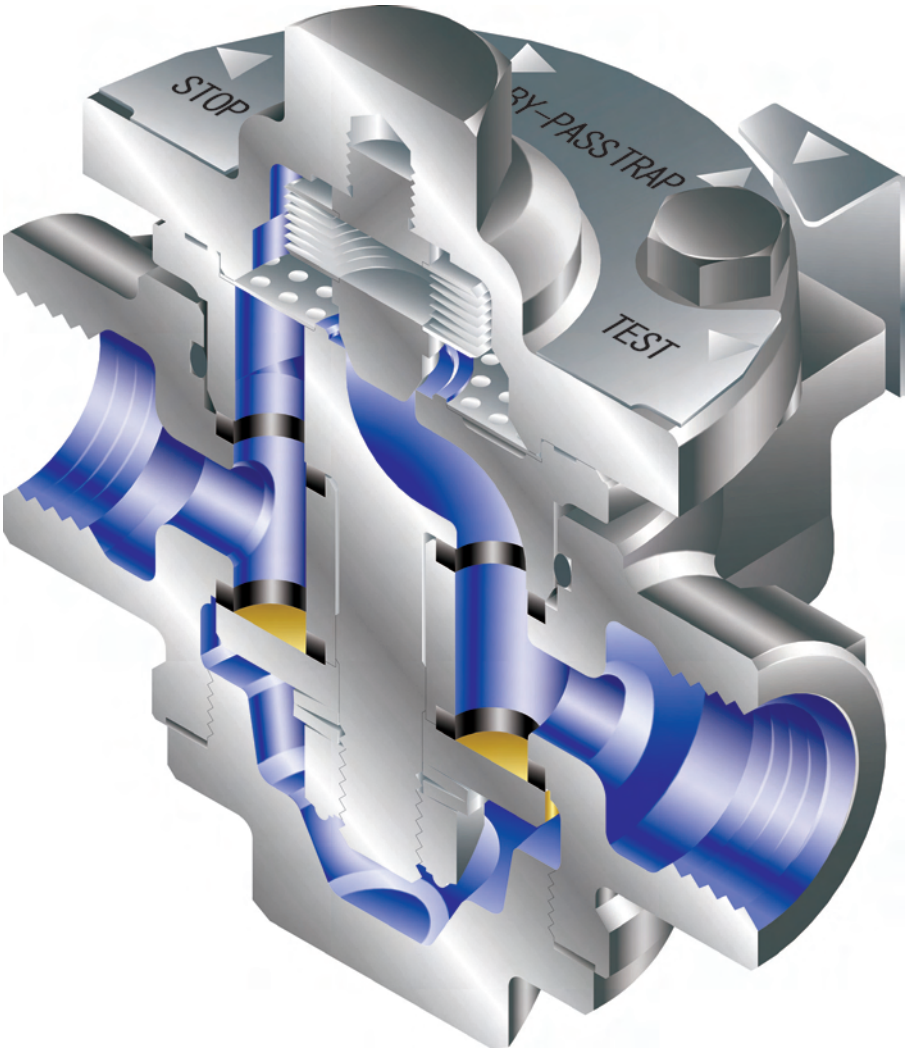
One valve can operate in four functions ——— “STOP,” “BY-PASS,” “TRAP,” and “TEST.” Installing TS-trap can save both space and installation cost!



2: Easy maintenance and installation

At "BY-PASS" position, the built-in strainer can be easily cleaned up and the bellows can be inspected without disturbance of flowing fluids. And, valve can be installed in any direction requiring only limited space.





3: Advantages

- Large discharge capacity
- Noiseless operation
- Small, lightweight

Guidelines for Installing Steam Trap

● Be sure to install a steam trap at a place where maintenance and inspections can be implemented.

Fig. 1 Standard Piping Example of Steam Trap

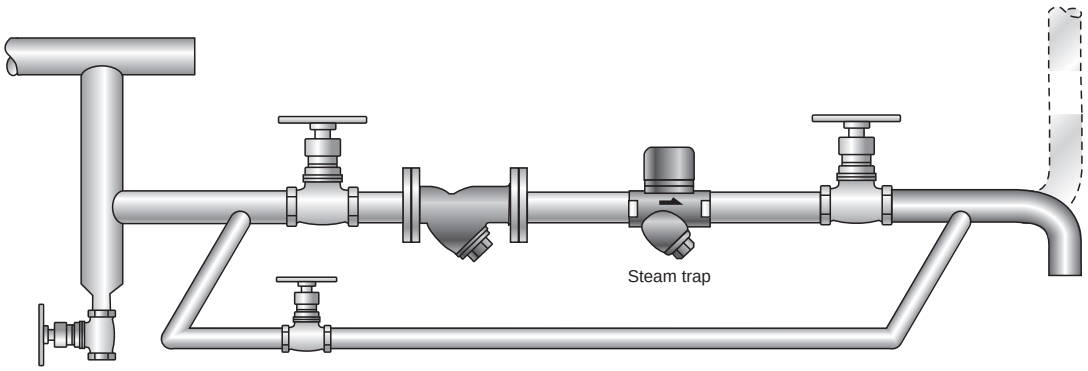
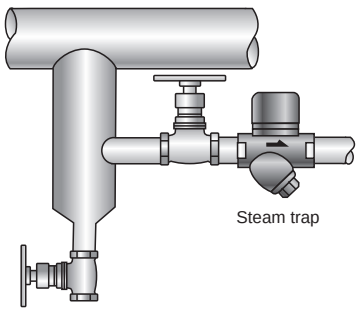
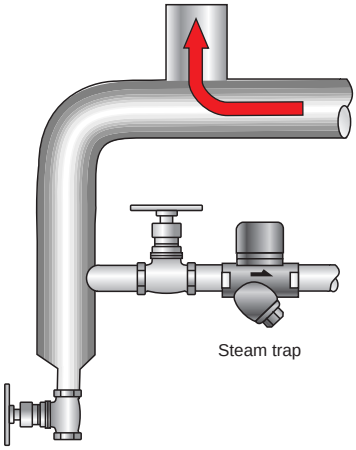


Fig. 2 Trapping of Main Steam Piping

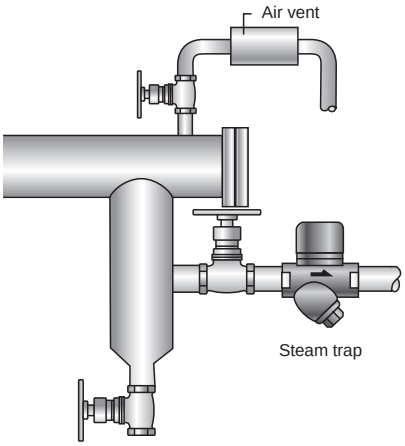
●Trapping at middle of piping



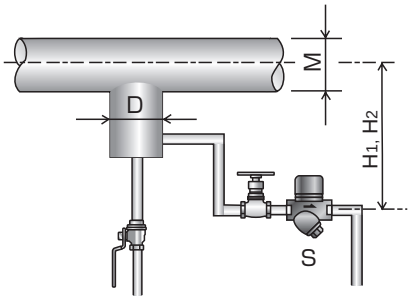
●Trapping at raiser



●Trapping at pipe end



●Drip leg sizing



M	D	H1	H2	S
20A	20A	260	720	15A
25A	25A	260	720	15A
40A	40A	260	720	15A
50A	50A	260	720	20A
80A	80A	260	720	25A
100A	100A	260	720	25A
200A	100A	300	720	40A
250A	125A	380	720	50A

・H_1 (mm) for manual warmup
・H_2 (mm) for automatic warmup

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TSD-42

Features

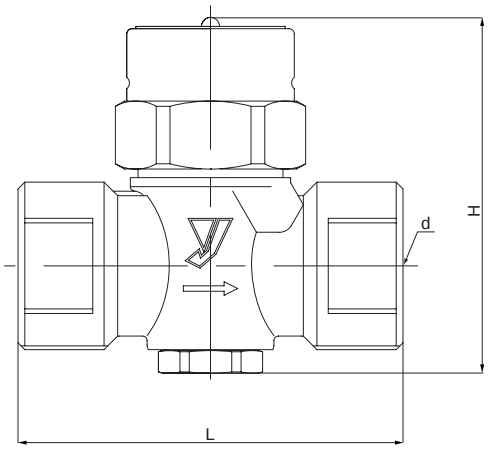
1. Stainless steel used for main parts, making a contribution to improved corrosion resistance.
2. Since it can operate under 425˚C temperature and 4.2 MPa pressure conditions, it can be applied in various types of industries, such as heavy, light, and general industries.
3. Bimetal solves air-binding problem and ensures a smooth discharge of cold condensate or air at the start of operation, enabling steam equipment to efficiently start to run.
4. "Insulation cover" avoids frequent on-off operation.
5. Plumbing is easy to perform because it can be installed vertically or horizontally as desired.
6. Built-in strainer eliminates requirement for strainer before the trap.

Specifications

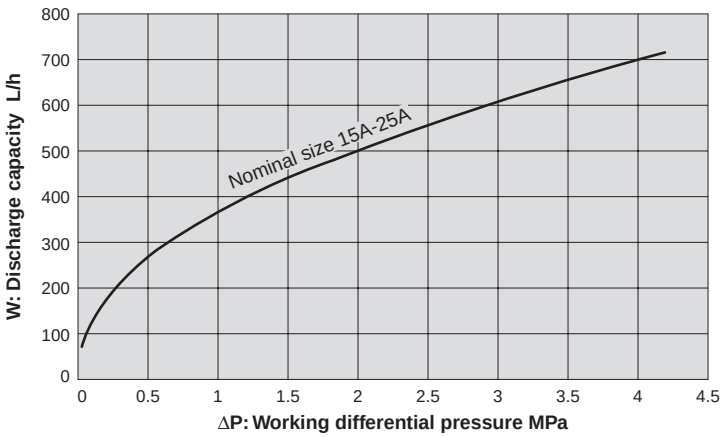
Model		TSD-42
Application		Steam condensate
Working pressure		0.035-4.2 MPa
Allowable back pressure		50% or less of inlet pressure
Maximum temperature		425˚C
Material	Body	Stainless steel (SCS2A)
	Disc, seat	Stainless steel (special heat treatment)
Connection		JIS Rc, NPT, BSPT screwed

Dimensions (mm) and Weights (kg)

Nominal size	d	L	H	Weight
15A	Rc 1/2	78	76	0.6
20A	Rc 3/4	85	79	0.7
25A	Rc 1	95	89	0.9



Maximum Continuous Discharge Capacity



- To select the product size, secure the safety factor of 4 to 5. For example, if you need a steam trap with a capacity of 100 kg/h, the trap with a capacity of 400 to 500 kg/h should be selected for maximum efficiency.
- The back pressure (outlet pressure) should be considered in selecting discharge capacity. This is because discharge capacity of a trap depends on the operating differential pressure (the difference between the inlet and the outlet pressures). For example, to find the discharge capacity obtained by the inlet pressure is 1.0 MPa and the outlet pressure is 0.2 MPa, trace up from the point of the operating differential pressure of 0.8 MPa in the above chart.

TD-10NA・30NA

Features

1. Bimetal solves air-binding problem and ensures a smooth discharge of cold condensate or air at the start of operation, enabling steam equipment to efficiently start to run.
2. The stainless steel valve disc and valve seat, which are subjected to special heat treatment, offers excellent durability.
3. The valve disc, valve seat and bimetal can be replaced on site without disconnecting the steam trap from the piping.
4. Easy maintenance and inspection due to simple structure: the valve disc is only movable part.
5. Compact, lightweight and inexpensive. Applicable in wide working pressure range and adjustment-free.
6. Installable in any direction and easy to plumb.
7. Free of improper operation and steam leakage due to air insulation type.
8. Built-in strainer eliminates requirement for strainer before the product.
9. Large discharge capacity.

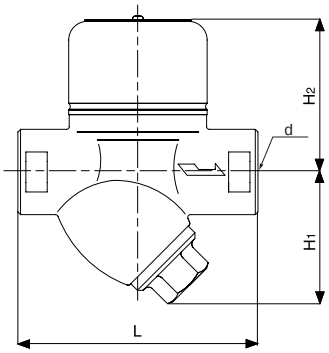
TD-10NA

TD-30NA

Specifications

Model		TD-10NA	TD-30NA	
Nominal size		15-25A		
Application		Steam condensate		
Working pressure		0.035-2.0 MPa	0.035-1.0 MPa	0.035-2.0 MPa
Allowable back pressure		50% or less of inlet pressure		
Max. temperature		220˚C		
Connection		JIS Rc screwed	JIS 10K FF flanged	JIS 20K FF flanged
Material	Body	Ductile cast iron		
	Disc, seat	Stainless steel (special heat treatment)		

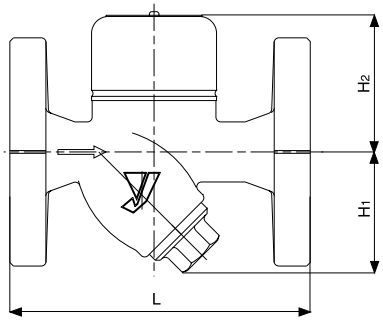
Dimensions (mm) and Weights (kg)



TD-10NA

●TD-10NA

Nominal size	d	L	H1	H2	Weight
15A	Rc 1/2	90	49	55.5	0.9
20A	Rc 3/4	90	53	60.5	1.2
25A	Rc 1	90	56	62.5	1.4



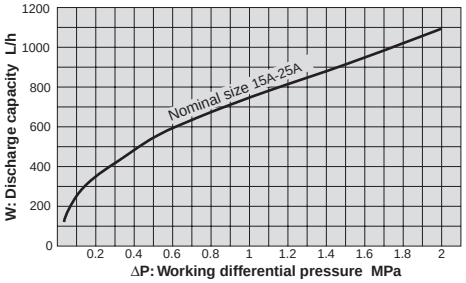
TD-30NA

●TD-30NA

Nominal size	L	H1	H2	Weight
15A	125	51	59	2.3
20A	140	54	63	3.4
25A	150	65	63	4.1

・The dimensions of the product with JIS 10K FF flanged and the product with JIS 20K FF flanged are identical.
・The thickness of JIS 10K FF flanges conforms to that of JIS 20K FF flanges.

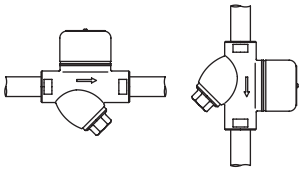
Maximum Continuous Discharge Capacity Chart



・The discharge capacity shown in the chart on the left is the maximum value. In designing a system, select a steam trap with a sufficient safety factor (four to five times the regular level). That is, for example, if a discharge capacity of 100 kg/h is required, select a steam trap capable of discharging 400 to 500 kg/h.

Installation Posture

The steam trap can be installed horizontally, sidlingly, or vertically.



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TSD-7・7F

Features

1. Four functions (STOP / BY-PASS / TRAP / TEST) can be switched easily with a spanner or monkey wrench.
2. The integrated bypass function helps reduce piping and construction work costs significantly.
3. Bimetal solves air-binding problem and ensures a smooth discharge of cold condensate or air at the start of operation, enabling steam equipment to efficiently start to run.
4. Can be checked without being affected by back pressure.
5. The stainless steel valve disc and valve seat are subjected to special heat treatment and very durable.
6. Equipped with a built-in strainer.
7. Can be installed vertically or horizontally as desired.
8. Rain cover is available as options for outdoor use.

TSD-7

TSD-7F

Specifications

Model		TSD-7	TSD-7F
Application		Steam condensate	
Working pressure		0.035-1.0 MPa	
Allowable back pressure		50% of inlet pressure	
Maximum temperature		183˚C	
Installation posture		At any angle between vertical and horizotal (Do not put the cover under the horizontal level.)	
Material	Body	Ductile cast iron	
	Disc, seat	Stainless steel (special heat treatment)	
Connection		JIS Rc screwed	JIS 10K FF flanged

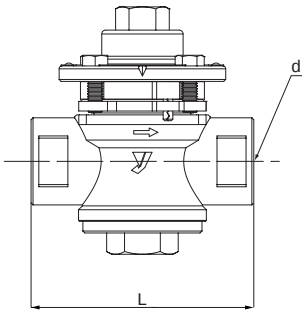
Dimensions (mm) and Weights (kg)

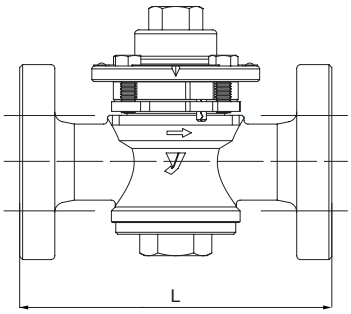
●TSD-7

Nominal size	d	H	Weight
15A	Rc 1/2	107	2.5
20A	Rc 3/4	109	2.6
25A	Rc 1	115	2.7

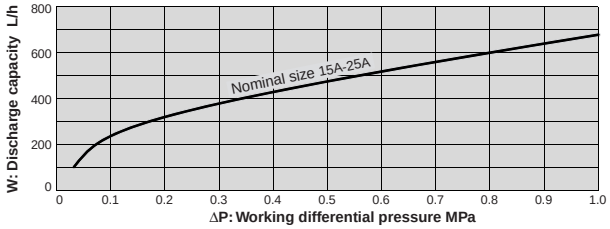
●TSD-7F

Nominal size	L	Weight
15A	156	4.1
20A	160	4.6
25A	160	5.7





Maximum Continuous Discharge Capacity Chart



・The discharge capacity shown in the chart on the left is the maximum value.
In designing a system, select a steam trap with a sufficient safety factor (four to five times the regular level). That is, for example, if a discharge capacity of 100 kg/h is required, select a steam trap capable of dischargeing 400 to 500 kg/h.

TS-7・8

Features

1. Four functions (STOP / BY-PASS / TRAP / TEST) can be switched easily with a spanner or monkey wrench.
2. The integrated bypass function helps reduce piping and construction work costs significantly.
3. Applicable in wide working pressure range due to welded bellows.
4. Works at a 12˚C lower temperature than the saturating temperature and discharges no live steam.
5. Trap check can be performed without being affected by back pressure.
6. The cock and valve, both made of stainless steel, are integrated into one unit.
7. Equipped with built-in strainer.
8. Installable in any direction.

TS-7

TS-8

Specifications

Model		TS-7	TS-8
Application		Steam condensate	
Maximum pressure		1.0 MPa *	
Minimum working differential pressure		0.03 MPa	
Max. temperature		183˚C	
Material	Body	Ductile cast iron	
	Cock (Valve seat)	Stainless steel	
	Bellows (Valve)	Stainless steel	
	Strainer	Stainless steel	
Connection		JIS Rc screwed	JIS 10K FF flanged

* When performing an airtightness test using water or air, keep the pressure at 0.5 MPa or less.

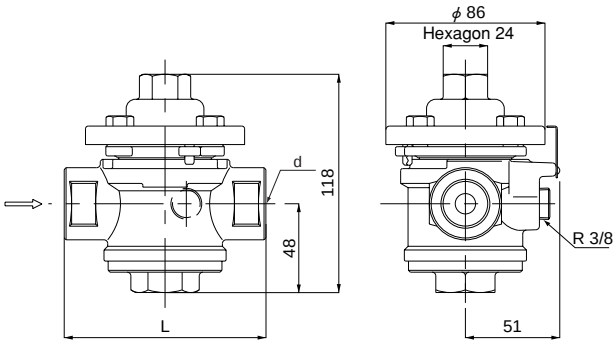
Dimensions (mm) and Weights (kg)

●TS-7

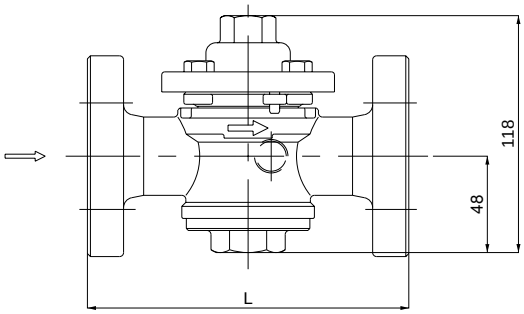
Nominal size	d	L	Weight
15A	Rc 1/2	107	2.3
20A	Rc 3/4	109	2.4
25A	Rc 1	115	2.5

●TS-8

Nominal size	L	Weight
15A	156	3.9
20A	160	4.4
25A	160	5.5

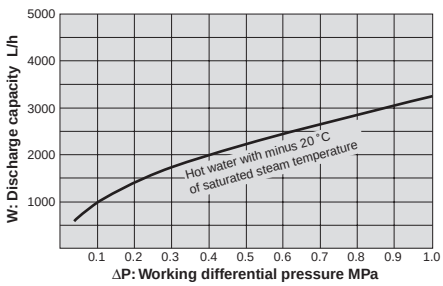


TS-7



TS-8

Maximum Continuous Discharge Capacity Chart



Maximum Continuous Discharge Capacity Table

(L/h)

Differential pressure MPa	0.03	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Hot water with minus 20 ˚C of saturated steam temperature	560	730	1020	1450	1780	2050	2300	2500	2700	2900	3100	3250

・The discharge capacities shown in the chart and table above are the maximum values. In designing a system, select a steam trap with a sufficient safety factor (at least three times the regular level).

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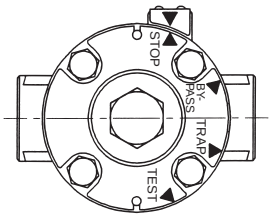
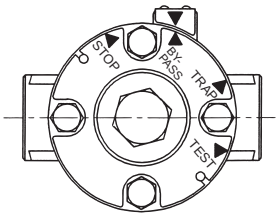
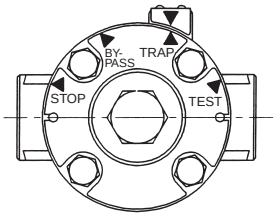
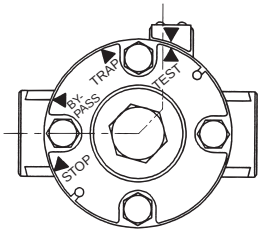
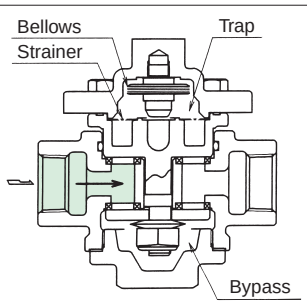
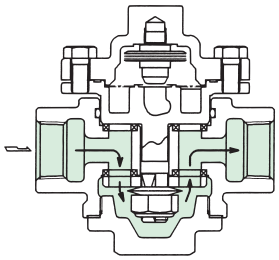
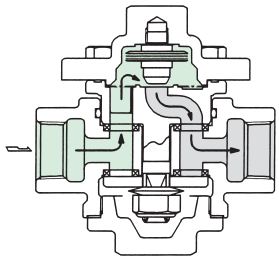
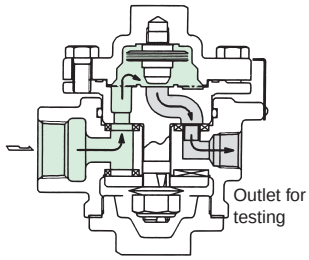
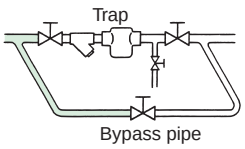
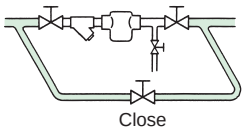
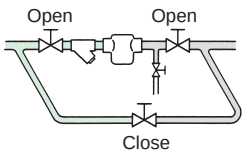
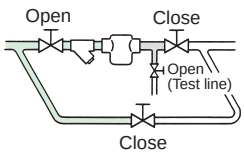
Switching Mechanism and Operation

	STOP	BY-PASS	TRAP	TEST
Position				
Operation				
Conventional piping				

Steam Condensate

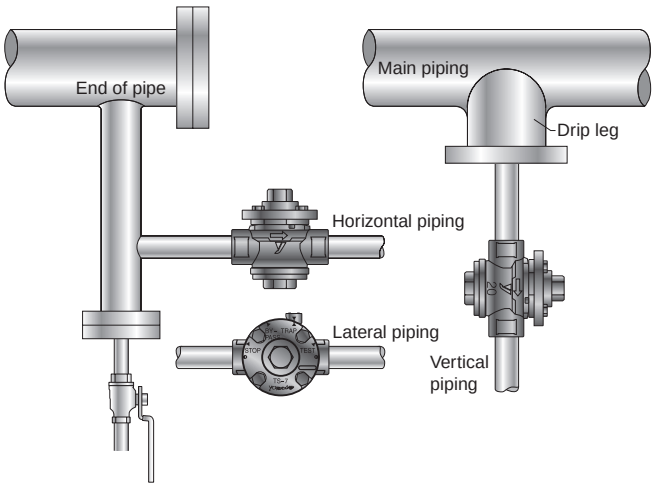
・All steam traps are set at the “STOP” position when delivered.

1. STOP: Fluid does not flow into the trap and out of the bypass because the inlet, the outlet, and the bypass are closed, and the strainer can be cleaned and the bellows can be inspected.
2. BY-PASS: Fluid flows through the bypass directly to the outlet. Select this position when blowing the piping during plumbing or discharging a large quantity of condensate before starting operation. Since fluid does not flow to the trap, the strainer can be cleaned and the bellows can be inspected.
3. TRAP: In this position, the steam trap performs regular trap operation, and condensate flows from the inlet to the outlet through the trap. It does not flow out of the bypass.
4. TEST: In this position, condensate is discharged from the inlet to the outlet for testing through the trap, and the operation of the trap can be checked. This check can be carried out with the outlet closed and without being affected by back pressure. Fluid does not flow out of the bypass.

Precaution for Installation

1. Carefully blow the piping before connecting the steam trap.
2. Connect the steam trap to the piping according to its arrow indicating the direction of flow.
3. Slope the piping and place the product at as a low position as possible in order to make condensate flow into the product by its own weight.
4. Do not insulate the piping inlet and the steam trap.
5. To install the product in a main steam pipe, provide a drip leg at the inlet side of the product.
6. Secure enough space for switching operation of the cock and maintenance (such as cleaning the strainer and inspection of the bellows).
7. If discharge capacity is not enough, install more than one trap. In this case, connect the traps to the piping so that their inlets are in the same level.
8. Do not install the steam trap in a place where ambient temperature is higher than the condensate to be discharged.

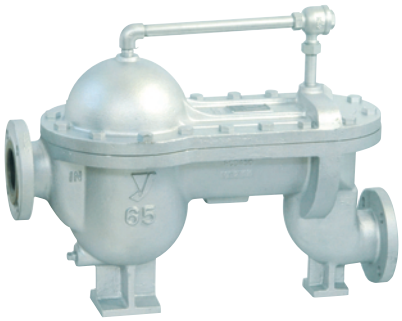
Piping Example



TF-1・2

Features

1. The stainless steel valve disc and valve seat offer excellent durability (TF-2).
2. Built-in air vent prevents air-binding problem, offering higher durability.
3. Compact, lightweight and large discharge capacity due to unique pressure balance mechanism.
4. Reliable performance and large discharge capacity ensured by lever float system.
5. Easy maintenance and inspection.



TF-1

TF-2

Specifications

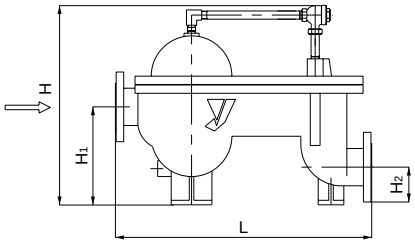
Model		TF-1	TF-2
Application		Steam condensate	
Working pressure		0.01-0.3 MPa	0.01-0.7 MPa
Max. temperature		150˚C	170˚C
Material	Body	Ductile cast iron	
	Valve, valve seat	Cast bronze	Stainless steel
	Float	Brass	Stainless steel
Connection		JIS 10K RF flanged	JIS Rc screwed

Dimensions (mm) and Weights (kg)

●TF-1

Nominal size	L	H	H_1	H_2	Weight
65A	680	530	260	100	84
80A	680	530	260	100	84

・H_1 and H are reference values.

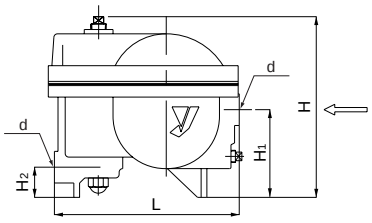


TF-1

●TF-2

Nominal size	d	L	H	H_1	H_2	Weight
15A	Rc 1/2	257	252	122	42	13.3
20A	Rc 3/4	257	252	122	42	13.3
25A	Rc 1	290	266	122	42	15.5
32A	Rc 1-1/4	290	266	122	42	15.5
40A	Rc 1-1/2	335	310	159	45	19.2
50A	Rc 2	335	310	159	45	19.2

・H_1, H_2, and H are reference values.



TF-2

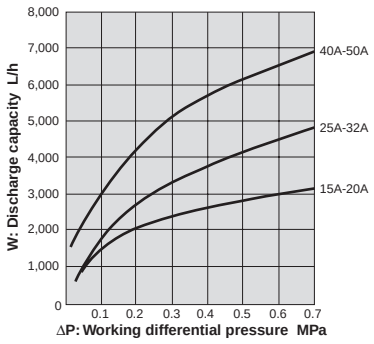
Maximum Continuous Discharge Capacity

●TF-1

Nominal size	Working differential pressure MPa					
	0.05	0.10	0.15	0.20	0.25	0.30
65A	6,500	8,700	10,000	11,000	13,000	13,000
80A	6,500	8,700	10,000	11,000	13,000	13,000

・The discharge capacities shown in the table and chart are the maximum values. In designing a system, select a steam trap with a sufficient safety factor (three times to five times the regular level).

●TF-2



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TFA-2000

Features

1. Function as a float trap with a built-in pump trap ensures reliable operation in all pressure ranges from positive to negative values.
2. Specially designed for condensate pumping at low pressure of small heat exchange systems such as heat exchangers and air handling units.
3. Easy maintenance without dismounting the trap from the piping. All main parts are set on the cover part.

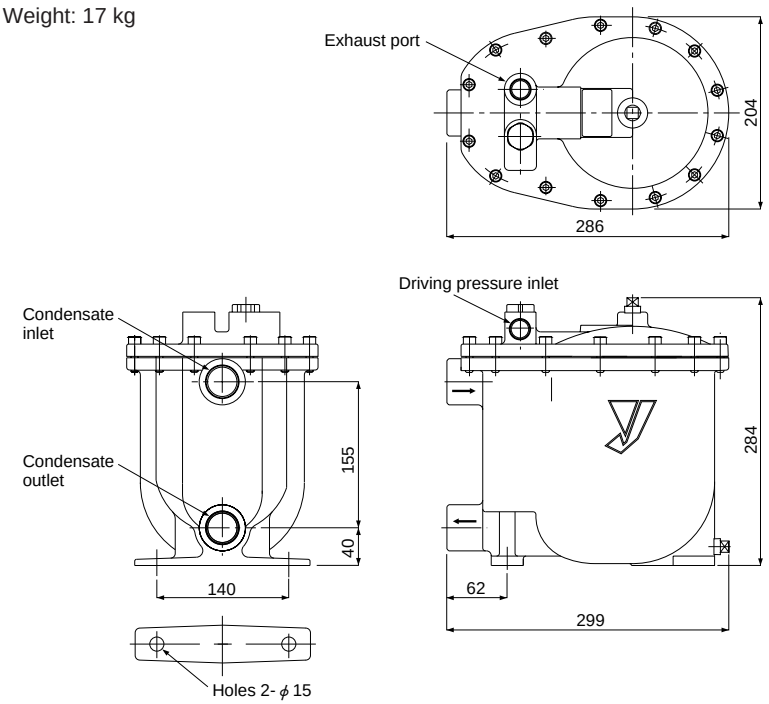
Specifications

Nominal size		25A
Application		Steam condensate
Driving fluid		Steam
Max. pressure		0.5 MPa
Driving pressure		0.03-0.5 MPa
Working differential pressure		(Back pressure + 0.03 MPa) to 0.5 MPa
Max. temperature		160˚C
Material	Body	Ductile cast iron
	Trim parts	Stainless steel
	Float	Stainless steel
Connection		JIS Rc screwed
Check valve at inlet side		Built in (Swing type)
Check valve at outlet side		Available (Use SCV-2, 25A)

Dimensions (mm) and Weights (kg)

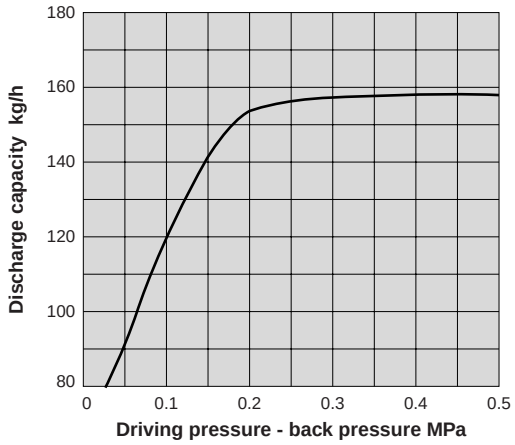
Condensate inlet	Condensate outlet	Driving pressure inlet	Exhaust port
Rc 1	Rc 1	Rc 1/2	Rc 1

Weight: 17 kg



Assist Capacity (Pump Capacity)

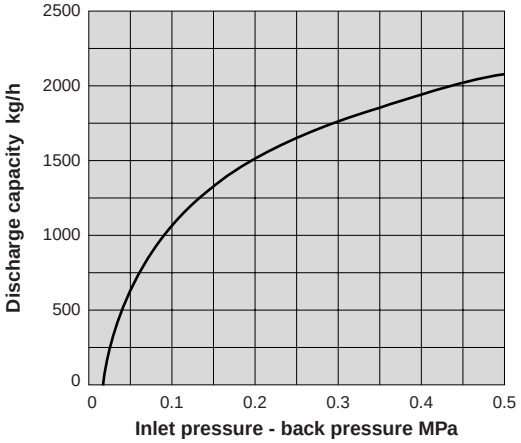
The assist capacity depends on the inflow height of condensate. Multiply the inflow height by the appropriate corrected coefficient shown in the table below.



• Corrected Coefficient for Assist

Inflow height (mm)	Corrected coefficient
250	0.65
300	1.0
400	1.1
500	1.75

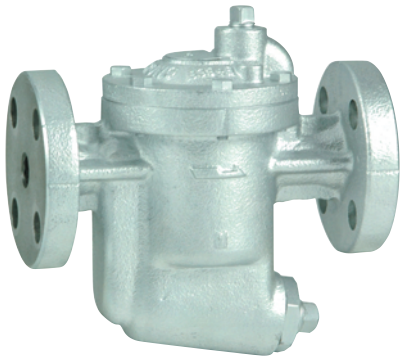
Steam Trap Capacity



TB-5

Features

1. Excellent durability ensured by unique internal structure (free floating lever system, spherical valve, etc).
2. Reliable performance due to all stainless steel made internal parts and the unique internal structure.
3. Superior energy saving since intermittent operation removes air adiabatic wall in the head exchanger and increases heat efficiency considerably.
4. Distinguished scale resistance provided by built-in strainer and dual separation system.
5. Wide variety of options, including large vent and built-in type check valve.



Specifications

Model		TB-5
Maximum pressure		1.0 MPa
Maximum working differential pressure		Refer to "Discharge Capacity Chart"
Max. temperature		220˚C
Material	Body	Ductile cast iron
	Valve, valve seat	Stainless steel
	Bucket	Stainless steel
Connection		JIS 10K FF flanged
Nominal size		15A-50A

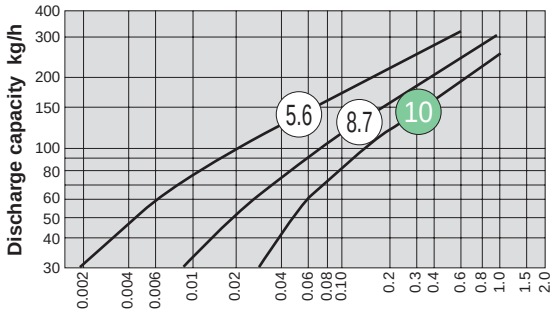
Dimensions (mm) and Weights (kg)

Nominal size	L	H	H_1	Plug	Weight
15A	175	177	98	NPT 3/8	4.5
20A	195	177	98	NPT 3/8	4.9
25A	215	177	98	NPT 3/8	6.2
32A	280	336	190	NPT 1/2	18.3
40A	280	336	190	NPT 1/2	18.7
50A	290	336	190	NPT 1/2	19.6

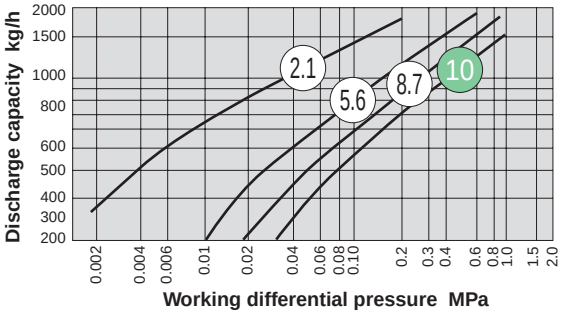
Discharge Capacity Chart

(The charts below show the discharge capacity of saturated condensate in actual operation.)

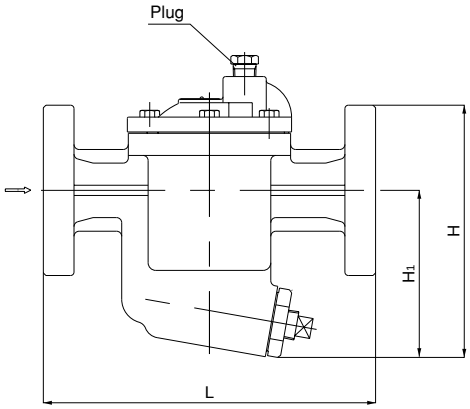
●15A-25A



●32A-50A



- The discharge capacity shown here is a continuous discharge capacity at the indicated differential pressure.
- In general, select a steam trap with a safety factor twice or threefold the regular level.
- The circled values are maximum working differential pressures (kgf/cm^2). (The values in white circles represent a standard product, and those in a green circle denote a custom-made product.)



Options

(The options listed below are made-to-order items. For further information, please contact us.)

- Large vent (LV)
- Thermic vent bucket (T)
- Scrub wire (VW)
- Built-in type check valve (V)

・Only either a built-in type check valve or a thermic vent bucket can be installed on 15A to 25A steam traps.

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TS-1

The TS-1 radiator trap is used for a wide variety of radiators for heating.

TS-1A
<Angle type>

TS-1S
<Straight type>

Features

1. Reduced noise.
2. Bellows type of air trouble free.
3. The bellows is manufactured from selected material under strict quality control. Quick discharge of condensate from the system, and no steam leakage with long service life.
4. Never freezing.

Specifications

Application		Steam condensate
Maximum pressure		100 kPa *
Maximum temperature		120˚C
Material	Body	Cast bronze
	Valve, valve seat	Brass
	Bellows	Phosphor bronze
	Union	Brass
Connection		Inlet: JIS R screwed (union joint) Outlet: JIS Rc screwed

* Available with 200 kPa (TS-1HA or TS-1HS, only 25A).

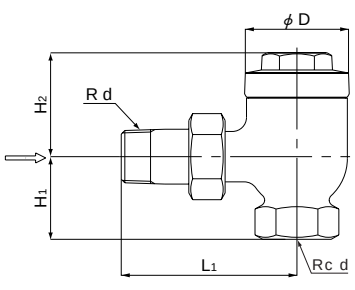
Dimensions (mm) and Weights (kg)

●TS-1A

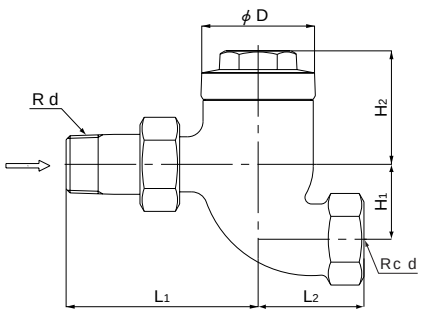
Nominal size	d	L_1	H_1	H_2	D	Weight
15A	1/2	80	35	39	52	0.6
20A	3/4	87	41	51.5	52	0.9
25A	1	105	52	49	52	1.6

●TS-1S

Nominal size	d	L_1	L_2	H_1	H_2	D	Weight
15A	1/2	80	43	28	39	52	0.7
20A	3/4	87	48	34	51.5	52	1.0
25A	1	105	60	40	49	52	1.7

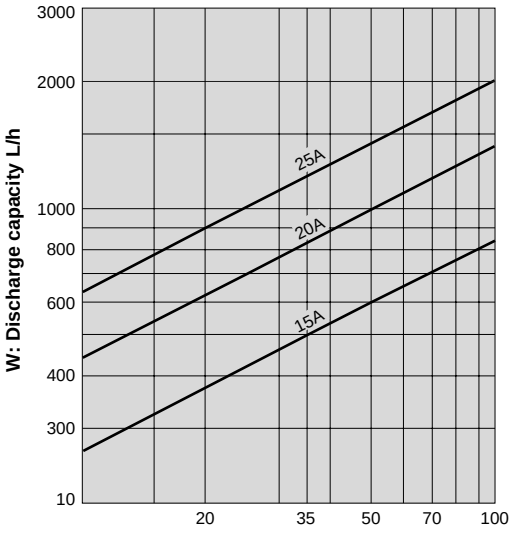


TS-1A <Angle type>



TS-1S <Straight type>

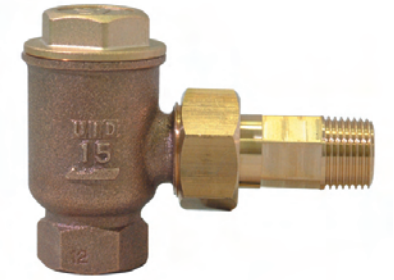
Maximum Continuous Discharge Capacity Chart



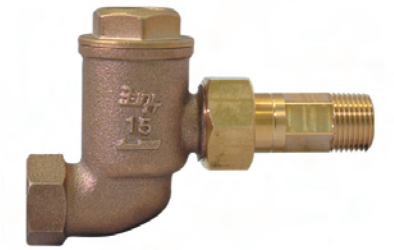
・This chart shows the maximum discharge. In designing a system, set a sufficient safety factor (two or three times).

TS-3

The TS-3 radiator trap, like the TS-1, is bellows thermostatic type and supports a working pressure of up to 0.2 MPa. It is used for a wide variety of radiators for heating.



TS-3A
<Angle type>



TS-3S
<Straight type>

Features

1. Compact, lightweight and reduced noise.
2. Prevents freezing damage since designed not to allow condensate to remain inside.
3. Quickly discharges cold condensate and air at the start of operation.
4. The valve and valve seat are made of stainless steel. Fluororesin is used for the cover gasket, making disassembly and assembly easy.

Specifications

Application		Steam condensate
Working pressure		0.01-0.2 MPa
Maximum temperature		135˚C
Material	Body	Cast bronze
	Valve	Brass
	Valve seat	Stainless steel
	Thermoelement	Phosphor bronze
	Union	Brass
Connection		Inlet: JIS R screwed (union joint) Outlet: JIS Rc screwed

* Available with 25A (TS-1HA・1HS).

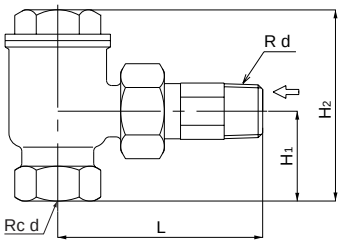
Dimensions (mm) and Weights (kg)

●TS-3A

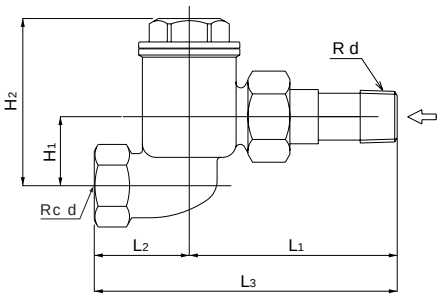
Nominal size	d	L	H_1	H_2	Weight
15A	1/2	80	35	74.5	0.5
20A	3/4	87	41	76.5	0.6

●TS-3S

Nominal size	d	L_1	L_2	L_3	H_1	H_2	Weight
15A	1/2	85	38	123	28	67.5	0.5
20A	3/4	94	41	135	34	69.5	0.7

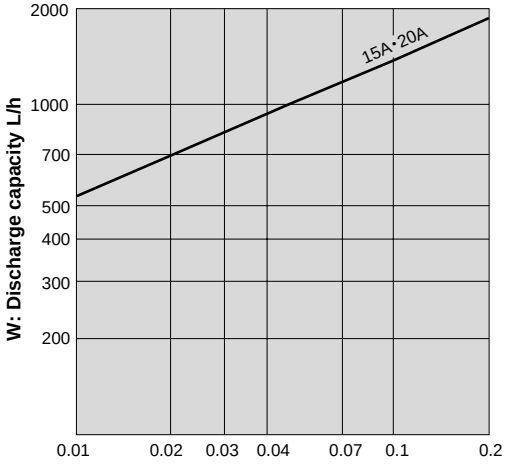


TS-3A <Angle type>



TS-3S <Straight type>

Maximum Continuous Discharge Capacity Chart



・This chart shows the maximum discharge. In designing a system, set a sufficient safety factor (two or three times).

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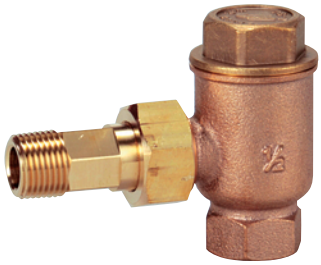
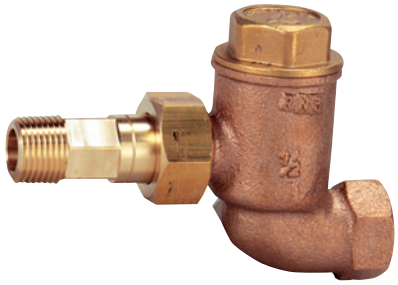
TS-4

The TS-4 radiator trap uses a wax type thermoelement for the heat sensing unit and supports a working pressure of up to 0.35 MPa. It is used for a wide variety of radiators for heating.



TS-4A
<Angle type>



TS-4S
<Straight type>

Features

1. Compact, lightweight and reduced noise.
2. Freezing damage can be prevented since designed not to allow condensate to remain inside it.
3. Quickly discharges cold condensate and air at the start of operation.
4. Stainless steel made valve and valve seat. Fluororesin is used for the cover gasket, making disassembly and assembly easy.

Specifications

Application		Steam condensate
Working pressure		0.02-0.35 MPa
Maximum temperature		150˚C
Material	Body	Cast bronze
	Valve	Stainless steel
	Valve seat	Stainless steel
	Thermoelement	Brass, others
	Union	Brass
Connection		Inlet: JIS R screwed (union joint) Outlet: JIS Rc screwed

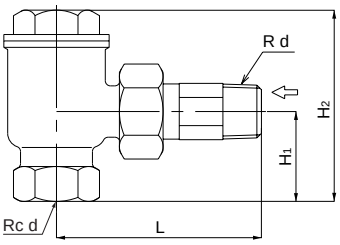
Dimensions (mm) and Weights (kg)

●TS-4A

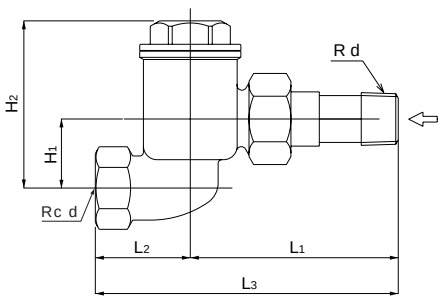
Nominal size	d	L	H_1	H_2	Weight
15A	1/2	80	35	77.5	0.5
20A	3/4	87	41	79.5	0.7

●TS-4S

Nominal size	d	L_1	L_2	L_3	H_1	H_2	Weight
15A	1/2	85	38	123	28	70.5	0.6
20A	3/4	94	41	135	34	72.5	0.7

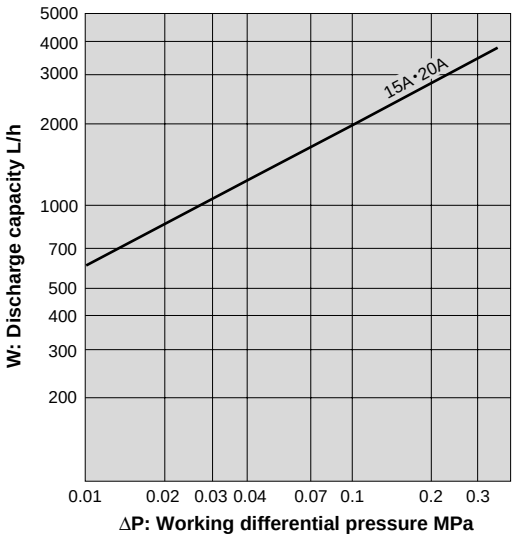


TS-4A <Angle type>



TS-4S <Straight type>

Maximum Continuous Discharge Capacity Chart



- This chart shows the maximum discharge. In designing a system, set a sufficient safety factor (two or three times).

Radiator Trap

FV-2

The FV-2 radiator valve is designed to use with radiators for heating using steam.

FV-2A
<Angle type>

FV-2S
<Straight type>

Features

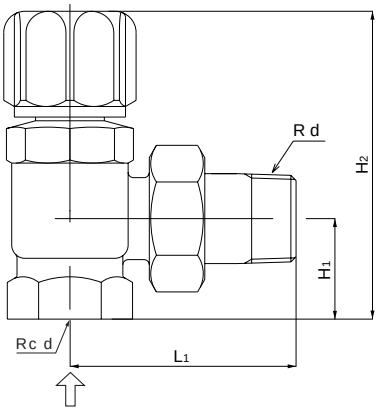
1. Totally free of leakage due to bellows pack less type.
2. Complete close with a fluororesin disc.
3. Usable for not only steam but cold and hot water.

Specifications

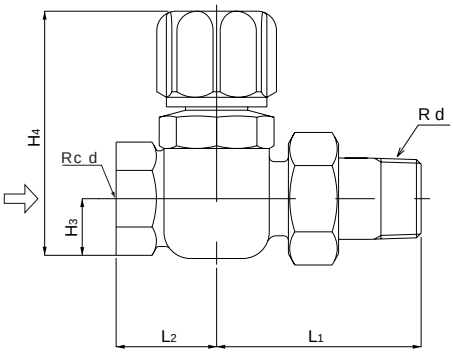
Application		Steam (Cold and hot water)
Maximum pressure		0.3 MPa
Maximum temperature		150˚C
Material	Body	Cast bronze
	Union	Brass
	Valve disc	PTFE
Connection		Inlet: JIS Rc screwed Outlet: JIS R screwed (union joint)

Dimensions (mm) and Weights (kg)

Nominal size	d	L_1	L_2	H_1	H_2	H_3	H_4	D	Weight	
									Angle type	Straight type
15A	1/2	65	35	28	101	17	95	15	0.5	0.6
20A	3/4	75	38	33	108	21	101	20	0.66	0.78
25A	1	86	42	38	117	25	109	25	0.96	1.02
32A	1-1/4	102	52	44	130	28	117	25	1.39	1.54



FV-2A <Angle type>



FV-2S <Straight type>

Maximum Flow Rate Chart (For Steam)

(kg/h)

Nominal size	Differential pressure MPa					
	0.05	0.1	0.15	0.2	0.25	0.3
15A	16	21	25	30	35	40
20A	28	36	44	52	60	71
25A	44	57	70	83	98	111
32A	64	84	103	122	142	161

・Since this table shows the maximum discharge, set a sufficient safety factor.

