# SL-43, 44 Type Series Safety Relief Valve (Lift Type)

for Pressure Vessels, Secondary Side of Pressure Reducing Valves, etc.

These safety relief valves are designed as intermediary products with advantages of safety valves mainly used for steam and gases and those for liquids.
Compared with conventional safety valves made of cast iron, these products are shorter in height and therefore lighter in weight (based on in-house data).

SL-43 Type

SL-44 Type

## PRESSURE DIVISION (MPa)

| Code No. | Pressure division |
|---|---|
| 1 | 0.05~0.1 |
| 2 | Over 0.1~0.2 |
| 3 | Over 0.2~0.5 |
| 4 | Over 0.5~1.0 |

## FEATURES

- Most parts (excluding main body and spring case) are made of corrosion-resistant stainless steel.
- 22~36% lighter than old models.
- Can be used in the same way as SL-37, 38 Type series. (Parts other than main body, spring case, and valve seat are the same as those of SL-37, 38 Type and have the same performance.)

## SPECIFICATIONS

| Type | | Standard item(Metal seat type) | | Soft seat type | |
|---|---|---|---|---|---|
| Model name | | SL-43 | SL-44 | SL-43V | SL-44V |
| Code name | | SL43-G□ | SL44-G□ | SL43V-G□ | SL44V-G□ |
| | | ※ Code No. of pressure division is required in □. | | | |
| Cap type | | With lever*1. | Without lever | With lever | Without lever |
| Applicable fluid | | Steam, gases & liquids*2. | | Air, gases & liquids*2. | |
| Fluid temperature | | Max. 150 °C (Max. 220 °C. *1.) | −5~184 °C*3. | Max. 120 °C | |
| Set pressure range | | 0.05~1.0MPa | | | |
| End connection | | Flanged JIS 10KFF | | | |
| Materials | Body | Cast iron | | | |
| | Disc & seat ring | Stainless steel | | Stainless steel(disc tip:Synthetic rubber) | |
| Valve body pressure test | | Hydraulic 1.5MPa | | | |

*1. The product for steam has open lever and the applicable temperature is up to 220 °C.
*2. For application in a system that deals with kerosene or solvent, please contact our agents in your area.
*3. Products for fluid temperature up to 220°C are also available.

## DIMENSIONS (mm)

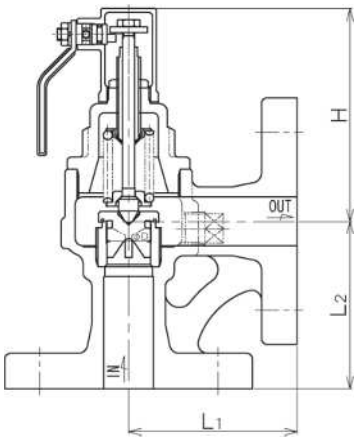
| Size | Seat opening dia. D | Effective area ($mm^2$) $\pi D\ell$ | Lift $\ell$ | Face to Face $L_1$ | Face to Face $L_2$ | Height H SL-43,43V Type | Height H SL-44,44V Type | Mass(kg) SL-43,43V Type | Mass(kg) SL-44,44V Type |
|---|---|---|---|---|---|---|---|---|---|
| 15(½″) | 14(13) | 17.5 | 0.4(0.43) | 70 | 70 | 99 | 89 | 2.5 | 2.4 |
| 20(¾″) | 19(18.6) | 29.8 | 0.5(0.51) | 75 | 75 | 103 | 94 | 3 | 2.9 |
| 25(1″) | 23(21.9) | 43.3 | 0.6(0.63) | 85 | 85 | 108 | 98 | 4.6 | 4.5 |
| 32(1 ¼″) | 32(29.4) | 80.3 | 0.8(0.87) | 95 | 90 | 131 | 122 | 6.2 | 6.1 |
| 40(1 ½″) | 40(36.7) | 125.6 | 1.0(1.09) | 100 | 95 | 137 | 128 | 7.8 | 7.7 |
| 50(2″) | 50(47.1) | 204.1 | 1.3(1.38) | 110 | 105 | 171 | 158 | 11.7 | 11.5 |

* Figures in ( ) are for SL-43V, 44V Type.