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Features		Radiator valve / Return valve	Thermo-radiator valve	Return valve
Model		HV-3	118 Series	109 Series
Picture		 HV-3A HV-3S		
Application		Cold and hot water	Hot water, Steam	Cold and hot water
Max. pressure		0.6 MPa	Hot water: 1.0 MPa Steam: 0.05 MPa	1.0 MPa
Max. temperature		90˚C	Hot water: 120˚C Steam: 110˚C	120˚C
Connection		Inlet: JIS Rc screwed Outlet: JIS R screwed (union joint)	Inlet: JIS Rp screwed Outlet: JIS R screwed (union joint)	Inlet: JIS R screwed (union joint) Outlet: JIS Rp screwed
Material	Body	Cast bronze	Bronze or Brass	Bronze or Brass
	Valve	PTFE	EPDM	Brass
	Valve seat	Bronze	Bronze or Brass	Bronze or Brass
Size		15A-25A	15A-25A (angle, straight) 15A-20A (reversed angle)	15A-20A
Others		HV-3A: Angle type HV-3S: Straight type	Thermostats: Bellows, wax, remote mount Valve: Angle, straight, reversed angle	Valve: Angle, straight

Primary Pressure Regulating Valve

Falling Water Preventing Valve
Differential Pressure Regulating Valve

Primary Pressure Regulating Valve Selection

Application				Pressure Regulating Range (MPa)	Fluid Temperature (˚C)	Model	Type		Page
Steam	Air	Water	Oil				Pilot Type	Direct Acting Type	
●				0.02-1.4	220	GPR-2000	●		247
●				0.02-1.0					
●				0.2-0.9		GD-47R		●	253
	●			0.002-0.2	5-80	GD-4R		●	253
	●	●	●	0.05-0.7		GD-20R		●	249
	●	●	●		5-60	GD-20RC		●	249
		●	●	0.05-0.7	5-80	GD-7R		●	252
		●		0.1-0.7	0-70	GP-50R	●		253

Falling Water Preventing Valve Selection

Application				Pressure Regulating Range (MPa)	Fluid Temperature (˚C)	Model	Type		Page
Steam	Air	Water	Oil				Pilot Type	Direct Acting Type	
	●	●	●	0.05-0.7	5-80	GD-20R		●	249
	●	●	●		5-60	GD-20RC		●	249
		●		0.1-0.7	0-70	GP-50S	●		253

Differential Pressure Regulating Valve Selection

Application				Pressure Regulating Range (MPa)	Fluid Temperature (˚C)	Model	Type		Page
Steam	Air	Water	Oil				Pilot Type	Direct Acting Type	
		●		0.05-0.7	5-80	GD-21		●	250
		●		0.1-0.7	0-70	GP-50RD	●		253

Selection of Primary Pressure Regulating Valve, Falling Water Preventing Valve, and Differential Pressure Regulating Valve

Applications	To keep the pressure inside of piping constant against the variation in the load applied by air conditioning equipment, heat exchanger, and etc.	To prevent the falling of water in an open circuit of air conditioning equipment in a mid-rise or high-rise building, etc., and to prevent the inside of piping from being a vacuum condition due to a siphon phenomenon.	To regulate the differential pressure between supply and return pipings of a closed circuit in a mid-rise or high-rise building, etc.
Models	**Primary pressure regulating valve** A primary pressure regulating valve is designed to discharge the fluid according to a variation in primary pressure and thus keep the pressure inside at a constant level.	**Falling water preventing valve** A falling water preventing valve prevents the falling of water inside return piping when the pump is not in operation.	**Differential pressure regulating valve** A differential pressure regulating valve keeps the difference between the inlet pressure and the outlet pressure constant.
Major Products	**GPR-2000** 	**GD-20R** 	**GD-21** 

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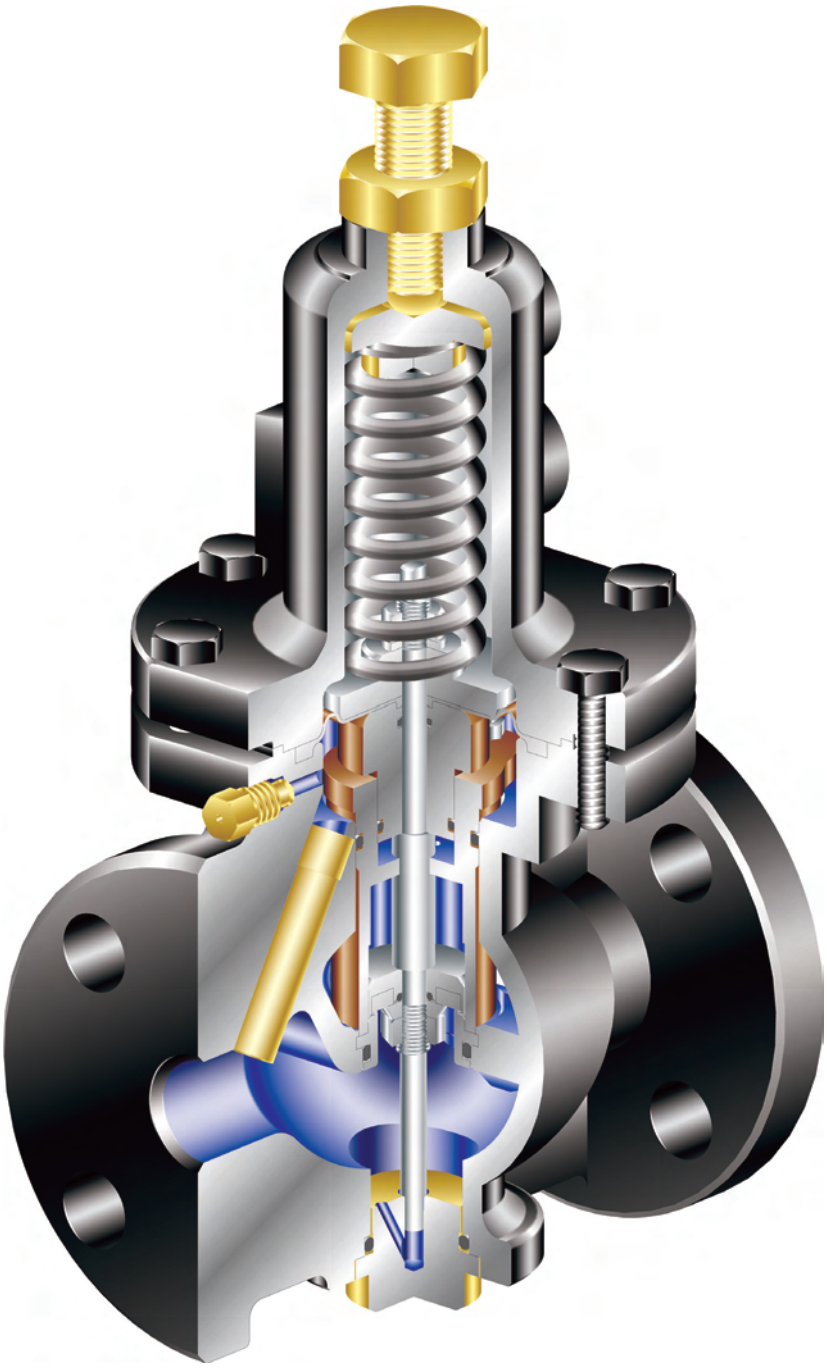
Features of Primary Pressure Regulating Valve ＜GD-20R＞



1: No leakage!
Soft seal used for the valve disc does not allow leakage to occur when the valve is closed.

2: Easy maintenance
No special tool is required to replace internal parts. All of the internal parts can be removed from the top of the valve, providing the valve with excellent maintainability.

3: Measure against air problems
Manual air vent function prevents air problems.

4: Stable operation
Due to a balance structure, the set pressure remains stable without being affected by back pressure.

5: Adjustable sensitivity
A large nominal size type has a needle valve in the sensing pipe, enabling sensitivity adjustment during operation.

6: Variations

GD-20R (SUS)

GD-20RC

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Nominal Size Selection of Primary Pressure Regulating Valve

Sizing Date

■ Calculation formula for Cv value

(1) For steam

When $P_2 > \frac{P_1}{2}$ $\quad Cv = \frac{Wk}{138\sqrt{\Delta P(P_1 + P_2)}}$

When $P_2 \leqq \frac{P_1}{2}$ $\quad Cv = \frac{Wk}{120P_1}$

(2) For gas

Where $P_2 > \frac{P_1}{2}$ $\quad Cv = \frac{Q}{2940}\sqrt{\frac{(273 + t)\,G}{\Delta P\,(P_1 + P_2)}}$

When $P_2 \leqq \frac{P_1}{2}$ $\quad Cv = \frac{Q\sqrt{(273 + t)\,G}}{2550P_1}$

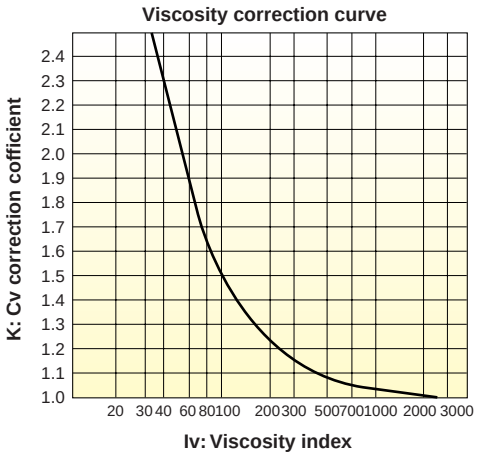
(3) For liquid

$$Cv = \frac{0.365V\sqrt{G}}{\sqrt{\Delta P}}$$

W: Max. steam flow rate [kg/h]
P_1: Inlet pressure [MPa•A]
P_2: Outlet pressure [MPa•A]
ΔP: $P_1 - P_2$ [MPa]
k : 1 + 0.0013 x {superheated steam temperature [˚C]
– saturated steam temperature [˚C]}
Q : Max. gas flow rate [m³/h (standard condition)]
G : Specific gravity (relative to air for gas, or relative to water for liquid)
t : Fluid temperature [˚C]
V : Max. liquid flow rate [m³/h]
Cv: Cv value of each nominal size
Iv : Viscosity index
Mcst: Viscosity [cSt]

■ Formula for correction of viscosity

$$Iv = \frac{72780}{Mcst}\left(\frac{\Delta P}{G}\right)^{\frac{1}{4}} V^{\frac{1}{2}}$$



■ Cv value table

Model \ Nominal size	15A	20A	25A	32A	40A	50A	65A	80A	100A	125A	150A	200A	250A	300A
GPR-2000 screwed	5.0	7.2	10.9	14.3	18.8	32								
GPR-2000 flanged	5.0	7.2	10.9	14.3	18.8	32	60	78	120					
GD-47R						36								
GD-4R		2	3	4	5	8	21	27	42	72	94			
GD-7R		2	3	6	8	15	23	30	40	50	60			
GD-20R•21	1.5	2.7	4	8.5	11	14	23	32.5	48	75	108			
GP-50R•50S•50RD										180	260	470	710	900

Falling Water Preventing Valve Sizing Check

Selecting a falling water preventing valve requires a system simulation. Conduct it according to the procedure described below (the procedure is described taking the GD-20R falling water preventing valve as an example).

Requirements concerning selection Check the following items:

		(Example)
Discharge pressure of pump at specified flow rate (Max. working flow rate)	P_0 [MPa]	0.5
Specified flow rate	V [m³/h]	20
Height from pump to top of piping	H_1 (m)	18
Height from falling water preventing valve to top of piping	H_2 (m)	16
Sum total of piping resistance between pump outlet and falling water preventing valve inlet and resistance of unit	W [MPa]	0.22

●Table-1 Shut-off pressure drop (Pb)

GD-20R

H_2 (m)	Pb MPa
5-20	0.02
21-40	0.04
41-70	0.06

GP-50S

H_2 (m)	Pb MPa
10-20	0.05
21-40	0.07
41-70	0.11

●Table-2 Rated accumulation

GD-20R

Set pressure P	Accumulation MPa
0.05-0.25	0.05
0.26-0.7	0.105

GP-50S

Set pressure P	Accumulation MPa
0.1-0.4	0.04
0.4-0.7	0.07

• Both of Tables 1 and 2 are for the selection of falling water preventing valves.

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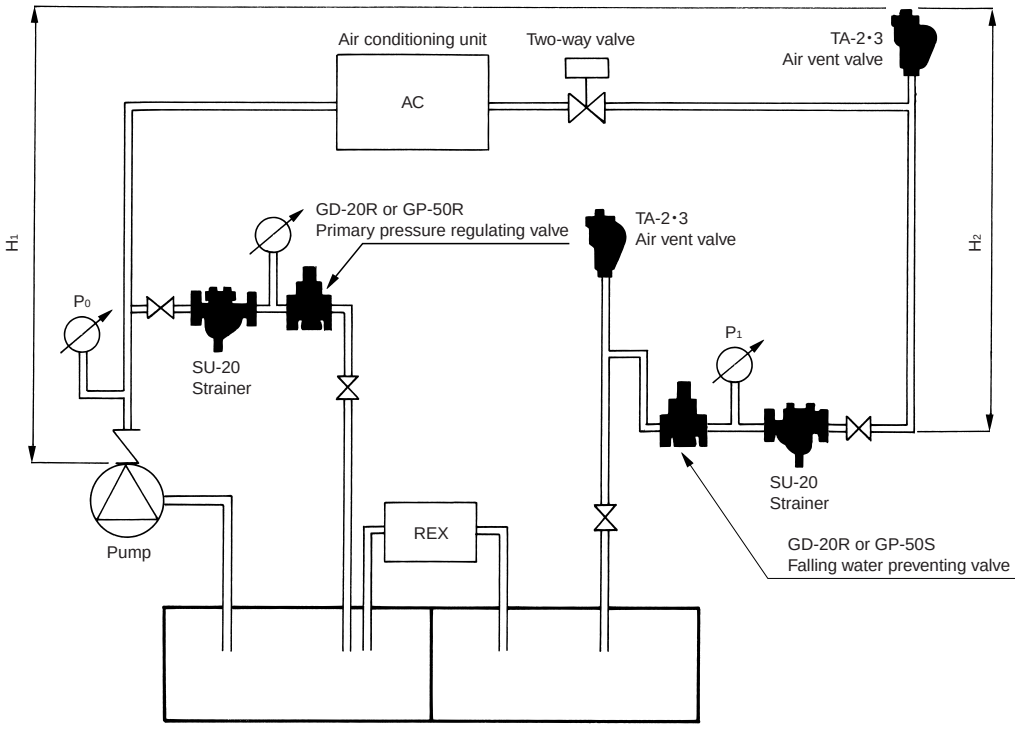
Selection calculation Conduct a system simulation according to the procedure described below.

Shut-off pressure drop See Table-1.	Pb MPa	0.02	In a selection calculation, calculate the shut-off pressure drop (Pb (MPa)) based on the height from the falling water preventing valve to the top of piping (H_2 (m)) according to Table-1 Shut-off pressure drop (Pb). In the example, the distance from the falling water preventing valve to the top of piping (H_2 (m)) is 16 m, and the shut-off pressure drop is consequently 0.02 MPa.
Minimum set pressure $P = \frac{0.098H_2}{10} + Pb$	P MPa	$\frac{0.098 \times 16}{10} + 0.02 = 0.17$	Calculate the minimum set pressure (P (MPa)). In the example, P = 0.17 MPa.
Nominal size Determine a tentative nominal size at P and V according to the nominal size selection chart.		65A	Select a tentative nominal size at the minimum set pressure P and the specified flow rate V according to the nominal size selection chart. In the example, assuming that P = 0.17 MPa and V = 20 m³/h are met, the nominal size of the GD-20R valve is 65A.
Rated flow rate $V_1 = \frac{Cv\sqrt{P}}{0.365\sqrt{G}}$	V_1 (m³/h)	26	Next, calculate the rated flow rate of the 65A GD-20R valve at a set pressure of 0.17 MPa. In the example, it is 26 m³/h.
Rated accumulation See Table-2.		0.05	Calculate the rated accumulation (MPa) at the minimum set pressure (P (MPa)) according to Table-2 Rated accumulation. In the example, it is 0.05 MPa.
Accumulation at specified flow rate $Pa = \frac{V}{V_1}$ x Rated accumulation	Pa MPa	0.04	Calculate the accumulation (Pa (MPa)) at the specified flow rate. In the example, it is 0.04 MPa
Falling water preventing valve inlet pressure $P_1 = P_0 - \frac{0.098(H_1 - H_2)}{10} - W$	P_1 MPa	0.26	Calculate the falling water preventing valve inlet pressure P_1. In the example, it is 0.26 MPa.
Pump allowance $\alpha = P_1 - P - Pa$ ・If α is negative, the specifications are not met. Select a larger nominal size, and recalculate α.	α MPa	0.04	Finally, check the pump allowance α. The accumulation (Pa) at the falling water preventing valve inlet pressure (P_1), the minimum set pressure (P), and the specified flow rate is the pump allowance α. If the value of α is negative, select a larger nominal size, and recalculate α. In the example, 0.04 MPa is acceptable.
Selection result Determine the set pressure between P and P + α.	Model Nominal size Set pressure range	GD-20R 65A 0.18-0.22 MPa	As the selection result, determine the set pressure between P and P + α. In the example, the set pressure for the 65A GD-20R valve is between 0.18 MPa and 0.22 MPa.

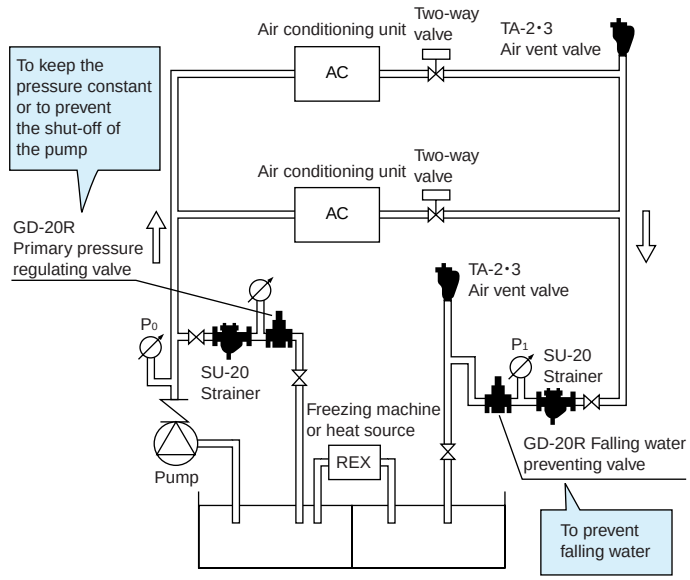
Piping Example of Falling Water Preventing Valves GD-20R and GP-50S



Application Guide about Falling Water Preventing Valve, Primary Pressure Regulating Valve, and Differential Pressure Regulating Valve

In the case of an open circuit system

● Falling water preventing valve and Primary pressure regulating valve



● Falling water preventing valve and primary pressure regulating valve are required

Falling water by the gravitation of the return piping causes damage to the air conditioning unit or air problems due to a vacuum. It is, therefore, necessary to prevent falling water in the return piping. In order to do this, use a falling water preventing valve. Additionally, use a primary pressure regulating valve to ensure stable supply even if the load on the air conditioning unit varies.

● For what purpose falling water preventing valve is used

To prevent falling water by gravitation when a pump is at rest by keeping the return piping full of water, as well as problems, such as air lock and noise resulting from the ingress of air into the piping when the flow rate into a load system decreases even if, for example, the pump is in operation.

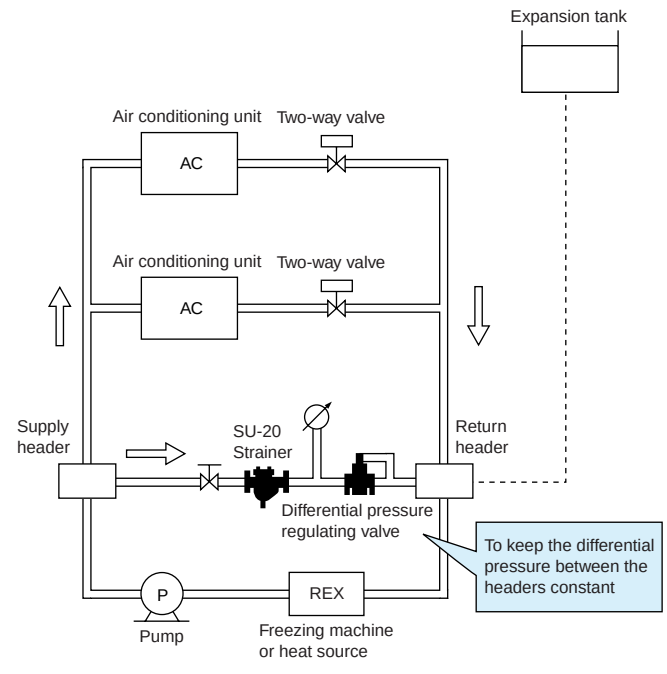
● For what purpose primary pressure regulating valve is used

1: To reduce a fluctuation in pump discharge pressure with a change in the flow rate of the unit used (load system) and thereby keep the regulated flow rate stable in the unit (load system).

2: To bypass the minimum flow rate required for the operation of the pump before the shut-off of the pump occurs as a result of an extreme decrease in the flow rate into the unit used.

In the case of a closed circuit system

● Differential pressure regulating valve



● Differential pressure regulating valve is required

The supply pressure (flow rate) to the heat source system or pump becomes unstable in response to a variation in the flow rate of the air conditioning unit. This also makes the discharge pressure of the pump unstable and, in the worst case, causes damage to the pump. As a measure to prevent such problems, use a differential pressure regulating valve.

・When an expansion tank is used as indicated by the dashed line, a primary pressure regulating valve can be used.

● For what purpose differential pressure regulating valve is used

1: To regulate the differential pressure between the supply and return headers to a constant level and consequently stabilize the flow rate to the load units by installing a differential pressure regulating valve between them.

2: To prevent the shut-off of the pump and also ensure a stable flow rate to the heat source system by bypassing the flow rate from the supply header to the return header when the flow rate to the load units extremely decreases.

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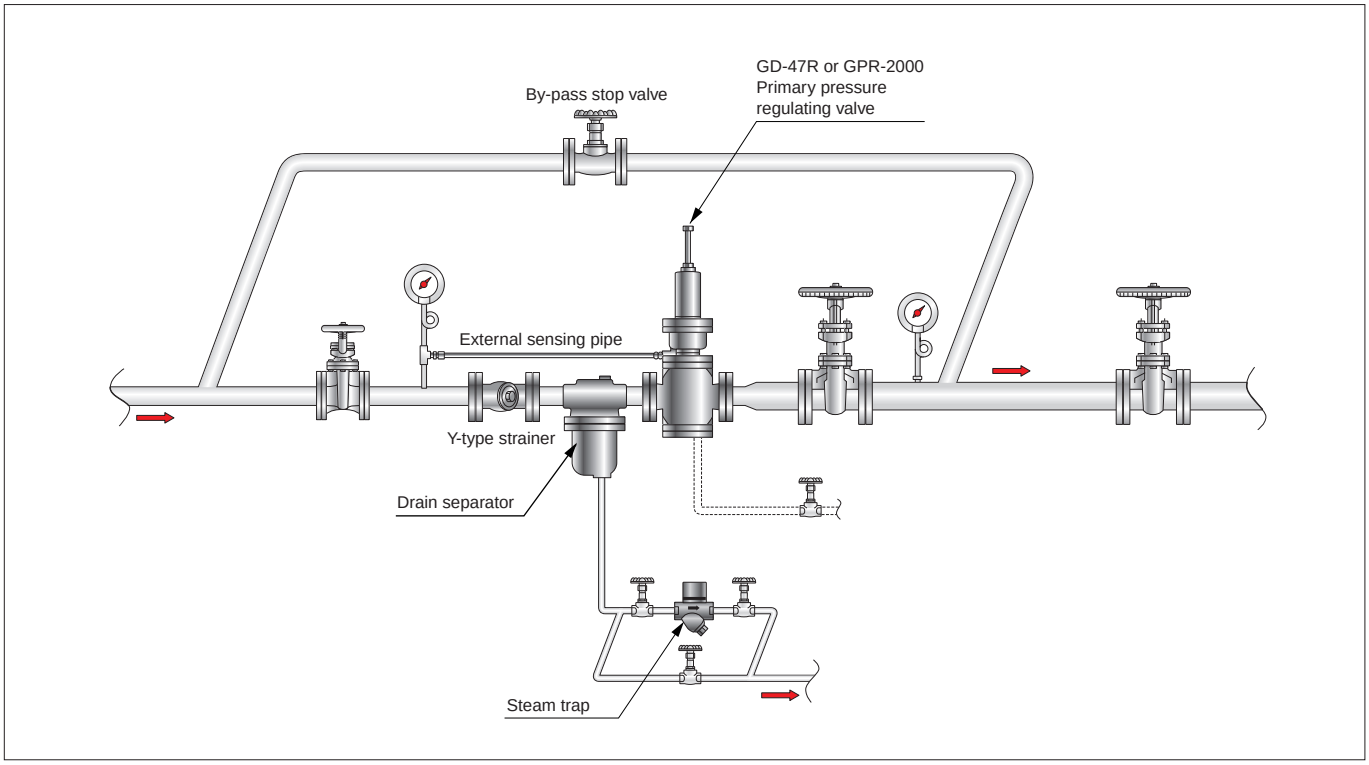
Guidelines for Primary Pressure Regulating Valves for Steam



⚠ Warning and Precaution for installation

1. Be sure to remove foreign substances and scales from inside of the piping before connecting the product to the piping.
   * Foreign substances and scales may prevent the product from functioning properly.
2. Be sure to install a strainer (recommendation: 80 mesh) at the inlet side of the product.
   * Foreign substances or scales may prevent the product from functioning properly.
3. Be sure to install pressure gauges to both the inlet and outlet sides of the product. At the inlet, install a pressure gauge as close to the connection port of external sensing pipe as possible.
   * Failure to follow this notice may hamper correct pressure adjustment.
4. Provide a trap at the bottom and end of the riser at the inlet and outlet of the product in order to prevent condensate problems. When branching trap piping from the main piping, connect pipes to the lower side of the main piping.
   * Failure to follow this notice may cause condensate problems.
5. Check the inlet, outlet and posture of the product and then connect the product in horizontal piping.
   * Failure to follow this notice may hamper correct pressure adjustment.
6. Arrange piping so that the product will not be subjected to excessive load, torque or vibration.
   * Failure to follow this notice may result in malfunction or a drastically shortened service life of the product.
7. Connect the sensing pipe to the piping with the external sensing pipe (8-2 m) and external joint (8-R 1/4) supplied with the product.
   * Using other external sensing pipe may prevent the product from functioning properly.
8. Avoid placing the external pipe just after valve or elbow; place it in a position with minimum disturbance (recommended length: ten or more times the piping diameter from the joint of the straight piping area).
   * Failure to follow this notice may make pressure at the detection unit unstable, resulting in incorrect pressure regulation.
9. Use stop valve at the inlet and outlet of the product.
   * Valve with high resistance, such as a glove valve, prevents the product from the product from functioning properly.
10. When disassembling or inspecting the product, space is required above and beneath the product from the center of the piping. Secure space above and beneath the product when connecting piping to it.

GPR-2000

Features

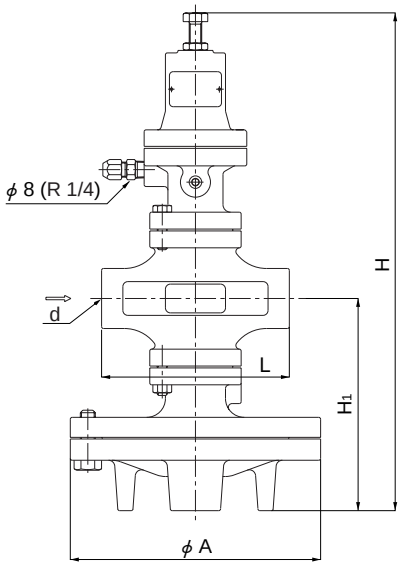
1. Large capacity and distinguished performance.
2. Excellent sealability ensured by spherical valve. Distinguished durability of stainless steel made valve and valve seat.
3. Wide range pressure adjustment.

Flanged type

Specifications

Application		Steam	
Primary pressure sensing method		External sensing type *1	
Pressure regulating range		0.02-0.15 MPa *2	
		0.1-1.1 MPa	0.1-1.0 MPa
		1.0-1.4 MPa	—
Minimum differential pressure		15% of set pressure (gauge pressure) (Minimum value: 0.10 MPa)	
Fluid temperature		220˚C or less	
Valve seat leakage		0.01% of rated flow rate	
Material	Body	Ductile cast iron	
	Main valve	Stainless steel	
	Valve seat	Stainless steel	
	Pilot valve	Stainless steel	
	Pilot valve seat	Stainless steel	
	Diaphragm	Stainless steel	
Connection		JIS Rc screwed, JIS 20K RF flanged	JIS 10K FF flanged

*1 External sensing method is used for the product because of controllability (performance). Available with internal sensing type, but the Cv value is different.
*2 When the set pressure is between 0.02 MPa and 0.1 MPa, back pressure should not exist.

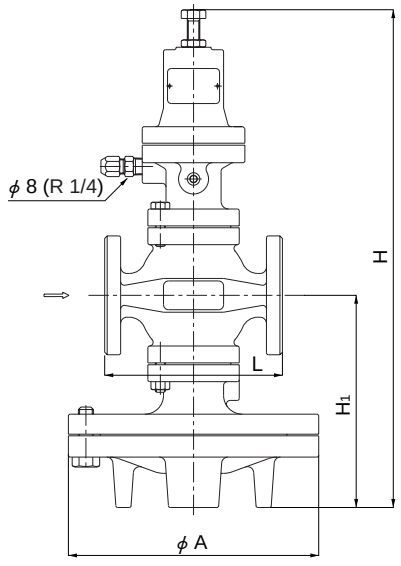


Dimensions (mm) and Weights (kg)

●Screwed type

Nominal size	d	L	H_1	H	A	Weight
15A	Rc 1/2	150	170	398	200	14.5
20A	Rc 3/4	150	170	398	200	14.5
25A	Rc 1	160	175	404	226	18.8
32A	Rc 1-1/4	180	192	434	226	22.0
40A	Rc 1-1/2	180	192	434	226	22.0
50A	Rc 2	230	216	498	276	33.6

・Available with NPT connection.



●Flanged type

Nominal size	L	H_1	H	A	Weight
15A	146 (142)	170	398	200	16.0 (15.8)
20A	146 (142)	170	398	200	16.5 (16.3)
25A	156 (152)	175	404	226	21.5 (21.1)
32A	176 (172)	192	434	226	24.5 (24.0)
40A	196 (192)	192	434	226	25.0 (24.6)
50A	222 (218)	216	498	276	36.6 (36.4)
65A	282 (278)	251	552	352	64.9 (64.6)
80A	302 (294)	264	575	352	72.1 (69.9)
100A	342 (330)	321	658	401	111.6 (108.0)

・The values in parentheses are the dimensions and weights of JIS 10K FF flanged.
・Please contact us for flanged type other than the above.

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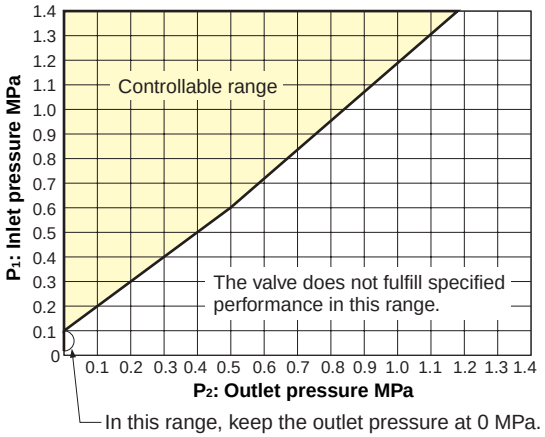
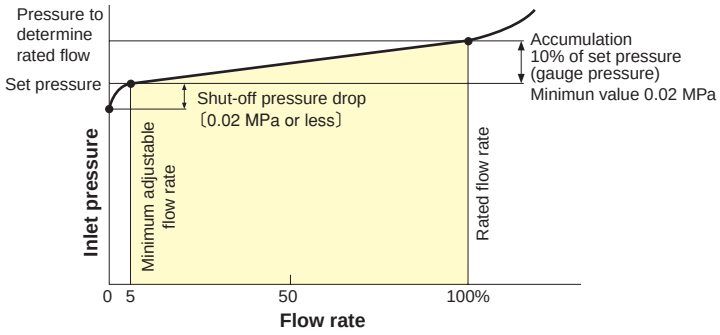
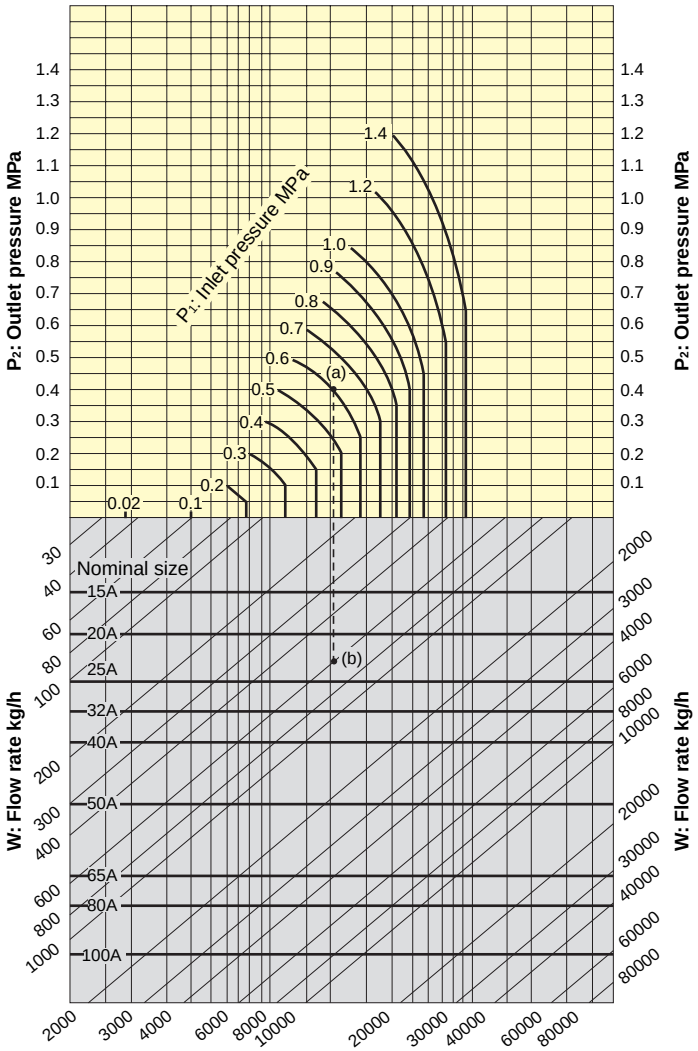
Specifications Chart



Flow Rate Characteristics Chart



Nominal Size Selection Chart (For Steam)



[Example]
When selecting the nominal size of a primary pressure regulating valve whose Inlet pressure (P_1), outlet pressure (P_2), and flow rate are 0.6 MPa, 0.4 MPa, and 600 kg/h, respectively, first find intersection point (a) of the Inlet pressure of 0.6 MPa and the outlet pressure of 0.4 MPa. Trace down vertically from this intersection point to find intersection point (b) with the flow rate of 600 kg/h. Since intersection point (b) lies between nominal sizes 20A and 25A, select the larger one, 25A.

GD-20R・20RC

Features

1. No leakage when closed due to single seat valve and valve disc.
2. Large diaphragm ensures reliable response to pressure fluctuations and shutoff.
3. Used as relief valves for pumps, relieves excess pressure caused by load fluctuations, and keeps internal pressure of piping constant during pump operation.
4. Used to prevent the falling of the water inside piping when the pump of open circuit system for mid-rise or high-rise building equipment is shutdown.
5. For the GD-20RC, the internal and external surfaces of the body are coated with Nylon 11, offering excellent corrosion resistance.

GD-20RC　　GD-20R

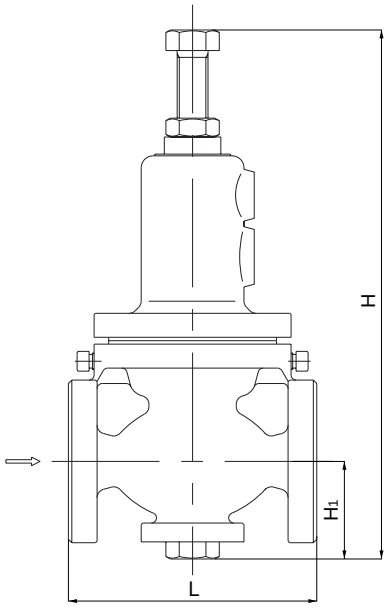
Specifications

Model		GD-20R	GD-20RC
Application		Cold and hot water, Oil (kerosene・heavy oils A and B), Air, Other non-dangerous fluids	
Pressure regulating range		15A-80A (A) 0.05-0.25 MPa (B) 0.26-0.7 MPa 100A-150A (A) 0.05-0.25 MPa (B) 0.26-0.5 MPa	
Fluid temperature		5-80˚C	5-60˚C
Fluid viscosity		600 cSt or less	
Material	Body	Ductile cast iron	
	Valve seat	Stainless steel or Bronze	
	Valve disc	NBR	
	Diaphragm	NBR	
Connection		JIS 10K FF flanged	
Inside surface treatment of body		15A-100A: Electrodeposition coating　125A-150A: Tar-based coating (black) or Electrodeposition coating	

- Available with FKM.
- Available with external sensing type.
- Available with stainless steel made trim parts.
- Available with stainless steel (15A to 100A). Please contact us about availability of 65A to 100A for all stainless steel made.
- Available with drain plug.

Dimensions (mm) and Weights (kg)

Nominal size	L	H	H_1	Weight
15A	145	309	57	8.2
20A	150	309	57	8.2
25A	150	330	67	10.0
32A	195	395	76	17.3
40A	195	395	76	17.3
50A	195	409	81	19.2
65A	270	555	105	40.0
80A	270	582	120	43.7
100A	308	645	135	70.0
125A	380	849	169	145.0
150A	400	918	194	175.0



The shapes are slightly different depending on the nominal size.

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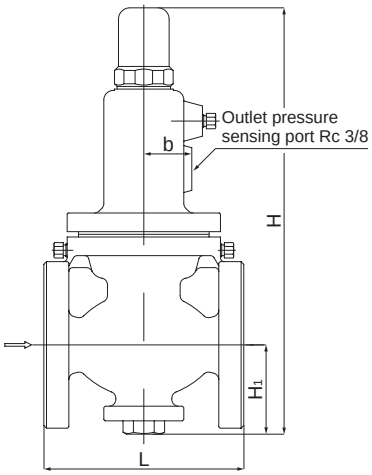
GD-21

Features

1. Most suitable for relief valve of a pump in closed circuit.
2. No leakage when closed due to single seat valve and valve disc.

Specifications

Application		Cold and hot water
Regulating differential pressure		15A-80A (A) 0.05-0.25 MPa (B) 0.26-0.7 MPa 100A-150A (A) 0.05-0.25 MPa (B) 0.26-0.5 MPa
Fluid temperature		5-80˚C
Material	Body	Ductile cast iron
	Valve seat	Bronze
	Valve disc	NBR
	Diaphragm	NBR
Connection		JIS 10K FF flanged
Inside surface treatment of body		15A-100A: Electrodeposition coating 125A-150A: Tar-based coating (black) or Electrodeposition coating

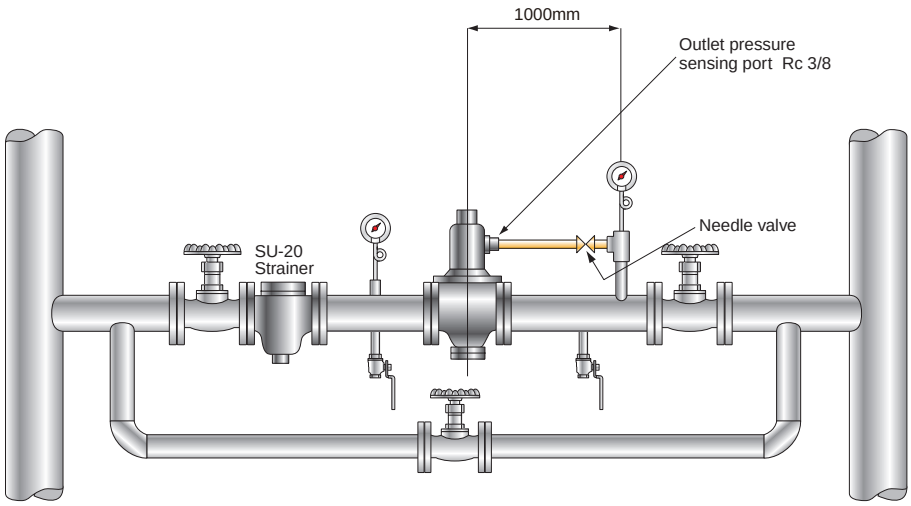


The shapes are slightly different depending on the nominal size.

Dimensions (mm) and Weights (kg)

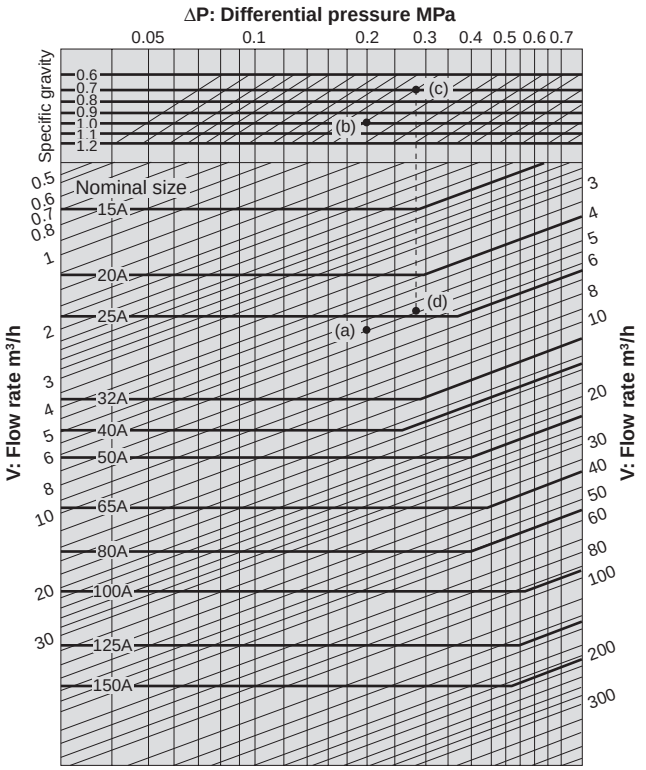
Nominal size	L	H	H_1	b	Weight
15A	145	298	57	36	8.3
20A	150	298	57	36	8.3
25A	150	320	67	36	10.1
32A	195	400	76	48	17.4
40A	195	400	76	48	17.4
50A	195	414	81	48	19.3
65A	270	572	110	63	40.0
80A	270	597	125	63	43.7
100A	308	665	143	68	70.0
125A	380	874	179	115	144.0
150A	400	929	204	115	173.0

Piping Example



Install a needle valve to the outlet side of the product and plumb it to the pressure sensing pipe using copper piping

GD-20R·21 Nominal Size Selection Chart (For Liquid)



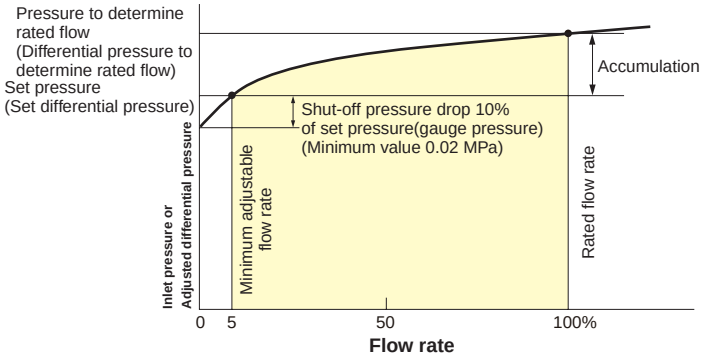
[Example]

When selecting the nominal size of a differential pressure regulating valve whose differential pressure (ΔP), specific gravity, and flow rate (V) are 0.2 MPa, 1 (water), and 5.5 m³/h, respectively, first trace down vertically from the differential pressure (ΔP) of 0.2 MPa to find intersection point (a) with the flow rate (V) of 5.5 m³/h. Since this intersection point (a) lies between nominal sizes 25A and 32A, select the larger one, 32A.

When the specific gravity is 0.7 under the same conditions, trace down vertically from the differential pressure (ΔP) of 0.2 MPa to find intersection point (b) with the specific gravity 1. Find intersection point (c) with the specific gravity of 0.7 by tracing horizontally to the slant lines from this intersection point (b). Then, find intersection point (d) with the flow rate (V) of 5.5 m³/h by tracing down vertically from intersection point (c). Since this intersection point (d) lies between nominal sizes 20A and 25A, select the larger one, 25A.

* Select the GD-21 differential pressure regulating valve under a specific gravity of 1.

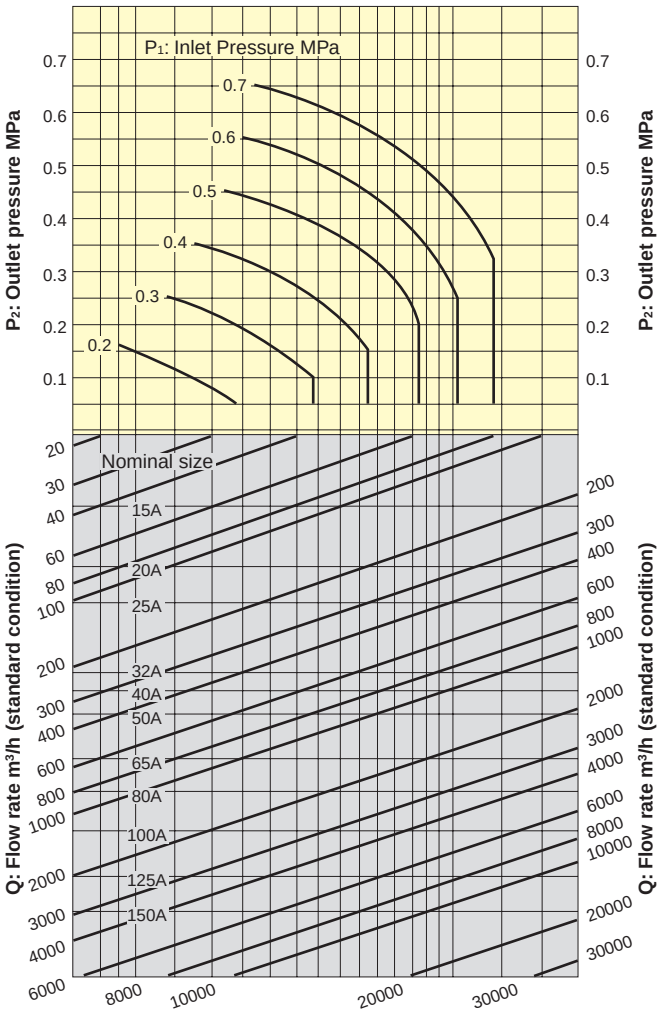
Flow Rate Characteristics Chart



* Accumulation

Set range MPa	Accumulation MPa
0.05-0.25	Within 0.05
0.26-0.7	Within 0.105

GD-20R Nominal Size Selection Chart (For Air)



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GD-7R

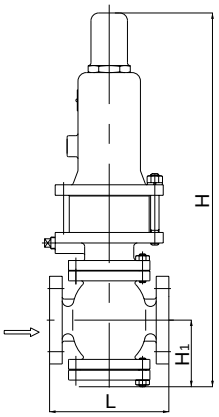
Features

1. Simple in structure, less prone to fail and easy to maintain.
2. Superior performance especially as relief unit for lubricating oil and heavy oil.

Specifications

Application		Cold and hot water, Oil, Other non-dangerous fluids	
Nominal size		20A-50A	65A-150A
Pressure regulating range		0.05-0.25 MPa 0.25-0.45 MPa 0.45-0.7 MPa *1	0.05-0.2 MPa 0.2-0.5 MPa 0.5-0.7 MPa *1
Fluid temperature		5-80˚C *2	
Valve seat leakage		0.5% or less of rated flow rate	
Fluid viscosity		700 cSt or less	
Material	Body	Cast iron	
	Valve disc, valve seat	Phosphor bronze *3	
	Piston	Bronze	
Connection		JIS 10K FF flanged	

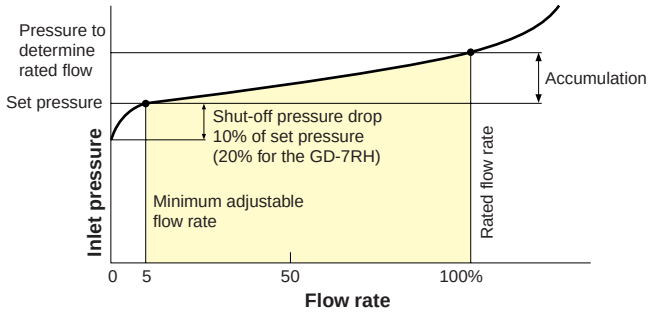
*1 Available with the GD-7RH, made of cast steel, with pressure regulating range of 0.7 to 1.6 MPa.
*2 Available with maximum temperature of 120˚C.
*3 Available with stainless steel made valve disc and valve seat.



Dimensions (mm) and Weights (kg)

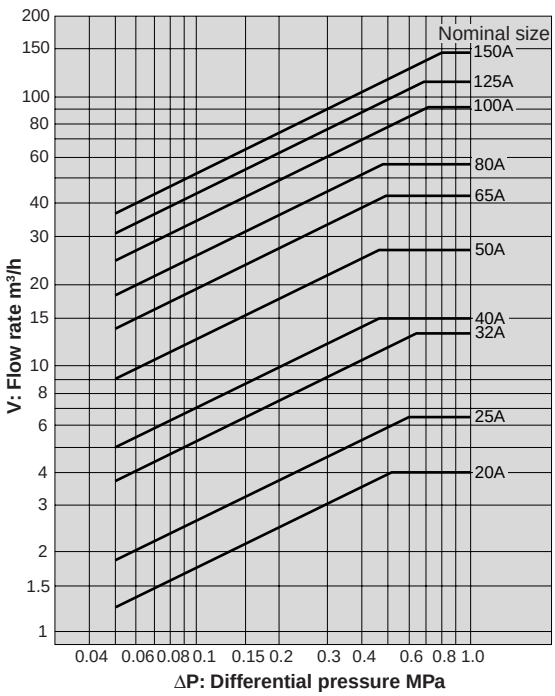
Nominal size	L	H	H_1	Weight
20A	170	535	95	20
25A	170	535	95	22
32A	180	545	100	23
40A	180	545	100	23
50A	180	565	110	26
65A	215	680	125	41
80A	260	700	135	51
100A	300	750	160	66
125A	360	810	190	90
150A	382	875	220	129

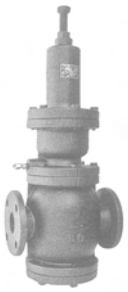
Flow Rate Characteristics Chart

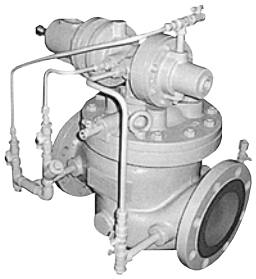
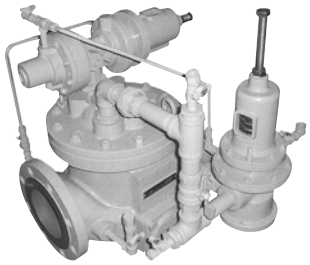
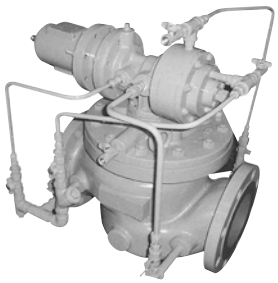


Nominal size	Set range MPa	Accumulation MPa
20A-50A	0.05-0.25	Within 0.04
	0.25-0.45	Within 0.06
	0.45-0.7	Within 0.08
	0.7-1.6	Within 0.23
65A-150A	0.05-0.2	Within 0.1
	0.2-0.5	Within 0.14
	0.5-0.7	Within 0.19
	0.7-1.6	Within 0.18

Nominal Size Selection Chart (For Water)



Feature		Primary pressure regulating valve	
Model		GD-47R	GD-4R
Picture			
Application		Steam	Air, Other non-dangerous fluids
Pressure regulating range		0.2-0.9 MPa	2-200 kPa *
Min. differential pressure		0.05 MPa	—
Max. temperature		220˚C	80˚C
Connection		JIS 10K FF flanged	JIS 10K FF flanged
Valve seat leakage		0.5% or less of rated flow rate	0.1% of rated flow rate 0.5% of rated flow rate
Material	Body	Ductile cast iron	Cast iron
	Main valve	Stainless steel	Stainless steel
	Main valve seat	Stainless steel	Stainless steel
	Diaphragm	—	NBR
	Bellows	Stainless steel	—
Size		50A	20A-150A
Others		* An external sensing pipe (ϕ 8-2 m) and an external joint (ϕ 8-R 1/4) are supplied with the product.	* Please contact us for pressure range of each size.

Feature		Primary pressure regulating valve	Falling water preventing valve	Differential pressure regulating valve
Model		GP-50R	GP-50S	GP-50RD
Picture				
Application		Cold and hot water	Cold and hot water	Cold and hot water
Pressure regulating range		0.1-0.7 MPa	0.1-0.7 MPa	0.1-0.7 MPa
Min. differential pressure		0.1 MPa	0.1 MPa	0.1 MPa
Max. temperature		70˚C	70˚C	70˚C
Connection		JIS 10K RF flanged	JIS 10K RF flanged	JIS 10K RF flanged
Valve seat leakage		—	—	—
Material	Body	Cast iron	Cast iron	Cast iron
	Main valve	NBR・Stainless steel	NBR・Stainless steel	NBR・Stainless steel
	Main valve seat	Stainless steel	Stainless steel	Stainless steel
	Piston	Bronze	Bronze	Bronze
Size		125A-300A	125A-300A	125A-300A
Others		—	—	—

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Expansion Joint

Ball Joint
Flexible Joint

Expansion Joint Selection

Application				Max. Pressure (MPa)	Expansion	Compression	Max. Temperature (˚C)	Model	Type		Page
Steam	Air	Water	Oil						Bellows	Sleeve	
●	●	●	●	0.98	10	25	220	EB-1J	●		274
●	●	●	●		20	50		EB-2J	●		274
●	●	●	●	1.0	40	160		ES-10		●	276
●	●	●	●	2.0				ES-11		●	276
●	●	●	●		10	25		EB-11	●		275
●	●	●	●		20	50		EB-12	●		275
	●	●	●	1.0	10	25	120	EB-31	●		276
	●	●	●		20	50		EB-32	●		276
		●			10-20	10-35	150	EB-51-3	●		276

Ball Joint Selection

Application				Max. Pressure (MPa)	Max. Temperature (˚C)	Model	Connection			Page
Steam	Air	Water	Oil				Screwed	Flanged	Butt-Weld	
●	●	●	●	0.98	220	UB-1	●			276
●	●	●	●			UB-2			●	276
●	●	●	●			UB-10		●		276
●	●	●	●			UB-11		●		276
	●	●	●	1.0	80	UB-3	●			276
	●	●	●			UB-13		●		276

Flexible Joint Selection

Application				Max. Pressure (MPa)	Max. Temperature (˚C)	Model	Connection		Page
Steam	Air	Water	Oil				Screwed	Flanged	
●	●	●	●	1.0	220	YBF-1E	●		273
●	●	●	●			YBF-2E		●	273

Expansion/Compression of Piping

Piping is susceptible to the ambient temperature and the fluid temperature and varies in length due to expansion or compression.
Or, if a structure or building sinks on soft ground or its piping is subjected to external force, a tensile or compressive load is imposed on the piping.
Piping is not always in the same condition as described above, and it is, therefore, necessary in some situations to pay attention to various factors in designing piping. Expansion joints and displacement absorption joints are used to deal with changes in situations.

Types and Features of Expansion Joint

Applications	・Heating and cooling system / air-conditioning unit / sanitary plumbing for general building utilities ・Cold/hot water supply piping requiring corrosion proof for hygiene reasons (copper piping) ・Specifications for public office	・Main piping of high-rise buildings, district heating and cooling, plants, factories, etc.	・Same as on the left ・Specifications for public office ・Countermeasures against earthquake and ground subsidence
Types	Bellows	Sleeve	Ball
Displacement types	Straight	Straight・Rotation	Angle・Rotation
Heat resistance	Excellent	Excellent	Excellent
Durability	Good	Excellent	Excellent
Pressure resistance	Good	Excellent	Excellent
Expansion/Compression	Small	Large	Arbitral
Reaction force	Large	Medium	Small
Airtightness	Excellent	Excellent	Excellent
Corrosion resistance	Excellent	Excellent	Excellent
Accumulated drain	–	Excellent	Excellent
Maintenance check	Unnecessary	Necessary	Necessary
Major products	 **EB-1J**	 **ES-10-100**	 **UB-1**

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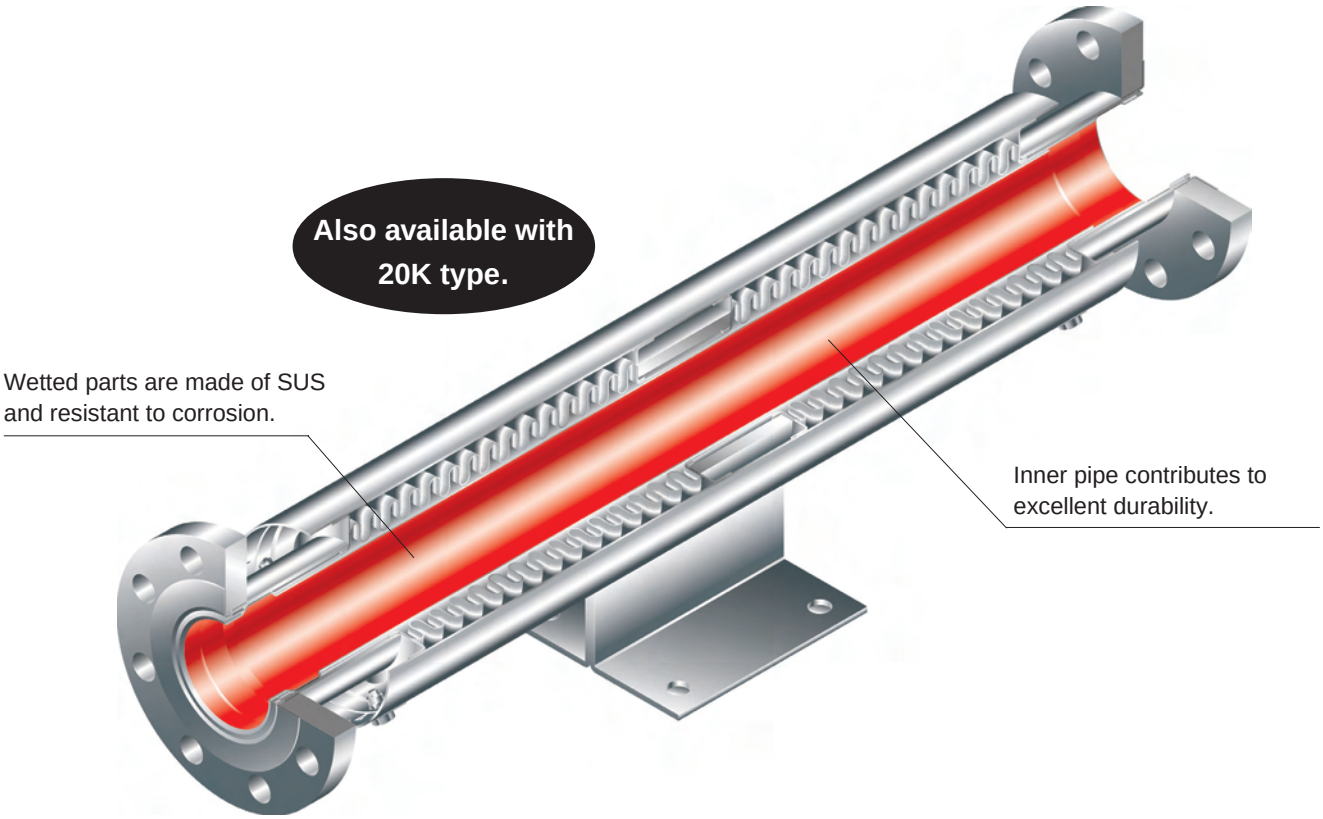
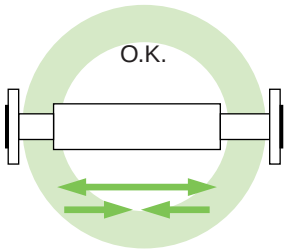
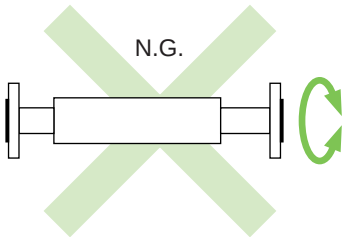
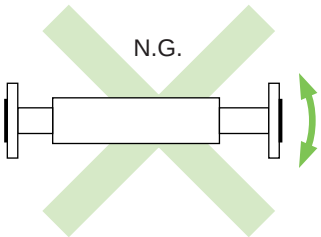
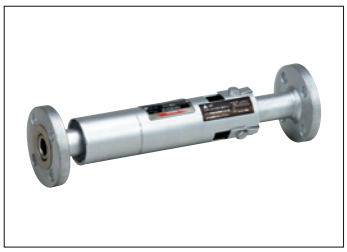
Bellows Type Expansion Joint ＜EB＞

This type of expansion joint is easy to maintain and manage because it does not use any packing. The EB expansion joint complies with application A of JIS B 2352 Bellows Type Expansion Joints (EB-1J・2J).

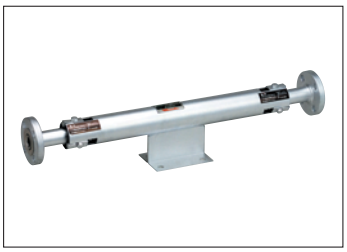


● Applicable displacement

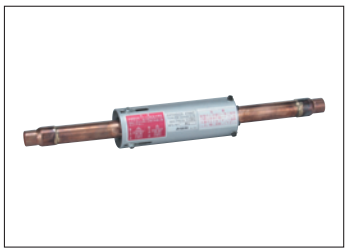
Straight	Rotation	Angle
		



EB-1J



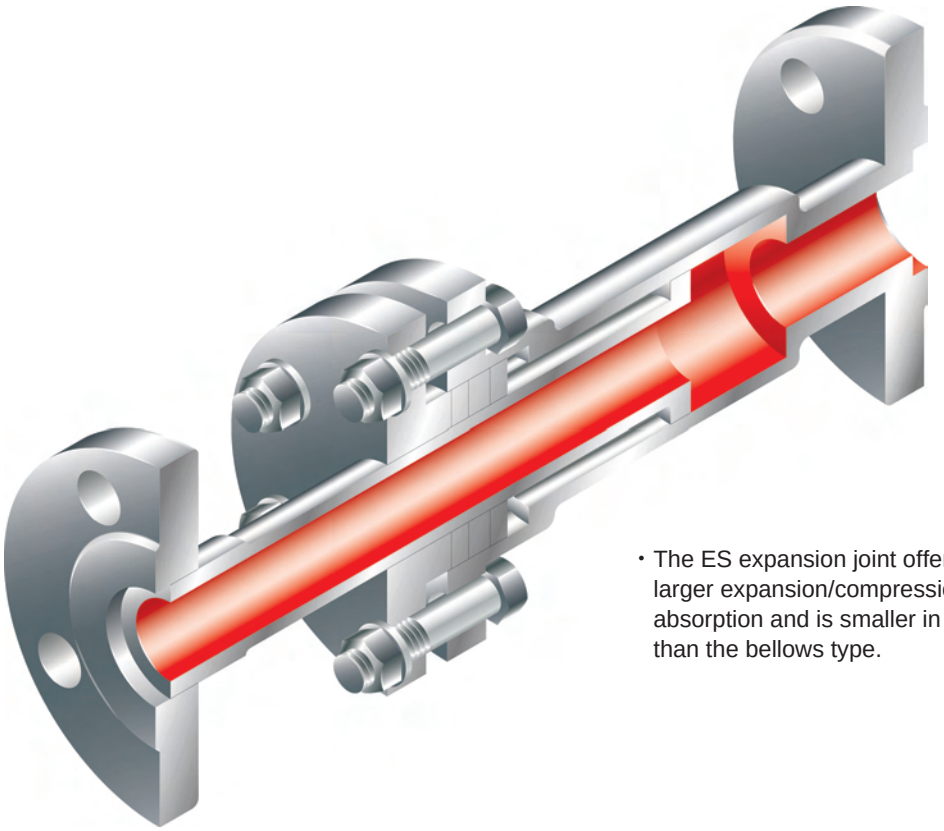
EB-2J



EB-31

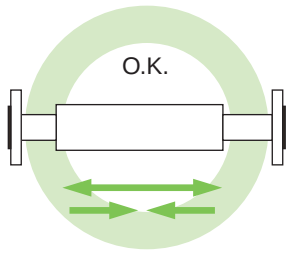
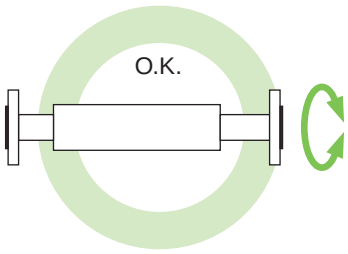
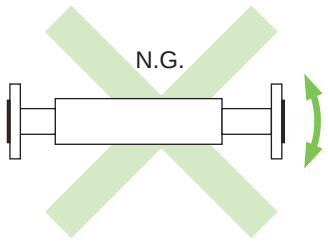
Sleeve Type Expansion Joint

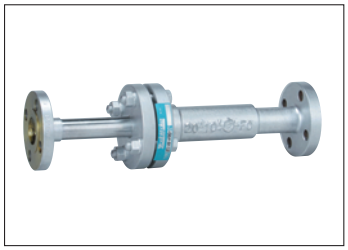
This type of expansion joint is superior to the bellows type in impact resistance.
The ES expansion joint complies with SHASE-S003 Sleeve Type Expansion Joints.



- The ES expansion joint offers a larger expansion/compression absorption and is smaller in size than the bellows type.

● Applicable displacement

Straight	Rotation	Angle
		



ES-10-100

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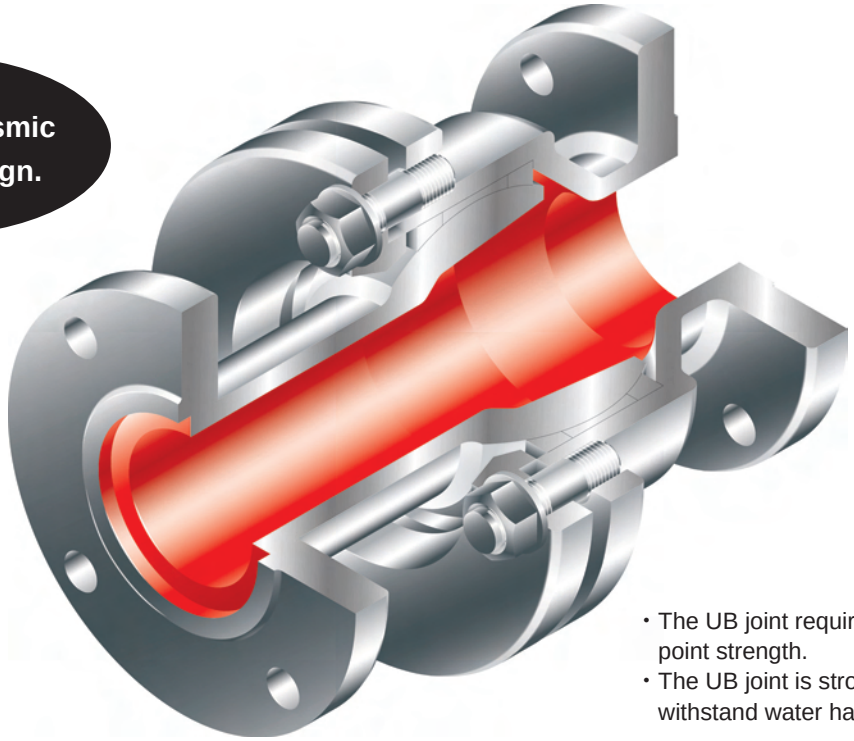
Ball joint ＜UB＞

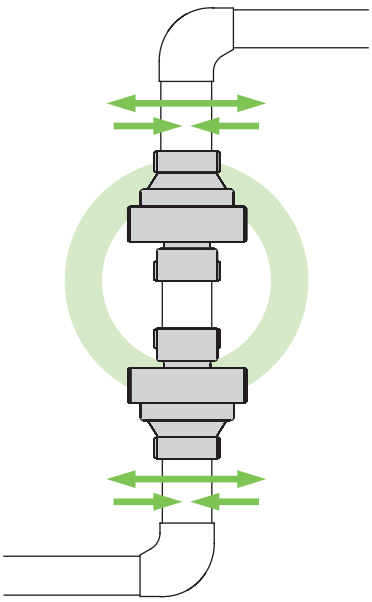
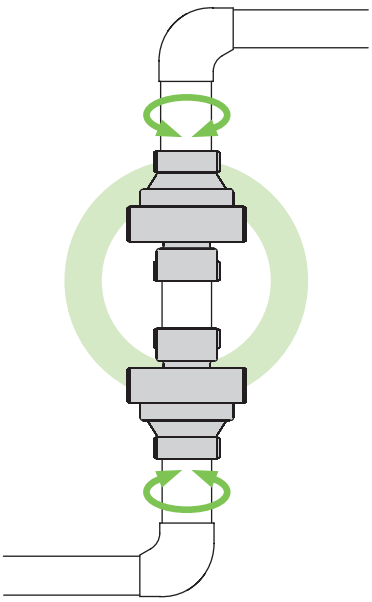
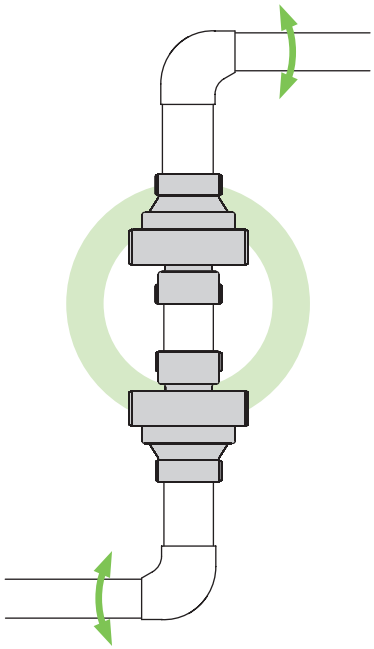
This type of joint is capable of absorbing an axial displacement of piping by combination use of ball joints angular absorption.
The UB joint complies with SHASE-S007 Mechanical Type Displacement Absorption Joints (UB-2・11).

Usable for seismic isolation design.



- The UB joint requires lower fixing point strength.
- The UB joint is strong enough to withstand water hammer, impact, etc.

● Applicable displacement

Straight	Rotation	Angle
O.K. 	O.K. 	O.K. 

Expansion/Compression Length of Piping

Calculation of Expansion/Compression Length of Piping

Calculate the expansion/compression length of piping based on the temperature condition of the fluid, the ambient temperature in the location where the piping is laid, and the material and length of the piping.

<Calculation formula>

$\Delta\ell = \beta\ (T - t_1)\ \ell$

$\Delta\ell$: Expansion/compression length of piping [mm]
β : Expansion coefficient of piping
(See Table-1 and Fig. 1.) [mm/m/˚C]
T : Maximum working temperature [˚C]
t_1 : Minimum working temperature or ambient temperature [˚C]
ℓ : Piping length [m]

<Calculation example>

β = 12.0 x 10^{-3} mm/m/˚C (See Table-1.)
T = 170˚C (saturated steam 0.7 MPa)
t_1 = –20˚C (minimum ambient temperature)
ℓ = 30 m (piping length)

Calculate the expansion/compression length of steel piping under the abovementioned conditions.

$\Delta = \beta\ (T - t_1)$
$= 12.0 \times 10^{-3} \times \{170 - (-20)\} \times 30$
$= 69$ mm

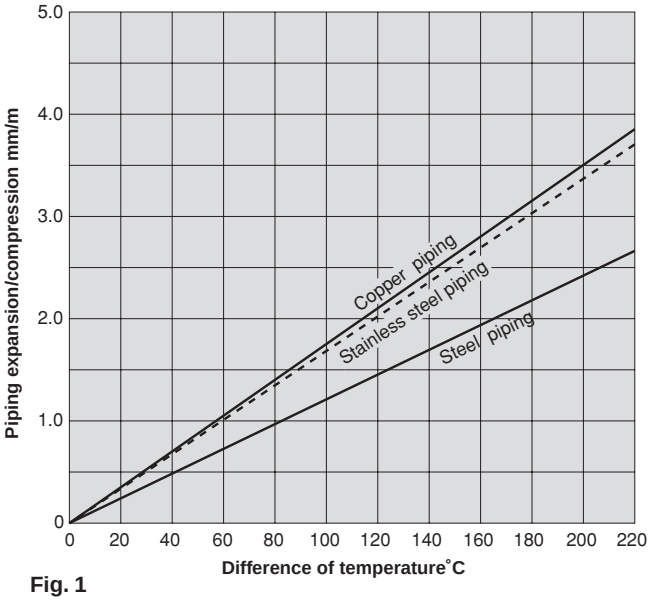


Fig. 1
Expansion/compression length of piping per meter (for 0˚C)

Steel piping	β = 12.3 x 10^{-3} mm/m/˚C
Copper piping	β = 17.6 x 10^{-3} mm/m/˚C
Stainless steel piping	β = 17.3 x 10^{-3} mm/m/˚C

Table-1 Expansion coefficient of steel piping per temperature β = 10^{-3} mm/m/˚C

Maximum temperature (˚C) \ Minimum temperature (˚C)	40	30	20	10	0	–10	–20	–30	–40
–30									10.8
–20								10.9	10.8
–10							11.0	10.9	10.9
0						11.0	11.0	10.9	10.9
10					11.1	11.0	11.0	11.0	10.9
20				11.2	11.2	11.1	11.0	11.0	11.0
30			11.5	11.4	11.3	11.2	11.1	11.1	11.1
40		11.6	11.6	11.4	11.4	11.3	11.2	11.2	11.1
50	11.9	11.8	11.7	11.6	11.5	11.4	11.3	11.3	11.2
60	11.9	11.8	11.7	11.6	11.5	11.4	11.4	11.3	11.3

Maximum temperature (˚C) \ Minimum temperature (˚C)	40	30	20	10	0	–10	–20	–30	–40
70	11.9	11.8	11.7	11.7	11.6	11.5	11.4	11.4	11.3
80	12.1	12.0	11.9	11.8	11.7	11.6	11.6	11.5	11.5
90	12.1	12.1	12.0	11.9	11.8	11.7	11.6	11.6	11.5
100	12.1	12.1	12.0	11.9	11.8	11.7	11.6	11.6	11.5
120	12.1	12.1	12.0	11.9	11.9	11.8	11.7	11.7	11.6
140	12.2	12.1	12.1	12.0	11.9	11.9	11.8	11.8	11.7
160	12.3	12.2	12.2	12.1	12.0	12.0	11.9	11.9	11.8
180	12.4	12.3	12.3	12.2	12.2	12.1	12.0	11.9	11.9
200	12.4	12.4	12.3	12.3	12.2	12.2	12.1	12.1	12.0
220	12.6	12.5	12.4	12.4	12.3	12.3	12.2	12.2	12.1

Table-2 Expansion/compression length of steel piping per meter [mm]

Maximum temperature (˚C) \ Minimum temperature (˚C)	40	30	20	10	0	–10	–20	–30	–40
–30									0.108
–20								0.109	0.216
–10							0.110	0.218	0.327
0						0.110	0.220	0.327	0.436
10					0.111	0.220	0.330	0.440	0.545
20				0.112	0.224	0.333	0.440	0.550	0.660
30			0.115	0.228	0.339	0.448	0.555	0.666	0.777
40		0.116	0.232	0.342	0.456	0.565	0.672	0.784	0.888
50	0.119	0.236	0.351	0.464	0.575	0.684	0.791	0.904	1.008
60	0.238	0.354	0.468	0.580	0.690	0.798	0.912	1.017	1.130

Maximum temperature (˚C) \ Minimum temperature (˚C)	40	30	20	10	0	–10	–20	–30	–40
70	0.357	0.472	0.585	0.702	0.812	0.920	1.026	1.140	1.243
80	0.484	0.600	0.714	0.826	0.936	1.044	1.160	1.265	1.380
90	0.605	0.726	0.840	0.952	1.062	1.170	1.276	1.392	1.495
100	0.726	0.847	0.960	1.071	1.180	1.287	1.139	1.508	1.610
120	0.968	1.089	1.200	1.309	1.428	1.534	1.638	1.755	1.856
140	1.220	1.331	1.452	1.560	1.666	1.785	1.888	2.006	2.106
160	1.476	1.586	1.708	1.715	1.920	2.040	2.142	2.261	2.360
180	1.736	1.845	1.968	2.074	2.196	2.299	2.400	2.499	2.618
200	1.984	2.108	2.214	2.337	2.440	2.562	2.662	2.783	2.880
220	2.268	2.375	2.480	2.604	2.706	2.829	2.928	3.050	3.146

・How to read the table: The expansion/compression length of steel piping is 2.196 mm per meter when the temperature changes from 0˚C (minimum temperature) to 180˚C (maximum temperature).

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Selection of Bellows Type (EB) and Sleeve Type (ES) Joints

Selecting a Model and Number of Joints

Select an expansion joint type and a number of joints based on the material and expansion/compression length of piping.

<Calculation formula>

$$n = \frac{\Delta \ell}{\delta}$$

$$\Delta \ell = \Delta K \times \ell$$

n : Number of joints [pieces]
δ : Maximum expansion/compression length of joint [mm]
$\Delta \ell$: Expansion/compression length of piping [mm]
ΔK : Expansion/compression length of piping per meter [mm/m]
ℓ : Piping length [m]
Δt : Temperature difference [˚C]

<Selection example>

Piping length (ℓ): 25 m
Maximum working temperature (T): 160˚C
Minimum working temperature (t_1): –10˚C
Ambient Temp. at the time of mounting (t_2): 20˚C
Piping material: Steel piping

<Calculation formula>

1: Calculate the expansion/compression length of the piping.
Temperature difference on the piping's expansion side:

$\Delta t_1 = T - t_2 = 160 - 20 = 140$ [˚C]

Temperature difference on the piping's compression side:

$\Delta t_2 = t_2 - t_1 = 20 - (-10) = 30$ [˚C]

From Table-2:

Expansion length of the steel piping per meter:

$\Delta K_1 = 1.708$ [mm/m]

Compression length of the steel piping per meter:

$\Delta K_2 = 0.333$ [mm/m]

Consequently:

Expansion of the 25-meter-long steel piping:

$\Delta \ell_1 = \Delta K_1 \times \ell = 1.708 \times 25 = 42.7$ [mm]

Compression of the 25-meter-long steel piping:

$\Delta \ell_2 = \Delta K_2 \times \ell = 0.333 \times 25 = 8.3$ [mm]

2: Determine a joint type, and calculate the number of joints (pieces).

Assuming that the joint type is the EB-1J (expansion: 10 mm, compression: 25 mm):

Piping's expansion side: $n_1 = \frac{\Delta \ell_1}{\delta} = \frac{42.7}{25} = 1.70$ (pieces)

Piping's compression side:

$n_2 = \frac{\Delta \ell_2}{\delta} = \frac{8.3}{10} = 0.83$ (piece)

Determine the number of joints based on n_1 or n_2, whichever is larger. In this case, the number of joint is two. Under the abovementioned conditions, two EB-1J joints are required.

Adjusting the Face-to-face Dimension

An expansion joint compresses or expands to absorb the expansion or compression of piping.
Before mounting an expansion joint, calculate the mounting face-to-face dimension from the air temperature at the time of mounting, the working temperature range, and the maximum expansion/compression length of the joint, and properly adjust it.

<Calculation formula>

$$Ls = L_1 - \delta \frac{t_2 - t_1}{T - t_1}$$

Ls : Mounting face-to-face dimension [mm]
L_1 : Maximum face-to-face dimension [mm]
δ : Maximum expansion/compression length of joint [mm]
T : Maximum working temperature [˚C]
t_1 : Minimum working temperature [˚C]
t_2 : Ambient temperature at the time of mounting [˚C]

<Calculation example>

$L_1 = 415 + 10 = 425$ mm (maximum face-to-face dimension of the EB-1J 80A joint)

$\delta = 35$ mm (maximum expansion/compression length of the EB-1J 80A joint): See page 274.

T = 170˚C (saturated steam: 0.7 MPa)

t_1 = –20˚C (minimum working temperature)

t_2 = 20˚C (ambient temperature at the time of mounting)

Calculate the mounting face-to-face dimension under the abovementioned conditions.

$$Ls = L_1 - \delta \frac{t_2 - t_1}{T - t_1} = 425 - 35 \times \frac{20 - (-20)}{170 - (-20)} = 417.6 \text{ mm}$$

Guidelines for Expansion Joints EB and ES Series

Precautions during Installation

- The expansion/compression of piping depends significantly on temperature. To ensure satisfactory results, use the expansion joints within the maximum expansion/compression length.
- The joint is fastened with shipping bolts and shipping washers to maintain the face-to-face distance during transportation or installation. Remove all of them after piping connection (anchoring point and guide installation work).
- Secure anchoring points (anchors) and guides are required to make full use of the function of the joint connected to piping.
  1. Use a main anchor at both ends of each straight piping portion, each bent piping portion, each branch point, and the location where a valve is installed.
  2. When two or more single type joints are used between main anchors, set an intermediate anchor between each pair of joints.
  3. Use main and intermediate anchors strong enough to withstand the load to be applied.
  4. Align the piping to enable the joints to properly expand or compress. Install guides for the purpose of protecting the joints from the weight of the piping or a bending load. Position the first guide close to a joint.
  5. Mount a main anchor whenever the piping diameter changes due to a reducer.
- Using a sufficient number of anchors and guides is important not only for guiding the piping to absorb its expansion or compression with the joints, but also for preventing piping bending or buckling or joint damage. Check where anchors and guides should be set, and mount them according to the correct procedure.

Mounting Anchoring Points (Anchors) and Guides

<What must be considered>
1. Precautions when mounting anchors
2. The strength of anchors
3. Mounting guides
Using a sufficient number of anchors and guides is important not only for guiding the piping to absorb its expansion or compression with the joints, but also for preventing piping bending or buckling or joint damage.

1. Precautions when mounting anchors
1) Use an anchor at both ends of each straight piping portion, each bent piping point, each branch point, and the location where a valve is installed.
2) When two or more single type joints are used between main anchors, set an intermediate anchor between each pair of joints.
3) Mount a main anchor whenever the piping diameter changes due to a reducer.
4) The anchor base of double type joint functions as an intermediate anchor. Fix the anchor of the joint.
5) Use main and intermediate anchors strong enough to withstand the load to be applied.

2. The strength of anchors
1) Anchor for straight piping portion
Mount a main anchor at both ends of the piping, each branch point, and the location where a reducer or valve is installed. These main anchors need to be strong enough to withstand the force required to stretch or contract the bellows or sleeve plus the internal pressure thrust resulting from the effect of the internal fluid pressure.
2) Main anchor for bent piping point
Mount a main anchor at each point where the piping changes its direction.
The thrust works in two different directions and becomes a resultant vector of two thrusts. Additionally, when the fluid is highly viscous and flows at high velocity, a thrust produced by centrifugal force resulting from fluid movement.
3) Intermediate anchor
An intermediate anchor is required when two or more joints are mounted between main anchors. Intermediate anchors are strong enough to withstand the force required to stretch or contract the bellows or sleeve, the frictional force of pipe guides, and other loads.

<EB>
$Fm = Fp + Fs = A \times 100P + \omega \ell$
<ES>
$Fm = Fp + Fs = A \times 100P + \mu$

Fm : Axial direction thrust [N]
Fp : Internal pressure thrust [N]
Fs : Force required to push joint [N]
A : Effective area of joint (See Table-3・4.) [cm^2]
P : Pressure [MPa]
ω : Spring constant of bellows (See Table-3.) [N/mm]
ℓ : Expansion/compression length [mm]
μ : Frictional force of joint (See Table-4.) [N]

<Calculation formula>

$$Fb = 2\,Fm \sin\frac{\theta}{2} + Fc$$

$$Fc = \frac{2A\rho V^2}{\delta} \sin\frac{\theta}{2} \times 9.8$$

Fb : Thrust of main anchor at bent piping point [N]
θ : Bending angle of piping [°]
Fc : Thrust by flowing centrifugal force of fluid [N]
V : Velocity of fluid [cm/sec]
ρ : Density of fluid [kg/cm^3]
g : Gravitational acceleration [cm/sec^2]
A : Effective area of joint
(See Table-3・4.) [cm^2]

<Calculation formula>

$Fi = Fs$

Fi : Thrust of intermediate anchor [N]

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Guidelines for Expansion Joints EB and ES Series

<Calculation example>
Nominal size of piping: 80A
Joint: EB-1J

= 25 mm (expansion/compression length)
A = 77 cm² (effective area of joint: See Table-3.)
ω = 75 N/mm
(spring constant of bellows: See Table-3.)

Fluid: 0.7 MPa saturated steam

Test pressure = 1.0 MPa

Calculate the load to be imposed on each anchor under the conditions shown on the left.
Main anchor for straight piping portion:

$$Fm = A \times 100\,P + \omega\ell$$
$$= 77 \times 100 \times 1.0 + 75 \times 25$$
$$= 9575\ N$$

Main anchor for bent piping point:

$$Fb = 2\,Fm \sin\frac{\theta}{2} + Fc$$
$$= 2 \times 9575 \times \sin\frac{90^\circ}{2} = 13541\ N$$

However, $\theta = 90^\circ$, and the value of Fc is disregarded because it is small.
Intermediate anchor: Fi = $\omega\ell$ = 75 x 25 = 1875 N

(Note) Use the test pressure for the value of the pressure P for calculating the loads Fm and Fb to be applied to the main anchors for straight and bent piping portions. In the case of vertical piping, anchors will also be subjected to the piping and fluid weights.

Table-3 Load to be applied to the main anchors for straight piping portions (EB type)

● **EB-1J・2J・11・12**

Force \ Nominal size			20A	25A	32A	40A	50A	65A	80A	100A	125A	150A	200A	250A
Spring constant ω N/mm			58	58	78	70	66	70	75	143	167	229	306	766
Effective area A cm²			10	10	16	21	36	54	77	117	196	275	441	638
Internal pressure thrust FpN	Internal pressure	0.2 MPa	200	200	320	420	720	1080	1540	2340	3920	5500	8820	12760
		0.4 MPa	400	400	640	840	1440	2160	3080	4680	7840	11000	17640	25520
		0.6 MPa	600	600	960	1260	2160	3240	4620	7020	11760	16500	26460	38280
		0.8 MPa	800	800	1280	1680	2880	4320	6160	9360	15680	22000	35280	51040
		1.0 MPa	1000	1000	1600	2100	3600	5400	7700	11700	19600	27500	44100	63800
Axial direction thrust at max. compression of 25 mm Fs N			1450	1450	1950	1750	1650	1750	1875	3575	4175	5725	7650	19150

● **EB-31・32**

Force \ Nominal size			20A	25A	32A	40A	50A	65A	80A
Spring constant ω N/mm			23.0	23.0	24.1	24.6	24.3	46.0	74.0
Effective area A cm²			8.84	8.84	14.7	19.4	30.8	47.8	67.9
Internal pressure thrust FpN	Internal pressure	0.2 MPa	177	177	294	388	616	956	1358
		0.3 MPa	266	266	441	582	924	1434	2037
		0.5 MPa	442	442	735	970	1540	2390	3395
		0.7 MPa	619	619	1029	1358	2156	3346	4753
Axial direction thrust at max. compression of 25 mm Fs N			575	575	603	615	608	1150	1850

Table-4 Load to be applied to the main anchors for straight piping portions (ES type)

● **ES-10-100, ES-11-100, ES-10-200, ES-11-200**

Force \ Nominal size			20A	25A	32A	40A	50A	65A	80A	100A	125A	150A	200A	250A	300A
Effective area A cm²			5.8	9.1	13.9	18.1	28.3	45.3	62.2	102.0	151.7	213.7	366.0	560.0	793.8
Internal pressure thrust FpN	Internal pressure	0.2 MPa	116	182	278	362	566	906	1244	2040	3034	4274	7320	11200	15876
		0.4 MPa	232	364	556	724	1132	1812	2488	4080	6068	8548	14640	22400	31752
		0.6 MPa	348	546	834	1086	1698	2718	3732	6120	9102	12822	21960	33600	47628
		0.8 MPa	464	728	1112	1448	2264	3624	4976	8160	12136	17096	29280	44800	63504
		1.0 MPa	580	910	1390	1810	2830	4530	6220	10200	15170	21370	36600	56000	79380
Frictional force Fs N			2100	2300	2500	3300	4000	5100	6200	7520	9400	11300	14800	18400	22000

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Guidelines for Expansion Joints EB and ES Series

3. Mounting guides

To enable joints to properly expand or compress, align piping and use guides for the purpose of protecting the joints from the piping's center of gravity or bending load. Mount the first and second guides so that the interval to the former (L_1) and that to the latter (L_2) will not exceed the values calculated from the calculation formulas shown below. The interval from the second guide to an intermediate guide (L_3) can be found on Fig. 3.

・Bellows type (EB)

Keep the misalignment of 20A to 125A piping within ±2 mm and that of 150A and larger piping within ±3 mm. Adjust the parallelism of 20A to 200A piping to ±1.5° or less and that of 250A piping to ±2° or less.

・Sleeve type (ES)

Keep the misalignment of 125A and smaller piping within ±2 mm and that of 150A and larger piping within ±3 mm. Adjust the parallelism of piping to ±0.5° or less.

<Calculation formula>

$L_1 \leqq 4D$

$L_2 \leqq 14D$

L_1 : Interval from joint to first guide
L_2 : Interval from first guide to second guide
L_3 : Interval from second guide to intermediate guide
D : Outside diameter of piping [mm]

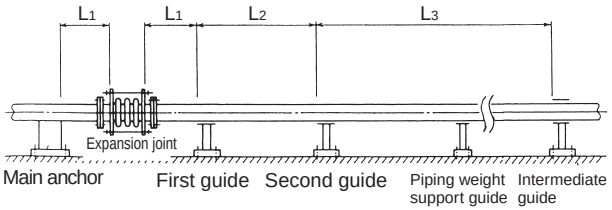


Fig. 2 Layout of guides

・Mounting piping weight support guides

Mount a roller support, hanger, etc. to prevent piping from bending under its weight or the weight of the fluid.

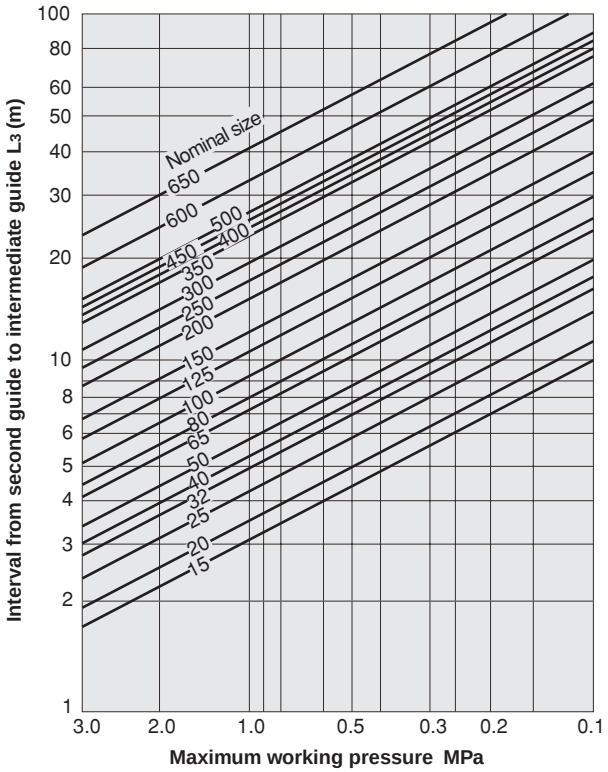
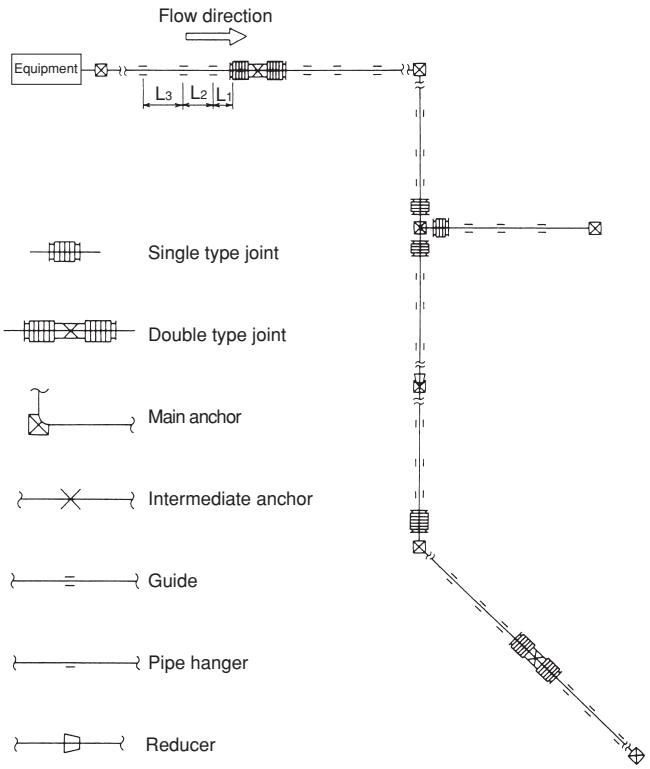


Fig. 3 Maximum interval to intermediate guide



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Selection of Ball Type UB-1・2・10・11 Joints

Consider the following points in selecting and installing the UB-1・2・10・11 joints:

- Determining the distance between joints
- Determining the positions for installing joints
- Calculating piping deflection and the minimum distance to the first guide
- Absorbing piping deflection
- The strength of anchors and guides

Determining the Distance between Joints

The axial direction displacement that the UB joints can absorb is determined by the distance between joints, and the relational formula shown below is established between the amount of the axial direction displacement and the distance.

<Calculation formula>

In the case of Fig. 4 (a)

$$\ell = \alpha \times \frac{\delta}{2 \times \sin(\theta/2)}$$

In the case of Fig. 4 (b)

$$\ell = \alpha \times \frac{\delta}{\sin(\theta/2)}$$

ℓ : Distance between joints [mm]
α : Safety factor (1.5 or more)
θ : Displacement angle [°]
δ : Displacement [mm]

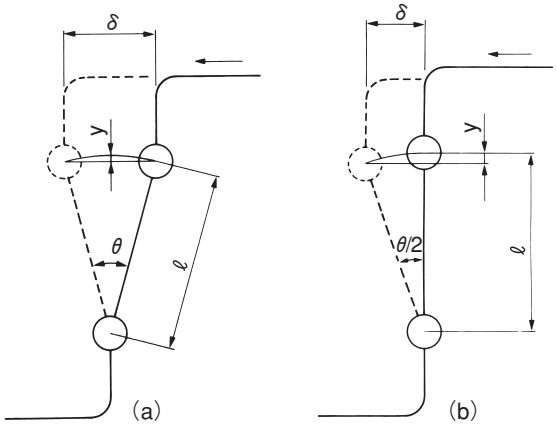

Fig. 4 Displacement of the UB joint (a)(b)

<Calculation formula>

$\theta = 20°$ (displacement angle of the UB joint),
$\delta = 69$ mm (displacement)

Calculate the distance between the joints in Fig. 4 (a) under the abovementioned conditions.

$$\ell = \alpha \times \frac{\delta}{2 \times \sin(\theta/2)} = 1.5 \times \frac{69}{2 \times \sin 10°}$$

$= 299$ mm or more

Determining the Positions for Installing Joints

The expansion or compression is absorbed by the displacement of joints. Before installing joints, adjust it with the ambient temperature at the time of installing, the working temperature range, and other factors taken into account.
When mounting the UB joints, secure space for the joint's displacement.

<Calculation formula>

$$\delta o = \left(\frac{1}{2} - \frac{t_2 - t_1}{T - t_1}\right)\delta$$

δo : Distance to position for installing the UB joint [mm]
T : Maximum working temperature [˚C]
t_1 : Minimum working temperature [˚C]
t_2 : Ambient temperature at the time of installing [˚C]
δ : Axial direction displacement of piping [mm]

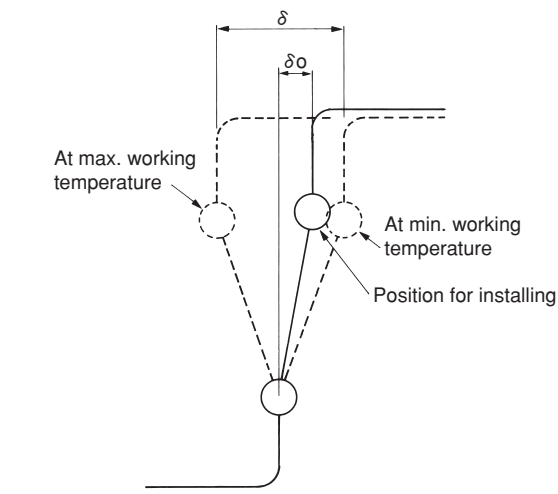

Fig. 5 Position for installing the UB joint

<Calculation example>

T = 170˚C (saturated steam: 0.7 MPa)
t_1 = –20˚C (minimum working temperature)
t_2 = 20˚C (ambient temperature at the time of installing)
$\delta = 69$ mm (axial direction displacement of piping)

Calculate the position for installing joints under the abovementioned conditions.

$$\delta o = \left(\frac{1}{2} - \frac{t_2 - t_1}{T - t_1}\right)\delta$$

$$= \left\{\frac{1}{2} - \frac{20 - (-20)}{170 - (-20)}\right\} \times 69 = 20 \text{ mm}$$

Selection of Ball Type UB-1·2·10·11 Joints

Calculating Piping Deflection and the Minimum Distance to the First Guide

When two UB joints are used, the joints move in an arc and, as a result, cause deflection as given by the following formula to the piping.

<Calculation formula>

In the case of Fig. 4 (a)

$$y = \ell - \sqrt{\ell^2 - \left(\frac{\delta}{2}\right)^2}$$

In the case of Fig. 4 (b)

$$y = \ell - \sqrt{\ell^2 - \delta^2}$$

y : Deflection of piping [mm]
ℓ : Distance between joints [mm]
δ : Displacement of piping [mm]

If the deflection of the piping exceeds a given limit, the degree of bending stress increases, which may result in a dangerous situation. The distance to the first guide must be longer than the value derived from the formula shown below.
The piping does not deflect when three or more UB joints are used. Place the first guide close to a joint.

<Calculation formula>

$$\chi = \alpha \sqrt{\frac{3EDy}{2\sigma}}$$

χ : Minimum distance to first guide [mm]
α : Safety factor (2 or more)
σ : Permissible stress of piping
(σ = 70 N/mm^2 in the case of steel piping) [N/mm^2]
E : Vertical elastic coefficient of piping (E = 21.0 x 10^4 N/mm^2 in the case of steel piping) [N/mm^2]
D : Outside diameter of piping [mm]
y : Deflection of piping [mm]

<Calculation formula>

ℓ = 303 mm (distance between joints)
δ = 69 mm (displacement of piping)
σ = 70 N/mm^2 (permissible stress of steel piping)
E = 21.0 x 10^4 N/mm^2 (vertical elastic coefficient of steel piping)
D = 89.1 mm (outside diameter of 80A SGP piping)

Calculate the distance to the first guide in the case of Fig. 4 (a) under the abovementioned conditions.

$$y = \ell - \sqrt{\ell^2 - \left(\frac{\delta}{2}\right)^2} = 303 - \sqrt{303^2 - \left(\frac{69}{2}\right)^2} = 2 \text{ mm}$$

$$\chi = \alpha \sqrt{\frac{3EDy}{2\sigma}} = 2 \times \sqrt{\frac{3 \times 21.0 \times 10^4 \times 89.1 \times 2}{2 \times 70}} = 1791 \text{ mm or more}$$

Absorbing Piping Deflection

The deflection of piping caused when two UB joints are used can be absorbed by using a third one. Three joints can also absorb expansion or compression in two directions and three-dimensional displacement. In this case, the distance between each pair of joints can be calculated in the same manner as when two joints are used. However, calculate that distance based on the maximum displacement (safety factor: 3 or more), and mount the joints at equal intervals.

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Selection of the UB-1・2・10・11 Joints

The Strength of Anchoring Points and Guides

When joints are used to absorb the displacement of piping, reaction force is generated at the anchors and the guides by the running torque of the joints as shown in Fig. 6 to Fig. 9. These anchors and guides are required to be strong enough to withstand this reaction force.

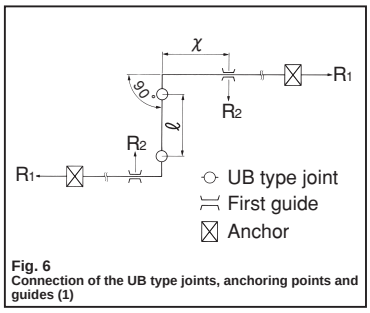

Fig. 6
Connection of the UB type joints, anchoring points and guides (1)

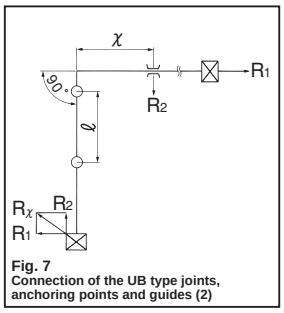

Fig. 7
Connection of the UB type joints, anchoring points and guides (2)

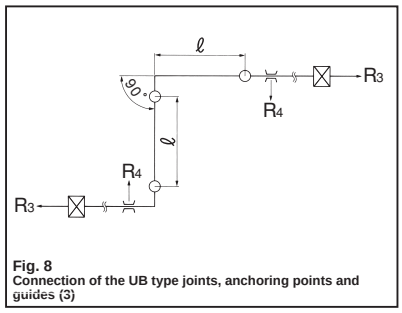

Fig. 8
Connection of the UB type joints, anchoring points and guides (3)

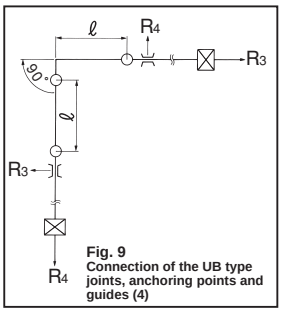

Fig. 9
Connection of the UB type joints, anchoring points and guides (4)

<Calculation formula>

$$R_1 = \frac{2T \times 1000}{\ell}$$

$$R_2 = \frac{3EIy}{\chi^3}$$

$$R_3 = \frac{2T \times 1000}{\ell}$$

$$R_4 = \frac{2T \times 1000}{\ell}$$

$$R_\chi = \sqrt{R_1^2 + R_2^2}$$

R : Load imposed on anchor and guide [N]
T : Running torque of the UB joint (See Fig. 10.) [N・m]
ℓ : Distance between the UB joints [mm]
χ : Distance between bent piping point and first guide [mm]
E : Vertical elastic coefficient of piping
(E = 21.0 x 10^4 N/mm^2 in the case of steel piping) [N/mm^2]
I : Moment of inertia of piping cross section [mm^4]

$$I = \frac{\pi}{64}(D^4 - d^4)$$

D : Outside diameter of piping (mm)
d : Inside diameter of piping (mm)
y : Deflection of piping [mm]

<Calculation example>

Nominal size of piping: 80A
Joint: UB-10

T = 410 N・m (running torque of joint: See Fig. 10.)
ℓ = 303 mm (distance between joints)
χ = 1791 mm
E = 21.0 x 10^4 N/mm^2 (vertical elastic coefficient of steel piping)
I = 101.185 x 10^4 mm^4 (moment of inertia of SGP 80A piping)
y = 2 mm (deflection of piping)

Fluid: 0.7 MPa saturated steam
Calculate the load to be imposed on the anchors and the guides in the case of Fig. 6 under the abovementioned conditions.

$$R_1 = \frac{2T \times 1000}{\ell} = \frac{2 \times 410 \times 1000}{303} = 2710 \text{ N}$$

$$R_2 = \frac{3EIy}{\chi^3} = \frac{3 \times 21.0 \times 10^4 \times 101.185 \times 10^4 \times 2}{1791^3} = 230 \text{ N}$$

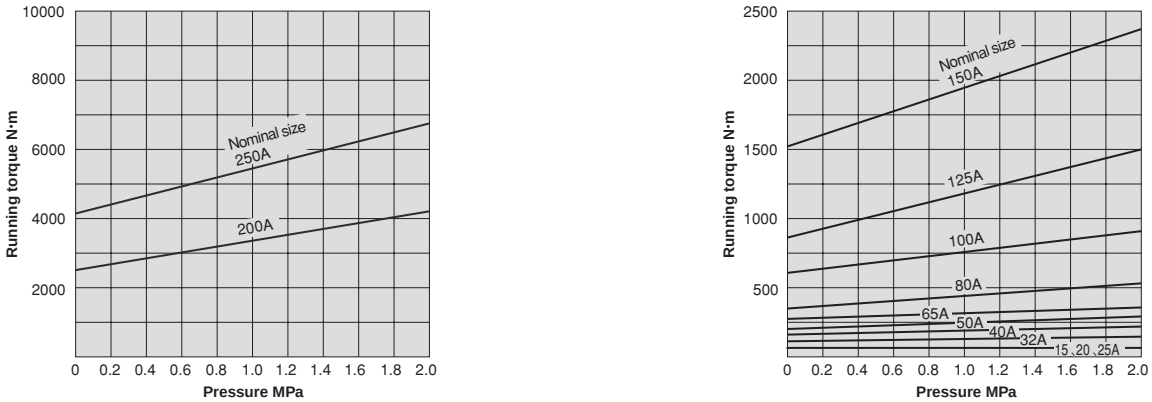

Fig. 10 Running torque of UB joint

Install guides for buckling prevention and piping weight support guides in the same manner as the EB and ES joints. Use a guide that can slide between the UB joints because of piping displacement.