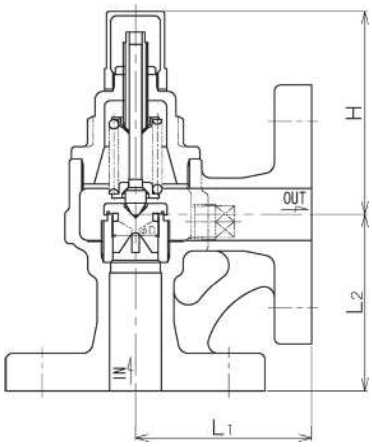
Flange code JIS 10KFF

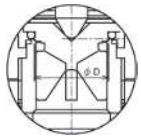
## CONSTRUCTION

SL-43 Type

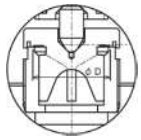



SL-44Type



Soft-seat type



Size 32mm

Note: See Page 65 for relieving capacity.

# Discharge Capacity

## 1. RELIEVING CAPACITY FOR STEAM (Pressure Vessel Construction Code)

(kg/h)

| Size | Set pressure(MPa) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.05 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
| 15(½″) | 13.5 | 17.5 | 25.4 | 34.2 | 42 | 50.6 | 59.2 | 67.7 | 76.3 | 84 | 92.4 |
| 20(¾″) | 23.1 | 29.8 | 43.3 | 58.2 | 71.6 | 86.2 | 100 | 115 | 129 | 143 | 157 |
| 25(1″) | 33.5 | 43.4 | 63 | 84.6 | 104 | 125 | 146 | 167 | 188 | 207 | 228 |
| 32(1¼″) | 62.2 | 80.4 | 116 | 156 | 193 | 232 | 271 | 310 | 350 | 385 | 424 |
| 40(1½″) | 97.4 | 125 | 182 | 245 | 302 | 363 | 424 | 486 | 547 | 602 | 663 |
| 50(2″) | 158 | 204 | 297 | 399 | 490 | 590 | 690 | 790 | 890 | 979 | 1070 |

※ In house data

Calculating formula:

$Qm=5.25CK_{dr}'AP$

Qm: Relieving capacity kg/h

$K_{dr}'$ : 0.864※ (Certified derated coefficient of discharge)

A : Seat opening area $mm^2$

P : Absolute pressure at relieving capacity (MPa・A)

(Select the larger one of set pressure × 1.1 + 0.101 or set pressure + 0.020 + 0.101.)

C': Coefficient depending on the nature of steam

(See Tab.1, Page 87.)

For saturated steam, see the following table:

| Absolute pressure at relieving capacity (MPa・A) | C': Coefficient depending on the nature of steam |
|---|---|
| Max. 0.5 | 1 |
| Over 0.5~1.0 | 0.98 |
| Over 1.0~2.0 | 0.97 |
| Over 2.0 | 0.96 |

For superheated steam, see the table 1 in Page 87.

## 2. RELIEVING CAPACITY FOR AIR (Pressure Vessel Construction Code)

(kg/h)

| Size | Set pressure(MPa) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.05 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
| 15(½″) | 21.7 | 28.3 | 41.2 | 55.3 | 69.5 | 83.6 | 97.7 | 111 | 126 | 140 | 154 |
| 20(¾″) | 37 | 48.3 | 70.2 | 94.3 | 118 | 142 | 166 | 190 | 214 | 238 | 262 |
| 25(1″) | 53.8 | 70.2 | 102 | 137 | 171 | 206 | 241 | 276 | 311 | 346 | 381 |
| 32(1¼″) | 99.8 | 130 | 189 | 254 | 318 | 383 | 448 | 513 | 578 | 643 | 708 |
| 40(1½″) | 156 | 203 | 296 | 397 | 498 | 600 | 701 | 803 | 904 | 1000 | 1100 |
| 50(2″) | 253 | 331 | 481 | 645 | 810 | 975 | 1140 | 1300 | 1470 | 1630 | 1790 |

※ In house data

Calculating formula:

$Qm=C''K_{dr}'P_1AK_b\sqrt{\frac{M}{ZT}}$

Qm : Relieving capacity kg/h

C" : 27.03 (coefficient)

$K_{dr}'$ : 0.864※ (Relieving coefficient)

$P_1$ : Absolute pressure at relieving capacity (MPa・A)

(Select the larger one of set pressure × 1.1 + 0.101 or set pressure + 0.020 + 0.101.)