Selection of the UB-3·13 Joints

Consider the following points in selecting and installing the UB-3·13 joints:

- Determining the distance between joints
- Calculating the displacement of the UB-3·13 joints
- The strength of anchors and guides

Determining the Distance between Joints

Calculate the distance between joints in the same manner as the UB joints.

Calculating the Displacement of the UB-3·13 Joints

The distance between joints changes with the displacement of a joint in piping shown in Fig. 11. The relational formula shown below is established between the distance and the displacement. Make sure that the displacement of the distance between joints calculated from the formula can be absorbed by joints.

<Calculation formula>

$$y = \ell - \sqrt{\ell^2 - \delta^2}$$

y : Displacement of distance between joints [mm]
ℓ : Distance between joints before displacement [mm]
δ : Displacement of piping [mm]

The Strength of Anchors and Guides

In case of piping displacement due to an earthquake or uneven settlement, reaction force is generated at the anchors and the guides as shown in Fig. 11. Anchors and guides that are strong enough to withstand this reaction force are thus required.
Mount an anchor and the first guide close to a joint. Additionally, mount guides for buckling prevention and piping weight support guides in the same manner as the EB and ES joints.

<Calculation formula>

$R_1 = A \times 100P + 2\mu$

$$R_2 = \frac{2T \times 1000}{\ell}$$

$$R_\chi = \sqrt{R_1^2 + R_2^2}$$

R : Load imposed on anchor and guide [N]
A : Effective area of joint (See Table-5.) [cm²]
P : Pressure [MPa]
μ : Frictional force of joint (See Table-5.) [N]
T : Running torque of UB joint (See Fig. 12.) [N·m]
ℓ : Distance between UB joints before displacement [mm]

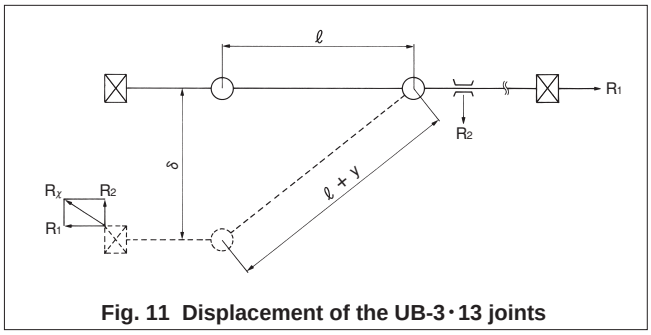

Fig. 11 Displacement of the UB-3·13 joints

<Calculation example>
ℓ = 400 mm (distance between joints before displacement)
δ = 100 mm (displacement of piping)
Joint: UB-13 80A
Calculate the displacement of the distance between joints under the abovementioned conditions.

$$y = \ell - \sqrt{\ell^2 - \delta^2} = 400 - \sqrt{400^2 - 100^2} = 13 \text{ mm}$$

The expansion/compression length of the UB-13 80A joint is within 40 mm.

<Calculation example>
Nominal size of piping: 80A
T = 400 N·m (running torque of joint: See Fig. 12.)
Joint: UB-13
ℓ = 400 mm (distance between joints before displacement)
A = 68.4 cm² (effective area of joint: See Table-5.)
Fluid: 0.3 MPa water
μ = 6550 N (frictional force of joint: See Table-5.)
Test pressure: 1.0 MPa
Calculate the load to be imposed on the anchors and the guides under the abovementioned conditions.

$R_1 = A \times 100P + 2\mu = 68.4 \times 100 \times 1.0 + 2 \times 6550 = 19940$ N

$$R_2 = \frac{2T \times 1000}{\ell} = \frac{2 \times 400 \times 1000}{400} = 2000 \text{ N}$$

$$R_\chi = \sqrt{R_1^2 + R_2^2} = \sqrt{19940^2 + 2000^2} = 20040 \text{ N}$$

(Note) Use the test pressure for the value of the pressure P for calculating the load to be applied to the anchors. In the case of vertical piping, the anchors will also be subjected to the piping and fluid weights.

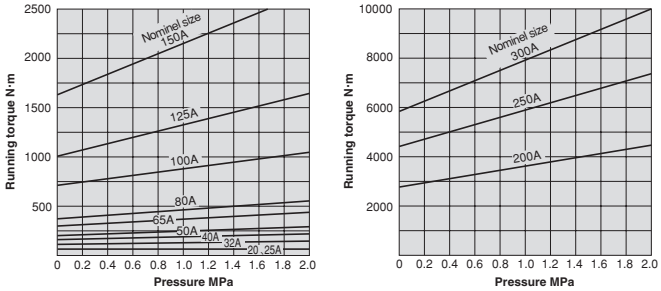

Fig. 12 Running torque of the UB-3·13 joints

Table-5 Load imposed on anchor (UB-3·13)

Force \ Nominal size			20A	25A	32A	40A	50A	65A	80A	100A	125A	150A	200A	250A	300A
Effective area A cm²			6.7	10.2	15.5	20.0	31.1	49.8	68.4	112.0	167.0	235.0	403.0	616.0	873.0
Internal pressure thrust N	Internal pressure	0.2 MPa	134	204	310	400	622	996	1368	2240	3340	4700	8060	12320	17460
		0.4 MPa	268	408	620	800	1244	1992	2736	4480	6680	9400	16120	24640	34920
		0.6 MPa	402	612	930	1200	1866	2988	4104	6720	10020	14100	24180	36960	52380
		0.8 MPa	536	816	1240	1600	2488	3984	5472	8960	13360	18800	32240	49280	69840
		1.0 MPa	670	1020	1550	2000	3110	4980	6840	11200	16700	23500	40300	61600	87300
Frictional force Fs N			2250	2440	2650	3500	4240	5400	6550	7980	9960	11950	14900	18500	22300

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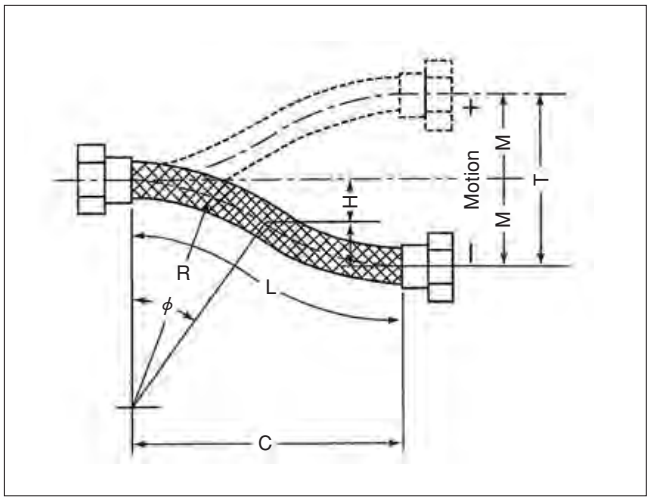
Selection of Flexible Joint

Moving Type and Estimation for Moving Displacement of Flexible Joint

● Moving of the misalignment (moving of the misaligned center line)

This is the case in which one side of the joint ends (flange, screw, union, or coupling, etc.) moves vertically up and down in the same horizontal length with the other side fixed (movement on the same level).



T: Total offset [mm]
M: Center line offset [mm]
H: 1/2M = 1/4T [mm]
L: Actual length of tube [mm]
C: Face-to-face distance of tube [mm]
R: Bending radius of center line [mm]
ϕ : Deviation angle [C°]

<Calculation formula>

1) $\frac{H}{R} = 1 - \cos\phi$

2) $\frac{C}{R} = 2\sin\phi$

3) $\phi = 28.65\frac{L}{R}$ when L ≒ C (when the movement is small)

4) $R = \frac{4H^2 + L^2}{8H}$

● Horizontal (lateral direction) and vertical (longitudinal direction) movement (plumbing of U-shaped joint/Sideways U-shaped joint)

Radial motion means the motion in which the end point of arc-shape joint moves horizontally or vertically when installed with bent as shown in Figs. 14 and 15 below.
This is generally called “moving loop”. Its moving distance is shown by horizontal or vertical moving distance.
If total distance T is given and curvature radius is chose properly, actual length of tube L and loop length K can be calculated by the formulas below.
* Total length = L + length of fitting

T= Total travel length [mm]
L= Actual length of tube [mm]
R= Curvature radius [mm]
K= Loop length [mm]

Note) Movement shall be on the same level of fixed side.

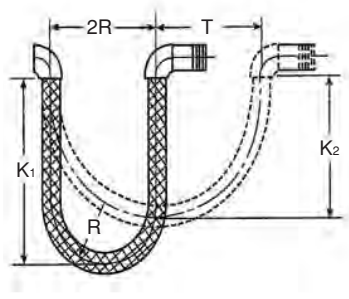


Fig. 14

<Calculation formula>
Formula for horizontal moving loop

1) $L = 4R + 1.57T$

2) $K_1 = 1.43R + .785T$

3) $K_2 = 1.43R + \frac{T}{2}$

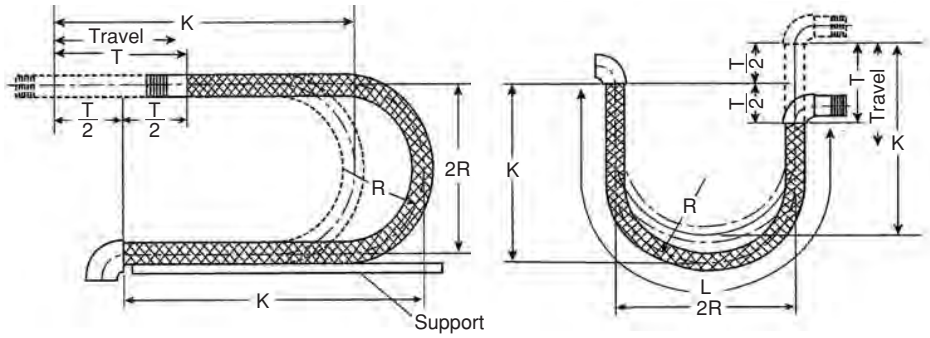


Fig. 15

<Calculation formula>
Formula for moving loop

1) $L = 4R + \frac{T}{2}$

2) $K = 1.43R + \frac{T}{2}$

Selection of Flexible Joint

● Eternal bending (fixed bending)

This means that using flexible joint with bent once without a normal bend to facilitate the connection of two piping components. Install the joint at more than allowable minimum bending radius (for low pressure piping only).
Do not use this to prevent vibration absorption or thermal expansion of piping system. Failure to follow this instruction may lead to trouble.

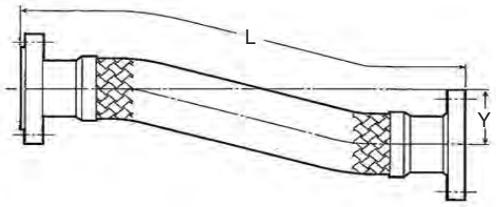
● For unregulated bending movement

If using flexible joint for sprinkler hose (garden hose), for example, it is recommended to use spring rolling to prevent bending stress from concentrating especially on the base of the fitting. In addition, spiral form is better for tube (bellows) due to the movement of pulling around freely.

● Prohibited movement

Do not displace the tube in axial direction on installation line. It is not possible since the tube is covered with braid. It also is not possible for uncovered tube (non braid type) since buckling occurs on the tube. For axial direction, it is recommended to use the bellows type expansion joint.

● The tube cannot be twisted.



Maximum Displacement of the YBF-2E Flexible Joint

(The values below are the calculated values when designation of pressure and temperature are disregarded and maximum repeated time is 1000.)

● The values below are one direction displacement from center line.

(mm)

Nominal size \ Length	200	300	400	500	600	700	800	1000	1200	1500	2000
15A	12	51	118	210	331	475	510	710	910	1210	1710
20A	9	37	83	150	236	338	463	640	840	1140	1640
25A	8	33	76	137	216	312	421	580	780	1080	1580
32A	5	22	50	91	143	207	282	463	695	1030	1530
40A	4	19	45	80	127	183	251	416	623	940	1440
50A	3	15	33	61	95	138	187	309	463	756	1387
65A	2	10	27	50	80	118	158	268	406	667	1233
80A	1	13	30	60	99	142	200	335	517	849	1200
100A	1	8	21	41	68	107	147	248	376	629	1165
125A	—	4	15	31	52	80	113	191	296	497	933
150A	—	3	13	28	49	71	102	182	277	461	882
200A	—	2	8	20	36	54	80	141	219	372	712
250A	—	1	7	17	30	47	68	128	198	333	647

Maximum Displacement of the YBF-2EM Flexible Joint

(The values below are the calculated values when designation of pressure and temperature are disregarded and maximum repeated time is 1000.)

● The values below are one direction displacement from center line.

(mm)

Nominal size \ Length	300	400	500	600	700	800	1000
20A	52	120	210	332	380	480	680
25A	35	76	140	216	316	425	660
32A	41	92	164	257	370	504	640
40A	32	74	131	206	296	403	667
45A	31	68	126	194	285	382	634
50A	26	59	105	165	237	323	534
65A	21	49	90	151	217	296	503
80A	18	44	86	142	213	286	479
100A	11	34	68	107	162	230	386
125A	8	26	49	86	133	182	323
150A	4	17	40	68	103	145	252
200A	3	14	31	56	88	126	225
250A	—	8	19	36	53	79	147
300A	—	6	17	29	45	69	118

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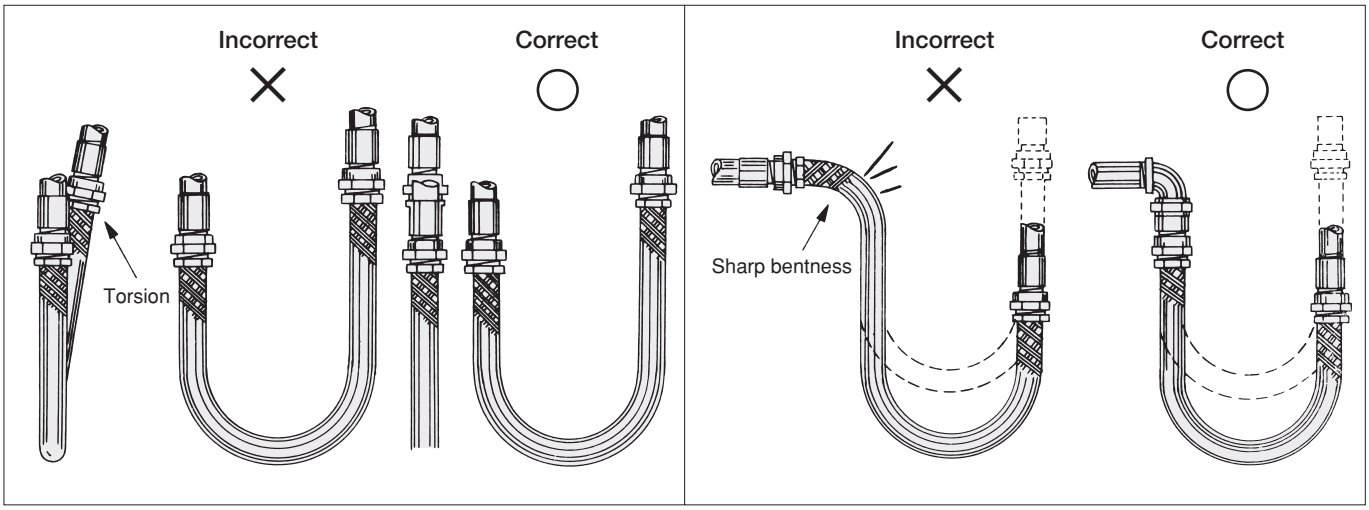
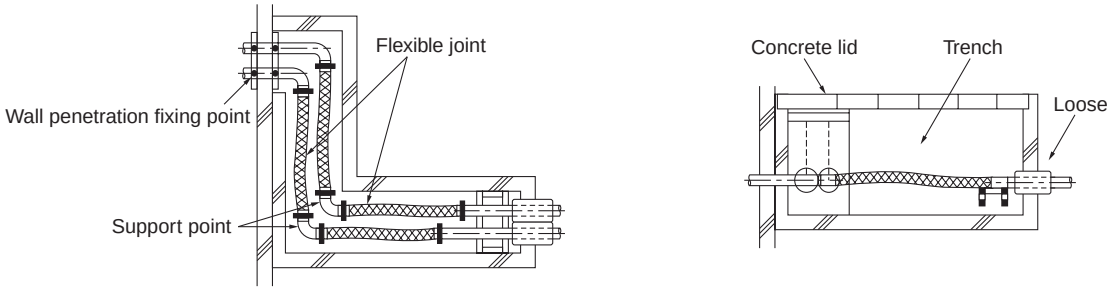
Precautions for Installation: Flexible Joints

- Install flexible joints so that bent portions of joints do not concentrate in a specific position.
- Install flexible joints so that the bending radius of joints does not become excessively small.
- Do not use flexible joints in a position subjected to a pressure higher than the permissible pressure.
- Beware of an excessive velocity of the internal fluid.

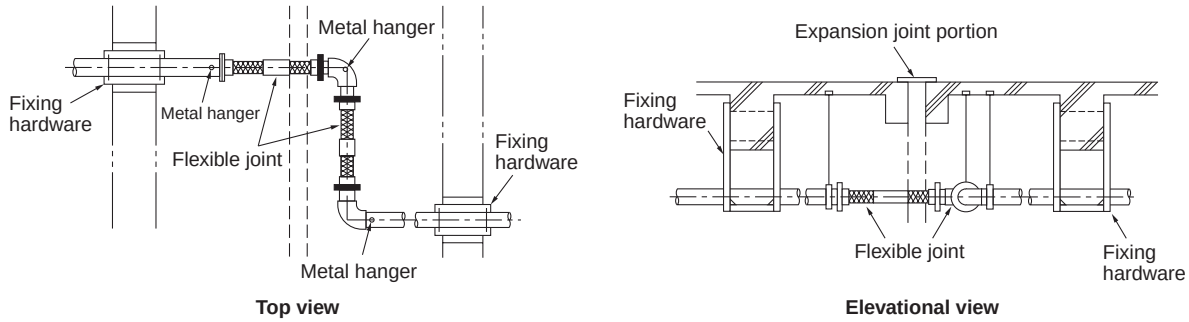


Piping Example

● Displacement absorption piping procedure for introduction area to building (when using flexible joint)



● Expansion joint piping procedure for building (when using flexible joint)



⚠ Warning

1. Prevent water hammer.
・Water hammer may damage the joints and lead to cause outside leakage.
2. Do not touch flexible joints with bare hands when fluid is in high temperature.
・This may lead to burn.
3. Do not use flexible joints as installed in axial direction of piping to absorb expansion or compression of piping.
・Failure to follow this instruction damages flexible joints.
4. Make sure to fix the devices or pipes to which flexible joints are connected.

YBF-1E・2E

Features

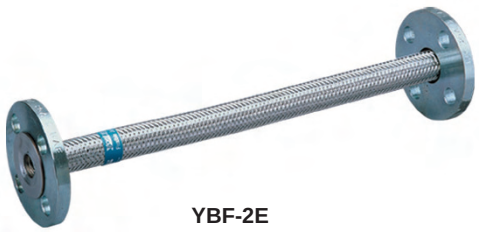
1. The best flexible joints among other similar products using metallic bellows, offering outstanding flexibility against bending.
2. Stainless steel made bent portions (bellows and braid) offers high resistance to corrosion and ensures distinguished durability.

Specifications

Model		YBF-1E	YBF-2E
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids	
Maximum pressure		1.0 MPa	*
Maximum temperature		220˚C	
Material	Connection	Malleable cast iron	Rolled steel
	Braid	Stainless steel	
	Bellows	Stainless steel	
Connection		JIS Rc screwed (union joint)	JIS 10K FF flanged (loose flanges on both sides)

・Wire braid is used for 100A or less, and plate braid is used for 125A or larger.
・Available with for high pressure, underground use or complies with the Fire Service Law.
・Available with all stainless steel made (YBF-6E・7E).
・For vibration absorption around pump, the YBF-2EM (flanged type only) is appropriate. Contact us for details.

YBF-1E



YBF-2E

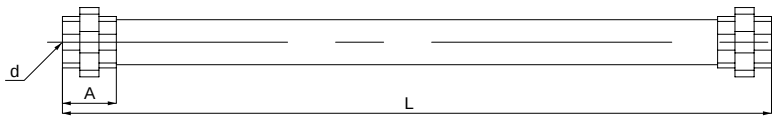
*〔YBF-2E Maximum pressure〕

Nominal size	Maximum pressure
15A-100A	1.0 MPa
125A-200A	0.8 MPa
250A	0.5 MPa

Dimensions (mm)

●YBF-1E

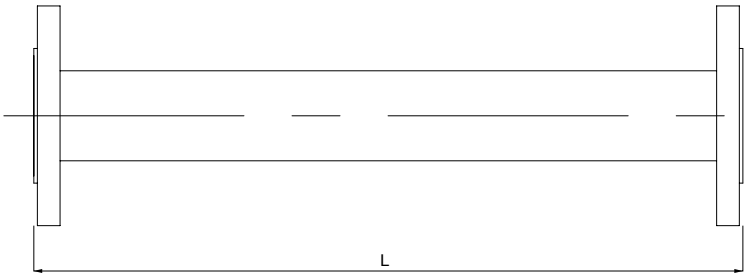
Nominal size	L	d	A
15A		Rc 1/2	42
20A	300	Rc 3/4	50
25A	500	Rc 1	55
32A	800	Rc 1-1/4	61
40A	1000	Rc 1-1/2	68
50A		Rc 2	76



YBF-1E

●YBF-2E

Nominal size	L
15A	
20A	300
25A	400
32A	500
40A	600
50A	700
65A	800
80A	1000
100A	
125A	300・400・500
150A	600・700・800
200A	1000・1200
250A	1500・2000



YBF-2E

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EB-1J・2J

Features

1. Complies with JIS B 2352 (Bellows type expansion joints: Application A) of Japanese Industrial Standards.
2. No need for retightening and replacement due to aging since packing is not used. Easy to maintain and manage.
3. Simple structure since flange, short pipe and bellows are united.
4. Outer pipe is attached in order to protect the bellows from damage due to external impact.
5. Stainless steel inner pipe is attached in order to prevent fluid pressure loss, vibration, impact, corrosion, etc.
6. Stainless steel made wetted parts offer high resistance to corrosion and ensures distinguished durability.

Specifications

Model		EB-1J	EB-2J
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids	
Maximum pressure		0.98 MPa	
Max. temperature		220˚C	
Max. axial extension		35 mm (Expansion 10 mm Compression 25 mm)	70 mm * (Expansion 20 mm Compression 50 mm)
Material	Outer pipe	Carbon steel	
	Bellows, inner pipe	Stainless steel (SUS316L)	
Connection		JIS 10K FF flanged	
Pressure test (Water pressure)		1.5 MPa	

EB-1J

EB-2J

* Expansion of one side from the centering anchor base is 10 mm and compression is 25 mm.
・Available with all stainless steel made.
・Available with loose flanged type (EB-1JL・2JL).
・Available with nominal size from 300A to 450A (EB-3・4).

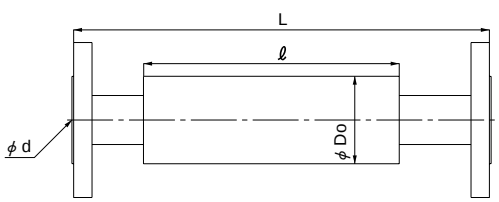
Dimensions (mm) and Weights (kg)

●EB-1J

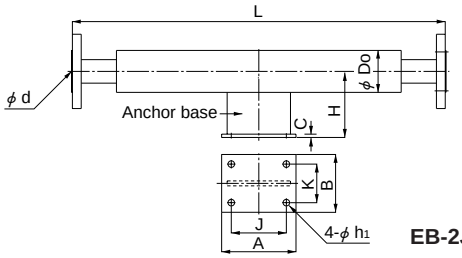
Nominal size	L	Max. operating length	Min. operating length	Max. axial extension δ	Do	d	ℓ	Weight
20A	365	375	340	35	58.2	20.6	235	2.6
25A	365	375	340	35	58.2	20.6	235	3.3
32A	365	375	340	35	73.2	28.1	235	4.8
40A	365	375	340	35	73.2	34.1	235	5.0
50A	365	375	340	35	98.2	44.0	239	5.7
65A	415	425	390	35	109.7	59.5	289	8.9
80A	415	425	390	35	135.7	72.0	288	10.1
100A	415	425	390	35	161.7	97.0	288	12.9
125A	440	450	415	35	212.1	121.0	292	21.0
150A	440	450	415	35	235.1	143.0	293	26.3
200A	440	450	415	35	291.6	193.0	280	35.3
250A	465	475	440	35	332.6	241.0	287	52.5

●EB-2J

Nominal size	L	Max. operating length	Min. operating length	Max. axial extension δ	Do	d	Dimensions of ancher base・JIS B 2352								Weight
							H	J	K	A	B	C	h_1	Bolt size	
20A	680	700	630	70	60.5	20.6	100	100	60	135	95	3.2	12	M10	4.6
25A	680	700	630	70	60.5	20.6	100	100	60	135	95	3.2	12	M10	5.5
32A	680	700	630	70	76.3	28.1	120	100	70	135	105	3.2	12	M10	6.7
40A	680	700	630	70	76.3	34.1	120	100	70	135	105	3.2	12	M10	7.0
50A	680	700	630	70	101.6	44.0	130	100	80	140	120	3.2	15	M12	9.8
65A	780	800	730	70	114.3	59.5	140	120	100	160	140	4.0	15	M12	11.1
80A	780	800	730	70	139.8	72.0	150	120	110	160	150	4.0	15	M12	12.6
100A	880	900	830	70	165.2	97.0	170	120	130	160	175	4.0	19	M16	16.3
125A	880	900	830	70	216.3	121.0	200	120	150	175	205	4.0	19	M16	34.5
150A	930	950	880	70	236.4	143.0	220	160	180	215	235	4.5	23	M20	41.6
200A	930	950	880	70	293.4	193.0	250	160	220	215	285	4.5	25	M22	59.9
250A	980	1000	930	70	334.4	241.0	300	180	280	255	375	4.5	27	M24	83.0



EB-1J



EB-2J

EB-11・12

Features

1. Control ring is provided for the purpose of reinforcement against internal pressure and equalization of bellows expansion.
2. No need for retightening and replacement due to aging since packing is not used. Easy to maintain and manage.
3. Simple structure since the flange, short pipe and bellows are united.
4. Outer pipe is attached in order to protect the bellows from damage due to external impact.
5. Stainless steel inner pipe is attached in order to prevent fluid pressure loss, vibration, impact, corrosion, etc.
6. Stainless steel made wetted parts offer high resistance to corrosion and ensures distinguished durability.

Specifications

Model		EB-11	EB-12
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids	
Maximum pressure		2.0 MPa	
Max. temperature		220˚C	
Max. axial extension		35 mm (Expansion 10 mm Compression 25 mm)	70 mm * (Expansion 20 mm Compression 50 mm)
Material	Outer pipe	Carbon steel	
	Bellows, inner pipe	Stainless steel (SUS316L)	
Connection		JIS 20K RF flanged	
Pressure test (Water pressure)		3.0 MPa	

* Expansion of one side from the centering anchor base is 10 mm and compression is 25 mm.
・Available with nominal size from 300A to 450A (EB-7・8).

EB-11

EB-12

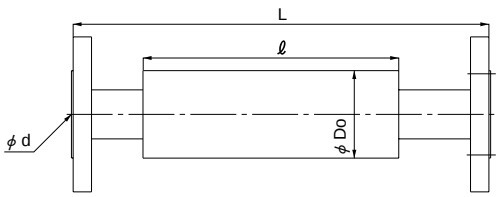
Dimensions (mm) and Weights (kg)

●EB-11

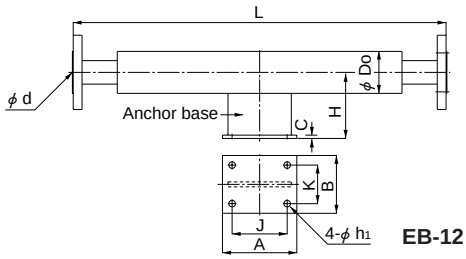
Nominal size	L	Max. operating length	Min. operating length	Max. axial extension	Do	d	ℓ	Weight
20A	365	375	340	35	58.2	20.6	235	2.7
25A	365	375	340	35	58.2	20.6	235	3.6
32A	365	375	340	35	73.2	28.1	235	4.4
40A	365	375	340	35	73.2	34.1	235	5.3
50A	365	375	340	35	98.2	44.0	239	6.8
65A	415	425	390	35	109.7	59.5	289	9.5
80A	415	425	390	35	135.7	72.0	288	13.1
100A	415	425	390	35	161.7	97.0	288	13.9
125A	440	450	415	35	212.1	121.0	292	34.7
150A	440	450	415	35	235.1	143.0	293	43.2
200A	440	450	415	35	291.6	193.0	280	55.8
250A	465	475	440	35	332.6	241.0	287	85.7

●EB-12

Nominal size	L	Max. operating length	Min. operating length	Max. axial extension δ	Do	d	Dimensions of ancher base・JIS B 2352								Weight
							H	J	K	A	B	C	h1	Bolt size	
20A	680	700	630	70	60.5	20.6	100	100	60	135	95	3.2	12	M10	4.8
25A	680	700	630	70	60.5	20.6	100	100	60	135	95	3.2	12	M10	5.7
32A	680	700	630	70	76.3	28.1	120	100	70	135	105	3.2	12	M10	7.5
40A	680	700	630	70	76.3	34.1	120	100	70	135	105	3.2	12	M10	7.6
50A	680	700	630	70	101.6	44.0	130	100	80	140	120	3.2	15	M12	10.8
65A	780	800	730	70	114.3	59.5	140	120	100	160	140	4.0	15	M12	13.4
80A	780	800	730	70	139.8	72.0	150	120	110	160	150	4.0	15	M12	18.2
100A	880	900	830	70	165.2	97.0	170	120	130	160	175	4.0	19	M16	21.6
125A	880	900	830	70	216.3	121.0	200	120	150	175	205	4.0	19	M16	48.2
150A	930	950	880	70	236.4	143.0	220	160	180	215	235	4.5	23	M20	58.5
200A	930	950	880	70	293.4	193.0	250	160	220	215	285	4.5	25	M22	80.4
250A	980	1000	930	70	334.4	241.0	300	180	280	255	375	4.5	27	M24	116.2



EB-11



EB-12

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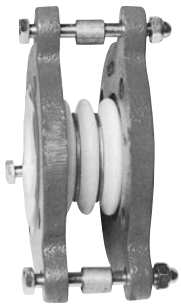
Feature		For copper pipe / Single type	For copper pipe / Double type	Anti-corrosion / PTFE joint	Sleeve joint / 1.0, 2.0 MPa
Model		EB-31	EB-32	EB-51-3	ES-10･11
Picture		 EB-31  EB-32			 ES-10-100
Application		Air, Cold and hot water, Oil, Other non-dangerous fluids		Cold and hot water, Chemicals, etc.	Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids
Max. pressure		1.0 MPa		1.0 MPa *1	ES-10: 1.0 MPa ES-11: 2.0 MPa
Max. temperature		120˚C		150˚C *1	220˚C
Axial extension		10 mm	20 mm	10-20 mm *2	ES-10-100, ES-11-100: 20 mm ES-10-200, ES-11-200: 40 mm
Axial compression		25 mm	50 mm	10-35 mm *2	ES-10-100, ES-11-100: 80 mm ES-10-200, ES-11-200: 160 mm
Connection		Socket soldered type		JIS 10K RF flanged	ES-10: JIS 10K RF flanged ES-11: JIS 20K RF flanged
Material	Outer pipe	Carbon steel		—	Body-ES-10: Cast iron or Rolled steel ES-11: Rolled steel
	Bellows	Stainless steel (SUS316L)		PTFE	
	Connection	Copper		Flange: Ductile cast iron	Sleeve: Carbon steel (HCr plating)
Size		20A-80A		25A, 40A-200A	20A-300A
Others		—	—	*1 Depends on the size and rating. Contact us for details. *2 Depends on the size. Contact us for details.	—

Feature		Ball joint / Screwed	Ball joint / Butt-weld	Ball joint / Flanged	Universal joint / Axial & angle
Model		UB-1	UB-2	UB-10･11	UB-3･13
Picture		 UB-1	 UB-10		 UB-13
Application		Steam, Air, Cold and hot water, Oil, Other non-dangerous fluids			Air, Cold and hot water, Oil, Other non-dangerous fluids
Max. pressure		0.98 MPa			1.0 MPa
Max. temperature		220˚C			80˚C *1
Max. displacement angle		20˚			UB-3: 20˚ UB-13: 30˚
Max. axial displacement		—			12 mm-80 mm *2
Connection		JIS Rc screwed	Butt-weld	JIS 10K RF flanged	UB-3: JIS Rc screwed UB-13: JIS 10K RF flanged
Material	Body	Cast iron	Carbon steel	UB-10: Cast iron UB-11: Carbon steel	Cast iron
	Ball	Cast iron (HCr plating)	Carbon steel (HCr plating)		Cast iron (HCr plating)
Size		20A-50A	50A-250A		UB-3: 20A-50A UB-13: 40A-300A
Others		—	—	—	*1 Available with max. temp. 120˚C. *2 Depends on the size. Contact us for details.

Sight Glass

Sight Glass Selection

Application			Max. Pressure (MPa)	Max. Temperature (˚C)	Model	Type				Page
Condensate	Water	Oil				Plain	Flap	Ball	Spinner	
●	●	●	1.0	150	SF-1S		●			282
●	●	●			SF-1F		●			282
●	●	●			SL-1S	●				281
●	●	●			SL-1F	●				281
●	●	●			150F-F		●			285
●	●	●			150L-F	●				284
●	●	●			150F-13S		●			285
●	●	●			150F-13F		●			285
●	●	●			150L-13S	●				284
●	●	●			150L-13F	●				284
	●		0.7	100	400				●	286
	●		1.0	85	SB-1S			●		283
	●				SB-1F			●		283

Types and Main Applications of Sight Glasses

Sight glasses are used as components for visually checking the flow of the fluid inside piping from outside.

Plain type 	For checking whether a fluid is present or how two fluids are mixed.	Be able to check the color of the fluid or an intermittent flow. The use of a mica plate makes this type of sight glass available for steam condensate.
Flap type 	For visually checking the variation in the flow rate of the fluid.	The rough flow rate can be identified from the position of the flap. For large flow rates.
Ball type 		The variation in the flow rate can be identified from the movement of the ball. For small to medium flow rates.
Spinner type 		The variation in the flow rate can be identified from the rotation of the spinner. For very small flow rates.

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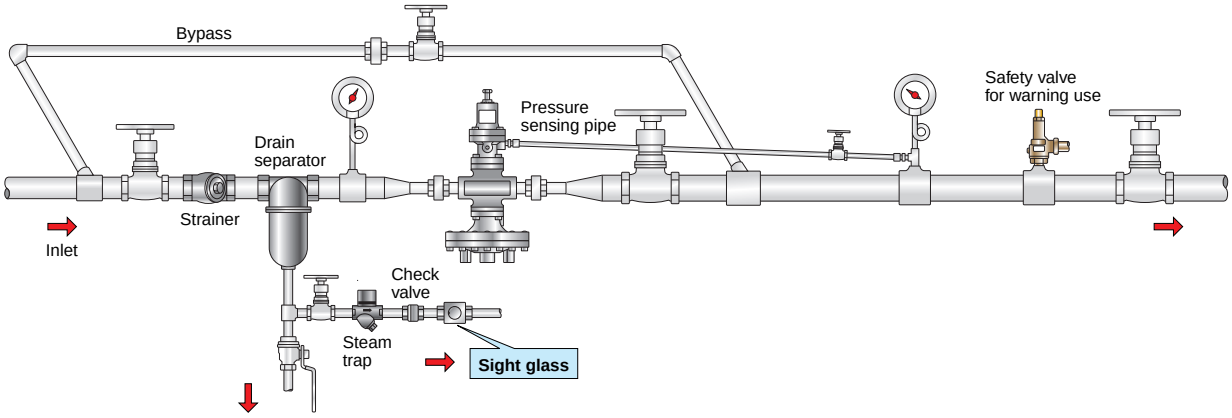
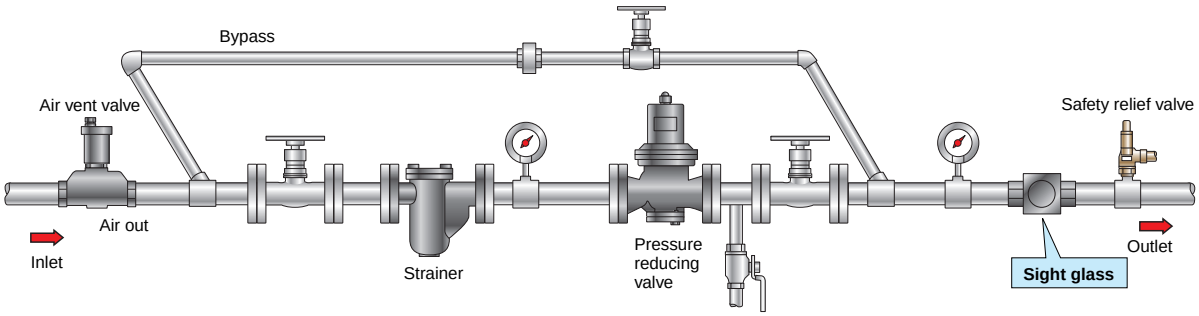
Guidelines for Sight Glass Installation

●For steam



●For water



Minimum Flow Rate of Sight Glasses

Water: (m³/h)

Nominal size	150F	SF-1S・1F	SB-1S・1F	400
	Flap type		Ball type	Spinner type
10A	—	—	—	0.048
15A	1	1	0.6	0.060
20A	1	1	0.7	0.090
25A	1	1	0.8	0.138
32A	1.3	1.3	1.6	—
40A	1.3	1.3	2.0	—
50A	2	2	2.5	—
65A	4.4	—	—	—
80A	4.4	—	—	—
100A	10	—	—	—
125A	10	—	—	—
150A	13	—	—	—

- Use flap type, ball type, and spinner type sight glasses at a flow rate equal to or higher than the minimum flow rate.
- The flow rate shown by the scale on the scale plate for a flap type sight glass is just for reference. It is not available as a flowmeter.
- Sight glasses can be installed in any posture.

SL-1S・1F

Features

1. Mixed state or color of two component fluid can be checked.
2. Intermittent fluid flow can be checked.
3. Can be connected to horizontal/vertical piping.
4. Mica plate is used for this type of sight glass for steam condensate.

Specifications

Model		SL-1S	SL-1F
Application		Cold and hot water, Oil, Other non-dangerous fluids	
Maximum working pressure		1.0 MPa	
Max. temperature		150˚C	
Max. thermal shock		100˚C	
Material	Body	Ductile cast iron	
	Glass	Hardened glass	
Connection		JIS Rc screwed	JIS 10K FF flanged

・Available with mica plate for steam condensate (SLM-1S・1F).
・Glass part is consumable supply.

SL-1S

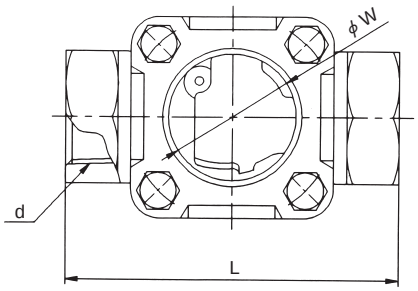
Dimensions (mm) and Weights (kg)

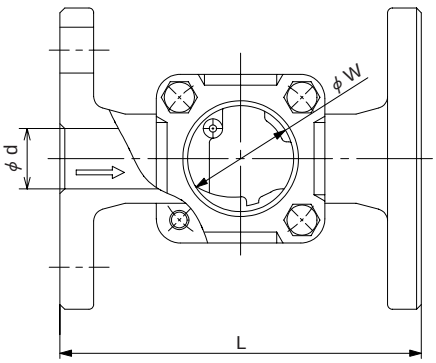
●SL-1S

Nominal size	d	L	W	Weight
15A	Rc 1/2	80	35	0.7
20A	Rc 3/4	90	35	0.8
25A	Rc 1	115	44	1.4
32A	Rc 1-1/4	127	57	2.1
40A	Rc 1-1/2	140	57	2.7
50A	Rc 2	162	73	5.2

●SL-1F

Nominal size	d	L	W	Weight
15A	15	130	35	2.2
20A	20	130	35	2.6
25A	25	150	44	4.1
32A	32	160	57	5.7
40A	40	170	57	6.0
50A	50	200	73	9.3





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SF-1S・1F

Features

1. Variation in flow rate can be checked easily with flap and scale plates.
2. Can be connected to horizontal/vertical piping.
3. Mica plate is used for this type of sight glass for steam condensate.

Specifications

Model		SF-1S	SF-1F
Application		Cold and hot water, Oil, Other non-dangerous fluids	
Maximum working pressure		1.0 MPa	
Max. temperature		150˚C	
Max. thermal shock		100˚C	
Material	Body	Ductile cast iron	
	Glass	Hardened glass	
	Flap	Stainless steel	
Connection		JIS Rc screwed	JIS 10K FF flanged

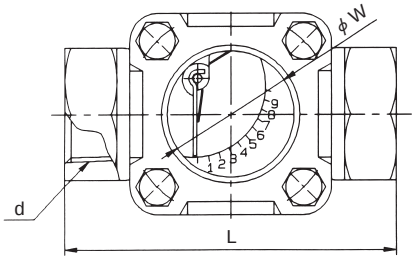
・Available with mica plate for steam condensate (SFM-1S・1F).
・Glass part is consumable supply.

SF-1S

Dimensions (mm) and Weights (kg)

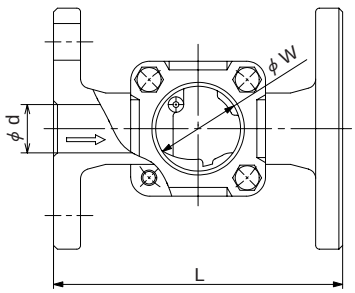
●SF-1S

Nominal size	d	L	W	Weight
15A	Rc 1/2	80	35	0.7
20A	Rc 3/4	90	35	0.8
25A	Rc 1	115	44	1.4
32A	Rc 1-1/4	127	57	2.5
40A	Rc 1-1/2	140	57	2.8
50A	Rc 2	162	73	5.4



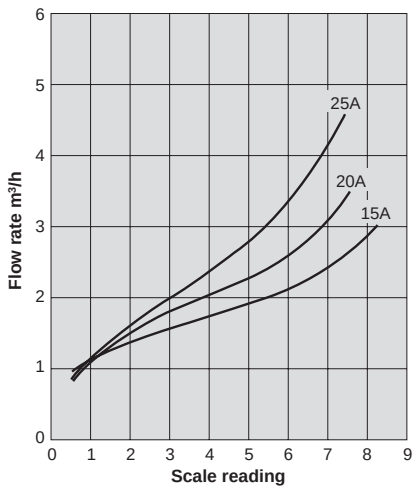
●SF-1F

Nominal size	d	L	W	Weight
15A	15	130	35	2.2
20A	20	130	35	2.6
25A	25	150	44	4.1
32A	32	160	57	5.9
40A	40	170	57	6.2
50A	50	200	73	9.5

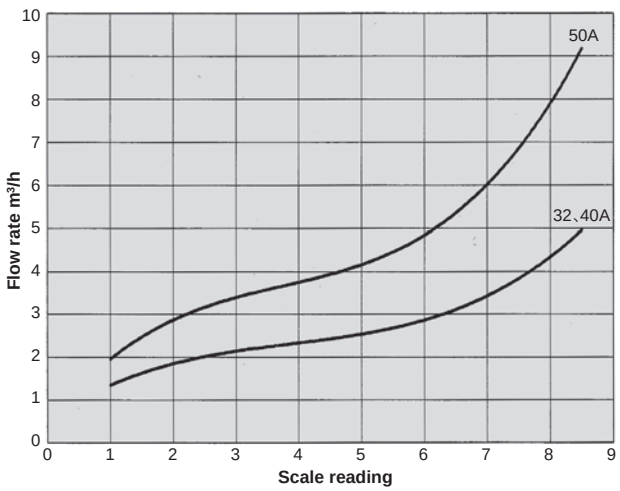


Flow Rate Characteristics Chart (For Water, Horizontal Piping)

●15A-25A



●32A-50A



・The flow characteristics shown in the charts above are just for reference and cannot be used for actual measurement.

SB-1S・1F

Features

1. Flowing state of fluid can be checked with the movement of the balls inside the sight glass.
2. Inside glass surface is less liable to water scale since the balls roll and contact the surface.
3. Compact, lightweight and space saving.
4. Can be connected to horizontal/vertical piping (but glass part should face sideways).

Specifications

Model		SB-1S	SB-1F
Application		Cold and hot water	
Maximum working pressure		1.0 MPa	
Max. temperature		85˚C	
Material	Body	Ductile cast iron	
	Glass	Hardened glass	
	Ball	Synthetic resin	
Connection		JIS Rc screwed	JIS 10K FF flanged

・Glass part and balls are consumable supply.

SB-1S

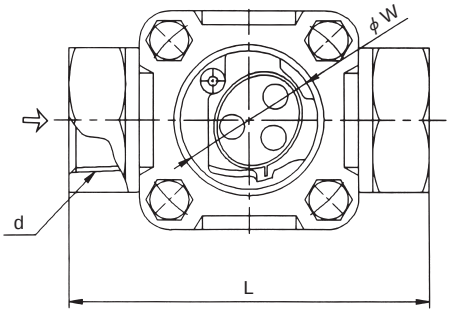
Dimensions (mm) and Weights (kg)

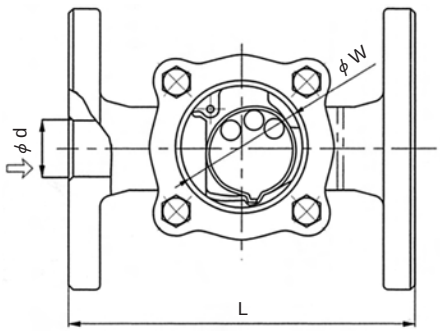
●SB-1S

Nominal size	d	L	W	Weight
15A	Rc 1/2	80	35	0.7
20A	Rc 3/4	90	35	0.8
25A	Rc 1	115	44	1.4
32A	Rc 1-1/4	127	57	2.5
40A	Rc 1-1/2	140	57	2.8
50A	Rc 2	162	73	8.4

●SB-1F

Nominal size	d	L	W	Weight
15A	15	130	35	2.2
20A	20	130	35	2.6
25A	25	150	44	4.1
32A	32	160	57	5.9
40A	40	170	57	6.2
50A	50	200	73	9.5





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150L

Features

1. Mixed state or color of two component fluid can be checked.
2. Intermittent fluid flow can be checked.
3. Can be connected to horizontal/vertical piping.
4. Mica plate is used for this type of sight glass for steam condensate.
5. The 150L Series sight glass come in a variety of materials, including ductile cast iron and cast stainless steel, which are available to choose from.

Specifications

Model		150L-F	150L-13S	150L-13F
Application		Cold and hot water, Oil, Other non-dangerous fluids		
Nominal size		65A-150A	15A-50A	15A-100A
Maximum working pressure		1.0 MPa		
Max. temperature		150˚C		
Max. thermal shock		100˚C		
Material	Body	Ductile cast iron	Cast stainless steel	
	Glass	Hardened glass		
Connection		JIS 10K FF flanged	JIS Rc screwed	JIS 10K FF flanged

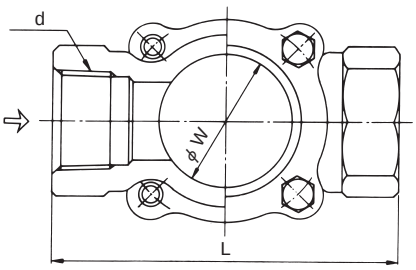
・Available with mica plate for sream condensate (150LM-□□S・□□F).
・Available with protector (150LP-□□S・□□F).
・Glass part is consumable supply.

150L-F

Dimensions (mm) and Weights (kg)

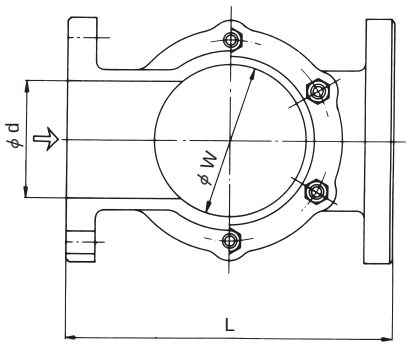
●150L-13S

Nominal size	d	L	W	Weight
15A	Rc 1/2	76	35	0.73
20A	Rc 3/4	89	35	0.82
25A	Rc 1	114	44	1.5
32A	Rc 1-1/4	127	53	2.3
40A	Rc 1-1/2	140	57	2.9
50A	Rc 2	162	73	5.8



●150L-F・13F

Nominal size	d	L	W	Weight	
				150L-F	150L-13F
15A	15	130	35	—	2.12
20A	20	130	35	—	2.47
25A	25	150	44	—	4.1
32A	32	160	53	—	5.4
40A	40	170	57	—	5.6
50A	50	200	73	—	9.7
65A	65	235	97	14.7	16.0
80A	73	235	97	15.1	16.5
100A	100	277	130	26.5	29.2
125A	125	336	155	36.8	—
150A	140	380	165	60.5	—



150F

Features

1. Variation in flow rate can be checked easily with flap and scale plates.
2. Pressure loss caused by the fluid flow is as low as 0.01 MPa even when the flap shows the maximum flow rate, and does not affect the pressure of the fluid.
3. Can be connected to horizontal/vertical piping.
4. Mica plate is used for this type of sight glass for steam condensate.
5. The 150F Series sight glass come in a variety of materials, including ductile cast iron and cast stainless steel, which are available to choose from.

Specifications

Model		150F-F	150F-13S	150F-13F
Application		Cold and hot water, Oil, Other non-dangerous fluids		
Nominal size		65A-150A	15A-50A	15A-100A
Maximum working pressure		1.0 MPa		
Max. temperature		150˚C		
Max. thermal shock		100˚C		
Material	Body	Ductile cast iron	Cast stainless steel	
	Glass	Hardened glass		
	Flap	Stainless steel		
Connection		JIS 10K FF flanged	JIS Rc screwed	JIS 10K FF flanged

150F-F

・Available with mica plate for steam condensate (150FM-□□S・□□F).
・Available with protector (150FP-□□S・□□F).
・Glass part is consumable supply.

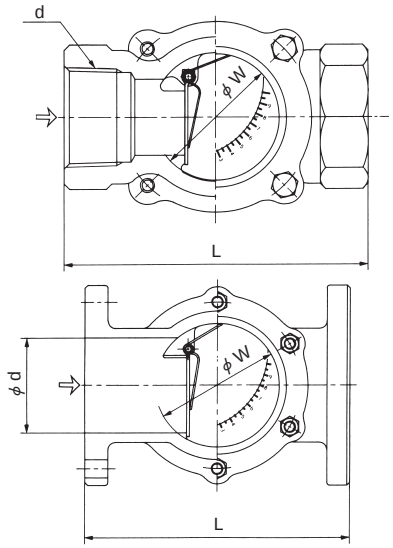
Dimensions (mm) and Weights (kg)

●150F-13S

Nominal size	d	L	W	Weight
15A	Rc 1/2	76	35	0.75
20A	Rc 3/4	89	35	0.84
25A	Rc 1	114	44	1.6
32A	Rc 1-1/4	127	53	2.4
40A	Rc 1-1/2	140	57	3.0
50A	Rc 2	162	73	5.9

●150F-F・13F

Nominal size	d	L	W	Weight	
				150F-F	150F-13F
15A	15	130	35	—	2.14
20A	20	130	35	—	2.49
25A	25	150	44	—	4.2
32A	32	160	53	—	5.5
40A	40	170	57	—	5.7
50A	50	200	73	—	9.8
65A	65	235	97	15.1	16.4
80A	73	235	97	15.5	16.9
100A	100	277	130	27.0	29.7
125A	125	336	155	37.3	—
150A	140	380	165	62.0	—

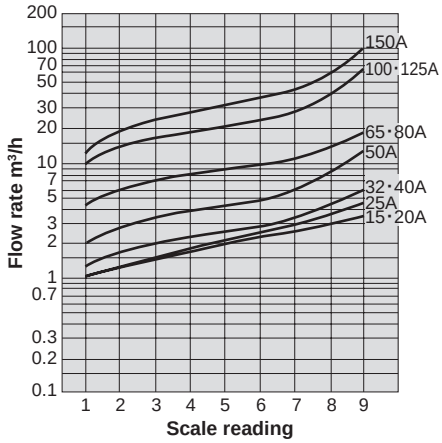


Sight glass model (type 150) code

150 □□ □□□

S: Screwed
F: Flanged
None: FCD450
13: SCS13
None: Without protector
M: With mica plate
P: With protector
L: Plain type
F: Flap
150 Series

Flow Rate Characteristics Chart (For Water, Horizontal Piping)



・The flow characteristics shown in the chart on the left are just for reference and cannot be used for actual measurement.

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400

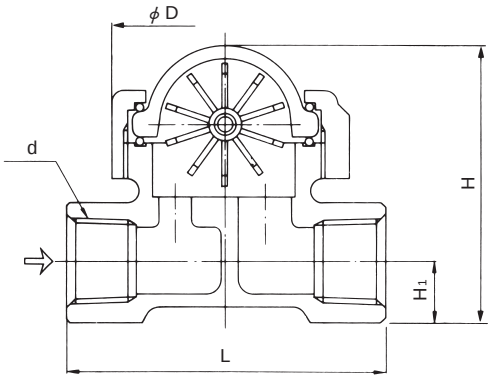
Features

1. No need for cleaning of the dome since rotating spinner keeps the inside of the dome clean.
2. Fluid flow can be detected from the rotation of the spinner, and flow rate change is identified by its rotating speed.
3. Easy to assemble and disassemble due to simple design. Can be connected to horizontal/vertical piping.

Specifications

Application		Cold and hot water
Maximum working pressure		0.7 MPa
Max. temperature		100˚C
Max. thermal shock		40˚C
Material	Body	Cast bronze
	Glass	Heat-resistant glass
	Spinner	Special heat-resistant resin
Connection		JIS Rc screwed

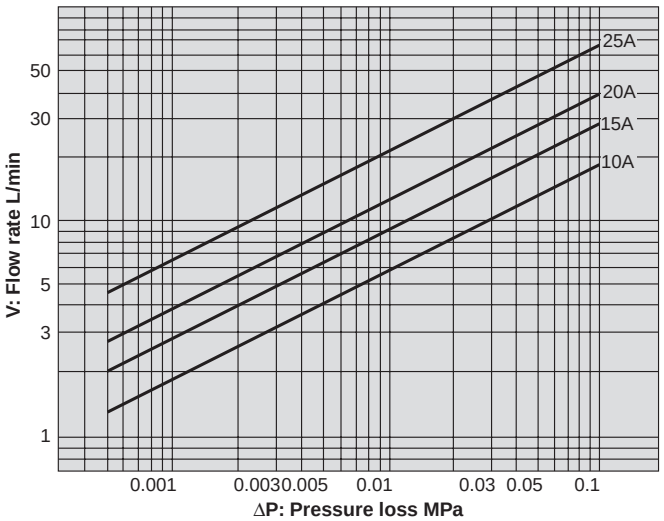
- When using this sight glass at a temperature difference of 40˚C or more, note that the glass may get damaged if the temperature rapidly rises or the glass is cooled from outside.
- Glass part and spinner are consumable supply.



Dimensions (mm) and Weights (kg)

Nominal size	d	L	H1	H	D	Weight
10A	Rc 3/8	76	12	67	54	0.45
15A	Rc 1/2	76	14.5	69.5	54	0.50
20A	Rc 3/4	83	17	76	54	0.60
25A	Rc 1	89	21.5	93.5	66.5	0.95

Pressure Loss Chart (For Water)



Min. & Max. Flow Rate (Water)

Nominal size	Min. flow rate L/min	Max. flow rate L/min
10A	0.8	8.3
15A	1.0	13
20A	1.5	18
25A	2.3	30

- The minimum flow rate is the value required for the spinner to continuously rotate.
- The maximum flow rate is the value when pressure loss is approximately 0.02 MPa.
  For further information, see the pressure loss chart on the left.

Air Vent Valve

Air Vent Valve Selection

Application			Max. Working Pressure (MPa)	Max. Temperature (˚C)	Model	Page
Steam	Water	Oil				
	●	●	1.0	90	TA-3	293
	●	●		60	TA-3C	299
	●	●		90	TA-2	294
	●	●		60	TA-2C	299
	●	●		90	TA-5	294
	●	●		120	TA-5F	294
	●	●		90	TA-6	293
	●		0.3	100	TA-11	295
	●				TA-11L	295
	●				TA-18	299
	●				TA-18L	299
	●		1.0	100	TA-22	296
	●				TA-22L	296
	●			90	TA-16	297
	●				TA-16CVA	298
	●				TA-16CVS	298
	●				TA-16L	297
	●			80	TAV-2	299
	●			35	TAV-3A	299

Selection of Air Vent Valve

What is an Air Vent Valve ??

An air vent valve is a safety device that discharges air at the water supply piping in order to avoid air related problems in the water piping systems.

Applications

- Cold and hot water supply system
- Hot water boiler
- Solar hot water system
- Other various devices
- Air conditioning system
- Hot water heater appliance
- Pressure tank

Purposes

- For protecting piping materials and systems from corrosion due to air (oxygen).
- For preventing water splashing at faucet due to the existence of air.
- For preventing noise resulted from the ingress of air into cold/hot water supply systems, air conditioning systems, and other systems.
- For the smooth startup and stable operation of water supply and other systems/devices through air discharge at the time of initial water conveyance.

Types

Float type	Float type W/ Quick ventilation	Float type W/ Vacuum breaker
Discharges air in the piping continuously.	Exhausts large quantity of air upon system start-up and release accumulated air continuously.	Takes in air to reduce vacuum condition and releases accumulated air if any.

Major Products

TA-3 Series	TA-2･5	TAV-3A
		

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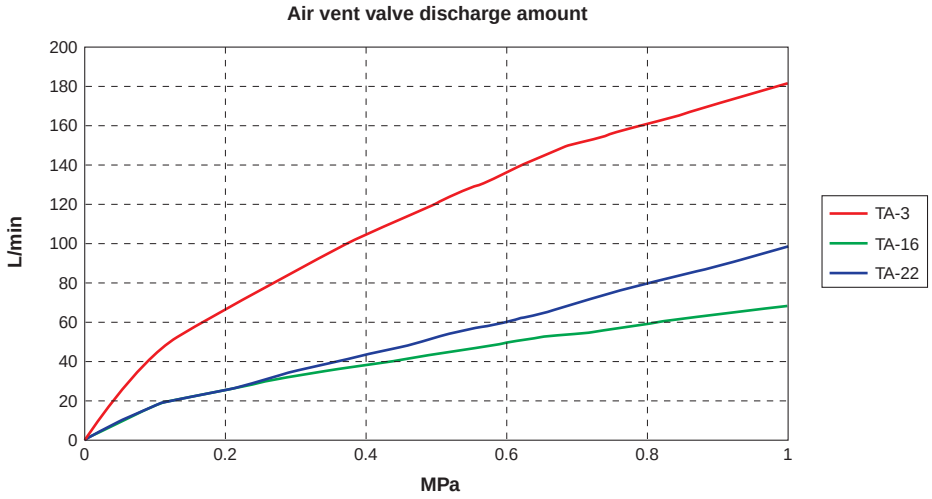
Note for Selecting Air Vent Valve

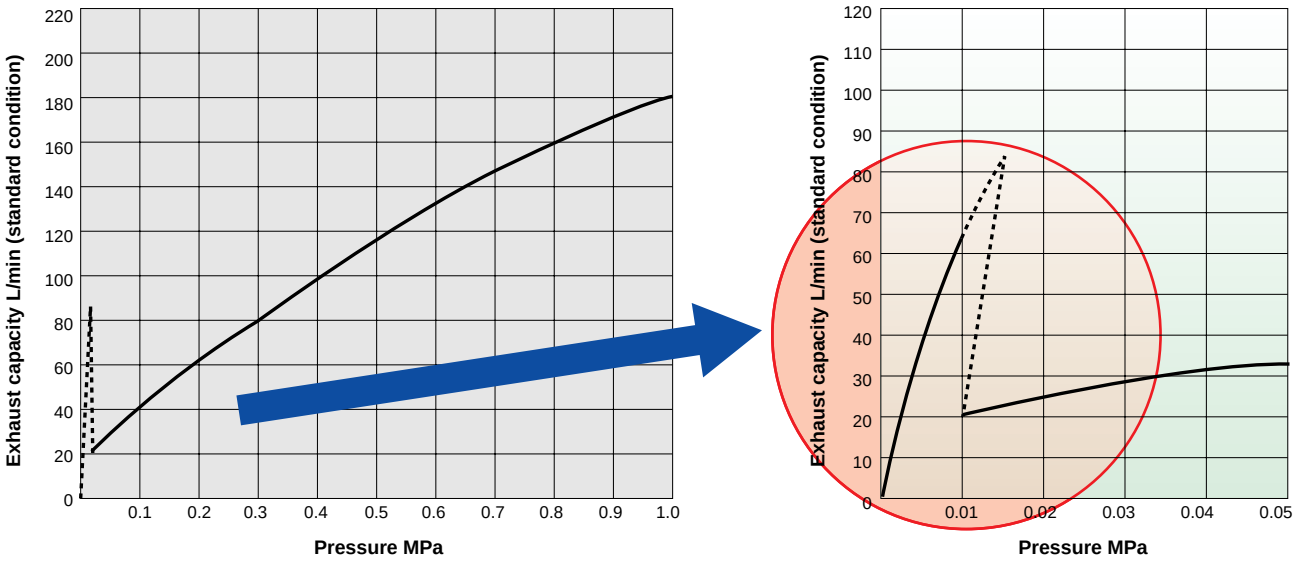
Discharge Amount

The discharge amount depends on the model. Please refer to the following chart to select a model adequate for the required discharge amount.



Feature of Quick Exhaust Mechanism

The difference between air vent valves with and without quick exhaust mechanism appears during the operation at low pressure up to 0.015 MPa. By exhausting large amount of air from the piping at low pressure, the valve ensures smooth initial water supply.



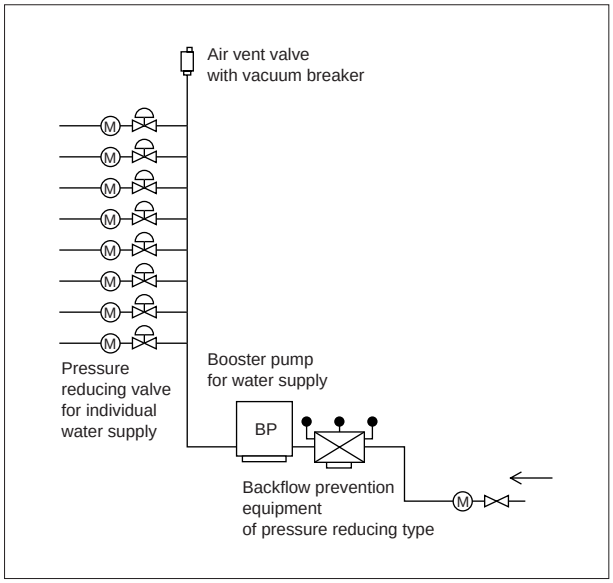
Note for Selecting Air Vent Valve

Air Vent Valve with Vacuum Breaker

An air vent valve with vacuum breaker operates in the same manner as an air vent valve but has an upgraded air intake function that works when negative pressure is generated. It prevents a backflow from a system or unit to which water is supplied by promptly eliminating negative pressure.

Necessity of Air Vent Valves with Vacuum Breaker

An “air vent valve” has been installed at the top of vertical water supply piping for the purpose of discharging air.
In this case, however, if the pressure inside piping drops because of temporary suspension of water supply or an accident, the pressure at the top of the vertical piping becomes negative, which may cause the phenomenon of a backflow (inverted siphon) within the building.
For this reason, the top of the vertical piping requires an “air vent valve with vacuum breaker” that has both a function of introducing into the piping a sufficient quantity of air to eliminate negative pressure, and a function capable of discharging air under pressure.



- Top of vertical piping in collective housing and buildings
- Top of vertical piping connected to direct boosting water supply lines

View about Intake Air Quantity

One of the probable causes of the generation of maximum negative pressure inside water supply piping is a large water leakage due to damage to piping. So, negative pressure no longer occurs if a larger quantity of air than this water leakage can be introduced into the piping.
The air intake performance standards of Scandinavian countries (established by N. Lindblad, Swedish Water & Wastewater Association) take the same view about the intake air quantity. The Nagoya City Waterworks & Sewerage Bureau and some other business units set an intake air quantity for each nominal size of vertical piping based on Scandinavian countries' view.

●Required intake air quantity (The Nagoya City Waterworks & Sewerage Bureau)

ΔP = –2.9 kPa

Size at the top of water supply piping	20	25	30	40	50
Intake air quantity [L/min (standard condition)]	90	150	240	420	840
Intake air quantity [L/sec (standard condition)]	1.5	2.5	4.0	7.0	14

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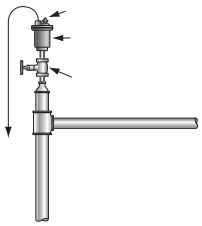
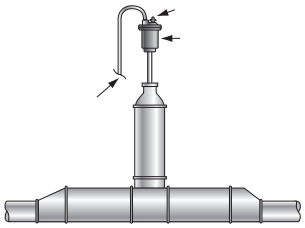
Guidelines for Installing Air Vent Valve

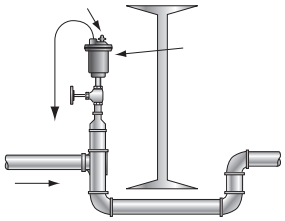
At the top of vertical piping



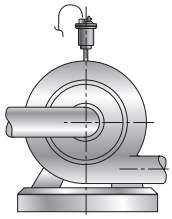
At the top of horizontal piping



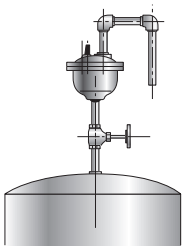
On loop in piping



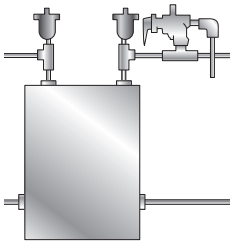
At the centrifugal pump



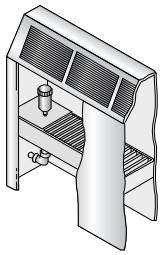
At hot water heating system



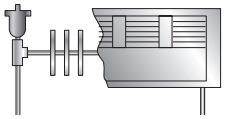
At venting boiler or chilling unit



At venting convectors



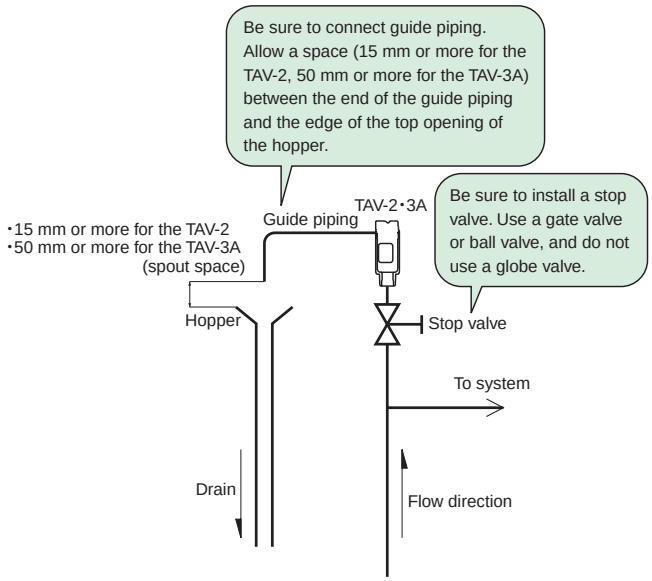
At venting baseboard radiation



Guidelines for Installing Air Vent with Vacuum Breaker

The TAV-2・3A Air Vent with Vacuum Breaker

＜Piping example＞



- In anticipation of water leakage from the air inlet or outlet of the product, connect induction piping to the air inlet and outlet, and guide it to the hopper (drain ditch). Keep a clearance (15 mm or more for the TAV-2, 50 mm or more for the TAV-3A) between the end of the induction piping and the overflow line of the hopper.
  * When hot water is used, its leakage may cause burns or contamination in the area where the product is installed.
- Before connecting the product, carefully wash the inside of piping to remove dirt, scale, etc.
- When connecting the product to piping, pay attention to the quantity and application position of sealing agent or where to attach seal tape.
- Do not disassemble the product.
- Prepare enough space for inspections, maintenance, and repairs. Do not install the product under the roof or inside the wall.
- Vertically install the product in a position where air tends to accumulate.
- Use a stop valve (gate valve, ball valve, cock, etc.) for maintenance and inspections in any case. Do not use a globe valve.
- Drain water when the atmospheric temperature is low, in winter for example, or water is not to be used for a long period of time.

TA-3・6

Features

1. Wider pressure range than that of conventional air vent valves and applicable to from low pressure to high.
2. No leakage from the valve due to synthetic rubber used for valve seat. However, just in case, the copper pipes are connected to the exhaust port.
3. To prevent scale problem, unique valve mechanism keeps the seat surface clean.
4. Parts are easy to replace, maintain and inspect from outside even if the valve seat surface is damaged in long period operation.
5. Since the body of the TA-6 is made of bronze, this type is free from rusty water.
6. Compact body while exhaust capacity is 1.5 times larger than that of conventional air vent valve.

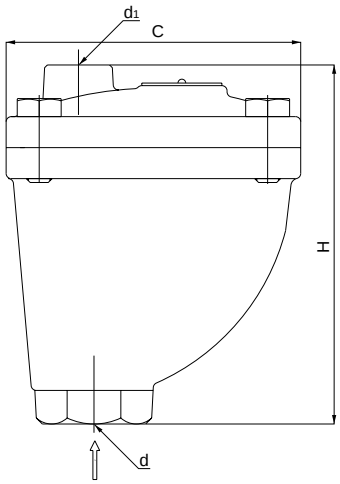
Specification

Model		TA-3	TA-6
Application		Cold and hot water, Oil (specific gravity: 0.8 or more)	
Working pressure		0.01-1.0 MPa	
Maximum temperature		90˚C	
Material	Body, cover	Ductile cast iron	Cast bronze
	Valve	Brass	
	Valve seat	Brass (equipped with NBR disc)	
	Float	Stainless steel	
Connection		JIS Rc screwed	

・The body of the TA-3 is electrodeposition-coated for rustproofing.

Dimensions (mm) and Weights (kg)

Nominal size	d	d1	H	C	Weight
15A	Rc 1/2	Rc 3/8	139	114	2.72
20A	Rc 3/4	Rc 3/8	139	114	2.72
25A	Rc 1	Rc 3/8	143	114	2.88
32A	Rc 1-1/4	Rc 3/8	143	114	2.88



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TA-2・5・5F

Features

1. Equipped with a quick exhaust mechanism, air inside piping can be quickly discharged at the time of initial water supply, ensuring smooth water supply.
2. Wider pressure range than that of conventional air vent valves and applicable to from low pressure to high.
3. Parts are easy to replace, maintain and inspect from outside even if the valve seat surface is damaged in long period operation.
4. Since the body of the TA-5 and TA-5F is made of bronze, these types are free from rusty water.
5. Sucks in air promptly and automatically when pressure becomes negative in piping or tank, preventing damage to piping components by negative pressure.

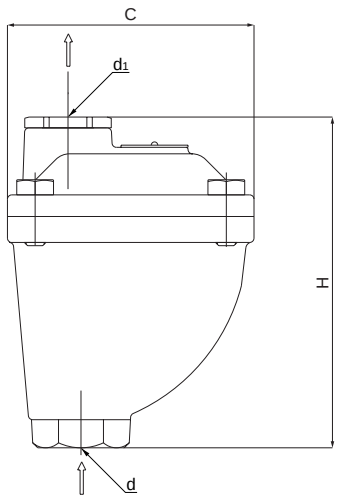
Specification

Model		TA-2	TA-5	TA-5F
Application		Cold and hot water, Oil (specific gravity: 0.8 or more)		
Working pressure		0.01-1.0 MPa		
Maximum temperature		90˚C		120˚C
Operating pressure range of quick exhaust valve		0.01 MPa or less		
Material	Body	Ductile cast iron	Cast bronze	
	Cover	Bronze		
	Valve	Brass		
	Sub valve	Brass (equipped with NBR disc)		Brass (equipped with FKM disc)
	Float	Stainless steel		
Connection		JIS Rc screwed		

・The body of the TA-2 is electrodeposition-coated for rustproofing.

Dimensions (mm) and Weights (kg)

Nominal size	d	d1	H	C	Weight
15A	Rc 1/2	Rc 3/8	153	114	3.18
20A	Rc 3/4	Rc 3/8	153	114	3.18
25A	Rc 1	Rc 3/8	157	114	3.22
32A	Rc 1-1/4	Rc 3/8	157	114	3.22



TA-11・11L

Features

1. Easy to clean by removing the valve seat even if scale or dirt deposits on the valve disc or valve seat.
2. Can be installed in small space because of compact body.
3. Since the shapes of valve and float adopt Yoshitake unique structure, stable performance and sufficient exhaust capacity can be obtained.
4. Even if water leaks out of the TA-11 due to failure, it can be stopped immediately by tightening the end cap, ensuring safety.
5. Vinyl hose can be connected easily to the TA-11L.

Specification

Application		Cold and hot water
Working pressure		0.01-0.3 MPa
Maximum temperature		100˚C
Material	Body	Brass
	Disc	NBR
	Seat	Brass
	Float	Heat-resistant resin
Connection	Inlet	JIS R screwed
	Outlet	TA-11: Cap type
		TA-11L: Hose joint type
Metal plating		Nickel-plated

TA-11

Dimensions (mm) and Weights (g)

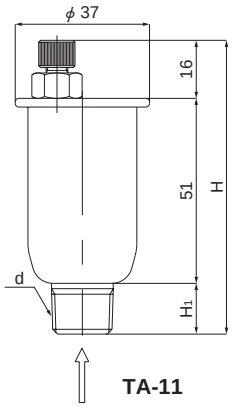
●TA-11

Nominal size	d	H	H1	Weight
6A	R 1/8	78	11	75
10A	R 3/8	81	14	77
15A	R 1/2	89	22	98
20A	R 3/4	95.5	28.5	148

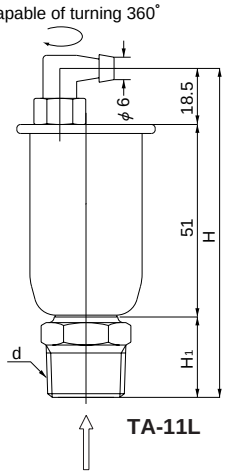
●TA-11L

Nominal size	d	H	H1	Weight
6A	R 1/8	80.5	11	72
10A	R 3/8	83.5	14	74
15A	R 1/2	91.5	22	95
20A	R 3/4	98	28.5	145

・The shapes of 6A and 10A are slightly different.

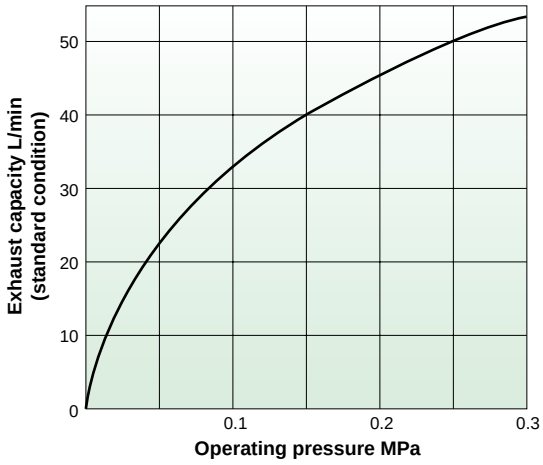


TA-11



TA-11L

Exhaust Capacity Chart



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TA-22・22L

Features

1. Easy to clean by removing the valve seat even if scale or dirt deposits on the valve disc or valve seat.
2. Can be installed in small space because of compact body.
3. Since the shapes of valve and float adopt Yoshitake unique structure, stable performance and sufficient exhaust capacity can be obtained.
4. Even if water leaks out of the TA-22 due to failure, it can be stopped immediately by tightening the end cap, ensuring safety.
5. Vinyl hose can be connected easily to the TA-22L.

Specification

Application		Cold and hot water
Working pressure		0.01-1.0 MPa
Maximum temperature		100˚C
Material	Body	Bronze
	Disc	FKM
	Seat	Brass
	Float	Heat-resistant resin
Connection	Inlet	JIS R screwed
	Outlet	TA-22: Cap type
		TA-22L: Hose joint type
Metal plating		Nickel-plated

TA-22

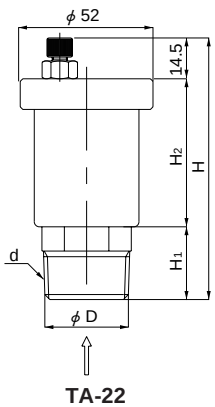
Dimensions (mm) and Weights (g)

●TA-22

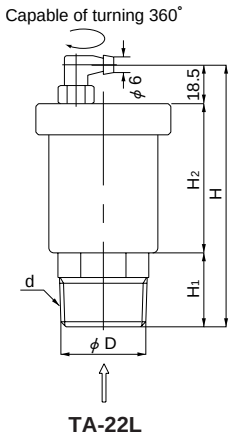
Nominal size	d	D	H	H1	H2	Weight
15A	R 1/2	13	92	19.5	58	360
20A	R 3/4	18	97.5	25	58	400
25A	R 1	23	100.5	28.5	57.5	460

●TA-22L

Nominal size	d	D	H	H1	H2	Weight
15A	R 1/2	13	96	19.5	58	360
20A	R 3/4	18	101.5	25	58	400
25A	R 1	23	104.5	28.5	57.5	460

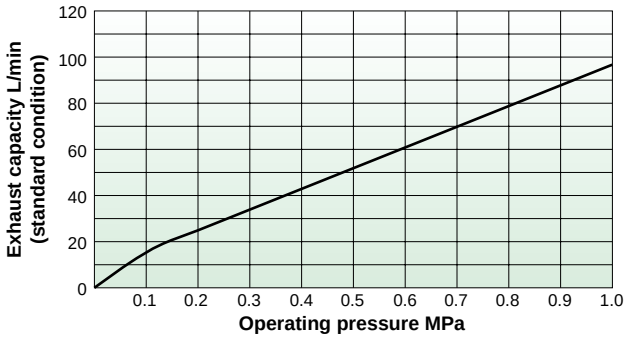


TA-22



TA-22L

Exhaust Capacity Chart



TA-16·16L

Features

1. All parts, except for the valve disc, gasket, L-shaped hose joint (TA-16L), are made of stainless steel, offering high resistance to corrosion and durability.
2. Wide working pressure range (0.01 to 1.0 MPa) ensures stable exhaust capacity.
3. Can be installed in small space because of compact body.
4. Outstanding sealability offered by fluororubber valve disc.
5. The TA-16 can be connected to any exhaust piping easily by attaching optional piping connection parts.

Specification

Model		TA-16	TA-16L
Application		Cold and hot water	
Working pressure		0.01-1.0 MPa	
Maximum temperature		90˚C	
Material	Body, cover	Stainless steel	
	Valve disc	FKM	
	Gasket	FKM	
	Float	Stainless steel	
Connection	Inlet	JIS R screwed	
	Outlet	JIS Rc screwed	Hose joint type

TA-16

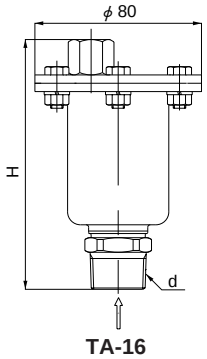
Dimensions (mm) and Weights (g)

●TA-16

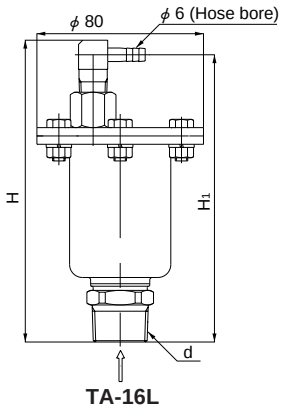
Nominal size	d	H	Weight
15A	R 1/2	118	660
20A	R 3/4	120	680
25A	R 1	124.5	740

●TA-16L

Nominal size	d	H_1	H	Weight
15A	R 1/2	136	143	700
20A	R 3/4	138	145	720
25A	R 1	144	149.5	780

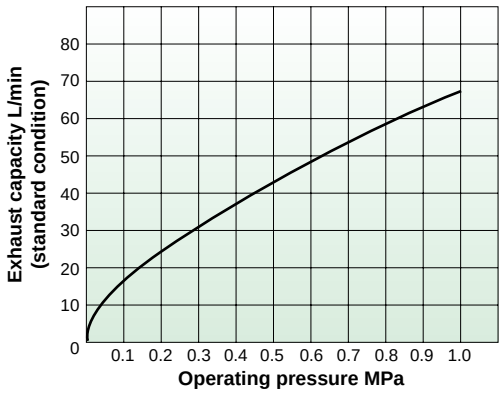


TA-16



TA-16L

Exhaust Capacity Chart



Option

Available with manual valves, swivel joints (capable of turning 360 degrees), etc. (made of brass) as piping connection parts for the exhaust ports of air vent valves.


●L-shaped hose joint
(R 1/4 x ϕ 6)


●Manual valve with copper joint
(R 1/4 x ϕ 8)


●Manual valve with hose joint
(R 1/4 x ϕ 6)


●Swivel joint
(R 1/4 x Rc 1/4)


●Swivel copper pipe joint
(R 1/4 x ϕ 8)


●Swivel hose joint
(R 1/4 x ϕ 6)

・For other connection parts, please contact us.

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TA-16CVA·16CVS

Features

1. All parts, except for the valve disc, gasket, check valve, check valve joint, are made of stainless steel, offering high resistance to corrosion and durability.
2. Wide working pressure range (0.01 to 1.0 MPa) ensures stable exhaust capacity.
3. Can be installed in small space because of compact body.
4. Outstanding sealability offered by fluororubber valve disc.
5. The TA-16CVS can be connected to any exhaust piping easily by attaching optional piping connection parts.
6. Provided with check valves, the product do not suck in air even if the inlet pressure is negative.

Specification

Model		TA-16CVA	TA-16CVS
Application		Cold and hot water	
Working pressure		0.01-1.0 MPa	
Closing pressure of check valve		-0.005 MPa	
Maximum temperature		90˚C	
Material	Body, cover	Stainless steel	
	Valve disc	FKM	
	Gasket	FKM	
	Float	Stainless steel	
	Check valve joint	Brass	
	Check valve	FKM	
Connection	Inlet	JIS R screwed	
	Outlet	JIS Rc screwed	

TA-16CVA　　TA-16CVS

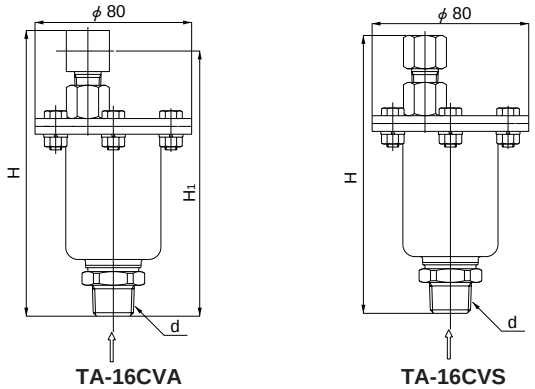
Dimensions (mm) and Weights (g)

●TA-16CVA

Nominal size	d	H1	H	Weight
15A	R 1/2	135.5	146	720
20A	R 3/4	137.5	148	740
25A	R 1	142	152.5	800

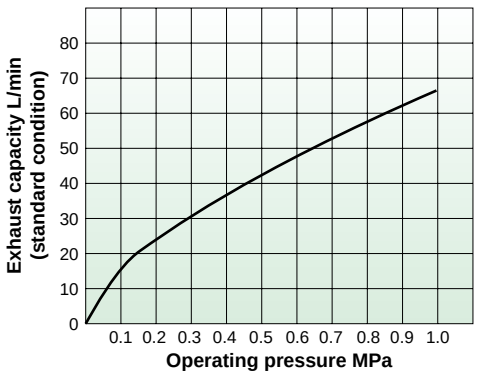
●TA-16CVS

Nominal size	d	H	Weight
15A	R 1/2	142	700
20A	R 3/4	144	720
25A	R 1	148.5	780



TA-16CVA　　TA-16CVS

Exhaust Capacity Chart

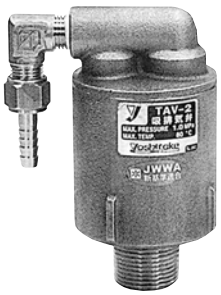


Option

Available with manual valves, swivel joints (capable of turning 360 degrees), etc. (made of brass) as piping connection parts for the exhaust ports of air vent valves.

●L-shaped hose joint (R 1/4 x ϕ 6)
●Manual valve with copper joint (R 1/4 x ϕ 8)
●Manual valve with hose joint (R 1/4 x ϕ 6)
●Swivel joint (R 1/4 x Rc 1/4)
●Swivel copper pipe joint (R 1/4 x ϕ 8)
●Swivel hose joint (R 1/4 x ϕ 6)

・For other connection parts, please contact us.

Feature		Nylon coating	Stainless steel body	Air vent with vacuum breaker
Model		TA-2C・3C	TA-18・18L	TAV-2
Picture		 TA-2C TA-3C	 TA-18 TA-18L	
Application		Cold and hot water, Oil (specific gravity: 0.8 or more)	Cold and hot water	City water
Max. pressure		1.0 MPa	0.3 MPa	1.0 MPa
Max. temperature		60˚C	100˚C	80˚C (no freeze condition)
Connection		JIS Rc screwed	JIS R screwed	JIS R screwed
Material	Body	Ductile cast iron	Stainless steel	Cast bronze (NPb-treated)
	Valve	Brass	Disc: FKM	EPDM
	Valve seat	Brass (equipped with NBR disc)	Brass	Bronze, Heat-resistant resin
	Float	Stainless steel	Heat-resistant resin	Heat-resistant resin
Size		15A-32A	15A, 20A	15A
Others		Nylon coated: TA-2C: Body TA-3C: Body and cover	—	・Operating pressure of vacuum breaker is −1.0 kPa or less.

Feature		Air vent with vacuum breaker
Model		TAV-3A
Picture		
Application		City water
Max. pressure		1.0 MPa
Max. temperature		35˚C (no freeze condition)
Connection		JIS R screwed
Material	Body	Cast bronze (NPb-treated)
	Valve	EPDM, NBR
	Valve seat	Bronze, Heat-resistant resin
	Float	Heat-resistant resin
Size		20A, 25A
Others		・Operating pressure of vacuum breaker is −1.0 kPa or less.

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M e m o

Noiseless Heater

Vacuum Relief Valve

Noiseless Heater Selection

Application	Max. Pressure (MPa)	Max. Warning Sound Temperature Limit (˚C)	Material		Model	Page
Steam			Stainless Steel	Bronze		
●	0.7	60		●	MS-1	307
●			●		MS-3-13	307
●		90		●	MS-2	308
●			●		MS-4-13	308
●			●		MS-6	306

Vacuum Relief Valve Selection

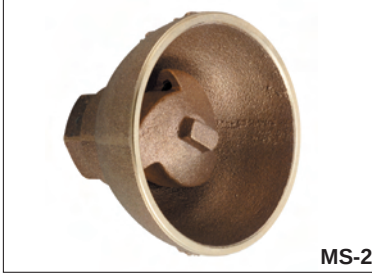
Application		Pressure Regulating Range (kPa)	Max. Temperature (˚C)	Material		Model	Page
Steam	Air			Brass	Stainless Steel		
●	●	–0.5 - –81	200	●		VB-7	309
●	●				●	VB-7S	309

Purposes and Types of Noiseless Heaters

Purposes of Noiseless Heaters

- A noiseless heater is used to reduce noise and vibration generated when steam is blown into water to produce hot water.
- A sound deadening effect can be expected by connecting a noiseless heater to piping simply.

Types and Principles of Noiseless Heaters

Model	Sound deadening principle	Max. warning sound temperature limit	Features
 MS-1	Steam and water are mixed and discharged from the outlet. * Noiseless heaters cannot be used as direct mixing type inline heaters.	60˚C	Simple in structure and trouble-free. Just attach to the end of piping.
 MS-2	Steam is blown out from the nozzle and mixed with water.	90˚C	Available in a higher temperature range than the MS-1.
 MS-6	Steam produces hot water while drawing water around.	90˚C	Lotus root shape, compact, and produces less vibration and noise.

* The max. warning sound temperature limit means the upper limit temperature at which a sound deadening effect can be expected.

Why Vacuum Relief Valves are Necessary


VB-7

Necessity

A vacuum relief valve is used to introduce air into a device or piping and, at the same time, prevent accidents attributable to a negative pressure (vacuum).

What is a Vacuum?

A vacuum means a specific state of space filled with a gas whose pressure is lower than the atmospheric pressure.

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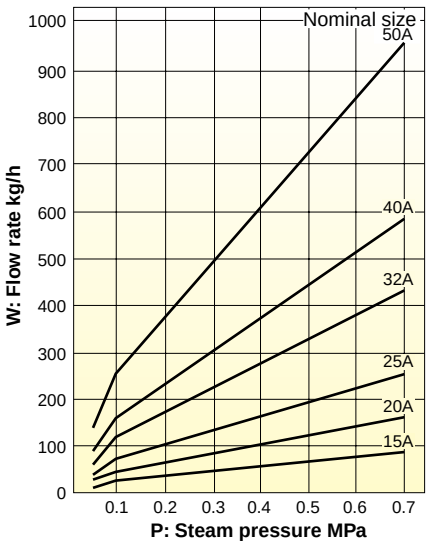
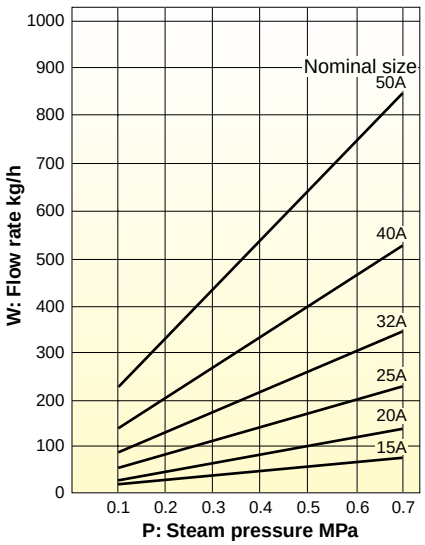
Sizing for Noiseless Heaters

Flow Rate Chart

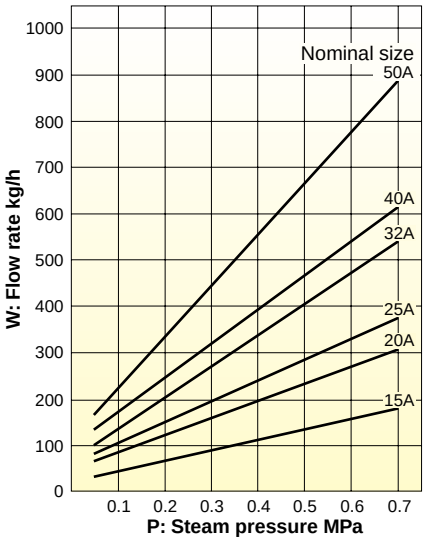
●MS-1・3



●MS-2・4

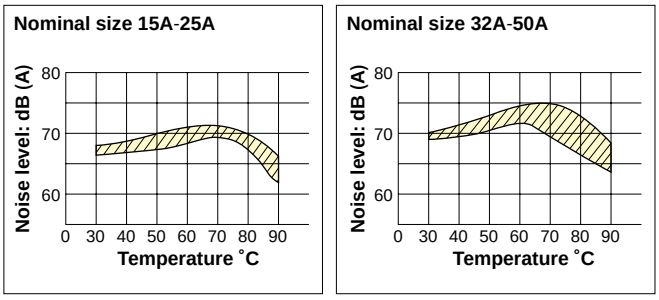


●MS-6

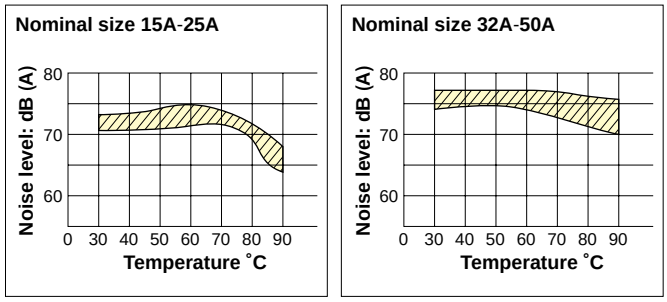


MS-6 Noise Characteristic Chart

●Steam pressure {0.3 MPa}



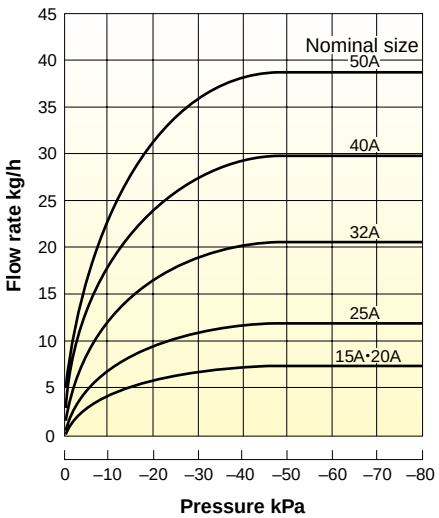
●Steam pressure {0.5 MPa}



・The noise characteristics of the MS-6 noiseless heater depend on the size and shape of the fluid tank, and the position where the noiseless heater is installed. Use these steam noise characteristic charts for reference.
・The noise levels are values measured at 1 meter above the water surface.

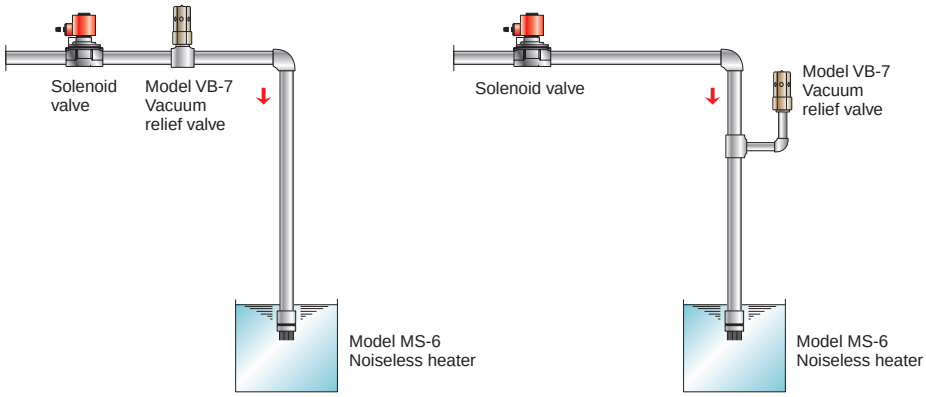
Sizing for Vacuum Relief Valve

Nominal Size Selection Chart

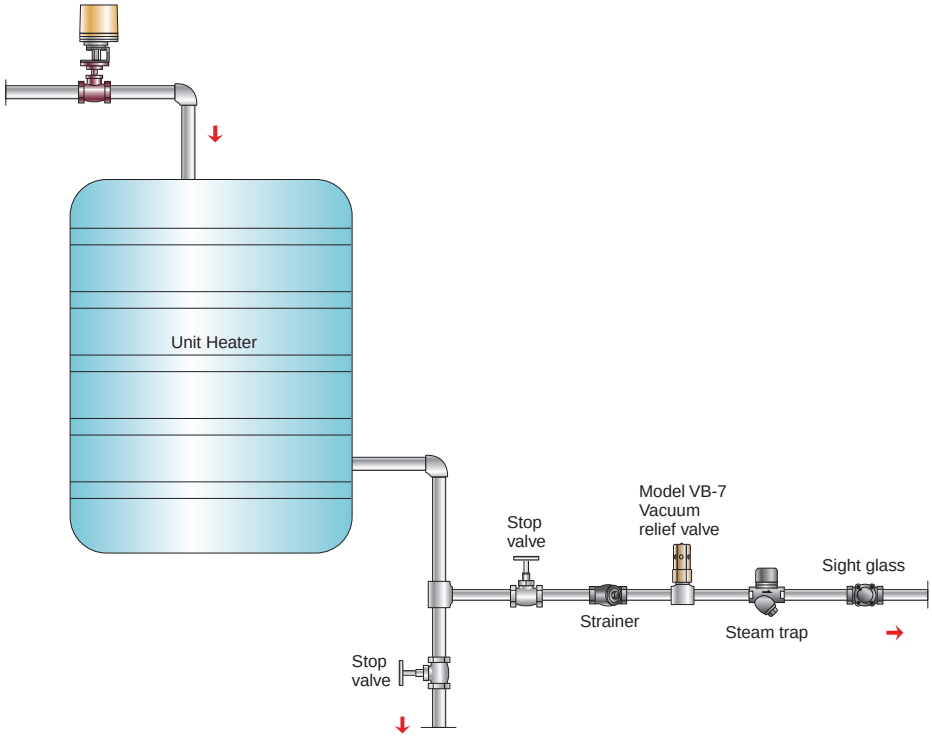


Guidelines for Noiseless Heater/Vacuum Relief Valve

●Piping example with a noiseless heater and without check valve



●Piping example of equipment for temperature regulation with vacuum relief valve



<Calculation formula>

The quantity of steam required to increase the temperature of Q kg of water by B˚C in time A (h) is:

$$W = \frac{B \times Q}{500 \times A}$$

Select a nominal size by applying the calculated quantity of steam W and the steam pressure P to the flow rate chart for nominal size selection.
(Note) Use the flow rate chart for nominal size selection for reference.

<Calculation example>

When increasing the temperature of 7000 kg of water from 20˚C to 60˚C in an hour with 0.5 MPa steam

$$W = \frac{(60 - 20) \times 7000}{500 \times 1} = 560 \text{ (kg/h)}$$

・When an MS-2 silencer is used
By applying the pressure of 0.5 MPa and the steam quantity of 560 kg/h to the flow rate chart for MS-2 nominal size selection, the nominal size of the MS-2 should be 50A.

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MS-6

Features

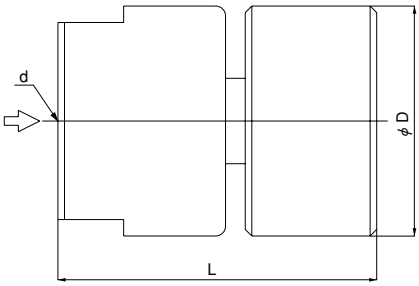
1. Stainless steel made body offers outstanding durability.
2. Easy to connect to piping, inexpensive.
3. Easy to maintain.

Specification

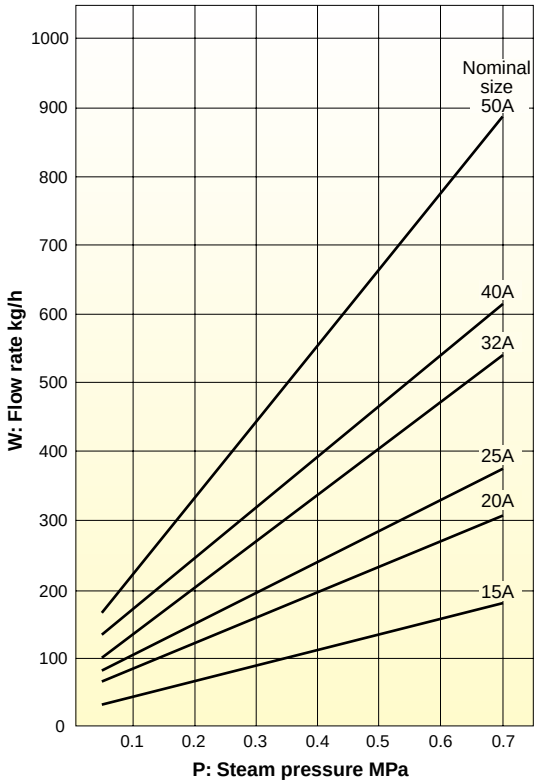
Application	Steam
Working pressure	0.05-0.7 MPa
Max. warning sound temperature limit	90˚C
Material	Stainless steel
Connection	JIS Rc screwed

Dimensions (mm) and Weights (kg)

Nominal size	d	L	D	Weight
15A	Rc 1/2	48.5	35	0.25
20A	Rc 3/4	49	45	0.40
25A	Rc 1	52	50	0.52
32A	Rc 1-1/4	55	60	0.77
40A	Rc 1-1/2	59	70	1.15
50A	Rc 2	65	105	2.99

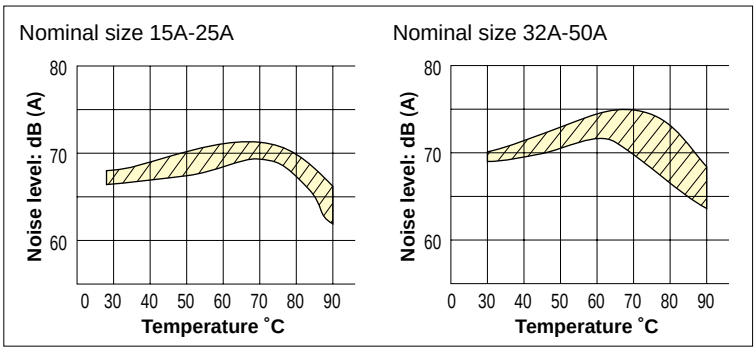


Nominal Size Selection Chart

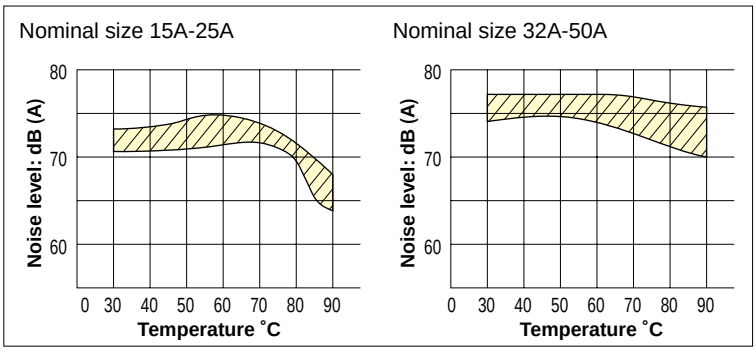


Noise Characteristic Chart

●Steam pressure {0.3 MPa}



●Steam pressure {0.5 MPa}



- The steam noise characteristic chart depends on the size or shape of the liquid tank, the location of the noiseless heater, and other factors. Use it for reference.
- The noise level was measured at a point 1 meter above the water surface.

MS-1・3

Features

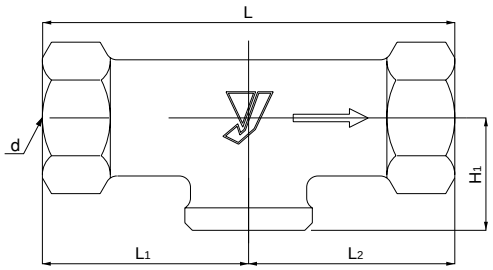
1. Noise can be reduced by attaching to the end of the piping.
2. Trouble-free simple structure.
3. Made of corrosion-free stainless steel (MS-3-13).

Specification

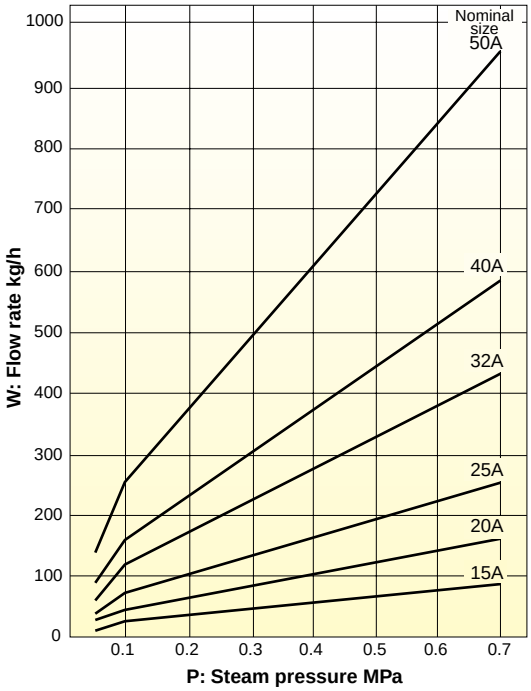
Model	MS-1	MS-3-13
Application	Steam	
Working pressure	0.05-0.7 MPa	
Max. warning sound temperature limit	60˚C	
Material	Cast bronze	Cast stainless steel
Connection	JIS Rc screwed	

Dimensions (mm) and Weights (kg)

Nominal size	d	L	L_1	L_2	H_1	Weight
15A	Rc 1/2	100	50	50	25	0.4
20A	Rc 3/4	110	55	55	30	0.4
25A	Rc 1	140	70	70	35	0.8
32A	Rc 1-1/4	180	90	90	45	1.0
40A	Rc 1-1/2	200	100	100	50	2.0
50A	Rc 2	270	130	140	65	4.0



Nominal Size Selection Chart



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MS-2·4

Features

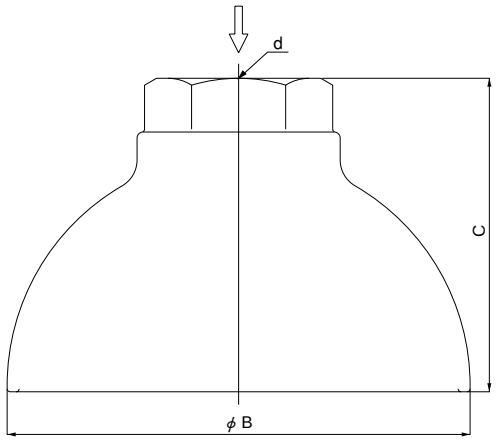
1. Noise can be reduced by attaching to the end of the piping.
2. Trouble-free simple structure.
3. Available in a higher temperature range than the MS-1 and MS-3.
4. Made of corrosion-free stainless steel (MS-4-13).