A : Seat opening area $mm^2$

$K_b$: Back pressure compensation coefficient, which depends on $P_2/P_1$ and κ .

(See Tab.6, Page 89)

$P_2$: Absolute pressure of back pressure (MPa・A)

M : 28.96 (Molecular weight of air)

Z : 1※ (Compression coefficient)

T : 293 (Absolute temperature, K)

■Converting kg/h to $m^3/h$ (standard state) (for reference only)

Density of air 1.226kg/$m^3$ (standard state, 15℃,1atm)

$$m^3/h(\text{standard state}) = \frac{\text{Value in the above table (kg/h)}}{1.226kg/m^3}$$

## 3. RELIEVING CAPACITY FOR WATER AND HOT WATER (Pressure Vessel Construction Code)

(kg/h)

| Size | Set pressure(MPa) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.05 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
| 15(½″) | 375 | 531 | 742 | 875 | 976 | 1070 | 1150 | 1230 | 1310 | 1380 | 1450 |
| 20(¾″) | 640 | 905 | 1260 | 1490 | 1660 | 1820 | 1970 | 2110 | 2240 | 2360 | 2470 |
| 25(1″) | 930 | 1310 | 1830 | 2160 | 2410 | 2650 | 2860 | 3060 | 3250 | 3430 | 3600 |
| 32(1¼″) | 1720 | 2430 | 3400 | 4010 | 4480 | 4910 | 5310 | 5680 | 6030 | 6360 | 6680 |
| 40(1½″) | 2690 | 3810 | 5320 | 6280 | 7000 | 7690 | 8310 | 8890 | 9440 | 9950 | 10400 |
| 50(2″) | 4380 | 6200 | 8650 | 10200 | 11300 | 12400 | 13500 | 14400 | 15300 | 16100 | 16900 |

Calculating formula:

$W=87.7S\sqrt{(P_1+0.1)\kappa\gamma_1}$

$\left(S=\frac{W}{87.7\sqrt{(P_1+0.1)\kappa\gamma_1}}\right)$

(If $(P_1+0.1)\kappa > (P_1-P_2)$, replace $(P_1+0.1)\kappa$ with $(P_1-P_2)$)

W: Relieving capacity kg/h

S: Seat opening area $mm^2$

$P_1$: Relieving pressure MPa

Set pressure×1.2: 0.05MPa≦set pressure<0.17MPa

Set pressure+0.034: 0.17MPa≦set pressure<0.34MPa

Set pressure×1.1: 0.34MPa≦set pressure

$P_2$: Outlet pressure MPa

κ : Coefficient of correction (see Fig.2 in Page 90)

Δt: difference between saturation temperature at $P_1$ (Relieving pressure) and the temperature of water/hot water at inlet side of valve℃

$\gamma_1$: Density of water/hot water at inlet side of valve kg/L (water(15℃)=1)

■Converting kg/h to L/min (for reference only)

Weight of 1 liter water (L)≒ 1kg,

$$L/min = \frac{\text{Value in the above table (kg/h=L/h)}}{60}$$

# Extract from JIS B8210-2009 Spring Safety Valve for Steam and Gases

## ■ Allowed deviation of discharge-starting pressure

**(1) For steam**

There is no provision on the relief pressure of safety valve for steam.

**(2) For gases**

For valve for gases, the allowed deviation of start to discharge pressure is set pressure ±5% (minimum pressure: ±0.025MPa). In case of allowed deviation, which is not allowed to exceed set pressure,add the "+" side to "−" side.

**Note**: For valves for gases, the set pressure is generally the start to discharge pressure.

## ■ Allowed deviation of opening pressure (popping pressure)

**(1) For steam**

See Table 1 for the deviation of opening pressure. In case of allowed deviation, which is not allowed to exceed set pressure, add the "+" side to "−" side.

**(2) For gases**

For safety valves for gases, the allowed deviation of discharge-starting pressure is less then1.1 times of star to discharge pressure. However, in the case of setting opening pressure, the deviation should be ±3% set pressure (minimum±0.015MPa).

In case of allowed deviation, which is not allowed to exceed set pressure, add the "+" side to "−" side.

## ■ BLOWDOWN

**(1) For steam**

See Table 2 for the blowdown pressure of safety valves for steam. For valves for steam used with through flow boilers, re-heater, and piping, which opening pressure exceeds 0.3MPa, the blowdown pressure can be less than 10% of set pressure.

**(2) For gases**

See Table 3 for blowdown pressure of safety valves for gases.

Note: Unless otherwise specified in JIS B8210, Blowdown Standard of VENN shall apply.

## ■ Restriction of material use (pressure parts of safety valve) (Source: JIS B8210-2009)

**(1) For steam**

| Material of pressure parts | Allowed range |
|---|---|
| Cast iron | Set pressure: Max.1.6 MPa.<br>Fluid temperature: Max.230°C |
| Ductile iron casting | Set pressure: Max.2.4 MPa.<br>Fluid temperature: Max.350°C |

**(2) For gases**

| Gas type / Material of pressure parts | Toxic,flammable gases | Gases other than toxic,flammable gases | Toxic,flammable gases, other gases |
|---|---|---|---|
| | Allowed range | | |
| Cast iron | Not allowed | Set pressure: Max.0.2 MPa | Not allowed |
| Ductile cast iron | Set pressure: Max.0.2 MPa | Set pressure: Max.1.6 MPa | Not allowed |
| Ductile iron casting | A: Application in system for highly toxic gases such as phosgene and hydrogen cyanide,etc is not allowed.<br>B: For gases other than those mentioned in A, the set pressure should be Max.2.4 MPa.<br>C: Fluid temperature should be higher than -5°C and lower than 350°C. | | |

**TABLE1. TOLERANCE OF OPENING PRESSURE OF SAFETY VALVES FOR STEAM**

(MPa)

| Set pressure | Tolerance |
|---|---|
| Below 0.5 | ±0.015 |
| 0.5 or more and less than 2.3 | ±(3% of set pressure) |
| 2.3 or more and less than 7.0 | ±0.07 |
| 7.0 or more | ±(1% of set pressure) |

∗1. For steam, generally the set pressure is assumed to be the opening pressure.

∗2. The tolerance of the opening pressure of the safety valves for steam used other than in boilers can be ±3% of the set pressure (minimum value ±0.015MPa).

**TABLE2. BLOWDOWN PRESSURE OF SAFETY VALVES FOR STEAM**

(MPa)

| Set pressure | Blowdown |
|---|---|
| 0.4 or less | 0.03 |
| Over 0.4 | 7%(4%) or less of set pressure |

∗1. Generally, the blowdown pressure for steam shall be the difference between the opening pressure and the reseating pressure.

∗2. The figures in ( ) can be determinated in accordance with the agreement between the parties concerned.

**TABLE3. BLOWDOWN PRESSURE OF SAFETY VALVES FOR GASES**

(MPa)

| Set pressure | Blowdown | |
|---|---|---|
| | Metal seat type | Soft seat type |
| 0.2 or less | 0.03 or less | 0.05 or less |
| Over 0.2 | 15% or less of set pressure | 25% or less of set pressure |

∗1. Generally, the blowdown pressure for gases shall be the difference between the start to discharge pressure and the reseating pressure.
However, when set by the opening pressure, it shall be the difference between the opening pressure and the reseating pressure.

∗2. The definition of the soft seated and metal seated types shall be in accordance with JIS B0100.

Note. Unless otherwise specified in JIS B8210, Blowdown Standard of VENN shall apply.

# Applicable Laws & Regulations and Formulas for Calculating Relieving Capacity

Coefficients assigned to equations may be those specified in applicable laws/regulations or in-house data(※).

※In-house data

## 1. PRESSURE VESSEL CONSTRUCTION CODE (from JIS B8210-2009)

### (1) For Steam

$Qm=5.25C'K_{dr}'AP$

Qm: Relieving capacity (kg/h)

A : Seat opening area ($mm^2$)

Lift type: $A=\pi D\ell$

Full bore type: $A=\frac{\pi d^2}{4}$

D: Seat opening diameter (mm)

ℓ: Lift (mm)

d: Throat diameter (mm)

P: Absolute relieving pressure (MPa·A)

(Select the larger one of set pressure × 1.1 + 0.101 or set pressure + 0.020 + 0.101).