Specification

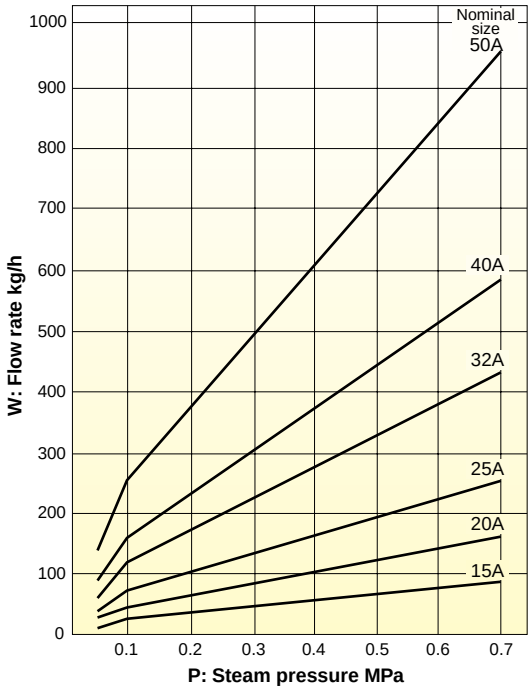
Model	MS-2	MS-4-13
Application	Steam	
Working pressure	0.1-0.7 MPa	
Max. warning sound temperature limit	90˚C	
Material	Cast bronze	Cast stainless steel
Connection	JIS Rc screwed	

Dimensions (mm) and Weights (kg)

Nominal size	d	C	B	Weight
15A	Rc 1/2	57	70	0.5
20A	Rc 3/4	71	93	0.7
25A	Rc 1	75	125	1.2
32A	Rc 1-1/4	105	155	3.0
40A	Rc 1-1/2	115	175	3.3
50A	Rc 2	142	220	7.0



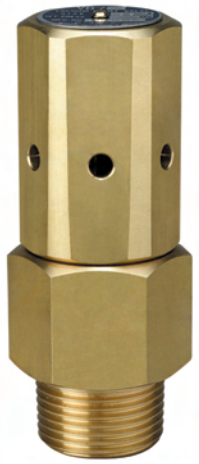
Nominal Size Selection Chart



VB-7・7S

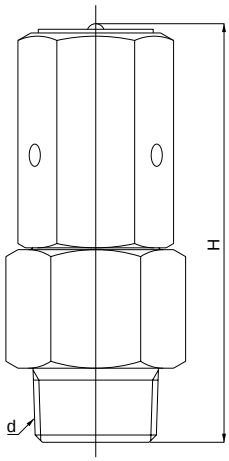
Features

1. Protects devices and piping by adjusting vacuum and preventing accidents resulting from vacuum pressure.
2. Special valve structure ensures stable performance without chattering and hunting.
3. Compact, lightweight and easy to handle.
4. Made of corrosion resistant material.



Specification

Model		VB-7	VB-7S
Application		Steam, Air	
Working pressure		1.0 MPa	
Pressure regulating range	Spring A	–0.5 - –21 kPa (Standard set pressure: –4 kPa)	
	Spring B	–21 - –48 kPa (Standard set pressure: –21 kPa)	
	Spring C	–48 - –81 kPa (Standard set pressure: –48 kPa)	
Maximum temperature		200˚C	
Material	Body	Brass	Stainless steel
	Valve	Cast bronze	Cast stainless steel
	Valve seat	Brass	Stainless steel
Connection		JIS R screwed	

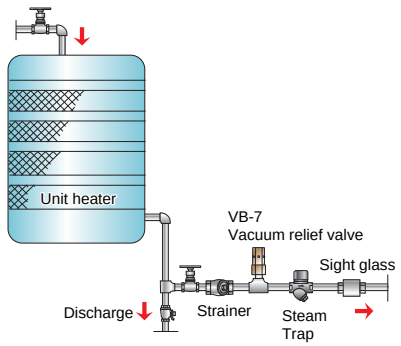


Dimensions (mm) and Weights (kg)

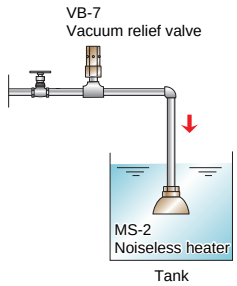
Nominal size	d	H	A	Weight
15A	R 1/2	100.0	35	0.50
20A	R 3/4	100.0	35	0.50
25A	R 1	112.5	41	0.75
32A	R 1-1/4	113.5	50	1.05
40A	R 1-1/2	130.0	55	1.45
50A	R 2	165.5	65	2.45

Example Piping Diagram

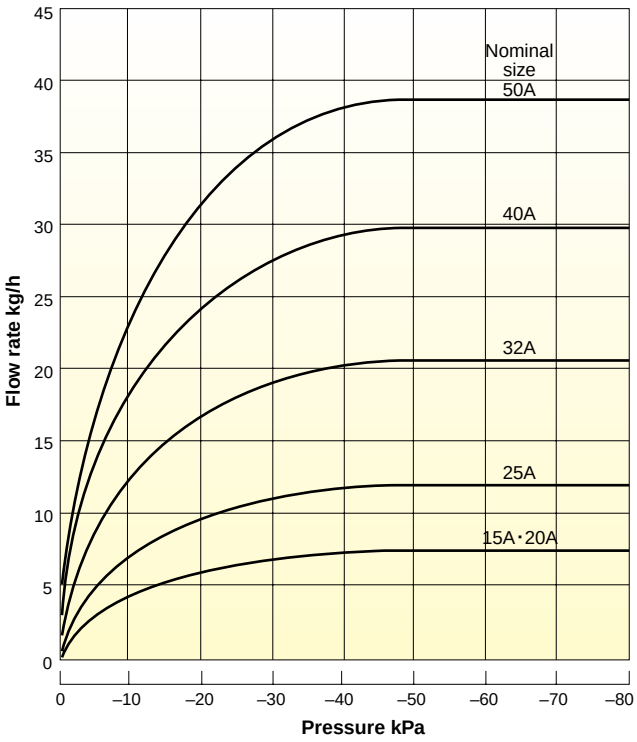
●Piping example of temperature regulating equipment



●Piping example of noiseless heater without check valve



Nominal Size Selection Chart



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M e m o

Fluid Control Product

SCV-2

The SCV-2 is an inline type check valve to prevent fluid backflow. It is used widely for steam or water (hot water) piping, etc. and effective in preventing water hammer.

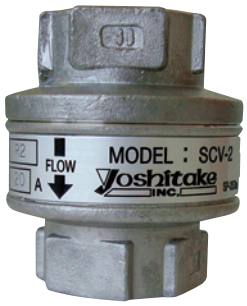
Features

1. Compact piping.
2. Can be connected in any direction (horizontal or vertical).
3. Outstanding corrosion resistance and excellent durability ensured by all stainless steel parts.

Specifications

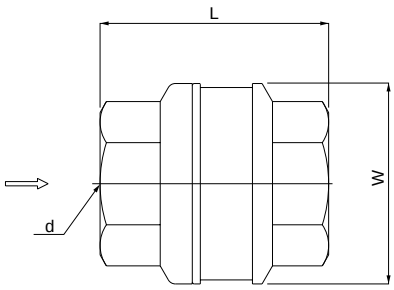
Application		Steam, Cold and hot water
Maximum pressure		1.6 MPa
Application temperature		5-220˚C
Minimum valve opening pressure		0.003 MPa
Material	Body	Cast stainless steel
	Disc	Stainless steel
Connection		JIS Rc screwed

・A small amount of fluid leaks out of the product. So, it should not be used for applications requiring complete closing.

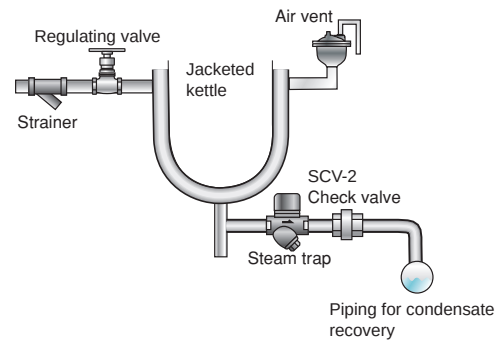


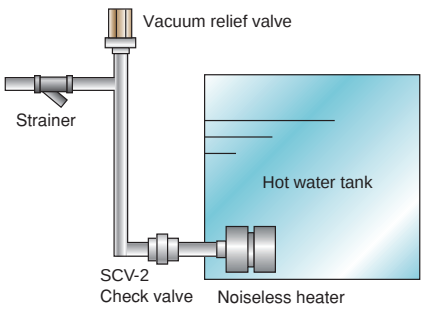
Dimensions (mm) and Weights (kg)

Nominal size	d	L	W	Weight
15A	Rc 1/2	57	50	0.5
20A	Rc 3/4	57	50	0.45
25A	Rc 1	72	69	1.1
40A	Rc 1-1/2	88	89	2.0
50A	Rc 2	88	89	1.5

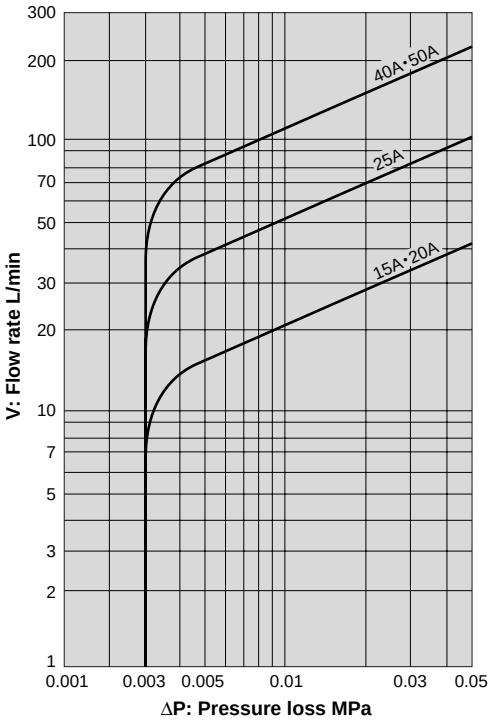


Piping Example





Pressure Loss Chart



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WP-1 (Shock Killer)

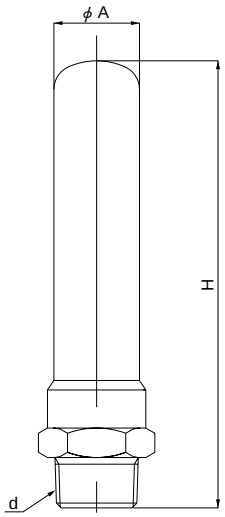
Since complex housing and office buildings become higher and larger, the residential environment, which should be comfortable, faces various threats. Among them is noise caused by water hammer. Just a little carelessness for it brings about damage to devices or disturbance of sleep. The Shock Killer absorbs water hammer and helps create a comfortable residential environment.

Features

1. Gently absorbs water hammer in buildings with high water pressure.
2. Prevents water hammer at the operation of water faucet lever at toilet or wash basin.
3. Slim and compact body permits horizontal or vertical piping.
4. Prevents water hammer damage to piping and devices.
5. Once installed, it can serve perpetually without maintenance.

Specifications

Nominal size		15A	20A	25A
Application		Cold and hot water, City water		
Maximum pressure		1.0 MPa		
Maximum temperature		90˚C		
Maximum flow velocity		3 m/s		
Material	Body	Brass		
	Pipe	Copper		
Connection		JIS R screwed		
Charged pressure		0.15 MPa		



Dimensions (mm) and Weights (kg)

Nominal size	d	H	A	B	Weight
15A	R 1/2	123	28.3	32	0.25
20A	R 3/4	154	28.3	32	0.30
25A	R 1	182	34.8	41	0.50

Effectiveness of the Shock Killer against Water Hammer

Figs. 1 and 2 show the difference in water hammer level between when the Shock Killer is used and not.

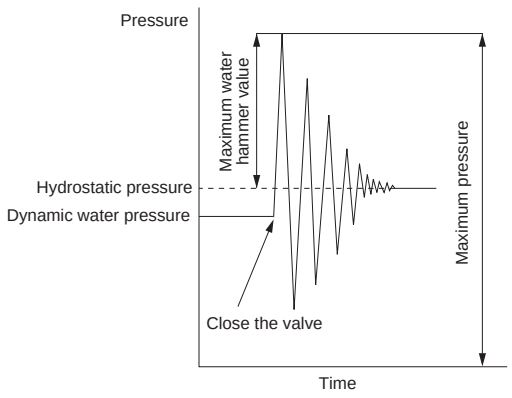


Fig. 1 When the Shock Killer is not used

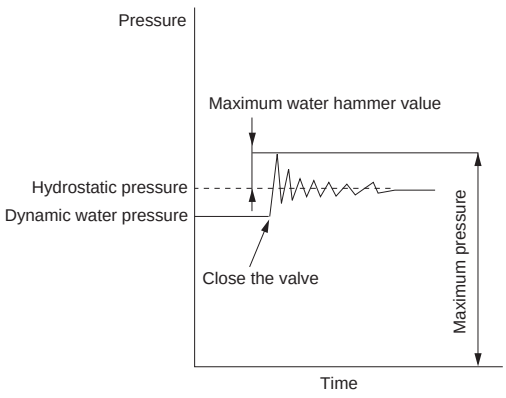


Fig. 2 When the Shock Killer is used

The Shock Killer is available mainly for the two applications below.

Application 1: General house and Complex housing

● How to use and select

1: In principle, install one Shock Killer in each house.
2: To select a nominal size, find the unit of load for each water supply device in Table-1 (under Private room). Apply it to Table-2, and find an appropriate nominal size of the Shock Killer.
3: Install another Shock Killer to branch piping if the branch piping is more than 4 meters.
4: Additionally, install the Shock Killer close to devices such as solenoid valves where water hammer is a serious problem.

● Installation position of the Shock Killer

1: Install the Shock Killer midway between the end branch piping and the branch piping before it (in a position within 6 meters from a water supply device).
2: When installing the Shock Killer to the branch piping, place it close to a water supply device. When two or more water supply devices are used, install it between the end water supply device and the water supply device before it.

Application 2: High-rise Buildings and Multipurpose Buildings

● How to use and select

1: Handle the water supply piping as separated on each water supply system.
2: In principle, install one Shock Killer per 6 meters of branch piping.
3: To select a nominal size, find the unit of load for each water supply device in Table-1 (under Public use). Apply it to Table-2, and find an appropriate nominal size of the Shock Killer.
・If the units of load in total is over 60, use a proper number of 25A Shock Killers to fulfill the units of load.

● Installation position of the Shock Killer

1: Install the Shock Killer midway between the end water supply device and the water supply device before it.
2: When installing two or more Shock Killers, install one midway between the end water supply device and the water supply device before it, and the others at equal intervals between the first Shock Killer and the water supply device on the start point.

Table-1 Unit of load for water supply devices (Excerpted from SHASE Handbook)

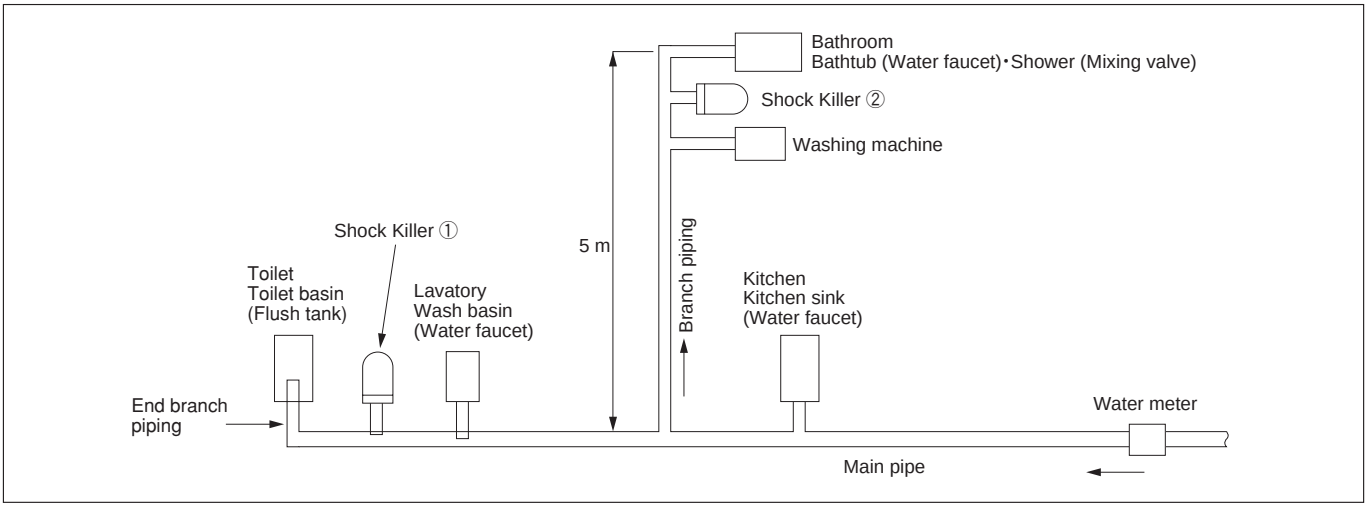
Name of device	Faucet	Unit of load for water supply devices	
		Under Public use	Under Private room
Toilet basin	Flush valve	10	6
〃	Flush tank	5	3
Urinal	Flush valve	5	
〃	Flush tank	3	
Wash basin	Water faucet	2	1
Hand wash basin	〃	1	0.5
Medical wash basin	〃	3	
Office sink	〃	3	
Kitchen sink	〃		3
Cookery sink	〃	4	2
〃	Mixing valve	3	
Dishwashing sink	Water faucet	5	
Multi-station sink	〃		3
Vanity sink (per faucet)	〃	2	
Scrab sink	〃	4	3
Bathtub	〃	4	2
Shower	Mixing valve	4	2
Bathroom-Modular bath	Equipped with toilet basin with flush valve		8
〃	Equipped with toilet basin with flush tank		6
Drinking water fountain	Drinking water faucet	2	1
Water heater	Ball tap	2	
Sprinkling・garage	Water faucet	5	

(Note) When a hot water tap is also used, the unit of load for a water supply device to a tap shall be 3/4 of the appropriate value shown in the table above.

Table-2 Nominal size selection table

Total units of load for water supply devices	Nominal size
1-11	15A
12-32	20A
33-60	25A

●Example of installation



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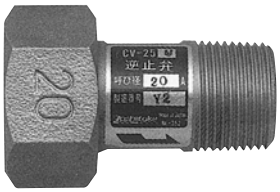
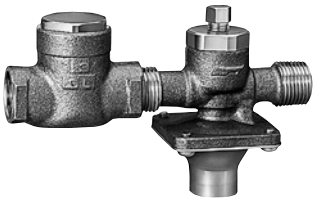
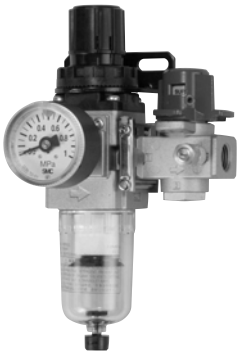
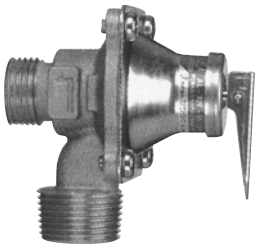
Feature		Check valve	Air out	PRV unit for kerosene
Model		CV-25U	AO-2	GD-65F･SU-55F
Picture				
Application		City Water	Cold and hot water	Kerosene
Inlet pressure		1.0 MPa or less	—	0.05-0.1 MPa
Pressure		Shut-off pressure: Min. 0.005 MPa	Max. pressure: 1.0 MPa	Reduced pressure: 0.02 MPa
Max. temperature		35˚C	120˚C	60˚C
Connection		JIS G screwed x JIS R screwed	JIS Rc screwed	JIS Rc screwed x JIS R screwed
Material	Body	Brass	Cast bronze	Cast bronze
	Valve	POM	—	FKM
	Valve seat	—	—	Cast bronze
	Diaphragm	—	—	FKM
Size		20A, 25A	20A-50A	15A
Others		—	—	Incorprated screen: 60 mesh

Feature		For air loaded PRV		PRV with filter	3 port solenoid valve
Model		GD-37U		GD-37	DD-37
Picture					
Application		Air			Air, Water, Oil
Inlet pressure		Max. 0.99 MPa			Max. 0.6 MPa
Reduced pressure		0.05-0.85 MPa			—
Max. temperature		60˚C			—
Connection		JIS Rc screwed			JIS Rc screwed
Material	Body	Zinc die casting			Brass
	Valve	NBR			NBR
	Valve seat	Zinc die casting			—
	Diaphragm	NBR			—
Size		8A		6A-8A	8A
Others		・Operating unit for air loaded pressure reducing valves. Filteration: 5 μm		Filteration: 5 μm	Rated voltage: AC 100 V 50 / 60 Hz AC 200 V 50 / 60 Hz

Feature	Home boiler regulator				
Model	GD-55-80	GD-56-80	GD-55R-80	GD-56R-80	GD-91R-80
Picture	 GD-55-80		 GD-56R-80		
Application	Cold and hot water				
Inlet pressure	100-750 kPa				
Reduced pressure	Standard set pressure: 80 ± 6 kPa Available with 30-200 kPa				
Max. temperature	60˚C				
Freezing test	—		Suitable for –20˚C		
Connection	JIS Rc screwed				
Material: Body	Cast bronze				
Material: Diaphragm	Synthetic rubber				
Material: Main valve	Synthetic rubber				
Material: Check valve	Synthetic rubber				
Material: Screen	Stainless steel				
Size	20A				
Face to face dimension	90 mm	115 mm	90 mm	115 mm	
Others	—				

Feature	Home boiler relief valve			
Model	AL-52F-95, AL-52FS-95	AL-72F-95	AL-50	AL-68-97
Picture				
Application	Cold and hot water			
Commence-to-blow pressure	95 $^{+4}_{-6}$ kPa			97 $^{+2}_{-4}$ kPa
Reseating pressure	87 kPa or more		75 kPa or more	92 kPa or more
Breathing pressure	—		—	–12 kPa or less
Max. temperature	100˚C			
Freezing test	Suitable for –20˚C			
Connection	Inlet: JIS R screwed Outlet: JIS Rc screwed	Inlet: JIS R screwed Outlet: JIS G screwed	Inlet: JIS R screwed Outlet: JIS Rc screwed	
Material: Body	Bronze			
Material: Valve	Synthetic rubber (diaphragm)		Synthetic rubber	
Material: Valve seat	Bronze			Stainless steel
Size	Inlet 20A x Outlet 15A			
Others	Available with commence-to-blow pressure 60-190 kPa. AF-52FS: Valve seat made of stainless steel		Available with commence-to-blow pressure 90-300 kPa.	Available with commence-to-blow pressure 190 kPa (AL-68-190).

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Y's JACKET

This specially designed jacket completely fits Yoshitake products in use at your site. The energy-saving and CO_2-reduction effects can be estimated prior to order.

Features

1. Energy saving
   Prevents room temperature rise as well as energy loss caused by heat release.
2. CO_2-reduction effect
   Contributes to CO_2-reduction of the global issue.
3. Safety
   Prevents accidents, such as burns or bruises and brings a safe and comfortable work environment.
4. Environmental enhancement
   Easy to set and reusable after valve maintenance, it produces no waste and thus is environment-friendly.

Specifications

Material	Surface material	Glass cloth + Silicone coating
	Inner material	Glass cloth + Silicone coating
	Insulating material	Needle punched mat made of glass fiber Thickness: 20 mm

Table of Energy-saving Effect and Amount of Decrease in CO_2 Emission (with Y's JACKET)

	Model (Size)		Amount of heat release (kJ/h)	Amount of steam reduction (kg/y)	Amount of decrease in CO_2 emission (kg-CO_2/y)
Pressure reducing valve	GP-2000	15A	2,253	7,540	1,049
		25A	2,655	8,886	1,237
		50A	4,470	14,959	2,082
		100A	8,959	29,981	4,172
	GP-1000	15A	1,724	5,768	803
		25A	2,095	7,011	976
		50A	3,285	10,993	1,530
		100A	6,426	21,514	2,993
Drain separator	DS-1	15A	1,663	5,566	775
		25A	1,706	5,707	794
		50A	3,389	11,341	1,578
	DS-2	15A	2,003	6,705	933
		25A	2,521	8,438	1,174
		50A	3,929	13,150	1,830
		100A	10,168	34,029	4,735
Strainer	SY-40	15A	393	1,316	183
		25A	621	2,079	289
		50A	1,227	4,105	571
		100A	3,100	10,373	1,443
	SY-5	15A	113	380	53
		25A	256	856	119
		50A	644	2,157	300

・Calculated conditions: steam pressure: 1 MPa, 24 hours per day, and Heavy oil A
・When steam pressure is 1 MPa,
Surface temperature of the valve without Y's jacket: 174˚C
Surface temperature of the valve with Y's jacket: 47˚C
(The temperature varies depending on measurement conditions.)

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KAWAKI Product

FS SIGHT FLOW INDICATORS

(Transparent Sight Glass)

Types: FS-Ⅰ-N: With nozzle
FS-Ⅱ-P: With flap
FS-B: With balls
FS-Ⅳ: Normal / reverse dual-use
FS-T: With rotor vane
FS-W: With wiper
Diameter: 3/8B-6B flanged type
Rc 3/8-Rc 2 screwed type
Withstanding Pressure: 1.0 MPa
Temperature: 80˚C or less
Construction:
Body: FC250, FCD450, CAC406, SS400, SUS304, SUS316
Main parts: C2801P, SUS304, SUS316
Note
・FS-Ⅱ type can be provided with a rough flow rate scale.

FS-Ⅱ-P

FS-B

FS-Ⅰ-N

FS-Ⅳ

FSJ SIGHT FLOW INDICATORS

(Compact Type)

Types: FSJ-Ⅱ: With flap
FSJ-B: With balls
Diameter: Rc 3/8-Rc 1
Withstanding Pressure: 1.0 MPa
Temperature: 80˚C or less
Construction:

	Body	Main parts
For oils:	A2017	C2801P
For water:	C3604B	C2801P
For chemicals:	SUS304	SUS304

FSJ-B

FS-M, FS-O SIGHT FLOW INDICATORS

(Magnet Following Type)

Types: FS-M: Magnet following sight flow
FS-O: Magnet following sight flow for small flow rate
Diameter: FS-M: 3/8B-6B flanged type
Rc 3/8-Rc 2 screwed type
FS-O: 3/8B-1B flanged type
Rc 3/8-Rc 1-1/2 screwed type
Withstanding Pressure: 1.0 MPa
Temperature: 80˚C or less
Construction:
Body: FC250, FCD450, CAC406, SS400, SUS304, SUS316
Main parts: C2801P, SUS304, SUS316

FS-M

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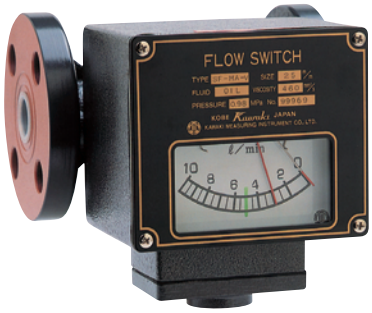
SF FLOW METER & FLOW SWITCH

Types: SF-M: Instantaneous flow indicator
SF-MA: Instantaneous flow indicator + lower (or upper) microswitch
SF-MAA: Instantaneous flow indicator + lower & upper microswitches
Diameter: 3/8B-12B flanged type, Rc 3/8-Rc 1-1/2 screwed type
Withstanding Pressure: Standard: 1.0 MPa
Special order: 30 MPa
Temperature: Standard: 80˚C or less
Special order: 300˚C or less
Accuracy: SF-M: ±3% of readings
SF-MA, SF-MAA: ±5% of readings
Contact Capacity:
Microswitches used for contacts are classified into the following three types according to diameter and flow rate:
- 15A : 125, 250 or 480 VAC
  0.5A: 125 VDC 0.25A: 250 VDC
- 5A : 125 or 250 VAC
  0.5A: 125 VDC 0.25A: 250 VDC
- 10A : 125 or 250 VAC

Characteristics:
- Most suitable for opaque liquids (oils, etc), high-temperature and high-pressure fluids. No restrictions on flow direction.
- The contact of the SF-MA･MAA standard flow switch is internally variable, but an external variable type can also be manufactured for frequent variations.
- Complete waterproof type (IEC IP67) is also manufactured for outdoor or severe-atmosphere use.

Construction:
Body: FC250, CAC406, SS400, SUS304, SUS316, SUS316L
Main parts: C3604B, SUS304, SUS316, SUS316L
Note
- For use in high vibration places, use vibration-proof type.



SF-MA

SA FLOW METER & FLOW SWITCH

(Proximity switches are used for small flow rate.)

Types: SA-M: Instantaneous flow indicator
SA-MA: Instantaneous flow indicator + lower (or upper) proximity switch contact
SA-MAA: Instantaneous flow indicator + lower & upper proximity switch contacts
Diameter: 3/8B-1B flanged type
Rc 3/8-Rc 1 screwed type
Withstanding Pressure: Standard: 1.0 MPa
Temperature: Standard: 80˚C or less
Special order: 300˚C or less
Accuracy: ±3% of readings
Contact Capacity: 50 W: 0.5A, 125 VAC
Self-holding proximity switch
Characteristics:
- Most suitable for relatively small flow rates (0-15 L/min in water) of opaque liquids (oils, etc.), high-temperature and high-pressure fluids.
- No restrictions on the flow direction.

Construction:
Body: FC250, CAC406, SS400, SUS304, SUS316, SUS316L
Main parts: C3604B, SUS304, SUS316, SUS316L
Note
- For use in high vibration places, use vibration-proof type.

FY FLOW METER & FLOW SWITCH

(Compact Type)

Types: FY-M: Instantaneous flow indicator
FY-MA: Instantaneous flow indicator + lower (or upper) microswitch
Diameter: 3/8B-5B flanged type,
Rc 3/8-Rc 1-1/2 screwed type
Withstanding Pressure: 1.0 MPa
Temperature: Standard: 80˚C or less
Accuracy: FY-M: ±3% of readings
FY-MA: ±5% of readings
Contact Capacity: 5A; 125, 250 VAC
0.5A; 125 VDC
0.25A; 250 VDC
Characteristics:
- Most suitable for opaque liquids (oils, etc), high-temperature and high-pressure fluids. No restrictions on flow direction.
- Available with external contact variable type.

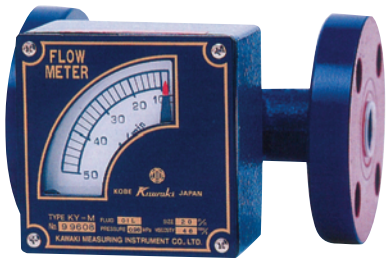
Construction:
Body: FC250, CAC406, SUS304
Main parts: C3604B, SUS304
Note
- For use in high vibration places, use vibration-proof SF type.
- For 1.0 MPa or higher operating pressure, use the SF type designed for high pressure.
- Complete waterproof type (IEC IP67) is also manufactured for outdoor or severe-atmosphere use.

FY-M

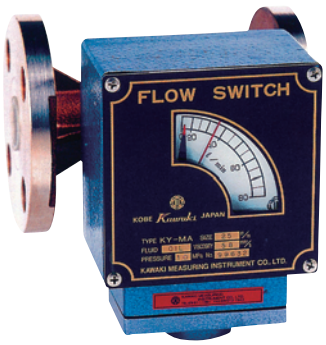
KY FLOW METER & FLOW SWITCH

Types: KY-M: Instantaneous flow indicator
KY-MA: Instantaneous flow indicator + lower (or upper) microswitch
Diameter: 3/8B-5B flanged type
Rc 3/8-Rc 1-1/2 screwed type
Withstanding Pressure: 1.0 MPa
Temperature: 80˚C or less
Accuracy: ±5% of reading
Contact Capacity: 15A; 125, 250 or 480 VAC
0.5A; 125 VDC
0.25A; 250 VDC
Applications:
Most suitable for flow rate indications and alarms for lubricating oil and fluids containing iron powder.
Characteristics:
- Most suitable for opaque liquids because the indicating section is mechanically sealed from fluid.
- No restrictions on the flow direction.
- The contact position is variable.

Construction:
Body: FC250, CAC406, SUS304
Main parts: C3604B, SUS304
Note
- For use in high vibration places, use vibration-proof SF type.
- For 1.0 MPa or greater operating pressure, use the SF type designed for high pressure.



KY-M



KY-MA

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FLOW KILLER

(Thermistor Flow Meter)

Type: FK
This flow meter, using thermistor characteristics, has no movable parts structurally. Fluids to be measured include water or aqueous solutions.
Diameter: 1B-12B flanged type
Operating Pressure: 1.0 MPa
Withstanding Pressure: 1.5 MPa
Liquid Temperature: 0-80˚C
Ambient Temperature: –20˚C to +60˚C
Accuracy: ±3% FS
Indication: LED
Output: 4-20 mA DC, two switching points: S_1 and S_2 can be set independently.
Power Source: 100 , 200 VAC
Characteristics:

- Little or no trouble and no pressure loss because there are no movable parts.
- No restrictions on installation of piping, allowing horizontal and vertical piping (in a full condition).
- This flow meter can be used in magnetic fields because of LED indication, and can be used for pure water measurement.
- The waterproof class is IEC IP67 and can be used outdoors.

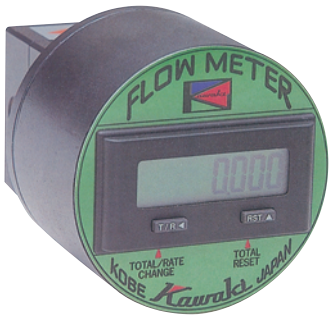
FK

RIVER FLOW

(Gear Type Flow Meter)

●RF-Ⅰ : Field Indication Type (Instantaneous + Integrated Indication)
This compact high-precision flow meter measures not only water and oils, but also chemicals. The rotations of two three-lobe elliptic gears output signals directly proportional to flow rates. Receiving the signals, the indicator provides field indication of instantaneous flow rates or integrated flow rates.

Diameter: Rc 1/8-Rc 3/8
Operating Pressure: 1.0 MPa
Withstanding Pressure: 1.5 MPa
Liquid Viscosity: 1,000 mm^2/s or less
Ambient Temperature: –5˚C to +40˚C
Liquid Temperature: 0-80˚C
Operating Humidity: 45-85% RH
Accuracy: ±1%
Indication: Instantaneous flow rate indication: 4 digits
Integrated flow rate indication: 8 digits



RF-Ⅰ

●RF-Ⅱ : Electronic Transmission Type
Field indication type (integrated type)
Remote transmission type (separate type)
(instantaneous + integrated indication + analog output + high/low alarm contact)
Pulse (contact) signals from the transmitter (RF-S) can be output variously by using a converter in accordance with the application. Available with integrated type (RF-Ⅱ) in which the trasmitter (sensor section), converter and indicating section are integrated, and separate type (RF-Ⅱ-S).

Power Source: AC 100 V / 200 V ±10%
DC 12 V / 24 V (option)
Output Signals: Current Output: 4-20 m ADC
Voltage Output: 0-1 V, 0-5 V, 0-10 V, 1-5 V
Relay Output: Instantaneous high/low alarm contact

RF-Ⅱ

Technical Information

INDEX

List of CE-marked Products

CE Marking is a mark to be displayed or printed on products to be distributed within the European Union (EU) and compliant with New Approach Directives issued by the European Commission for the purpose of protecting the health and safety of their users and consumers and ensuring the free distribution of these products within the EU.
Yoshitake acquired a CE Marking certificate for the Pressure Equipment Directive (97/23/EC) in April 2004. The certified products are listed below.

CE

Pressure Equipment Directive	Model	Size	Connection
97/23/EC	GP-2000	65A-150A	DIN25/40RF
	GDK-2000	65A-100A	DIN25/40RF
	GPR-2000	65A-100A	DIN25/40RF
	OB-2000	65A-100A	DIN25/40RF
	DS-2	65A-100A	DIN25/40RF

Note) The abovementioned product models of 15A to 50A are prohibited from displaying CE Marking but equal to those listed in the table in safety, etc.

Manufacture License of Special Equipment in China

We have the manufacture license of safety valve for boiler and pressure vessel in China.
Boiler and pressure vessel sold in China require safety valves manufactured under this license.
Model numbers of the licensed products are shown in the table below.

Model	Nominal size (mm)	Pressure (MPa)
AL-150	15-50	0.05-1.0
AL-150L	15-50	0.05-1.0
AL-150H	15-50	1.0-1.6
AL-150HL	15-50	1.0-1.6
AL-5	20-50	0.05-1.5
AL-6	65-150	0.05-1.5
AF-5	20-50	0.1-1.6

* When ordering the licensed product, contact us in advance.


中华人民共和国
特种设备制造许可证
Manufacture License of Special Equipment
People's Republic of China
（安全附件）(Safety Appurtenances)
No.: TSF700A36-2012
公司/Company: Yoshitake Inc.
地址/Address: 7-3 Futano-Cho, Mizuho-Ku, Nagoya 467-0861, Japan
经审查，获准从事下列安全附件的制造：
Has been audited and approved to manufacture the Safety Appurtenances within the scope as:
Name of Products | Level | Structure type | Media | Nominal Pressure (MPa) | Nominal dia. (mm)
Safety Valves | A2 | Spring Loaded | Gas, Steam & Water | PN 0.05-1.6 | DN 15-150
审批机关：
Approval/Issue Organ:
General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China
有效期至：2012 年 06 月 04 日
Date of Expiration: June 4, 2012
发证日期：2007 年 06 月 05 日
Date of Issue: June 5, 2007
国家质量监督检验检疫总局制

7-3, Futano-cho, Mizuho-ku, Nagoya, 467-0861, Japan Phone: 81-52-881-7199 Fax: 81-52-881-7201
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RoHS Directive

The Directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS Directive) prohibits the use of hazardous chemical substances in electrical and electronic products, including computers, communication devices, and household electrical appliances, in the European Union (EU). This directive is intended to minimize substances of concern and the risk of adverse effects on human health throughout the life cycle of products, from production to disposal.
To be specific, the use of six substances — lead, hexavalent chromium, mercury, cadmium, polybrominated biphenyl (PBB) used for fire retardants, and polybrominated diphenyl ether (PBDE) — is restricted.
Since July 2006, products containing a specific quantity of any of the abovementioned substances have not been sold at all in the entire EU according the RoHS Directive.
Yoshitake is ready to manufacture RoHS-Directive-compliant products in-house. For further information, please contact us.

■Content thresholds of hazardous substances (maximum permitted concentrations)

The content thresholds (maximum permitted concentrations) set on the six hazardous substances restricted by the RoHS Directive are shown in the table below.
Some applications of these substances are designated as exceptions.

Substance name	Threshold (maximum permitted concentration)	Excepted application
Pb Lead	1000 ppm (0.1%)	・Pb contained in glass for cathode ray tubes, electronic parts, and fluorescent tubes ・Pb in high-melting-point solder (Sn and Pb eutectic solder with Pb content of 85% or more) ・Pb of up to 0.35 wt% contained in steel materials as an alloy Pb of up to 0.4 wt% contained in aluminum materials Pb of up to 4 wt% contained in copper materials
Cr^{+6} Hexavalent chromium	1000 ppm (0.1%)	Cr^{+6} used for rust prevention of carbon steel cooling systems in absorption type refrigerators
Hg Mercury	1000 ppm (0.1%)	・Hg of less than 5 mg per small-sized fluorescent lamp ・Hg contained in striplights for special applications, etc.
Cd Cadmium	100 ppm (0.01%)	Surface treatment other than that prohibited by revised 91/338/EEC of Directive 76/769/EEC (91/338/EEC prohibits the use of Cd for coloring of polyvinyl chloride (PVC).)
PBB Polybrominated biphenyl	1000 ppm (0.1%)	No exceptions.
PBDE Polybrominated diphenyl ether	1000 ppm (0.1%)	No exceptions.

Conversion Table: To/from SI Units

■Major metering units switched to SI units

	Metering unit (conventional unit) switched	SI unit	Unit conversion relationship *1
Pressure	Kilogram-force per square meter(kgf/m², kgw/m², kg/m²) Meter of mercury (mHg) *2 Meter of water (mH₂O, mAq) Torr *3	Pascal (Pa)	1 kgf/m² ≒ 9.8 Pa 1 mHg ≒ 133 kPa 1 mH₂O (mAq) ≒ 9.8 kPa 1 Torr ≒ 133 Pa
		Bar (bar)	1 kgf/m² ≒ 9800 bar 1 mHg ≒ 1.33 bar 1 mH₂O (mAq) ≒ 0.098 bar 1 Torr ≒ 0.00133 bar
Moment of force	Kilogram-force meter (kgf・m, kgw・m, kg・m)	Newton meter (N・m)	1 kgf・m ≒ 9.8 N・m
Force	Kilogram-force (kgf, kgw)	Newton (N)	1 kgf ≒ 9.8 N
Amount of heat	Calorie (cal) *4	Joule (J)	1 cal ≒ 4.2 J
Length	Micron (μ)	Meter (m)	1 μ = 1 μm

*1 The accurate conversion coefficients for unit conversion relationships are as shown below.
9.8 = 9.80655, 4.2 = 4.18605 (temperature not specified), 133 = 133.322
*2 Except blood pressure measurement. *3 Except the field of medicine. *4 Except the field of nutrition.

■Conversion systems

1: New value system: A system that uses values rounded based on values in conventional units as SI-unit values
2: Converted value system: A system that uses values calculated by multiplying values in conventional units by specified conversion factors as SI-unit values

Yoshitake, in principle, uses the new value system. The converted value system is adopted when converting SI-unit values into values in conventional units.

Conventional unit	SI unit	Converted value
kgf/cm²	(Convert conventional unit by new value system) → MPa	(Convert SI unit to conventional unit by converted value system) → kgf/cm²

■Indication of gauge pressure and absolute pressure

Category	Conventional unit	SI unit
Indication of gauge pressure	kgf/cm²G	MPa
Indication of absolute pressure	kgf/cm²abs	MPa・A
Indication of atmospheric pressure	1.033 kgf/cm²abs	0.1013 MPa・A

"・A" is added only to absolute pressure in the form of "MPa・A." "・G" is not added to gauge pressure.

■Conversion table for negative pressure

Conventional unit	SI unit	Converted value (kgf/cm²)
−50 mmHg = −0.068 kgf/cm²	−6.8 kPa	−0.0693
−160 mmHg = −0.218 kgf/cm²	−21.8 kPa	−0.222
−360 mmHg = −0.489 kgf/cm²	−48.9 kPa	−0.499
−600 mmHg = −0.816 kgf/cm²	−81.6 kPa	−0.823
−0.10 kgf/cm²	−10.0 kPa	−0.1020

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■Conversion table for positive pressure

Conventional unit (kgf/cm²)	SI unit (MPa)	SI unit (kPa)	Converted value (kgf/cm²)
0.01		1	0.0102
0.02		2	0.0204
0.03		3	0.0306
0.04		4	0.0408
0.05		5	0.0510
0.06		6	0.0612
0.07		7	0.0714
0.08		8	0.0816
0.09		9	0.0918
0.1	0.01	10	0.102
0.2	0.02	20	0.204
0.3	0.03	30	0.306
0.4	0.04	40	0.408
0.5	0.05	50	0.51
0.6	0.06	60	0.612
0.7	0.07	70	0.714
0.8	0.08	80	0.816
0.9	0.09	90	0.918
1.0	0.10	100	1.02
1.1	0.11	110	1.12
1.2	0.12	120	1.22
1.3	0.13	130	1.33
1.4	0.14	140	1.43
1.5	0.15	150	1.53
1.6	0.16	160	1.63
1.7	0.17	170	1.73
1.8	0.18	180	1.84
1.9	0.19	190	1.94
2.0	0.20	200	2.04
2.1	0.21	210	2.14
2.2	0.22	220	2.24
2.3	0.23	230	2.35
2.4	0.24	240	2.45
2.5	0.25	250	2.55
2.6	0.26	260	2.65
2.7	0.27	270	2.75
2.8	0.28	280	2.86
2.9	0.29	290	2.96
3.0	0.30	300	3.06
3.1	0.31	310	3.16
3.2	0.32	320	3.26
3.3	0.33	330	3.37
3.4	0.34	340	3.47
3.5	0.35	350	3.57
3.6	0.36	360	3.67
3.7	0.37	370	3.77
3.8	0.38	380	3.87
3.9	0.39	390	3.98
4.0	0.40	400	4.08
4.1	0.41	410	4.18
4.2	0.42	420	4.28
4.3	0.43	430	4.38
4.4	0.44	440	4.49
4.5	0.45	450	4.59
4.6	0.46	460	4.69
4.7	0.47	470	4.79
4.8	0.48	480	4.89
4.9	0.49	490	5.00
5.0	0.50	500	5.10
5.1	0.51	510	5.20
5.2	0.52	520	5.30
5.3	0.53	530	5.40
5.4	0.54	540	5.51
5.5	0.55	550	5.61
5.6	0.56	560	5.71

Conventional unit (kgf/cm²)	SI unit (MPa)	SI unit (kPa)	Converted value (kgf/cm²)
5.7	0.57	570	5.81
5.8	0.58	580	5.91
5.9	0.59	590	6.02
6.0	0.60	600	6.12
6.1	0.61	610	6.22
6.2	0.62	620	6.32
6.3	0.63	630	6.42
6.4	0.64	640	6.53
6.5	0.65	650	6.63
6.6	0.66	660	6.73
6.7	0.67	670	6.83
6.8	0.68	680	6.93
6.9	0.69	690	7.04
7.0	0.70	700	7.14
7.1	0.71	710	7.24
7.2	0.72	720	7.34
7.3	0.73	730	7.44
7.4	0.74	740	7.55
7.5	0.75	750	7.65
7.6	0.76	760	7.75
7.7	0.77	770	7.85
7.8	0.78	780	7.95
7.9	0.79	790	8.06
8.0	0.80	800	8.16
8.1	0.81	810	8.26
8.2	0.82	820	8.36
8.3	0.83	830	8.46
8.4	0.84	840	8.57
8.5	0.85	850	8.67
8.6	0.86	860	8.77
8.7	0.87	870	8.87
8.8	0.88	880	8.97
8.9	0.89	890	9.08
9.0	0.90	900	9.18
9.1	0.91	910	9.28
9.2	0.92	920	9.38
9.3	0.93	930	9.48
9.4	0.94	940	9.59
9.5	0.95	950	9.69
9.6	0.96	960	9.79
9.7	0.97	970	9.89
9.8	0.98	980	9.99
9.9	0.99	990	10.1
10.0	1.0		10.2
10.5	1.05		10.7
11	1.1		11.2
12	1.2		12.2
13	1.3		13.3
14	1.4		14.3
15	1.5		15.3
16	1.6		16.3
17	1.7		17.3
18	1.8		18.4
19	1.9		19.4
20	2.0		20.4
21	2.1		21.4
22	2.2		22.4
23	2.3		23.5
24	2.4		24.5
25	2.5		25.5
26	2.6		26.5
27	2.7		27.5
28	2.8		28.6
29	2.9		29.6
30	3.0		30.6

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Conversion Table for Each Unit

■Conversion table for length

Meter m	Centimeter cm	Inch in	Foot ft	Yard yd
1	100	39.37	3.281	1.094
0.01	1	0.393 7	0.032 81	0.010 94
0.025 4	2.54	1	0.083 33	0.027 78
0.304 8	30.48	12	1	0.333 3
0.914 4	91.44	36	3	1

■Conversion table for area

Square meter m^2	Square centimeter cm^2	Square Inch in^2	Square Foot ft^2	Square Yard yd^2
1	10000	1 550	10.76	1.196
$0.0_3$64 52 *	6.452	1	$0.0_2$69 44	$0.0_3$77 16
0.092 90	929	144	1	0.111 1
0.836 1	8361	1 296	9	1

* Example: $0.0_3$6452 is short for 0.0006452.

■Conversion table for volume

Cubic meter m^3	Cubic Inch in^3	Cubic Foot ft^3	Cubic Yard yd^3
1	61 024	35.31	1.308
$0.0_4$16 39	1	$0.0_3$57 87	$0.0_4$21 43
0.028 32	1 728	1	0.037 04
0.764 6	46 656	27	1

Liter L	Cubic meter m^3	Imperial gallon gal (UK)	US gallon gal (US)	Cubic inch in^3
1	0.001	0.220 0	0.264 2	61.02
1000	1	220.0	264.2	66020
4.546	0.0_2 4546	1	1.201	277.4
3.785	0.0_2 3785	0.832 7	1	231
0.016 39	0.0_4 1629	$0.0_3$36 05	$0.0_2$43 29	1

■Conversion table for velocity

Meter per second m/s	Kilometer per hour km/h	Knot kn	Foot per second ft/s	Mile per hour mil/h
1	3.6	1.944	3.281	2.237
0.277 8	1	0.540 0	0.911 3	0.621 4
0.514 4	1.852	1	1.688	1.151
0.304 8	1.097	0.592 5	1	0.681 8
0.447 0	1.609	0.869 0	1.467	1

■Conversion table for mass

kilogram kg	Grain gr	Ounce oz	Pound lb	Ton t	Long ton ton	Short ton sh ton
1	15432	35.27	2.205	0.001	$0.0_3$98 42	$0.0_2$11 02
$0.0_4$64 80	1	$0.0_2$22 86	$0.0_3$14 29	$0.0_7$64 80	$0.0_7$63 78	$0.0_7$71 43
0.028 35	437.5	1	0.062 5	$0.0_4$28 35	$0.0_4$27 90	$0.0_4$31 25
0.453 6	7 000	16	1	$0.0_3$45 36	$0.0_3$44 64	0.000 5
1 000	1.543×10^7	35 274	2 205	1	0.984 2	1.102
1 016	1.568×10^7	35 840	2 240	1.016	1	1.12
907.2	1.4×10^7	32 000	2 000	0.907 2	0.892 9	1

■Conversion table for density

Kilogram per cubic meter kg/m^3	Gram per cubic centimeter g/cm^3	Pound per cubic inch lb/in^3	Pound per cubic foot lb/ft^3
1	1×10^{-3}	3.613×10^{-5}	6.243×10^{-2}
1.000×10^3	1	3.613×10^{-2}	6.243×10
2.7680×10^4	2.7680×10	1	1.728×10^3
1.602×10	1.602×10^{-2}	5.787×10^{-4}	1

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■Conversion table for force

Newton N	Kilogram-force kgf	Pound-force lbf	poundal pdl
1	0.102 0	0.224 8	7.233
9.807	1	2.205	70.93
4.448	0.453 6	1	32.17
0.138 3	0.014 10	0.031 08	1

■Conversion table for pressure

Kilo pascal kPa	Mega pascal MPa	Bar	Kilogram-force per square centimeter kgf/cm^2	Pound-force per square inch lbf/in^2 or PSI	Atmosphere atm	Millimeter of mercury mmHg or Torr	Inch of mercury inHg	Millimeter of water mmH$_2$O or mmAq
1	0.001	0.01	0.010197	0.14504	0.009869	7.501	0.29530	102.1
1000	1	10	10.197	145.0	9.869	7501	295.3	102.1 x 10^3
100	0.1	1	1.0197	14.50	0.9869	750	29.53	10.21 x 10^3
98.0665	0.098067	0.98067	1	14.223	0.9678	735.5	28.96	10.01 x 10^3
6.8948	0.006895	0.06895	0.07031	1	0.06804	51.71	2.0355	703.7
101.325	0.101325	1.01325	1.0333	14.70	1	760.0	29.92	10.34 x 10^3
0.13332	0.133322 x 10^{-3}	0.133322 x 10^{-2}	1.3596 x 10^{-3}	19.34 x 10^{-3}	1.316 x 10^{-3}	1	39.37 x 10^3	13.61
3.3864	0.003386	0.03386	0.03453	0.4912	0.03342	25.40	1	345.6
9.8067 x 10^{-3}	0.009807 x 10^{-3}	0.009807 x 10^{-2}	0.09991 x 10^{-3}	1.421 x 10^{-3}	0.0967 x 10^{-3}	0.07349	2.893 x 10^3	1

■Conversion table for viscosity

Pascal second Pa・s	Centipoise cP	Poise P
1	1 000	10
0.001	1	0.01
0.1	100	1

■Conversion table for kinetic viscosity

Square meter per second m^2/s	Centistokes cSt	Stokes St
1	1 000 000	10 000
0.0$_5$1	1	0.01
0.0001	100	1

■Conversion table for work, energy and calorie

Joule J	Kilocalorie kcal	Kilogram force meter kgf・m	Foot pound force ft・lbf	Kilowatt hour kW・h	British thermal unit BTU
1	0.0$_3$23 89	0.102 0	0.737 6	0.0$_6$27 78	0.0$_3$94 80
4.186 x 10^3	1	426.9	3 087	0.001 163	3.968
9.807	0.002 343	1	7.233	0.0$_5$27 24	0.009 297
1.356	0.0$_3$32 39	0.138 3	1	0.0$_6$37 66	0.001 285
3.6 x 10^6	860.0	3.671 x 10^5	2.655 x 10^6	1	3 413
1.055 x 10^3	0.252 0	107.6	778.0	0.0$_3$293 0	1

■Conversion table for power

Kilowatt kW	Kilocalorie per second kcal/s	Kilogram force meter per second kgfm/s	Foot pound force per second ft・lbf/s	British thermal unit per second BTU/s
1	0.238 9	102.0	737.6	0.918 0
4.186	1	426.9	3 087	3.968
0.009 807	0.002 343	1	7.233	0.009 297
0.001 356	0.0$_2$32 39	0.138 3	1	0.001 285
1.055	0.252 0	107.6	778.0	1

■Conversion table for temperature

Conversion formula ˚C = 5/9 x (˚F – 32) ˚F = 9/5 x ˚C + 32

How to use: Find the temperature value to be converted in the middle column, and see the left value when converting from Celsius to Fahrenheit and see the right value for vice versa.
Example) 20˚C is converted to 68.0˚F. 20˚F is converted to –6.7˚C.