C': Coefficient determined according to the property of steam (See Tab.1 in Page 87.)

For saturated steam, see the following table:

| Absolute relieving pressure (MPa·A) | C': Coefficient determined according the property of steam |
|---|---|
| Max.0.5 | 1※ |
| over 0.5~1.0 | 0.98※ |
| over 1.0~2.0 | 0.97※ |
| over 2.0 | 0.96※ |

For superheated steam, See Tab1. in Page 87.

$K_{dr}'$: Relieving coefficient

Lift type:0.864※

Full bore type:0.777

### (2) For Gases

$Qm=C''K_{dr}'P_1AK_b\sqrt{\frac{M}{ZT}}$

Qm: Relieving capacity (kg/h)

A : Seat opening area ($mm^2$)

Lift type: $A=\pi D\ell$

Full bore type: $A=\frac{\pi d^2}{4}$

D: Seat opening diameter (mm)

ℓ: Lift (mm)

d: Throat diameter (mm)

Z: Compression coefficient: 1※ (See Fig.1 in Page 90)

T: Absolute temperature (K) of gases at relieving pressure

$P_1$: Relieving pressure (MPa·A)

(Select the larger one of set pressure × 1.1 + 0.101 or set pressure + 0.020 + 0.101. )

$P_2$: Back pressure (MPa·A)

C'': Coefficient determined according to κ (See Tab.5 in Page 88)

κ : Adiabatic exponent (Isentropic, See Tab.4 in Page 88).

The value will be 1.001 if it is not specified, in which case C''=23.95

$K_{dr}'$: Relieving coefficient

Lift type:0.864※

Full bore type:0.777

$K_b$: Back pressure compensation coefficient (Depending on $P_2/P_1$ and κ . See Tab.6 in Page 89 )

M: Molecular weight of gas (See Tab.4 in Page 88 )

### ■ Calculating maximum flow-in gas using the following formula:

$G=0.0028\,\upsilon\rho d^2$

G: Flow in gas (kg/h)

υ : Velocity of gas (m/sec)

(More than 20 for saturated steam, or more than 30 for super-heated steam, or more than 10 for common gas)

ρ : Density of gas ($kg/m^3$)

d : Internal diameter of pipe (mm)

### (3) For water/hot water (also applicable for hot water with temperature higher than 120°C)

(1) In case of searching from relieving capacity:

$$S=\frac{W}{87.7\sqrt{(P_1+0.1)\,\kappa\,\gamma_1}}$$

(2) In case of searching from thermal input of pressure vessel or thermal output of hot water boiler:

$$S=\frac{Q\varepsilon}{87.7C\sqrt{(P_1+0.1)\,\kappa\,\gamma_1}}$$

(If $(P_1+0.1)^{\kappa} > (P_1-P_2)$ in formula (1) and (2), replace $(P_1-P_2)$ with $(P_1+0.1)^{\kappa}$ )

S : Seat opening area ($mm^2$)

W: Relieving capacity of valve (kg/h)

$P_1$: Relieving pressure (MPa) (See Note)

Lift type: set pressure ×1.1

For SL-37~40, 43,44 type,see Page 65.

Full bore type: select the larger one of set pressure×1.15 or set pressure +0.034

Relief valve (type E・ED): select the larger one of set pressure×1.25 or set pressure +0.034

$P_2$: Outlet pressure (MPa)

κ : Coefficient correction (See Fig.2 in Page 90)

Δt: Difference between the saturated temperature of relieving pressure $P_1$ and the temperature of hot water at inlet. (°C)

$\gamma_1$: Density of the hot water at inlet (kg/L) (See Tab.2 in Page 87)

Q : Thermal input of pressure vessel or thermal output of hot water boiler (kJ/h)

ε : Coefficient of volumetrical expansion for water(1/°C) (See Tab.3 in Page 87)

C: Specific heat of water at constant pressure (kJ/kg°C) (See Tab.3 in Page 87)

Note: In the case of full-bore valve and relief valve, make sure the relieving pressure ($P_1$) does not exceed "maximum working pressure of pressure vessel or hot water boiler X 1.1" or "maximum working pressure + 0.034".