˚F←˚C	˚F→˚C		˚F←˚C	˚F→˚C		˚F←˚C	˚F→˚C		˚F←˚C	˚F→˚C		˚F←˚C	˚F→˚C	
	–459.7	–273.2	–0.4	–18	–27.8	194.0	90	32.2	388.4	198	92.2	986	530	276.7
	–450	–267.8	+3.2	–16	–26.7	197.6	92	33.3	392.0	200	93.3	1004	540	282.2
	–440	–262.2	6.8	–14	–25.6	201.2	94	34.4	395.6	202	94.4	1022	550	287.8
	–430	–256.7	10.4	–12	–24.4	204.8	96	35.6	399.2	204	95.6	1040	560	293.3
	–420	–251.1	14.0	–10	–23.3	208.4	98	36.7	402.8	206	96.7	1058	570	298.9
	–410	–245.6	17.6	–8	–22.2	212.0	100	37.8	406.4	208	97.8	1076	580	304.4
	–400	–240.0	21.2	–6	–21.1	215.6	102	38.9	410.0	210	98.9	1094	590	310.0
	–390	–234.4	24.8	–4	–20.0	219.2	104	40.0	413.6	212	100	1112	600	315.6
	–380	–228.9	28.4	–2	–18.9	222.8	106	41.1	417.2	214	101.1	1130	610	321.1
	–370	–223.3	32.0	0	–17.8	226.4	108	42.2	420.8	216	102.2	1148	620	326.7
	–360	–217.8	35.6	+2	–16.7	230.0	110	43.3	424.4	218	103.3	1166	630	332.2
	–350	–212.2	39.2	4	–15.6	233.6	112	44.4	428.0	220	104.4	1184	640	337.8
	–340	–206.7	42.8	6	–14.4	237.2	114	45.6	431.6	222	105.6	1202	650	343.3
	–330	–201.1	46.4	8	–13.3	240.8	116	46.7	435.2	224	106.7	1220	660	348.9
	–320	–195.6	50.0	10	–12.2	244.4	118	47.8	438.8	226	107.8	1238	670	354.4
	–310	–190.0	53.6	12	–11.1	248.0	120	48.9	442.4	228	108.9	1256	680	360.0
	–300	–184.3	57.2	14	–10.0	251.6	122	50.0	446.0	230	110	1274	690	365.6
	–290	–178.9	60.8	16	–8.9	255.2	124	51.1	449.6	232	111.1	1292	700	371.1
	–280	–173.3	64.4	18	–7.8	258.8	126	52.2	453.2	234	112.2	1310	710	376.7
–459.7	–273.2	–169.6	68.0	20	–6.7	262.4	128	53.3	456.8	236	113.3	1328	720	382.2
–454	–270	–167.8	71.6	22	–5.6	266.0	130	54.4	460.4	238	114.4	1346	730	387.3
–436	–260	–162.2	75.2	24	–4.4	269.0	132	55.6	464.0	240	115.6	1364	740	393.3
–418	–250	–156.7	78.8	26	–3.3	273.2	134	56.7	467.6	242	116.7	1382	750	398.9
–400	–240	–151.1	82.4	28	–2.2	276.8	136	57.8	471.2	244	117.8	1400	760	404.4
–382	–230	–145.6	86.0	30	–1.1	280.4	138	58.9	474.8	246	118.9	1418	770	410.0
–364	–220	–140.0	89.6	32	0	284.0	140	60.0	478.4	248	120.0	1436	780	415.6
–346	–210	–134.4	93.2	34	+1.1	287.6	142	61.1	482.0	250	121.1	1454	790	421.1
–328	0	–128.9	96.8	36	2.2	291.2	144	62.2	500	260	126.7	1472	800	426.8
–310	–190	–123.3	100.4	38	3.3	294.8	146	63.3	518	270	132.2	1490	810	432.2
–292	–180	–117.8	104.0	40	4.4	298.4	148	64.4	536	280	137.8	1508	820	437.8
–274	–170	–112.2	107.6	42	5.6	302.0	150	65.6	554	290	143.3	1526	830	443.3
–256	–160	–106.7	111.2	44	6.7	305.6	152	66.7	572	300	148.9	1544	840	448.9
–238	–150	–101.1	114.8	46	7.8	309.2	154	67.8	590	310	154.4	1562	850	454.4
–220	–140	–95.6	118.4	48	8.9	312.8	156	68.9	608	320	160.0	1580	860	460.0
–202	–130	–90.0	122.0	50	10.0	316.4	158	70.0	626	330	165.6	1598	870	465.6
–184	–120	–84.4	125.6	52	11.1	320.0	160	71.1	644	340	171.1	1616	880	471.1
–166	–110	–78.9	129.2	54	12.2	323.6	162	72.2	662	350	176.7	1634	890	476.7
–148	–100	–73.3	132.8	56	13.3	327.2	164	73.3	680	360	182.2	1652	900	482.2
–130	–90	–67.8	136.4	58	14.4	330.8	166	74.4	698	370	187.8	1670	910	487.8
–112	–80	–62.2	140.0	60	15.6	334.4	168	75.6	716	380	193.3	1688	920	493.3
–94.0	–70	–56.7	143.6	62	16.7	338.0	170	76.7	734	390	198.9	1706	930	498.9
–76.0	–60	–51.1	147.2	64	17.8	341.6	172	77.8	752	400	204.4	1724	940	504.4
–58.0	–50	–45.6	150.8	66	18.6	345.2	174	78.9	770	410	210.0	1742	950	510.0
–40.0	–40	–40.0	154.4	68	20.0	348.8	176	80.0	788	420	215.6	1760	960	515.6
–36.4	–38	–38.9	158.0	70	21.1	352.4	178	81.1	806	430	221.1	1778	970	521.1
–32.8	–36	–37.8	161.6	72	22.2	356.0	180	82.2	824	440	226.7	1796	980	526.7
–29.2	–34	–36.7	165.2	74	23.3	359.6	182	83.3	842	450	232.2	1814	990	532.2
–25.6	–32	–35.6	168.8	76	24.4	363.2	184	84.4	860	460	237.8	1832	1000	537.7
–22.0	–30	–34.4	172.4	78	25.6	366.8	186	85.6	878	470	243.3	1922	1050	565.6
–18.4	–28	–33.3	176.0	80	26.7	370.4	188	86.7	896	480	248.9	2012	1100	593.3
–14.8	–26	–32.2	179.6	82	27.8	374.0	190	87.8	914	490	254.4	2102	1105	621.1
–11.2	–24	–31.1	183.2	84	28.9	377.6	192	88.9	932	500	260.0	2192	1200	648.9
–7.6	–22	–30.0	186.8	86	30.0	381.2	194	90.0	950	510	265.6	2282	1250	676.7
–4.0	–20	–28.9	190.4	88	31.1	384.8	196	91.1	968	520	271.1	2372	1300	704.4

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Table of Steam

■Saturated steam table (SI unit)

Absolute pressure of steam MPa・A	Steam temperature ˚C	Volume of 1 kg of water before evaporation L	Volume of 1 kg of steam m³	Weight of 1 m³ of steam kg	Calorie of 1 kg of steam kJ			Absolute pressure of steam MPa・A	Steam temperature ˚C	Volume of 1 kg of water before evaporation L	Volume of 1 kg of steam m³	Weight of 1 m³ of steam kg	Calorie of 1 kg of steam kJ		
					Sensible heat i'	Latent heat r	Total of heat i" = i' + r						Sensible heat i'	Latent heat r	Total of heat i" = i' + r
0.010	45.83	1.0102	14.67	0.0681	191.8	2392.9	2584.7	0.740	167.21	1.1110	0.26	3.8655	706.9	2057.4	2764.3
0.015	54.00	1.0140	10.02	0.0998	226.0	2373.2	2599.2	0.760	168.30	1.1123	0.25	3.9645	711.7	2053.7	2765.4
0.020	60.09	1.0172	7.65	0.1307	251.5	2358.4	2609.9	0.780	169.37	1.1137	0.25	4.0634	716.3	2050.1	2766.4
0.025	64.99	1.0199	6.20	0.1612	272.0	2346.4	2618.4	0.80	170.41	1.1150	0.24	4.1622	720.9	2046.5	2767.4
0.030	69.12	1.0223	5.23	0.1912	289.3	2336.1	2625.4	0.86	173.44	1.1189	0.22	4.4582	734.2	2036.2	2770.4
0.035	72.71	1.0245	4.53	0.2210	304.3	2327.2	2631.5	0.92	176.29	1.1226	0.21	4.7537	746.8	2026.2	2773.0
0.040	75.89	1.0265	3.99	0.2504	317.7	2319.2	2636.9	0.98	179.01	1.1262	0.20	5.0486	758.7	2016.7	2775.4
0.045	78.74	1.0284	3.58	0.2796	329.6	2312.0	2641.6	1.04	181.60	1.1297	0.19	5.3432	770.2	2007.5	2777.7
0.050	81.35	1.0301	3.24	0.3086	340.6	2305.4	2646.0	1.10	184.07	1.1331	0.18	5.6375	781.1	1998.5	2779.6
0.060	85.95	1.0333	2.73	0.3661	359.9	2293.6	2653.5	1.16	186.44	1.1364	0.17	5.9315	791.6	1989.9	2781.5
0.070	89.96	1.0361	2.36	0.4229	376.8	2283.3	2660.1	1.22	188.71	1.1397	0.16	6.2254	801.8	1981.5	2783.3
0.080	93.51	1.0387	2.09	0.4792	391.7	2274.0	2665.7	1.28	190.90	1.1428	0.15	6.5191	811.5	1973.4	2784.9
0.090	96.71	1.0412	1.87	0.5350	405.2	2265.6	2670.8	1.34	193.01	1.1459	0.15	6.8127	821.0	1965.5	2786.5
0.100	99.63	1.0434	1.69	0.5904	417.5	2257.9	2675.4	1.40	195.04	1.1489	0.14	7.1063	830.1	1957.7	2787.8
0.120	104.81	1.0476	1.43	0.7002	439.4	2244.1	2683.5	1.46	197.01	1.1519	0.14	7.3998	838.9	1950.2	2789.1
0.140	109.32	1.0513	1.24	0.8089	458.4	2231.9	2690.3	1.52	198.92	1.1548	0.13	7.6934	847.5	1942.8	2790.3
0.160	113.32	1.0547	1.09	0.9165	475.4	2220.9	2696.3	1.58	200.77	1.1577	0.13	7.9871	855.8	1935.6	2791.4
0.180	116.93	1.0579	0.98	1.0233	490.7	2210.8	2701.5	1.64	202.56	1.1605	0.12	8.2808	863.9	1928.5	2792.4
0.200	120.23	1.0608	0.89	1.1294	504.7	2201.6	2706.3	1.70	204.31	1.1633	0.12	8.5747	871.8	1921.5	2793.3
0.220	123.27	1.0636	0.81	1.2348	517.6	2193.0	2710.6	1.76	206.00	1.1660	0.11	8.8687	879.5	1914.7	2794.2
0.240	126.09	1.0663	0.75	1.3397	529.6	2184.9	2714.5	1.82	207.66	1.1687	0.11	9.1628	887.1	1908.0	2795.1
0.260	128.73	1.0688	0.69	1.4440	540.9	2177.3	2718.2	1.88	209.27	1.1714	0.11	9.4572	894.4	1901.5	2795.9
0.280	131.20	1.0712	0.65	1.5479	551.4	2170.1	2721.5	1.94	210.84	1.1740	0.10	9.7518	901.6	1895.0	2796.6
0.300	133.54	1.0735	0.61	1.6514	561.4	2163.2	2724.6	2.0	212.37	1.1766	0.10	10.047	908.6	1888.6	2797.2
0.320	135.75	1.0757	0.57	1.7544	570.9	2156.7	2727.6	2.2	217.24	1.1850	0.09	11.031	931.0	1868.1	2799.1
0.340	137.86	1.0779	0.54	1.8572	579.9	2150.4	2730.3	2.4	221.78	1.1932	0.08	12.019	951.9	1848.5	2800.4
0.360	139.86	1.0799	0.51	1.9595	588.5	2144.4	2732.9	2.6	226.04	1.2011	0.08	13.011	971.7	1829.6	2801.3
0.380	141.78	1.0819	0.49	2.0616	596.8	2138.6	2735.4	2.8	230.05	1.2088	0.07	14.008	990.5	1811.5	2802.0
0.400	143.62	1.0839	0.46	2.1635	604.7	2133.0	2737.7	3.0	233.84	1.2163	0.07	15.009	1008.4	1793.9	2802.3
0.420	145.39	1.0858	0.44	2.2650	612.3	2127.5	2739.8	3.2	237.45	1.2237	0.06	16.016	1025.4	1776.9	2802.3
0.440	147.09	1.0876	0.42	2.3663	619.6	2122.3	2741.9	3.4	240.88	1.2310	0.06	17.028	1041.8	1760.3	2802.1
0.460	148.73	1.0894	0.41	2.4674	626.7	2117.2	2743.9	3.6	244.16	1.2381	0.06	18.046	1057.6	1744.2	2801.8
0.480	150.31	1.0911	0.39	2.5683	633.5	2112.2	2745.7	3.8	247.31	1.2451	0.05	19.070	1072.7	1728.4	2801.1
0.500	151.84	1.0928	0.37	2.6690	640.1	2107.4	2747.5	4.0	250.33	1.2521	0.05	20.101	1087.4	1712.9	2800.3
0.520	153.33	1.0945	0.36	2.7695	646.5	2102.7	2749.2	4.25	253.95	1.2606	0.05	21.399	1105.1	1694.0	2799.1
0.540	154.76	1.0961	0.35	2.8698	652.8	2098.1	2750.9	4.5	257.41	1.2691	0.04	22.708	1122.1	1675.6	2797.7
0.560	156.16	1.0978	0.34	2.9700	658.8	2093.7	2752.5	4.75	260.73	1.2775	0.04	24.029	1138.6	1657.5	2796.1
0.580	157.52	1.0993	0.33	3.0700	664.7	2089.3	2754.0	5	263.91	1.2858	0.04	25.362	1154.5	1639.7	2794.2
0.600	158.84	1.1009	0.32	3.1698	670.4	2085.0	2755.4	6	275.55	1.3187	0.03	30.828	1213.7	1571.3	2785.0
0.620	160.12	1.1024	0.31	3.2696	676.0	2080.9	2756.9	7	285.79	1.3513	0.03	36.532	1267.4	1506.0	2773.4
0.640	161.38	1.1039	0.30	3.3692	681.5	2076.8	2758.3	8	294.97	1.3842	0.02	42.507	1317.1	1442.8	2759.9
0.660	162.60	1.1053	0.29	3.4687	686.8	2072.7	2759.5	9	303.31	1.4179	0.02	48.792	1363.7	1380.9	2744.6
0.680	163.79	1.1068	0.28	3.5680	692.0	2068.8	2760.8	10	310.96	1.4526	0.02	55.428	1408.0	1319.7	2727.7
0.700	164.96	1.1082	0.27	3.6673	697.1	2064.9	2762.0	15	342.13	1.6579	0.01	96.710	1611.0	1004.0	2615.0
0.720	166.10	1.1096	0.27	3.7665	702.0	2061.1	2763.1	20	365.70	2.0370	0.01	170.17	1826.5	591.9	2418.4
								22.12	374.15	3.1700	0.003	315.46	2107.4	0.0	2107.4

■Saturated steam table (Conventional unit)

Absolute pressure of steam abs		Steam temperature		Volume of 1 kg of water before evaporation	Volume of 1 kg of steam	Weight of 1 m³ of steam	Calorie of 1 kg of steam kcal			Absolute pressure of steam abs		Steam temperature		Volume of 1 kg of water before evaporation	Volume of 1 kg of steam	Weight of 1 m³ of steam	Calorie of 1 kg of steam kcal		
							Sensible heat	Latent heat	Total of heat								Sensible heat	Latent heat	Total of heat
kgf/cm²	lbf/in²	°C	°F	L	m³	kg	i'	r	i" = i' + r	kgf/cm²	lbf/in²	°C	°F	L	m³	kg	i'	r	i" = i' + r
0.02	0.28	17.2	62.9	1.0012	68.26	0.0147	17.2	587.8	605.0	13.50	192.0	192.4	378.3	1.1451	0.1485	6.734	195.5	469.9	665.4
0.04	0.57	28.6	83.5	1.0039	35.45	0.0282	28.7	581.3	610.0	14.00	199.1	194.1	381.4	1.1476	0.1434	6.974	197.3	468.4	665.7
0.06	0.85	35.8	96.4	1.0063	24.18	0.0414	35.8	577.3	613.1	14.50	206.2	195.8	384.4	1.1500	0.1386	7.214	199.0	466.9	665.9
0.08	1.14	41.2	106.2	1.0083	18.44	0.0542	41.2	574.2	615.4	15	213.3	197.4	387.3	1.1524	0.1342	7.454	200.7	465.5	666.2
0.10	1.42	45.5	113.9	1.0101	14.95	0.0669	45.4	571.8	617.2	16	227.5	200.4	392.7	1.1572	0.1260	7.934	204.1	462.6	666.7
0.15	2.13	53.6	128.5	1.0138	10.21	0.0980	53.5	567.1	620.6	17	241.7	203.4	398.1	1.1618	0.1189	8.414	207.2	459.9	667.1
0.20	2.84	59.7	139.5	1.0170	7.791	0.1284	59.6	563.5	623.1	18	256.0	206.2	403.2	1.1663	0.1124	8.894	210.2	457.2	667.4
0.25	3.56	64.6	148.3	1.0197	6.319	0.1583	64.5	560.7	625.2	19	270.2	208.8	407.8	1.1706	0.1067	9.375	213.1	454.6	667.7
0.30	4.27	68.7	155.7	1.0221	5.326	0.1878	68.7	558.2	626.9	20	284.4	211.4	412.5	1.1749	0.1015	9.857	215.9	452.1	668.0
0.35	4.98	72.3	162.1	1.0242	4.609	0.2170	72.2	556.1	628.3	21	298.6	213.9	417.0	1.1791	0.0967	10.34	218.6	459.6	668.2
0.40	5.69	75.4	167.7	1.0262	4.067	0.2459	75.4	554.2	629.6	22	312.8	216.2	421.2	1.1833	0.0924	10.82	221.2	447.2	668.4
0.45	6.40	78.3	172.9	1.0281	3.642	0.2746	78.3	552.5	630.8	23	327.1	218.5	425.3	1.1873	0.0885	11.31	223.8	444.8	668.6
0.50	7.11	80.9	177.6	1.0298	3.300	0.3030	80.9	550.9	631.8	24	341.3	220.8	429.4	1.1913	0.0848	11.79	226.2	442.6	668.8
0.60	8.53	85.5	185.9	1.0329	2.782	0.3594	85.5	548.1	633.6	25	355.5	222.9	433.2	1.1953	0.0815	12.28	228.6	440.3	668.9
0.70	9.95	89.5	193.1	1.0357	2.408	0.4152	89.5	545.7	635.2	26	369.7	225.0	437.0	1.1991	0.0784	12.76	230.9	438.1	669.0
0.80	11.4	93.0	199.4	1.0383	2.125	0.4705	93.0	543.5	636.5	27	383.9	227.0	440.6	1.203	0.0755	13.25	233.2	435.9	669.1
0.90	12.8	96.2	205.2	1.0407	1.904	0.5253	96.2	541.5	637.7	28	398.2	229.0	444.2	1.207	0.0728	13.74	235.4	433.8	669.2
1.00	14.2	99.1	210.4	1.0430	1.725	0.5797	99.2	539.6	638.8	29	412.4	230.9	447.6	1.210	0.0703	14.23	237.5	431.7	669.2
1.20	17.1	104.3	219.7	1.0471	1.454	0.6875	104.4	536.3	640.7	30	426.6	232.8	451.0	1.214	0.0679	14.72	239.6	429.7	669.3
1.40	19.9	108.7	227.7	1.0508	1.259	0.7942	108.9	533.5	642.4	32	455.0	236.4	457.5	1.221	0.0637	15.70	243.7	425.6	669.3
1.60	22.8	112.7	234.9	1.0542	1.111	0.8999	112.9	530.8	643.7	34	483.5	239.8	463.6	1.229	0.0599	16.69	247.6	421.7	669.3
1.80	25.6	116.3	241.3	1.0573	0.9952	1.005	116.6	528.4	645.0	36	511.9	243.0	469.4	1.236	0.0565	17.69	251.3	417.9	669.2
2.00	28.4	119.6	247.3	1.0603	0.9018	1.109	119.9	526.3	646.2	38	540.4	246.2	475.2	1.243	0.0535	18.69	254.9	414.2	669.1
2.50	35.6	126.8	260.2	1.0669	0.7317	1.367	127.2	521.4	648.6	40	568.8	249.2	480.6	1.249	0.0508	19.70	258.4	410.5	668.9
3.00	42.7	132.9	271.2	1.0728	0.6168	1.621	133.4	517.2	650.6	42	597.2	252.1	485.8	1.256	0.0483	20.72	261.7	407.0	668.7
3.50	49.8	138.2	280.8	1.0782	0.5337	1.874	138.8	513.4	652.2	44	625.7	254.9	490.8	1.263	0.0460	21.74	265.0	403.5	668.5
4.00	56.9	142.9	289.2	1.0831	0.4708	2.124	143.7	510.0	653.7	46	654.1	257.6	495.7	1.269	0.0439	22.77	268.2	400.0	668.2
4.50	64.0	147.2	297.0	1.0877	0.4214	2.373	148.1	506.8	654.9	48	682.6	260.2	500.4	1.276	0.0420	23.80	271.3	396.6	667.9
5.00	71.1	151.1	304.0	1.0920	0.3816	2.620	152.1	503.9	656.0	50	711.0	262.7	504.9	1.283	0.0402	24.85	274.3	393.3	667.6
5.50	78.2	154.7	310.5	1.0961	0.3489	2.867	155.8	501.2	657.0	55	782.1	268.7	515.7	1.299	0.0364	27.49	281.5	385.1	666.6
6.00	85.3	158.1	316.6	1.1000	0.3213	3.112	159.3	498.6	657.9	60	853.2	274.3	525.7	1.315	0.0331	30.18	288.3	377.2	665.5
6.50	92.4	161.2	322.2	1.1037	0.2980	3.356	162.6	496.1	658.7	65	924.3	279.5	535.1	1.331	0.0304	32.93	294.8	369.4	664.2
7.00	99.5	164.2	327.6	1.1072	0.2778	3.600	165.7	493.8	659.5	70	995.4	284.5	544.1	1.347	0.0280	35.75	301.0	361.8	662.8
7.50	106.7	167.0	332.6	1.1111	0.2602	3.843	168.6	491.6	660.2	75	1066.5	289.2	552.6	1.363	0.0259	38.62	307.0	354.3	661.3
8.00	113.8	169.6	337.3	1.1140	0.2448	4.086	171.3	489.5	660.8	80	1137.6	293.6	560.5	1.379	0.0241	41.56	312.8	346.9	659.7
8.50	120.9	172.1	341.8	1.1172	0.2311	4.328	174.0	487.4	661.4	85	1208.7	297.9	568.2	1.395	0.0224	44.58	318.4	339.6	658.0
9.00	128.0	174.5	346.1	1.1203	0.2188	4.570	176.5	485.4	661.9	90	1279.8	301.9	575.4	1.412	0.0210	47.67	323.8	332.4	656.2
9.50	135.1	176.8	350.2	1.1233	0.2079	4.811	178.9	483.5	662.4	95	1350.9	305.8	582.4	1.429	0.0197	50.85	329.1	325.2	654.3
10.00	142.2	179.0	354.2	1.1262	0.1979	5.052	181.3	481.6	662.9	100	1422.0	309.5	589.1	1.446	0.0185	54.12	334.3	318.0	652.3
10.50	149.3	181.2	358.2	1.1291	0.1890	5.293	183.5	479.8	663.3	120	1706.4	323.1	613.6	1.518	0.0147	68.22	354.0	289.4	643.4
11.00	156.4	183.2	361.8	1.1319	0.1807	5.533	185.6	478.1	663.7	140	1990.8	335.1	635.2	1.599	0.0118	84.52	372.8	260.0	632.8
11.50	163.5	185.2	365.4	1.1346	0.1732	5.774	187.7	476.4	664.1	160	2275.2	345.8	654.4	1.693	0.0096	104.0	391.3	228.4	619.7
12.00	170.6	187.1	368.8	1.1373	0.1663	6.014	189.8	474.7	664.5	180	2559.6	355.4	671.7	1.814	0.0078	128.3	410.8	192.9	603.7
12.50	177.8	188.9	372.0	1.1400	0.1599	6.254	191.7	473.1	664.8	200	2844.0	364.1	687.4	1.990	0.0062	161.6	431.6	151.2	582.8
13.00	184.9	190.7	375.3	1.1425	0.1540	6.494	193.6	471.5	665.1	225.56	3208.7	374.15	705.47	3.170	0.0032	315.5	503.3	0	503.3

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Standard Flow Velocity of Fluid

In order to reduce pressure loss inside piping, it is an ideal way to make the diameter of the piping as large as possible. On the other hand, the smaller the piping diameter, the better in terms of piping costs, etc. In addition, heat loss also increases with an increase in the piping diameter.
In selecting a nominal size of piping, it is better to identify permissible pressure loss from the purpose of use, and find the smallest nominal size of piping that can keep the actual pressure loss within the range. However, an excessively high flow velocity results in serious wear in piping and may cause vibration. Then, it is a general way to determine a standard flow velocity of fluid according to the purpose of use and based on the type and characteristics of the fluid to be used and the piping diameter.

Fluid	Remarks	Standard flow velocity
Saturated steam	Auxiliary piping for vacuum or small-diameter piping	15 m/s (10-20)
	Large-diameter piping	30 m/s (20-40)
Superheated vapor	Piping diameter: Approx. ϕ 75-ϕ 250	40 m/s (30-50)
	Piping of high-grade material	70 m/s (65-80)
Inlet of steam coil	0.3-0.7 MPa	30 m/s (25-30)
Air	High pressure: 1.0 MPa	20 m/s (20-25)
	Low pressure	15 m/s (5-15)
	Extremely low pressure: 0.1 MPa	10 m/s (3-10)
Water, Oil		2 m/s (2- 4)

・This table shows a standard flow velocity of each type of fluid set based on the requirements defined in JIS F 7101 (Shipbuilding – Pipes of machinery – Standard velocity of flow).

Flow Velocity Table for Steam inside the Pipe

■Carbon steel pipe for piping v = 30 m/s Saturated steam

(kg/h)

Nominal size / Pressure (MPa)	15A	20A	25A	32A	40A	50A	65A	80A	100A	125A	150A	200A	250A
0.05	18	33	55	92	125	202	334	471	803	1239	1745	3036	4682
0.1	24	44	72	120	164	265	437	617	1051	1623	2285	3975	6130
0.2	35	64	105	176	240	388	639	903	1538	2373	3341	5812	8963
0.3	47	84	138	231	314	508	837	1183	2015	3109	4377	7615	11743
0.4	58	104	170	285	387	627	1033	1460	2485	3835	5400	9394	14487
0.5	69	124	202	339	460	745	1227	1734	2952	4555	6413	11156	17205
0.6	79	143	234	392	533	862	1420	2006	3415	5270	7420	12908	19905
0.7	90	163	266	445	605	978	1611	2276	3876	5981	8421	14650	22591
0.8	101	182	297	498	676	1094	1802	2546	4335	6690	9418	16385	25267
0.9	112	201	329	551	748	1209	1993	2815	4793	7396	10413	18115	27936
1.0	122	220	360	603	819	1325	2183	3083	5250	8101	11406	19842	30599
1.1	133	240	392	655	890	1440	2372	3351	5707	8805	12397	21567	33258
1.2	144	259	423	708	961	1555	2562	3619	6162	9509	13388	23290	35915
1.3	154	278	454	760	1033	1670	2752	3887	6618	10212	14378	25012	38572
1.4	165	297	486	813	1104	1785	2941	4155	7074	10915	15368	26734	41227
1.5	176	316	517	865	1175	1900	3131	4422	7530	11619	16358	28457	43884
1.6	186	336	548	917	1246	2015	3320	4690	7986	12322	17349	30181	46542
1.7	197	355	580	970	1317	2130	3510	4958	8442	13027	18340	31905	49202
1.8	208	374	611	1022	1389	2246	3700	5227	8899	13732	19333	33632	51865
1.9	218	393	642	1075	1460	2361	3890	5496	9357	14438	20328	35363	54533
2.0	229	413	674	1128	1532	2477	4081	5765	9816	15145	21323	37094	57204

Flow Velocity Table for Air inside the Pipe

■Carbon steel pipe for piping v = 15 m/s・t = 20˚C

(kg/h)

Nominal size / Pressure (MPa)	15A	20A	25A	32A	40A	50A	65A	80A	100A	125A	150A	200A	250A
0.1	26	47	77	129	175	283	467	659	1123	1733	2440	4245	6547
0.2	39	70	115	193	263	425	700	989	1685	2600	3660	6368	9821
0.3	52	94	154	258	350	567	934	1319	2247	3467	4881	8491	13094
0.4	65	118	192	322	438	708	1167	1649	2808	4333	6101	10614	16368
0.5	78	141	231	387	526	850	1401	1979	3370	5200	7321	12737	19642
0.6	91	165	270	451	613	992	1635	2309	3932	6067	8542	14860	22915
0.7	105	189	308	516	701	1134	1868	2639	4494	6934	9762	16983	26189
0.8	118	212	347	581	789	1275	2102	2969	5055	7801	10982	19106	29463
0.9	131	236	385	645	876	1417	2335	3299	5617	8667	12203	21228	32737
1.0	144	260	424	710	964	1559	2569	3629	6179	9534	13423	23351	36011
1.1	157	283	463	774	1052	1701	2802	3959	6741	10401	14643	25474	39284
1.2	170	307	501	839	1139	1843	3036	4289	7302	11268	15864	27597	42558
1.3	183	330	540	903	1227	1984	3270	4619	7864	12134	17084	29720	45832
1.4	196	354	578	968	1315	2126	3503	4949	8426	13001	18304	31843	49106
1.5	210	378	617	1033	1402	2268	3737	5279	8988	13868	19525	33966	52379
1.6	223	401	656	1097	1490	2410	3970	5609	9549	14735	20745	36089	55653
1.7	236	425	694	1162	1578	2551	4204	5938	10111	15602	21965	38212	58927
1.8	249	449	733	1226	1665	2693	4437	6268	10673	16468	23186	40335	62201
1.9	262	472	771	1291	1753	2835	4671	6598	11235	17335	24406	42457	65474
2.0	275	496	810	1355	1841	2977	4905	6928	11796	18202	25626	44580	68748

Flow Velocity Table for Water inside the Pipe

■Carbon steel pipe for piping

(m^3/h)

Nominal size / Flow Velocity (m/s)	15A	20A	25A	32A	40A	50A	65A	80A	100A	125A	150A	200A	250A
0.2	0.15	0.26	0.43	0.72	0.98	1.58	2.61	3.68	6.27	9.67	13.61	23.68	36.52
0.4	0.29	0.53	0.86	1.44	1.96	3.16	5.21	7.36	12.53	19.34	27.23	47.37	73.04
0.6	0.44	0.79	1.29	2.16	2.93	4.74	7.82	11.04	18.80	29.01	40.84	71.05	109.57
0.8	0.59	1.05	1.72	2.88	3.91	6.33	10.42	14.72	25.07	38.68	54.46	94.73	146.09
1.0	0.73	1.32	2.15	3.60	4.89	7.91	13.03	18.40	31.33	48.35	68.07	118.42	182.61
1.2	0.88	1.58	2.58	4.32	5.87	9.49	15.63	22.09	37.60	58.02	81.68	142.10	219.13
1.4	1.03	1.85	3.01	5.04	6.85	11.07	18.24	25.77	43.87	67.69	95.30	165.78	255.65
1.6	1.17	2.11	3.44	5.76	7.82	12.65	20.85	29.45	50.14	77.36	108.91	189.46	292.18
1.8	1.32	2.37	3.87	6.48	8.80	14.23	23.45	33.13	56.40	87.03	122.53	213.15	328.70
2.0	1.47	2.64	4.31	7.20	9.78	15.82	26.06	36.81	62.67	96.70	136.14	236.83	365.22
2.5	1.83	3.30	5.38	9.00	12.23	19.77	32.57	46.01	78.34	120.87	170.17	296.04	456.52
3.0	2.20	3.96	6.46	10.81	14.67	23.72	39.09	55.21	94.00	145.05	204.21	355.25	547.83
3.5	2.56	4.61	7.53	12.61	17.12	27.68	45.60	64.42	109.67	169.22	238.24	414.45	639.13
4.0	2.93	5.27	8.61	14.41	19.56	31.63	52.12	73.62	125.34	193.40	272.28	473.66	730.44
5.0	3.66	6.59	10.76	18.01	24.45	39.54	65.15	91.02	156.67	241.75	340.35	592.08	913.05

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Property of Gas

Properties / Name of gas	Chemical formula	Molecular weight	Adiabatic index Cp/Cv k	Limit temperature Tc (K)	Critical pressure Pc (bar)	Critical pressure Pc (kgf/cm²abs)
Acetylene	C_2H_2	26.04	1.26	308.7	62.5	63.7
Air		28.96	1.40	—	—	—
Ammonia	NH_3	17.03	1.31	405.6	114.6	116.9
Argon	Ar	39.95	1.67	150.8	49.4	50.4
Benzene	C_6H_6	78.12	1.12	562.8	49.6	50.6
Isobutane	iso-C_4H_{10}	58.13	1.10	408.2	37.0	37.7
n-butane	n-C_4H_{10}	58.13	1.09	425.2	37.5	38.2
Carbon disulfide	CS_2	76.14	1.21	549.2	76.5	78.0
Carbon dioxide	CO_2	44.00	1.29	304.2	76.3	77.8
Carbon monoxide	CO	28.01	1.40	133.0	36.2	36.9
Chlorine	Cl_2	70.91	1.36	417.2	78.3	79.8
Cyclohexane	C_6H_{12}	84.16	1.09	481.6	40.6	41.4
n-decane	n-$C_{10}H_{22}$	142.29	1.03	618.4	21.3	21.7
Ethane	C_2H_6	30.07	1.19	305.4	48.9	49.9
Ethyl alcohol	C_2H_5OH	46.07	—	516.2	63.8	65.0
Ethylene	C_2H_4	28.05	1.24	282.7	50.9	51.9
Helium	n-CH_3 $(CH_2)_5CH_3$	4.00	1.66	5.3	2.4	2.4
n-heptane	n-C_6H_{14}	100.21	1.05	540.2	27.3	27.8
n-hexane	n-C_3H_{14}	86.18	1.06	507.7	30.3	30.9
Hydrogen chloride	HCl	36.46	1.41	324.7	84.3	86.0
Hydrogen	H_2	2.02	1.41	33.2	13.2	13.5
Hydrogen sulfide	H_2S	34.08	1.32	373.6	91.6	93.4
Methane	CH_4	16.04	1.31	190.9	47.1	48.0
Methyl alcohol	CH_3OH	32.04	1.20	512.6	80.2	81.8
Methyl sulfide	CH_3Cl	50.49	1.20	416.3	67.5	68.8
Nitrogen	N_2	28.01	1.40	126.3	34.4	35.1
Nitrous oxide	N_2O	44.01	1.30	309.3	73.9	75.4
n-nonan	n-CH_3 $(CH_2)_7CH_3$	128.26	1.04	594.7	23.0	23.5
Oxygen	O_2	32.00	1.40	154.7	51.2	52.2
n-pentane	n-CH_3 $(CH_2)_3CH_3$	72.15	1.07	470.1	33.5	34.2
n-propane	n-$CH_3CH_2CH_3$	44.11	1.13	370.0	42.7	43.5
Steam	H_2O	18.02	1.33	647.1	221.2	225.6
Sulfur dioxide	SO_2	64.06	1.29	593.6	42.3	43.1
Toluene	$C_6H_5CH_3$	92.15	1.09	593.6	32.3	43.1
Propylene	CH_3CHCH_2	42.08	1.15	365.1	46.0	46.9
Octane	C_8H_{18}	114	1.05	—	—	—

Remark 1 The Tc and Pc of air are 132.45 (K) and 38.433 (kg/cm²abs), respectively (adopted from ISO).
Remark 2 Add 8 to each of the Tc and Pc of hydrogen and helium when calculating the compression factor Z.

Density of Liquid

This table shows the density of each type of fluid under atmospheric pressure.

Liquid	Temperature ˚C	Density kg/m³	Liquid	Temperature ˚C	Density kg/m³	Liquid	Temperature ˚C	Density kg/m³
Acetone	20	791	Glycerine	18	1260	Rapeseed oil	15	910-920
Aniline	20	1022	Whale oil	15	880	Castor oil	18	961
Linseed oil	15	930	Crude oil	15	660-750	Beer	12	1020-1040
Ammonia water (approx. 25% NH_3)	20	900	Acetic acid	20	1049	Lard	15	920
			Saline solution (5%NaCl)		10345	Benzine		680-720
Alcohol (ethyl)	20	789	〃 (15% 〃)	18	1109	Benzol	20	879
〃 (ethyl)	20	791	〃 (25% 〃)	18	1189.7	Machine oil	20	900-910
Ether (ethyl)	18	717	Heavy oil		850-910	Sulfuric acid (25%H_2SO_4)	18	1179.6
Hydrochloric acid 10%	18	1048.2	Nitric acid (25%NHO_3)	18	1154	〃 (50% 〃)	18	1397
〃 20%	18	1098.9	〃 (55% 〃)	18	1314	〃 (100% 〃)	18	1833
〃 40%	18	1199	〃 (100% 〃)		1502	Copper sulfate salt (5%$CuSO_4$)		1107
Olive oil	18	915	Cylinder oil	20	920-940		18	1167
Seawater	4	1026	Spindle oil	20	890-900	Fresh water	0	999.87
			Petroleum (kerosene)	15	790-820	〃	4	1000
Caustic potash (10%KOH)	18	1091				〃	15	999.13
〃 (30% 〃)	18	1290	Caustic soda (10%NaOH)	18	1109.8	〃	25	997.07
〃 (50% 〃)	18	1510	〃 (30% 〃)	18	1329			
Gasoline (volatile oil)		660-750	〃 (50% 〃)	18	1526.8			
Milk (whole milk)	15	1028	Tar (coal)		1110-1260			
〃 (skim)	15	1032	Turpentine oil	18	870			

Density of Gas

This table shows the density and specific gravity of each type of gas in the standard condition (temperature: 0˚C, pressure: 0.1013 MPa･A).

Gas or steam	Chemical formula	Molecular weight	Standard density kg/m³	Specific gravity (Gas) Air = 1	Gas or steam	Chemical formula	Molecular weight	Standard density kg/m³	Specific gravity (Gas) Air = 1
Nitrous oxide	N_2O	44	1.978	1.530	Oxygen	O_2	32	1.43	1.105
Acetylene	C_2H_2	26.04	1.16	0.910	Cyanogen	$(CN)_2$	52	2.32	1.81
Acetone	C_3H_6O	58	2.58	2.00	Hydrogen cyanide	CNH	27	1.22	0.95
					Bromine	Br_2	160	6.87	5.39
Ammonia gas	NH_3	17.03	0.76	0.596	Mercury	Hg	200	9.02	6.98
					Steam (100˚C)	H_2O	18.02	0.60	0.463
Sulfur dioxide	SO_2	64.06	2.92	2.26	Hydrogen	H_2	2.02	0.09	0.070
Alcohol (ethyl)	C_2H_6O	46.07	2.65	1.61	Carbon dioxide	CO_2	44	1.97	1.529
Argon	Ar	39.95	1.78	1.38	Nitrogen	N_2	28.01	1.25	0.967
Aldehyde	C_2H_4O	44	1.96	1.53	City gas		12.54	0.56	0.43
Sulfur	S_2	64	2.85	2.20	Toluene	C_7H_8	92.15	4.10	3.18
Carbon monoxide	CO	28.01	1.250	0.967	Naphthalene	$C_{10}H_8$	128	5.72	4.43
Ethane	C_2H_6	30.07	1.34	1.049					
Ethylene	C_2H_4	28.05	1.26	0.975	Helium	He	4	0.178	0.138
Ether	$C_4H_{10}O$	74	3.30	2.56	Benzene	C_6H_6	78.12	3.48	2.69
					Propane	C_3H_8	44.11	1.96	1.529
Hydrogen chloride (Hydrochloric acid)	HCl	36.46	1.63	1.268	Pentane	C_5H_{12}	72.15	3.22	2.49
					Methane (marsh gas)	CH_4	16.04	0.717	0.555
					Hydrogen sulfide	H_2S	34.08	1.54	1.191
Carbonate chloride	$COCl_2$	99	4.42	3.42	Carbon disulfide	CS_2	76.14	3.42	2.64
Chlorine	Cl_2	70.91	3.16	2.491	Sulfuric acid	H_2SO_4	98	2.78	2.15
Xylol	C_8H_{10}	106	4.72	3.67					
Chloroform	$CHCl_3$	119.5	5.30	4.12	Hydrogen phosphide	PH_3	34	1.53	1.18
Air		28.96	1.293	1.000					
Nitrogen oxide	NO	30	1.34	1.037					

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How to Convert the Volume of a Gas

Since the volume of a gas changes according to temperature or pressure, it is indicated in mass per unit volume (kg/m³) in the standard condition (temperature: 0˚C, pressure: 1 atm ≒ 0.1 MPa･A).
Explained below is how to convert the volume of a gas.

■How to convert the volume [m³] of a gas into [m³ (standard condition)]

[Example] Assuming that the volume of the fluid, air in this example, is 100 m³ at a pressure of 0.2 MPa and a temperature of 17˚C, apply Boyle-Charle's law:

$$\text{From } \frac{PV}{T} = \frac{P'V'}{T'}, \quad V = \frac{T}{P} \times \frac{P'V'}{T'}$$

where:
P : Pressure in the standard condition = 0.1 MPa･A
P' : Pressure in the condition to be obtained (current condition) [MPa･A]
V : Volume in the standard condition [m³ (standard condition)]
V' : Volume in the condition to be obtained (current condition) [m³]
T : Temperature in the standard condition = 273 K (0˚C)
T' : Temperature in the condition to be obtained (current condition) [K]

$$\text{From } V = \frac{T}{P} \times \frac{P'V'}{T'}$$

The volume in the standard condition is:

$$\frac{273}{0.1} \times \frac{(0.2 + 0.1) \times 100}{(273 + 17)} \fallingdotseq 283 \text{ m}^3 \text{ (standard condition)}$$

■How to convert the volume [m³ (standard condition)] of a gas into kg

When the fluid is air, its standard density is 1.293 kg/m³ (standard condition). So:

283 [m³ (standard condition)] x 1.293 [kg/m³ (standard condition)] ≒ 365 (kg)

Fluid name	Standard density〔kg/m³〕(standard condition)
Air	1.293
Nitrogen	1.25
Ammonia gas	0.76
Argon	1.78
Carbon dioxide	1.97

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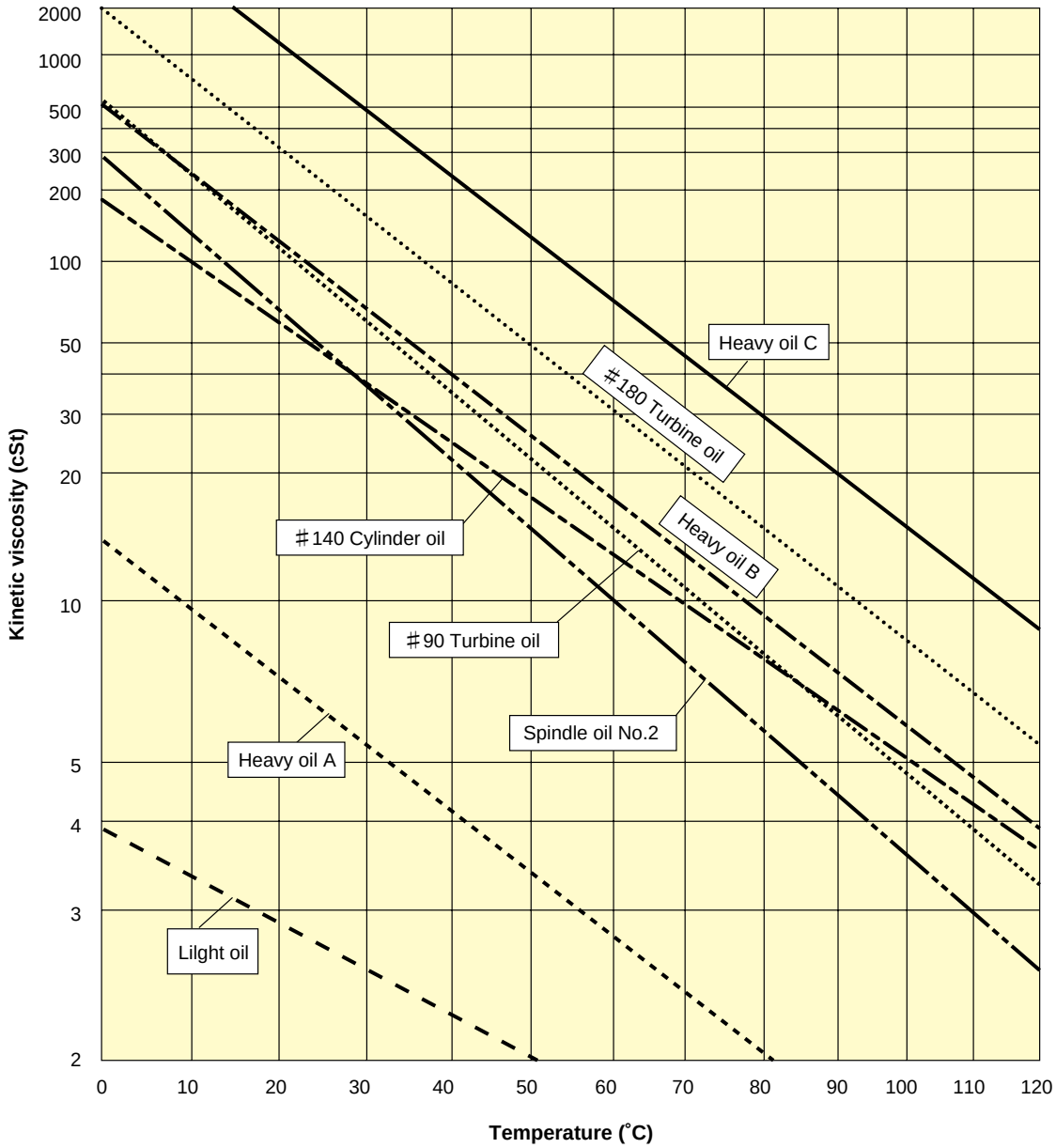
Oil Viscosity Chart



Conversion of viscosity unit

$$\text{Kinetic viscosity (cSt)} = \frac{\text{Absolute viscosity (cP)}}{\text{Density (g/cm}^3\text{)}}$$

■Densities of major fuel oils

Fluid name		Density〔g/m³〕
Kerosene		0.79-0.82
Light oil		0.83-0.88
Heavy oil	Heavy oil A	0.85-0.9
	Heavy oil B	0.9-0.92
	Heavy oil C	0.92-1.0
Cylinder oil		0.92-0.94
Spindle oil		0.89-0.9

・This table shows the densities of the oils at atmospheric pressure and room temperature.

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Cast Iron Pipe Flanges Excerpt from JIS B 2239-2004

The relationship among the nominal pressures and materials of cast iron pipe flanges for connecting piping and valves to be used for general piping, such as piping for steam, air, gas, water, and oil, the condition of the fluid, and the maximum working pressure is defined as follows in JIS B 2239-2004.
This standard applies to the pressure ratings of flanged type valves and flanged piping joints.

Table 1 Pressure - Temperature rating

Unit: MPa

Nominal pressure	Material group symbol	Maximum working pressure			
		Temperature of fluid ˚C			
		–10 - 120	220	300	350
5K	G2・G3	0.7	0.5	—	—
	D1・M1・M2	0.7	0.6	0.5	—
10K	G2・G3	1.4	1.0	—	—
	D1・M1・M2	1.4	1.2	1.0	—
10K Thin-model	G2・D1・M1・M2	0.7	—	—	—
16K	G2・G3	2.2	1.6	—	—
	D1・M1・M2	2.2	2.0	1.8	1.6
20K	G3・M1	2.8	2.0	—	—
	D1・M2	2.8	2.5	2.3	2.0

Remark 1 For material group symbols, refer to Table 2.
Remark 2 To calculate the maximum working pressure at an intermediate temperature of each temperature shown in the table, use proportional interpolation.

Table 2 Material group

Material		Mechanical property			Material standard		Material standard (reference)	
Type	Material group symbol	Minimum tensile strength N/mm²	Minimum elongation %	Minimum 0.2%/strength N/mm²	Standard No	Material symbol	Standard No.	Material symbol
Gray cast iron	G1 *2	145	—	—	—	—	ASTM A 126	A
	G2	200	—	—	JIS G 5501	FC 200	ISO 185	200
		214	—	—	—	—	ASTM A 126	B
	G3	250	—	—	JIS G 5501	FC 250	ISO 185	250
Ductile cast iron	D1	415	18	276	JIS B 8270	FCD-S *1	ASTM A 395	—
		350	22	220	JIS G 5502	FCD 350	ISO 1083	350-22
		400	15	250	JIS G 5502	FCD 400	ISO 1083	400-15
		450	10	280	JIS G 5502	FCD 450	ISO 1083	450-10
	D2 *2	(400)	(5)	(300)	—	—	ISO 2531	400-5
		(600)	(3)	(370)	—	—	ISO 1083	600-3
Blackheart malleable cast iron	M1	270	5	165	JIS G 5705	FCMB 27-05	ISO/DIS 5922	BF 27-05
		300	6	190	—	—	ISO/DIS 5922	BF 30-06
	M2	340	10	220	—	—	ASTM A 47	32510
		350	10	200	JIS G 5705	FCMB 35-10 FCMB 35-10S *1	ISO/DIS 5922	BF 35-10

*1 It is not necessary to take into account the impact value except when the impact value specified in the appropriate material standard must be met according to the applicable regulation.
*2 Material group symbols G1 and D2 are shown for reference because they represent the organization of the respective material groups. The values in parentheses under Mechanical property are values based on the appropriate standards.