# Applicable Laws & Regulations and Formulas for Calculating Relieving Capacity

Coefficients assigned to equations may be those specified in applicable laws/regulations or in-house data (※). ※In-house data

## 2. BOILER CONSTRUCTION CODE (from JIS B8210-2009)

### (1) For Steam

$Qm=5.25C'K_{dr}'AP$

Qm: Relieving capacity (kg/h)

A : Seat opening area ($mm^2$)

Lift type: $A=\pi D\ell$

Full bore type: $A=\frac{\pi d^2}{4}$

D: Seat opening diameter (mm)

ℓ: Lift (mm)

d: Throat diameter (mm)

P: Absolute relieving pressure (MPa·A)

(Select the larger one of set pressure × 1.03 + 0.101 or set pressure + 0.015 + 0.101)

C': Coefficient determined according the property of steam (See Tab.1 in Page 87)

For saturated steam, see the following table:

| Absolute relieving pressure (MPa·A) | C': Coefficient determined according the property of steam |
|---|---|
| Max.0.5 | 1※ |
| over 0.5~1.0 | 0.98※ |
| over 1.0~2.0 | 0.97※ |
| over 2.0 | 0.96※ |

For superheated steam, see Tab.1 in Page 87.

$K_{dr}'$: Relieving coefficient

Lift type:0.864※

Full bore type:0.777

### (2) For hot water (applicable when temperature is less than 120°C. If temperature is higher than 120 °C, then use the formula described in (1))

(1) In case of searching from relieving capacity:

$$S=\frac{W}{87.7\sqrt{(P_1+0.1)\,\kappa\,\gamma_1}}$$

(2) In case of searching from thermal input of pressure vessel thermal output of hot water boiler:

$$S=\frac{Q\varepsilon}{87.7C\sqrt{(P_1+0.1)\,\kappa\,\gamma_1}}$$

In formula (i) and (ii), if $(P_1+0.1)\,\kappa > (P_1-P_2)$, then $(P_1+0.1)\kappa$ should be replaced by $(P_1-P_2)$.

S: Seat opening area ($mm^2$)

W: Required relieving capacity of valve (kg/h)

Note: In the case of full-bore valve and relief valve, make sure the relieving pressure ($P_1$) does not exceed "maximum working pressure of pressure vessel or hot water boiler X 1.1" or "maximum working pressure + 0.034".

$P_1$: Relieving pressure (MPa) (see Note)

Lift type: set pressure ×1.1

For SL-37~40,43,44 type see Page 65.

Full bore type: select the larger one of set pressure×1.15 or set pressure +0.034

Relief valve (type E・ED): select the larger one of set pressure×1.25 or set pressure +0.034

$P_2$: Outlet pressure (MPa)

$\kappa$ : Coefficient correction (See Fig.2 in Page 90)

$\Delta t$: Difference between the saturated temperature of relieving pressure $P_1$ and the temperature of hot water at inlet. (°C)

$\gamma_1$: Density of the hot water at inlet (kg/L) (See Tab.2 in Page 87)

Q : Thermal input of pressure vessel or thermal output of hot water boiler (kJ/h)

$\varepsilon$ : Coefficient of volumetrical expansion for water(1/°C) (See Tab.3 in Page 87)

C: Specific heat of water at constant pressure (kJ/kg°C) (See Tab.3 in Page 87)

**■ NOTE**

It is necessary installing safety valve when water temperature exceeds 120°C. The fomula is as the following:

$Qm=5.25C'K_{dr}'AP$

In this case, the required relieving capacity (kg/h) of safety valve can be calculated using the following fomula:

$$W=\frac{Q}{h_1-h_2}$$

W: Required relieving capacity of safety valve (kg/h)

Q: Thermal output of hot water boiler (kJ/h)

$h_1$: Enthalpy of saturated steam that is equivalent to the maximum working pressure of boiler (kJ/kg).