Steel Pipe Flanges Excerpt from JIS B 2220-2004

The relationship among the nominal pressures and materials of steel pipe flanges for connecting piping and valves to be used for general piping, such as piping for steam, air, gas, water, and oil, the condition of the fluid, and the maximum working pressure is defined as follows in JIS B 2220-2004.
This standard applies to the pressure ratings of flanged type valves and flanged piping joints.

Table 1 Pressure - Temperature rating

Unit: MPa

Nominal pressure	Material group no.		Classification	Maximum working pressure								
				Temperature of fluid ˚C								
	Specified material	Reference material		TL-120	220	300	350	400	425	450	475	490
5K	001・002・003a	1.1	Ⅰ	0.7	0.6	0.5	—	—	—	—	—	—
			Ⅱ	0.5	0.5	0.5	—	—	—	—	—	—
			Ⅲ	0.5	—	—	—	—	—	—	—	—
	021a・021b・022a・022b	2.1, 2.2	Ⅰ	0.7	0.6	0.5	—	—	—	—	—	—
			Ⅱ	0.5	0.5	0.5	—	—	—	—	—	—
			Ⅲ	0.5	—	—	—	—	—	—	—	—
	023a・023b	2.3	Ⅰ	0.7	0.6	0.5	—	—	—	—	—	—
			Ⅱ	0.5	0.5	0.5	—	—	—	—	—	—
			Ⅲ	0.5	—	—	—	—	—	—	—	—
10K	001・002・003a	1.1	Ⅰ	1.4	1.2	1.0	—	—	—	—	—	—
			Ⅱ	1.0	1.0	1.0	—	—	—	—	—	—
			Ⅲ	1.0	—	—	—	—	—	—	—	—
	021a・021b・022a・022b	2.1, 2.2	Ⅰ	1.4	1.2	1.0	—	—	—	—	—	—
			Ⅱ	1.0	1.0	0.9	—	—	—	—	—	—
			Ⅲ	1.0	—	—	—	—	—	—	—	—
	023a・023b	2.3	Ⅰ	1.4	1.2	1.0	—	—	—	—	—	—
			Ⅱ	1.0	0.9	0.8	—	—	—	—	—	—
			Ⅲ	1.0	—	—	—	—	—	—	—	—
16K	002・003a	1.1	Ⅰ	2.7	2.5	2.3	2.1	1.8 *1	1.6 *1	—	—	—
			Ⅱ	1.6	1.6	1.6	—	—	—	—	—	—
			Ⅲ	1.6	—	—	—	—	—	—	—	—
	021a・021b・022a・022b	2.1, 2.2	Ⅰ	2.7	2.5	2.3	2.1	1.8	1.6	—	—	—
			Ⅱ	1.6	1.6	1.6	1.6	1.5	1.5	—	—	—
			Ⅲ	1.6	—	—	—	—	—	—	—	—
	023a・023b	2.3	Ⅰ	2.7	2.5	2.3	2.1	1.8	1.6	—	—	—
			Ⅱ	1.6	1.6	1.5	1.4	1.3	1.3	—	—	—
			Ⅲ	1.6	—	—	—	—	—	—	—	—
20K	002・003a	1.1	Ⅰ	3.4	3.1	2.9	2.6	2.3 *1	2.0 *1	—	—	—
			Ⅱ	2.0	2.0	2.0	—	—	—	—	—	—
			Ⅲ	2.0	—	—	—	—	—	—	—	—
	021a・021b・022a・022b	2.1, 2.2	Ⅰ	3.4	3.1	2.9	2.6	2.3	2.0	—	—	—
			Ⅱ	2.0	2.0	2.0	2.0	1.9	1.9	—	—	—
			Ⅲ	2.0	—	—	—	—	—	—	—	—
	023a・023b	2.3	Ⅰ	3.4	3.1	2.9	2.6	2.3	2.0	—	—	—
			Ⅱ	2.0	2.0	1.9	1.7	1.7	1.7	—	—	—
			Ⅲ	2.0	—	—	—	—	—	—	—	—
30K	002・003a	1.1	Ⅰ	5.1	4.6	4.3	3.9	3.4 *1	3.0 *1	—	—	—
			Ⅱ	3.9	3.9	3.9	—	—	—	—	—	—
	013a	1.5	Ⅰ	5.1	4.6	4.3	3.9	3.8 *2	3.6 *2	3.4 *2	3.0 *2	—
			Ⅱ	3.9	3.9	3.9	3.9	3.7 *2	3.6 *2	3.4 *2	3.0 *2	—
	015a	1.9	Ⅰ	5.1	4.6	4.3	3.9	3.8	3.6	3.4	3.2	3.0
			Ⅱ	3.9	3.9	3.9	3.9	3.8	3.6	3.4	3.2	2.0
	021a・021b・022a・022b	2.1, 2.2	Ⅰ	5.1	4.6	4.3	3.9	3.8	3.6	3.4 *3	3.2 *3 *4	3.0 *3 *4
			Ⅱ	3.9	3.6	3.4	3.0	2.5	2.3	2.3 *3	2.3 *3 *4	2.3 *3 *4
			Ⅲ	3.9	—	—	—	—	—	—	—	—
	023a・023b	2.3	Ⅰ	5.1	4.6	4.3	3.9	3.8	3.6	3.4 *5	—	—
			Ⅱ	3.5	3.0	2.9	2.6	2.1	2.0	2.0 *5	—	—
			Ⅲ	3.5	—	—	—	—	—	—	—	—

*1 The values do not apply to JIS G 5101 SC 480 of material group 002 and ASTMA 537 CL1 and ISO 9328-2 PH355 of material group 1.1.
*2 The values do not apply to ASTM A 352 LC1 of material group 1.5.
*3 The values do not apply to ASTM A 351 CF3 and ISO 4991 C46 of material groups 021b and 2.1.
*4 The values do not apply to ASTM A 351 CF3M, ISO 4991 C57, ISO 4991 C60, ISO 4991 C61, and ISO 4991 C61LC of material groups 022b and 2.2.
*5 The values do not apply to ASTM A 240 304L, ASTM A 182 F304L, and ISO 9328-5 x 2 CrNi 1810 of material groups 023a and 2.3.

Remark 1 Refer to Table 2 for the specified materials in the Material group No. column, and Reference Tables 1 and 2 for reference materials.
Remark 2 TL is a minimum working temperature equal to or below room temperature, and a minimum working temperature below room temperature needs to be determined by consultation between the parties who place and receive an order.
Remark 3 To calculate the maximum working pressure at an intermediate temperature of each temperature shown in the table, use proportional interpolation.

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Steel Pipe Flanges Excerpt from JIS B 2220-2004

Table 2 Material group

Material type	Rolled material		Forged material		Cast material		Material group No.
	Standard No.	Material symbol	Standard No.	Material symbol	Standard No.	Material symbol	
Carbon steel	JIS G 3101 JIS G 4051	SS 400 S 20 C	JIS G 3201 JIS G 3202	SF 390A SFVC1	JIS G 5101 JIS G 5151	SC 410 SCPH 1	001
	JIS G 4051	S 25 C	JIS G 3201	SF 440A	JIS G 5101	SC 480	002
	—	—	JIS G 3202	SFVC2A	JIS G 5151	SCPH 2	003a
Low-alloy steel	—	—	JIS G 3203	SFVAF1	JIS G 5151	SCPH 11	013a
	—	—	JIS G 3203	SFVAF11A	JIS G 5151	SCPH 21	015a
Stainless steel	JIS G 4304 JIS G 4305	SUS 304 SUS 304	JIS G 3214	SUS F304	JIS G 5121	SCS 13A	021a
	—	—	—	—	JIS G 5121	SCS 19A	021b
	JIS G 4304 JIS G 4305	SUS 316 SUS 316	JIS G 3214	SUS F316	JIS G 5121	SCS 14A	022a
	—	—	—	—	JIS G 5121	SCS 16A	022b
	JIS G 4304 JIS G 4305	SUS 304L SUS 304L	JIS G 3214	SUS F304L	—	—	023a
	JIS G 4304 JIS G 4305	SUS 316L SUS 316L	JIS G 3214	SUS F316L	—	—	023b

Remark 1 SS 400 specified in JIS G 3101 and SF 390A and SF 440A stipulated in JIS G 3201 shall not contain more than 0.35% of carbon.
Remark 2 S20 C and S25 C specified in JIS G 4051 shall undergo an inspection according to JIS G 0303. S20 C and S25 C shall have tensile strengths of 400 N/mm^2 or more and 440 N/mm^2 or more, respectively.

Reference table 1 ASTM materials

Material type	Rolled material		Forged material		Cast material		Material group No.
	Standard No.	Material symbol	Standard No.	Material symbol	Standard No.	Material symbol	
Carbon steel	A 515 A 516 A 537	70 70 CL 1	A 105 A 350	— LF2	A216	WCB	1.1
Low-alloy steel	A 204 A 204	A B	A 182	F1	A217 A352	WC1 LC1	1.5
	A 387	11 CL2	A 182 A 182	F11 CL2 F12 CL2	A217	WC6	1.9
Stainless steel	A 240 A 240	304 304H	A 182 A 182	F304 F304H	A351 A351	CF3 CF8	2.1
	A 240 A 240 A 240	316 316H 317	A 182 A 182	F316 F316H	A351 A351 A351	CF3M CF8M CG8M	2.2
	A 240 A 240	304L 316L	A 182 A 182	F304L F316L	—	—	2.3

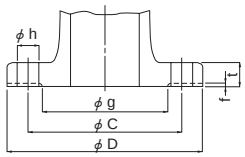
Reference table 2 ISO materials

Unit: mm

Material type	Rolled material			Forged material			Cast material		Material group No.
	Standard No.	Material symbol	Thickness	Standard No.	Material symbol	Thickness	Standard No.	Material symbol	
Carbon steel	ISO 9328-2	PH290	60 or less	ISO 2604-1	F13	63 or less	ISO 4991	C26-52H	1.1
		PH315	60-100		F18	63-250			
		PH355	100 or less		F22	63 or less			
Low-alloy steel	ISO 9328-2	16 Mo 3	60 or less	ISO 2604-1	F28	—	ISO 4991	C28H	1.5
	—	—	—	—	—	—	ISO 4991	C32H	1.9
Stainless steel	ISO 9328-5	X5 CrNi 18 9	—	ISO 2604-1	F49	—	ISO 4991	C46	2.1
								C47	
	ISO 9328-5	X5 CrNiMO 17 12	—	ISO 2604-1	F62	—	ISO 4991	C57	2.2
					F64	—		C60	
		X7 CrNiMO 17 12	—					C61	
								C61LC	
	ISO 9328-5	X2 CrNi 18 10	—	ISO 2604-1	F46	—	—	—	2.3
		X2 CrNiMo 17 12	—		F59	—			
		X2 CrNiMo 17 13	—						

Basic Dimensions of Pipe Flanges

Excerpt from JIS B 2220-2004 Steel pipe flanges
Excerpt from JIS B 2239-2004 Cast iron pipe flanges



■Basic dimensions of nominal pressure 10K flanges

Unit: mm

Nominal size	Outer diameter of steel piping applied	Outer diameter of flange D	Each dimension of flange						Bolt hole				Nominal size of bolt thread	
			t				f	Diameter g	PCD C	Quantity	Diameter h			
			Other than gray cast iron		Gray cast iron									
			Standard-model	Thin-model	Standard-model	Thin-model					Standard-model	Thin-model	Standard-model	Thin-model
10	17.3	90	12	9	14	12	1	46	65	4	15	12	M12	M10
15	21.7	95	12	9	16	12	1	51	70	4	15	12	M12	M10
20	27.2	100	14	10	18	14	1	56	75	4	15	12	M12	M10
25	34.0	125	14	12	18	16	1	67	90	4	19	15	M16	M12
32	42.7	135	16	12	20	18	2	76	100	4	19	15	M16	M12
40	48.6	140	16	12	20	18	2	81	105	4	19	15	M16	M12
50	60.5	155	16	14	20	18	2	96	120	4	19	15	M16	M12
65	76.3	175	18	14	22	18	2	116	140	4	19	15	M16	M12
80	89.1	185	18	14	22	18	2	126	150	8	19	15	M16	M12
100	114.3	210	18	16	24	20	2	151	175	8	19	15	M16	M12
125	139.8	250	20	18	24	22	2	182	210	8	23	19	M20	M16
150	165.2	280	22	18	26	22	2	212	240	8	23	19	M20	M16
200	216.3	330	22	20	26	24	2	262	290	12	23	19	M20	M16
250	267.4	400	24	22	30	26	2	324	355	12	25	23	M22	M20
300	318.5	445	24	22	32	28	3	368	400	16	25	23	M22	M20
350	355.6	490	26	24	34	28	3	413	445	16	25	23	M22	M20
400	406.4	560	28	24	36	30	3	475	510	16	27	25	M24	M22
450	457.2	620	30	—	38	—	3	530	565	20	27	25	M24	M22
500	508.0	675	30	—	40	—	3	585	620	20	27	25	M24	M22
550	558.8	745	32	—	42	—	3	640	680	20	33	—	M30	—
600	609.6	795	32	—	44	—	3	690	730	24	33	—	M30	—

■Basic dimensions of nominal pressure 16K flanges

Unit: mm

Nominal size	Outer diameter of steel piping applied	Outer diameter of flange D	Each dimension of flange				Bolt hole			Nominal size of bolt thread
			t		f	Diameter g	PCD C	Quantity	Diameter h	
			Other than gray cast iron	Gray cast iron						
10	17.3	90	12	—	1	46	65	4	15	M12
15	21.7	95	12	—	1	51	70	4	15	M12
20	27.2	100	14	—	1	56	75	4	15	M12
25	34.0	125	14	—	1	67	90	4	19	M16
32	42.7	135	16	—	2	76	100	4	19	M16
40	48.6	140	16	—	2	81	105	4	19	M16
50	60.5	155	16	20	2	96	120	8	19	M16
65	76.3	175	18	22	2	116	140	8	19	M16
80	89.1	200	20	24	2	132	160	8	23	M20
100	114.3	225	22	26	2	160	185	8	23	M20
125	139.8	270	22	26	2	195	225	8	25	M22
150	165.2	305	24	28	2	230	260	12	25	M22
200	216.3	350	26	30	2	275	305	12	25	M22
250	267.4	430	28	34	2	345	380	12	27	M24
300	318.5	480	30	36	3	395	430	16	27	M24
350	355.6	540	34	38	3	440	480	16	33	M30 x 3
400	406.4	605	38	42	3	495	540	16	33	M30 x 3
450	457.2	675	40	46	3	560	605	20	33	M30 x 3
500	508.0	730	42	50	3	615	660	20	33	M30 x 3
550	558.8	795	44	54	3	670	720	20	39	M36 x 3
600	609.6	845	46	58	3	720	770	24	39	M36 x 3

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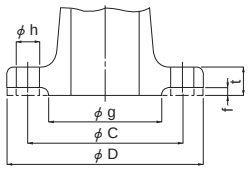
Basic Dimensions of Pipe Flanges

Excerpt from JIS B 2220-2004 Steel pipe flanges
Excerpt from JIS B 2239-2004 Cast iron pipe flanges



■Basic dimensions of nominal pressure 20K flanges

Unit: mm

Nominal size	Outer diameter of steel piping applied	Outer diameter of flange D	Each dimension of flange				Bolt hole			Nominal size of bolt thread
			t		f	Diameter g	PCD C	Quantity	Diameter h	
			Other than gray cast iron	Gray cast iron						
10	17.3	90	14	16	1	46	65	4	15	M12
15	21.7	95	14	16	1	51	70	4	15	M12
20	27.2	100	16	18	1	56	75	4	15	M12
25	34.0	125	16	20	1	67	90	4	19	M16
32	42.7	135	18	20	2	76	100	4	19	M16
40	48.6	140	18	22	2	81	105	4	19	M16
50	60.5	155	18	22	2	96	120	8	19	M16
65	76.3	175	20	24	2	116	140	8	19	M16
80	89.1	200	22	26	2	132	160	8	23	M20
100	114.3	225	24	28	2	160	185	8	23	M20
125	139.8	270	26	30	2	195	225	8	25	M22
150	165.2	305	28	32	2	230	260	12	25	M22
200	216.3	350	30	34	2	275	305	12	25	M22
250	267.4	430	34	38	2	345	380	12	27	M24
300	318.5	480	36	40	3	395	430	16	27	M24
350	355.6	540	40	44	3	440	480	16	33	M30 x 3
400	406.4	605	46	50	3	495	540	16	33	M30 x 3
450	457.2	675	48	54	3	560	605	20	33	M30 x 3
500	508.0	730	50	58	3	615	660	20	33	M30 x 3
550	558.8	795	52	62	3	670	720	20	39	M36 x 3
600	609.6	845	54	66	3	720	770	24	39	M36 x 3

■Basic dimensions of nominal pressure 30K flanges

Unit: mm

Nominal size	Outer diameter of steel piping applied	Outer diameter of flange D	Each dimension of flange			Bolt hole			Nominal size of bolt thread
			t	f	Diameter g	PCD C	Quantity	Diameter h	
10	17.3	110	16	1	52	75	4	19	M16
15	21.7	115	18	1	55	80	4	19	M16
20	27.2	120	18	1	60	85	4	19	M16
25	34.0	130	20	1	70	95	4	19	M16
32	42.7	140	22	2	80	105	4	19	M16
40	48.6	160	22	2	90	120	4	23	M20
50	60.5	165	22	2	105	130	8	19	M16
65	76.3	200	26	2	130	160	8	23	M20
80	89.1	210	28	2	140	170	8	23	M20
90	101.6	230	30	2	150	185	8	25	M22
100	114.3	240	32	2	160	195	8	25	M22
125	139.8	275	36	2	195	230	8	25	M22
150	165.2	325	38	2	235	275	12	27	M24
200	216.3	370	42	2	280	320	12	27	M24
250	267.4	450	48	2	345	390	12	33	M30 x 3
300	318.5	515	52	3	405	450	16	33	M30 x 3
350	355.6	560	54	3	450	495	16	33	M30 x 3
400	406.4	630	60	3	510	560	16	39	M36 x 3

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Copper Alloy Pipe Flanges Excerpt from JIS B 2240-1996 Copper alloy pipe flanges

The relationship among the nominal pressures and materials of copper alloy flanges for connecting piping and valves to be used for general piping, such as piping for steam, air, gas, water, and oil, the condition of the fluid, and the maximum working pressure is defined as follows in JIS B 2240-1996.
This standard applies to the pressure ratings of flanged type valves and flanged piping joints.

■The relation between condition of fluid and maximum working pressure

Unit: MPa

Nominal pressure (Symbol)	Condition of fluid		Maximum working pressure	Pressure for water pressure test (Reference) (1)
5K	220˚C or less	Steam, air, gas, oil or pulsating flow (with pressure fluctuation)	0.49	0.98
	185˚C or less		0.59	
	Steady flow at the temperature of 120˚C or less (with small pressure fluctuation)		0.69	
10K	220˚C or less	Steam, air, gas, oil or pulsating flow (with pressure fluctuation)	0.98	1.96
	185˚C or less		1.18	
	Steady flow at the temperature of 120˚C or less (with small pressure fluctuation)		1.37	
16K	220˚C or less	Steam, air, gas, oil or pulsating flow (with pressure fluctuation)	1.57	3.14
	185˚C or less		1.86	
	Steady flow at the temperature of 120˚C or less (with small pressure fluctuation)		2.16	

Note (1) The pressure for water pressure tests is a reference test pressure with a flange connected to piping. Follow another specified pressure, if any.
Remark When the temperature or pressure is an intermediate level of the temperature or pressure specified in the table, the maximum working pressure or temperature can be defined by interpolation.

■Basic materials

Nominal pressure (Symbol)	Integral flange	Slip-on flanges (3)
5K	JIS H 5111 CAC402・CAC406 (2)・CAC407	JIS H 5101 CAC202 (2) (4)・JIS H 5111 CAC407 (5)
10K		
16K		

Note (2) Use the flanged when the temperature of the fluid is 205˚C or less.
Note (3) The material of a slip-on flanged for piping to be connected by welding needs to be determined by agreement or consultation between the parties who place and receive an order.
Note (4) It is recommended that the Pb content be 1% or less.
Note (5) CAC407 can be used for slip-on brazed flanges on condition that the temperature of the fluid is in excess of 205˚C and the Sn and Pb contents are 5 to 6% and 1% or less, respectively.

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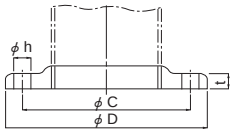
Basic Dimensions of Copper Alloy Pipe Flanges Excerpt from JIS B 2240-1996 Copper alloy pipe flanges



■Basic dimensions of nominal pressure 10K flanges

Unit: mm

Nominal size	Outer diameter of the pipe applied		Outer diameter of flange D	Flange thickness t	Bolt hole			Nominal size of bolt thread
	(1)	(2)			PCD C	Quantity	Diameter h	
10	16	12.70	90	12	65	4	15	M12
15	19	15.88	95	12	70	4	15	M12
20	25.4	22.22	100	14	75	4	15	M12
25	31.8	28.58	125	14	90	4	19	M16
32	38.1	34.92	135	16	100	4	19	M16
40	45	41.28	140	16	105	4	19	M16
50	50	53.98	155	16	120	4	19	M16
65	65･75	66.68	175	18	140	4	19	M16
80	75･76.2	79.38	185	18	150	8	19	M16
(90)	100	—	195	18	160	8	19	M16
100	100	104.78	210	18	175	8	19	M16
125	125	130.18	250	20	210	8	23	M20
150	150	155.58	280	22	240	8	23	M20
(175)	150	—	305	22	265	12	23	M20
200	200	—	330	22	290	12	23	M20
(225)	200	—	350	22	310	12	23	M20
250	250	—	400	24	355	12	25	M22
300	—	—	445	24	400	16	25	M22
350	—	—	490	26	445	16	25	M22
400	—	—	560	28	510	16	27	M24
450	—	—	620	30	565	20	27	M24
500	—	—	675	30	620	20	27	M24
550	—	—	745	32	680	20	33	M30
600	—	—	795	32	730	24	33	M30

Remark 1 Do not use flanges of the nominal sizes in parentheses wherever possible.
Remark 2 The (1) column under Outer diameter of the pipe applied shows the outer diameters of representative piping among the piping shown in Table 7 (1) in JIS H 3300 and Table 6 in JIS H 3320. Piping of outer diameters other than those specified in this table may apply based on agreement or consultation between the parties who place and receive an order.
The (2) column under Outer diameter of the pipe applied shows outer diameters within the range specified in Table 7 (2) in JIS H 3300.
Remark 3 The gasket seat shall be a flat face.
Remark 4 The bolt thread nominal size of M30 conforms to class 2 specified in JIS B 1001.
Reference Use SS400 specified in JIS G 3101 for bolts and nuts to be used for clamping flanges.

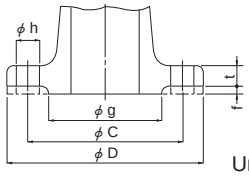
■Basic dimensions of nominal pressure 16K flanges

Unit: mm

Nominal size	Outer diameter of the pipe applied		Outer diameter of flange D	Flange thickness t	Bolt hole			Nominal size of bolt thread
	(1)	(2)			PCD C	Quantity	Diameter h	
10	16	12.70	90	12	65	4	15	M12
15	19	15.88	95	12	70	4	15	M12
20	25.4	22.22	100	14	75	4	15	M12
25	31.8	28.58	125	14	90	4	19	M16
32	38.1	34.92	135	16	100	4	19	M16
40	45	41.28	140	16	105	4	19	M16
50	50	53.98	155	16	120	8	19	M16
65	65･75	66.68	175	18	140	8	19	M16
80	75･76.2	79.38	200	20	160	8	23	M20
(90)	100	—	210	20	170	8	23	M20
100	100	104.78	225	22	185	8	23	M20
125	125	130.18	270	22	225	8	25	M22
150	150	155.58	305	24	260	12	25	M22
200	200	—	350	26	305	12	25	M22
250	250	—	430	28	380	12	27	M24
300	—	—	480	30	430	16	27	M24

Remark 1 Do not use flanges of the nominal sizes in parentheses wherever possible.
Remark 2 The (1) column under "Outer diameter of the pipe applied" shows the outer diameters of representative piping among the piping shown in Table 7 (1) in JIS H 3300 and Table 6 in JIS H 3320. Piping of outer diameters other than those specified in this table may apply based on agreement or consultation between the parties who place and receive an order.
The (2) column under "Outer diameter of the pipe applied" shows outer diameters within the range specified in Table 7 (2) in JIS H 3300.
Remark 3 The gasket seat shall be a flat face.
Reference Use SS400 specified in JIS G 3101 for bolts and nuts to be used for clamping flanges.

Basic Dimensions of ASME (ANSI) Pipe Flanges Excerpt from ASME B 16.5-2009



■Basic dimensions of 150lb steel flanges

Unit: mm

Nominal size	Outer diameter of flange D	Each dimension of flange			Bolt hole			Nominal size of bolt
		Thickness t	Diameter of raised face g	f	PCD C	Quantity	Diameter h	
15	90	9.6	34.9	2	60.3	4	16	1/2
20	100	11.2	42.9	2	69.9	4	16	1/2
25	110	12.7	50.8	2	79.4	4	16	1/2
32	115	14.3	63.5	2	88.9	4	16	1/2
40	125	15.9	73.0	2	98.4	4	16	1/2
50	150	17.5	92.1	2	120.7	4	19	5/8
65	180	20.7	104.8	2	139.7	4	19	5/8
80	190	22.3	127.0	2	152.4	4	19	5/8
90	215	22.3	139.7	2	177.8	8	19	5/8
100	230	22.3	157.2	2	190.5	8	19	5/8
125	255	22.3	185.7	2	215.9	8	22	3/4
150	280	23.9	215.9	2	241.3	8	22	3/4
200	345	27.0	269.9	2	298.5	8	22	3/4
250	405	28.6	323.8	2	362.0	12	26	7/8
300	485	30.2	381.0	2	431.8	12	26	7/8
350	535	33.4	412.8	2	476.3	12	29	1
400	595	35.0	469.9	2	539.8	16	29	1
450	635	38.1	533.4	2	577.9	16	32	1-1/8
500	700	41.3	584.2	2	635.0	20	32	1-1/8
600	815	46.1	692.2	2	749.3	20	35	1-1/4

The height of packing seat shall be 2 mm.

■Basic dimensions of 300lb steel flanges

Unit: mm

Nominal size	Outer diameter of flange D	Each dimension of flange			Bolt hole			Nominal size of bolt
		Thickness t	Diameter of raised face g	f	PCD C	Quantity	Diameter h	
15	95	12.7	34.9	2	66.7	4	16	1/2
20	115	14.3	42.9	2	82.6	4	19	5/8
25	125	15.9	50.8	2	88.9	4	19	5/8
32	135	17.5	63.5	2	98.4	4	19	5/8
40	155	19.1	73.0	2	114.3	4	22	3/4
50	165	20.7	92.1	2	127.0	8	19	5/8
65	190	23.9	104.8	2	149.2	8	22	3/4
80	210	27.0	127.0	2	168.3	8	22	3/4
90	230	28.6	139.7	2	184.2	8	22	3/4
100	255	30.2	157.2	2	200.0	8	22	3/4
125	280	33.4	185.7	2	235.0	8	22	3/4
150	320	35.0	215.9	2	269.9	12	22	3/4
200	380	39.7	269.9	2	330.2	12	26	7/8
250	445	46.1	323.8	2	387.4	16	29	1
300	520	49.3	381.0	2	450.8	16	32	1-1/8
350	585	52.4	412.8	2	514.4	20	32	1-1/8
400	650	55.6	469.9	2	571.5	20	35	1-1/4
450	710	58.8	533.4	2	628.6	24	35	1-1/4
500	775	62.0	584.2	2	685.8	24	35	1-1/4
600	915	68.3	692.2	2	812.8	24	42	1-1/2

The height of packing seat shall be 2 mm.

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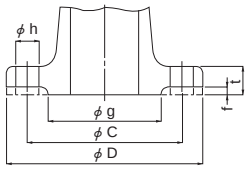
Basic Dimensions of ASME (ANSI) Pipe Flanges Excerpt from ASME B 16.42-1998



■Basic dimensions of 150lb ductile iron flanges

Unit: mm

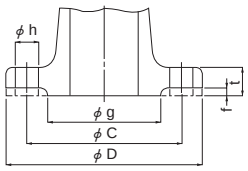
Nominal size	Outer diameter of flange D	Each dimension of flange			Bolt hole			Nominal size of bolt
		Thickness t	Diameter of raised face g	f	PCD C	Quantity	Diameter h	
25	108.0	14.3	50.8	1.5	79.4	4	15.8	1/2
32	117.4	15.8	63.5	1.5	88.9	4	15.8	1/2
40	127.0	17.6	73.0	1.5	98.4	4	15.8	1/2
50	152.4	19.1	92.1	1.5	120.7	4	19.1	5/8
65	177.8	22.4	104.8	1.5	139.7	4	19.1	5/8
80	190.5	23.9	127.0	1.5	152.4	4	19.1	5/8
90	215.9	23.9	139.7	1.5	177.8	8	19.1	5/8
100	228.6	23.9	157.2	1.5	190.5	8	19.1	5/8
125	254.0	23.9	185.7	1.5	215.9	8	22.4	3/4
150	279.4	25.4	215.9	1.5	241.3	8	22.4	3/4
200	342.9	28.5	269.9	1.5	298.5	8	22.4	3/4
250	406.4	30.3	323.8	1.5	362.0	12	25.4	7/8
300	482.6	31.8	381.0	1.5	431.8	12	25.4	7/8
350	533.4	35.1	412.8	1.5	476.3	12	28.5	1
400	596.9	36.6	469.9	1.5	539.8	16	28.5	1
450	635.0	39.7	533.4	1.5	577.9	16	31.8	1-1/8
500	698.5	43.0	584.2	1.5	635.0	20	31.8	1-1/8
600	812.8	47.8	692.2	1.5	749.3	20	35.1	1-1/4

■Basic dimensions of 300lb ductile iron flanges

Unit: mm

Nominal size	Outer diameter of flange D	Each dimension of flange			Bolt hole			Nominal size of bolt
		Thickness t	Diameter of raised face g	f	PCD C	Quantity	Diameter h	
25	124.0	17.6	50.8	1.5	88.9	4	19.1	5/8
32	133.4	19.1	63.5	1.5	98.4	4	19.1	5/8
40	155.5	20.6	73.0	1.5	114.3	4	22.4	3/4
50	165.1	22.4	92.1	1.5	127.0	8	19.1	5/8
65	190.5	25.4	104.8	1.5	149.2	8	22.4	3/4
80	209.6	28.5	127.0	1.5	168.3	8	22.4	3/4
90	228.6	30.3	139.7	1.5	184.2	8	22.4	3/4
100	254.0	31.8	157.2	1.5	200.0	8	22.4	3/4
125	279.4	35.1	185.7	1.5	235.0	8	22.4	3/4
150	317.5	36.6	215.9	1.5	269.9	12	22.4	3/4
200	381.0	41.2	269.9	1.5	330.2	12	25.4	7/8
250	444.5	47.8	323.8	1.5	387.4	16	28.5	1
300	520.7	50.8	381.0	1.5	450.8	16	31.8	1-1/8
350	584.2	53.9	412.8	1.5	514.4	20	31.8	1-1/8
400	647.7	57.2	469.9	1.5	571.5	20	35.1	1-1/4
450	711.2	60.5	533.4	1.5	628.6	24	35.1	1-1/4
500	774.7	63.5	584.2	1.5	685.8	24	35.1	1-1/4
600	914.4	69.9	692.2	1.5	812.8	24	41.2	1-1/2

Basic Dimensions of EN Pipe Flanges Excerpt from BS EN 1092-2: 1997



■Basic dimensions of PN 10/16 ductile iron flanges

Unit: mm

Nominal size	Outer diameter of flange D	Each dimension of flange			Bolt hole			Nominal size of bolt
		Thickness t	Diameter of raised face g	f	PCD C	Quantity	Diameter h	
10	90	14.0	41	2	60	4	14	M12
15	95	14.0	46	2	65	4	14	M12
20	105	16.0	56	2	75	4	14	M12
25	115	16.0	65	3	85	4	14	M12
32	140	18.0	76	3	100	4	19	M16
40	150	19.0	84	3	110	4	19	M16
50	165	19.0	99	3	125	4	19	M16
60	175	19.0	108	3	135	4	19	M16
65	185	19.0	118	3	145	4	19	M16
80	200	19.0	132	3	160	8	19	M16
100	220	19.0	156	3	180	8	19	M16
125	250	19.0	184	3	210	8	19	M16
150	285	19.0	211	3	240	8	23	M20
200	340	20.0	266	3	295	12	23	M20

■Basic dimensions of PN 25 ductile iron flanges

Unit: mm

Nominal size	Outer diameter of flange D	Each dimension of flange			Bolt hole			Nominal size of bolt
		Thickness t	Diameter of raised face g	f	PCD C	Quantity	Diameter h	
10	90	14.0	41	2	60	4	14	M12
15	95	14.0	46	2	65	4	14	M12
20	105	16.0	56	2	75	4	14	M12
25	115	16.0	65	3	85	4	14	M12
32	140	18.0	76	3	100	4	19	M16
40	150	19.0	84	3	110	4	19	M16
50	165	19.0	99	3	125	4	19	M16
60	175	19.0	108	3	135	8	19	M16
65	185	19.0	118	3	145	8	19	M16
80	200	19.0	132	3	160	8	19	M16
100	235	19.0	156	3	190	8	23	M20
125	270	19.0	184	3	220	8	28	M24
150	300	20.0	211	3	250	8	28	M24
200	360	22.0	274	3	310	12	28	M24

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Corrosion Resistance of Metallic Materials

Corrosion-resistant materials need to be selected based on such conditions as the type and property of the fluid, pressure, and temperature, and with actual equipment data taken into account.
This table just shows reference data. For actual use of materials, please contact us.

●Corrosion resistance class

Corrosion resistance class	Corrosion rate (mm/Y)	Remarks
A	0.125 or less	The material is extremely low in corrosion rate and most suitable for the material for valve bodies and trims.
B	0.125-1.25	The material may be used when another material superior to it in corrosion resistance is expensive or unavailable for practical use, only for portions allowed to corrode to a certain extent.
C	1.25 or more	The material is unavailable.

		Corrosion condition		Carbon steel	Cast iron	Stainless steel					Bronze	Nickel	Monel	Hastelloy B	Hastelloy C	Inconel	Titanium	Zirconium	Remarks
		Concentration (%)	Temperature (˚C)			SUS304	SUS316	SUS440C	SUS630 (17-4PH)	20Cr-30Ni									
Acetone		100	Room temperature	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
			100	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Acetylene		100	Room temperature	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	(a)
			100	A	A	A	A	A	A	A	—	—	—	A	A	A	—	—	
Acetaldehyde			Room temperature	A	A	A	A	A	A	A	A	A	B	—	A	A	—	A	
Aniline		100	Room temperature	A	A	A	A	A-B	A-B	A	C	A-B	A-B	A	A	A	A	A	
Sulfur dioxide	Dry		Room temperature	A	A	A	A	A	A	A	—	—	—	—	A	A	A	—	
			100	A	A	A	A	A	A	A	—	—	—	—	A	A	A	—	
	Wet	5	Room temperature	C	C	A	A	A	—	A	—	C	—	A	A	A	B	—	
		Total concentration	100	C	C	B	B	C	—	A	B	C	C	A	A	A	C	—	
Alcohol (ethyl)		Total concentration	Room temperature	A-B	A-B	A	A	A	A	A	A-B	A	A	A	A	A	A	A	
Alcohol (methyl)		Total concentration	Room temperature	A-B	A-B	A	A	A	A	A	A	A	A	A	A	A	A	A	
Benzoic acid		Total concentration	Room temperature	C	C	A-B	A-B	A-B	A-B	A-B	A-B	A-B	A-B	A	A	A-B	A	A	
Ammonia		100 (Anhydrous)	Room temperature	A	A	A	A	A	A	A	C	A-B	A-B	A	A	A	—	—	
Ammonia wet steam			Room temperature	A	A	B	A	A	A	A	C	C	C	A	A	A	A	—	
			70	B	B	B	A	—	—	A	C	C	C	A-B	A	A	A	—	
Sulfur (molten)		100		A	A	A	A	A	A	A	C	A	A	—	A	A	—	—	
Ethane				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Ethylene				A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Ethylene glycol			30	A	A	A	A	A-B	A	A	A-B	—	—	A	A	—	A	A	
Zinc chloride		5	Room temperature	C	C	C	B	C	C	A	C	A-B	A-B	A-B	A-B	—	A	A	(b)
			boiling	C	C	C	C	C	C	A	C	—	A-B	A-B	A-B	—	A	A	
Aluminum chloride		5	Room temperature	C	C	A	A	—	A	A	C	B	A-B	—	A	A-B	A	A	
Ammonium chloride		1	Room temperature	C	C	A	A	C	—	A	B	A	A	A	A	A	A	A	
		10	boiling	C	C	C	B	C	—	A-B	C	A-B	A-B	A-B	A	A-B	A	A	
		28	boiling	C	C	C	B	C	—	A-B	C	A-B	A-B	A	A	A-B	—	A	
		50	boiling	C	C	C	B	C	—	A-B	C	A-B	A-B	—	A	A-B	—	—	
Sulfur chloride (dry)				C	C	C	C	C	C	A-B	A-B	A-B	A-B	A-B	A	A-B	—	—	
Ethyl chloride		5	Room temperature	C	C	A	A	B	—	A	A-B	A	A	A	A	A	A	A	
Ethylene chloride		100	Room temperature	A	A-B	A	A	A	A	A	A	A	A	A	A	A	A	—	(c)
Calcium chloride		0-60	Room temperature	A-B	A-B	A-B	A-B	A-B	A-B	A-B	A	A	A	A	A	A	A	A	
Silver chloride			Room temperature	C	C	C	C	C	C	B	C	A-B	A-B	C	A-B	—	A	—	
Stannous chloride		5	Room temperature	C	C	C	B	C	C	A-B	C	C	C	A-B	A-B	C	—	A	
Ferric chloride		5	Room temperature	C	C	C	B	C	C	A-B	C	C	C	A-B	A-B	C	A	C	
Sodium chloride				C	C	B	A-B	B	B	A	A-B	A	A	A	A	A	A	A	
Hydrochloric acid		1-5	< 30	C	C	C	B	C	C	B	B	B	B	A	A	B	A-B	A	
			< 50	C	C	C	C	C	C	B	C	B	B	A	B	B	B	A	
			boiling	C	C	C	C	C	C	C	C	C	C	A	C	C	C	A	
		5-10	< 30	C	C	C	C	C	C	B	B	B	B	A	A	B	B	A	
			< 70	C	C	C	C	C	C	C	C	C	C	A	B	C	C	A	
			boiling	C	C	C	C	C	C	C	C	C	C	A	C	C	C	A	
		10-20	< 30	C	C	C	C	C	C	C	C	C	B	A	A	B	C	A	
			< 70	C	C	C	C	C	C	C	C	C	C	A	B < 50˚C	C	C	A	
			boiling	C	C	C	C	C	C	C	C	C	C	B	C	C	C	B	
		> 20	< 30	C	C	C	C	C	C	C	C	C	C	A	C	C	C	A	
			< 80	C	C	C	C	C	C	C	C	C	C	A	C	C	C	A	
			boiling	C	C	C	C	C	C	C	C	C	C	B	C	C	C	B	(d)
Chlorine	Dry		< 30	A	A	A	A	A	A	A	A	A	A	A	—	A	C	A	
	Wet		< 30	C	C	C	C	C	C	—	A	—	—	—	—	—	A	—	

	Corrosion condition		Carbon steel	Cast iron	Stainless steel					Bronze	Nickel	Monel	Hastelloy B	Hastelloy C	Inconel	Titanium	Zirconium	Remarks
	Concentration (%)	Temperature (˚C)			SUS304	SUS316	SUS440C	SUS630 (17-4PH)	20Cr-30Ni									
Seawater		Room temperature	C	C	A	A	C	A	A	A	—	A	A	A	—	A	A	(e)
Hydrogen peroxide	< 30	Room temperature	—	—	A	A	A-B	A-B	A	C	A	A	A	A	A	A	A	
Caustic soda	< 10	< 30	B	B	A	A	A	A	A	B	A	A	A	A	A	A	A	
		< 90	B	B	A	A	A	A	A	B	A	A	A	A	A	A	A	
		boiling	—	—	A	A	A	A	A	B	A	A	A	A	A	A	A	
	10-30	< 30	B	B	A	A	A	A	A	B	A	A	A	A	A	A	A	
		< 100	B	B	A	A	A	A	A	C	A	A	A	A	A	A	A	
		boiling	—	—	B	B	—	—	A	C	A	A	A	A	A	—	—	
	30-50	< 30	B	B	A	A	A	A	A	C	A	A	A	A	A	—	—	
		< 100	B	B	A	A	—	B	A	C	A	A	A	A	A	—	—	
		boiling	—	—	—	—	—	—	—	C	A	A	A	A	A	—	—	
	50-70	< 30	C	C	B	B	—	—	B	C	A	A	A	A	A	—	—	
		< 80	C	C	—	—	—	—	—	C	A	A	A	A	A	—	—	
		boiling	C	C	—	—	—	—	—	C	A	A	A	A	A	—	—	
	70-100	≦ 260	—	—	B	B	—	—	B	—	A	B	B	B	B	—	—	
	100	≦ 480	—	—	C	C	—	—	C	—	A	B	B	B	B	—	—	
Formic acid	< 10	Room temperature	C	C	A	A	C	B	A	C	—	A-B	A	A	A-B	—	A	
Citric acid	5	< 70	C	C	A-B	A	A	A	A	C	A-B	A-B	A	A	A	A	A	
	15	Room temperature	C	C	A-B	A	B	A-B	A	C	A-B	A-B	A	A	A	A	A	
		boiling	C	C	A-B	A	B	—	A	C	A-B	A-B	A	A	A-B	A	A-B	
	Concentrated	boiling	C	C	C	B	—	—	A	C	—	—	A	A	—	A	—	
Creosote			A	A	A	A	A	A	A	C	A	A	A	A	A	—	—	
Chromic acid	5	< 66	C	C	B	B	C	—	A-B	C	C	C	—	A-B	A-B	A	A	
	10	boiling	C	C	C	C	C	—	—	C	C	C	—	A-B	B	A	A	
	Concentrated	boiling	C	C	C	C	C	—	—	C	C	C	—	—	—	A	A	
Sodium chromate			—	—	A	A	—	A	—	A	A	A	—	—	A	—	—	
Acetic acid	≦ 10	≦ 30	C	C	A	A	A-B	A	A	B-C	A	A	A	A	A	A	A	
		boiling	C	C	A	A	—	—	A	B-C	—	A-B	A	A	A	A	A	
	10-20	< 60	C	C	A	A	—	—	A	—	A	—	—	A	—	A	A	
		boiling	C	C	A	A	—	—	A	—	—	—	—	A	—	A	A	
	20-50	< 60	C	C	A	A	—	—	A	—	A	A	A	A	—	A	A	
		boiling	C	C	A	A	—	—	A	—	—	—	A	A	—	A	A	
	50-99.5 Anhydrous	< 60	C	C	A	A	—	—	A	—	—	—	A	A	—	A	A	
		boiling	C	C	A	A	—	—	A	—	—	—	A	A	—	A	A	
		Room temperature	C	C	A-B	A	—	—	A	—	—	—	A	A	—	A	A	
Sodium acetate			A-B	A-B	A-B	A-B	A-B	A-B	A-B	A-B	A-B	A-B	A-B	A-B	A-B	A	A	
Sodium hypochlorite	< 20	Room temperature	C	C	C	B	C	C	B	C	C	C	—	A	C	A	A	
Carbon tetrachloride			B	B	A	A	B	A	A	A	A	A	A	A	A	A	A	
Oxalic acid	5	Room temperature	C	C	A-B	A-B	A-B	A-B	A	—	C	A-B	A	A	A	A-B	A	
	10	Room temperature	C	C	A-B	A-B	A-B	A-B	A	—	C	A-B	A	A	A	C	A	
		boiling	C	C	C	A-B	C	C	A	—	C	A-B	B	A	A	C	A	
Nitric acid	≦ 0.5	≦ 30	C	C	A	A	A	A	A	C	C	C	C	A	A	A	A	
		≦ 60	C	C	A	A	A	A	A	C	C	C	C	A	A	A	A	
		boiling	C	C	A	A	A	A	A	C	C	C	C	A	A	A	A	
	0.5-20	≦ 30	C	C	A	A	A	A	A	C	C	C	C	A	A	A	A	
		≦ 60	C	C	A	A	A	A	A	C	C	C	C	A	—	A	A	
		boiling	C	C	A	A	—	—	A	C	C	C	C	A	—	A	A	
	20-40	≦ 30	C	C	A	A	A	A	A	C	C	C	C	A	A	A	A	
		≦ 60	C	C	A	A	—	—	A	C	C	C	C	A	—	A	A	
		boiling	C	C	A	A	—	—	A	C	C	C	C	—	—	C	A	
	40-70	≦ 30	C	C	A	A	A	A	A	C	C	C	C	—	—	A	A	
		≦ 60	C	C	A	A	—	—	A	C	C	C	C	—	—	A	A	
		boiling	C	C	B	B	—	—	B	C	C	C	C	—	—	C	A	
	70-80	≦ 30	C	C	B	A	A-B	A-B	A	C	C	C	C	—	—	A	A	
		≦ 60	C	C	A	A	—	—	B	C	C	C	C	—	—	A	A	
		boiling	C	C	C	C	—	—	C	C	C	C	C	—	—	C	A	
	80-95	≦ 30	C	C	A	A	—	—	A	C	C	C	C	—	—	A	A	
		≦ 60	C	C	A	A	—	—	B	C	C	C	C	—	—	A	A	
		boiling	C	C	C	C	—	—	C	C	C	C	C	—	—	—	—	
	> 95	< 30	A	—	A	A	—	—	A	—	—	—	—	—	—	A	A	
Silver nitrate			C	C	A	A	A-B	A-B	A	C	C	C	A-B	A-B	—	A	A	
Potassium hydroxide	5	Room temperature	A-B	A-B	A	A	A-B	A	A	B	A	A	A-B	A	A-B	A	A	
	27	boiling	A-B	A-B	A	A	A-B	—	A-B	B	A	A	A-B	A-B	A-B	C	A	
	50	boiling	—	—	B	A	—	—	A-B	—	A	A	A-B	A-B	A-B	C	A	

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	Corrosion condition		Carbon steel	Cast iron	Stainless steel					Bronze	Nickel	Monel	Hastelloy B	Hastelloy C	Inconel	Titanium	Zirconium	Remarks
	Concentration (%)	Temperature (˚C)			SUS304	SUS316	SUS440C	SUS630 (17-4PH)	20Cr-30Ni									
Magnesium hydroxide (concentrated)		Room temperature	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Hydrogen			A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Mercury			A	A	A	A	A	A	A	C	A-B	A-B	A	A	A	—	—	
Stearic acid (concentrated)		50	—	C	A	A	A-B	A-B	A	C	A-B	A-B	A	A	A-B	A	—	
Tar			A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Sodium carbonate	Total concentration	Room temperature	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Sodium thiosulfate	20	Room temperature	C	C	A-B	A-B	—	—	A	—	—	—	A	A	—	—	—	
Turpentine			B	B	A	A	—	—	A	A	—	B	A	A	A	A	A	
Trichlene			A-B	A-B	A	A	A	A	A	A	A	A	A	A	A	A	A	
Carbon dioxide Dry		Room temperature	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Carbon dioxide Wet			C	C	A	A	A	A	A	B	—	—	—	A	A	A	A	
Carbon disulfide			A	A	A	A	B	—	A	C	—	B	A	A	A	A	A	
Picric acid			C	C	A-B	A-B	A-B	A-B	A	C	C	C	C	A	A-B	—	—	
Hydrofluoric acid			C	C	C	C	C	C	C	C	C	A-B	A	B	C	C	C	(f)
			C	C	C	A	C	C	C	C	C	A	A	A-B	C	C	C	(g)
Freon Dry			A-B	A-B	A	A	A	A	A	A	—	A	A	A	—	A	—	
Freon Wet			B	B	B	A	—	—	A	A	—	A	A	A	—	A	—	
Propane			A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Butane			A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Benzine			A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Boric acid			C	C	A	A	B	A	A	A-B	A-B	A-B	A	A	A-B	A	A	
Formaldehyde			B	B	A	A	A	A	A	A	A	A	A	A	A	A	A	
Milk			—	—	A	A	—	—	A	—	—	—	A	A	—	—	—	
Methyl ethyl ketone			A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
Hydrogen sulfide	Wet		B-C	C	A-B	A-B	—	—	B	C	C	—	—	A	B	A	—	
Sulfuric acid	≦ 0.25	≦ 30	C	C	A	A	C	A-B	A	A-B	C	A	A	A	—	—	A	
		≦ 60	C	C	A	A	C	A-B	A	A-B	C	A	A	A	—	—	A	
		boiling	C	C	—	—	C	—	A	C	C	A	A	A	—	—	A	
	0.5-5	≦ 30	C	C	B	B	C	—	A	C	C	C	A	A	C	C	A	
		≦ 60	C	C	C	B	C	—	A	C	C	C	A	A	C	C	A	
		boiling	C	C	C	C	C	C	A	C	C	C	A	A	C	C	A	
	5-25	≦ 30	C	C	C	B-C	C	C	A	C	C	C	A	A	C	C	A	
		≦ 50	C	C	C	C	C	C	A	C	C	C	A	A	C	C	A	
		boiling	C	C	C	C	C	C	B < 80%	C	C	C	A	B	C	C	A	
	25-50	≦ 30	C	C	C	C	C	C	A	C	C	C	A	A	C	C	A	
		≦ 50	C	C	C	C	C	C	A	C	C	C	A	A	C	C	A	
		boiling	C	C	C	C	C	C	C	C	C	C	B	C	C	C	—	
	50-60	≦ 30	C	C	C	C	C	C	A	C	C	C	A	A	C	C	A	
		≦ 60	C	C	C	C	C	C	B	C	C	C	A	B	C	C	A	
		boiling	C	C	C	C	C	C	C	C	C	C	B	C	C	C	A-B	
	60-75	≦ 30	C	C	C	C	C	C	A	C	C	C	A	A	C	C	A-B	
		≦ 60	C	C	C	C	C	C	B	C	C	C	A	B	C	C	A-B	
		boiling	C	C	C	C	C	C	C	C	C	C	B	C	C	C	C	
	75-95	≦ 30	B	—	B	B	C	C	A	C	C	C	A	—	—	—	A	
		≦ 50	C	—	C	B	C	C	B	C	C	C	A	—	—	—	A	
		boiling	C	—	C	C	C	C	C	C	C	C	—	—	—	—	—	
	95-100	≦ 30	A > 98%	—	A > 98%	A > 98%	—	—	A	—	C	C	A	A	—	—	—	
		≦ 50	B > 98%	—	B > 98%	B > 98%	C	C	A-B	—	C	C	A	B-C	—	—	—	
		boiling	—	—	—	—	—	—	C	—	C	C	C	C	—	—	—	
Zinc sulfate	5	Room temperature	—	—	A	A	—	—	A	A	A-B	A-B	A	A	A-B	—	—	
	Saturation	Room temperature	—	—	A	A	—	—	A	A	—	—	A	A	A-B	—	—	
	25	boiling	—	—	A	—	—	—	A	B	—	—	A	A	—	—	—	
Ammonium sulfate	1-5	Room temperature	—	—	A	A	—	—	A	—	A	A	A	A	A	A	A	
Copper sulfate	< 25	< 100	—	—	—	—	—	—	A	—	—	—	—	A	—	A	A	
Phosphoric acid	≦ 65	≦ 30	C	C	A < 50%	A	—	—	A	—	—	—	A	A	A < 50%	—	A	
		≦ 70	C	C	A	A	—	—	A	—	—	A	A	A	—	A < 25%	A	(h)
		boiling	C	C	A-B	A	—	—	A	—	—	—	A	A	—	—	A < 50%	
	65-85	≦ 30	C	C	C	A	—	—	A	—	—	B	A	—	—	—	—	
		≦ 90	C	C	C	A	—	—	A	—	—	B	A	—	—	—	—	
		boiling	C	C	C	C	—	—	A	—	—	C	A-B	—	—	—	—	

Note (a) Copper and copper alloy will explode when they contain water.
Note (b) SUS304 and SUS316 may develop pits or stress corrosion cracks.
Note (c) Stainless steel and carbon steel will be ranked "C" when they contain water.
Note (d) These materials will be ranked "B" or "C" when tantalum is 30 or over and in a boiling condition.
Note (e) Stainless steel may develop pitting.
Note (f) Data when air is contained.
Note (g) Data when air is not contained.
Note (h) Data when air is not contained in the case of monel.

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Printed in Japan 2-22-00