$h_2$: Enthalpy of water supply (kJ/kg)

$$W=\frac{Q\varepsilon}{C}$$

$\varepsilon$ : Coefficient of volumetrical expansion of water (1/°C) (See Tab.3 in Page 87)

C: Specific heat of water at constant pressure (kJ/kg°C) (See Tab.3 in Page 87)

### (3) For dowtherm boiler

$$Qm=C''K_{dr}'P_1AK_b\sqrt{\frac{M}{ZT}}$$

Qm: Relieving capacity (kg/h)

A : Seat opening area ($mm^2$)

Lift type: $A=\pi D\ell$

Full bore type: $A=\frac{\pi d^2}{4}$

D: Seat opening diameter (mm)

ℓ: Lift (mm)

d: Throat diameter (mm)

Z: Compression coefficient: 1※ (See Fig.1 in Page 90)

T: Absolute temperature (K) of gases at absolute relieving pressure

$P_1$: Absolute relieving pressure (MPa·A)

(Select the larger one of set pressure × 1.1 + 0.101 or set pressure + 0.020 + 0.101)

$P_2$: Absolute back pressure (MPa·A)

C': Coefficient determined according to $\kappa$ (See Tab.5, Page 88)

$\kappa$ : Adiabatic exponent (Isentropic, See Tab.4 in Page 88)

The value will be 1.001 if it is not specified, in which case C"=23.95

$K_{dr}'$: Relieving coefficient

Lift type:0.864※

Full bore type:0.777

$K_b$: Back pressure compensation coefficient (Depending on $P_2/P_1$ and $\kappa$ . See Tab.6 in Page 89 )

M: Molecular weight of air (See Tab.4 in Page 88 )

# Applicable Laws & Regulations and Formulas for Calculating Relieving Capacity

Coefficients assigned to equations may be those specified in applicable laws/regulations or in-house data (※).

※In-house data

## 3. JIS B8210-2009: SPRING SAFETY VALVE FOR STEAM AND GAS

### (1) For Steam

$Qm=5.25C'K_{dr}'AP$

Qm: Relieving capacity (kg/h)

A : Seat opening area ($mm^2$)

Lift type: $A=\pi D\ell$

Full bore type: $A=\frac{\pi d^2}{4}$

D: Seat opening diameter (mm)

ℓ: Lift (mm)

d: Throat diameter (mm)

P: Absolute relieving pressure (MPa·A)

Products for boiler: (Select the larger one of set pressure × 1.03 + 0.101 or set pressure + 0.015 + 0.101)

Products for pressure vessels: (Select the larger one of set pressure × 1.1 + 0.101 or set pressure + 0.020 + 0.101)

C': Coefficient determined according to the property of steam (See Tab.1 in Page 87.)

For saturated steam, see the following table:

| Absolute flow rating pressure (MPa·A) | C': Coefficient depending on the nature of steam |
|---|---|
| Max.0.5 | 1※ |
| Over 0.5~1.0 | 0.98※ |
| Over 1.0~2.0 | 0.97※ |
| Over 2.0 | 0.96※ |

For superheated steam, See the table in Page 87.

$K_{dr}'$: Relieving coefficient

Lift type:0.864※

Full bore type:0.777

### (2) For Gases

$Qm=C''K_{dr}'P_1AK_b\sqrt{\frac{M}{ZT}}$

Qm: Relieving capacity (kg/h)

A : Seat opening area ($mm^2$)

Lift type: $A=\pi D\ell$

Full bore type: $A=\frac{\pi d^2}{4}$

D: Seat opening diameter (mm)

ℓ: Lift (mm)

d: Throat diameter (mm)

Z: Compression coefficient: 1※ (See Fig.1 in Page 90)

T: Absolute temperature (K) of gases at relieving pressure

$P_1$: Absolute relieving pressure (MPa·A)
(Select the larger one of set pressure × 1.1 + 0.101 or set pressure + 0.020 + 0.101)

$P_2$: Absolute back pressure (MPa·A)

C'': Coefficient determined according to κ (See Tab.5 in Page 88)

κ : adiabatic exponent (See Tab.4, Page 88)
The value will be 1.001 if it is not specified, in which case C"=23.95

$K_{dr}'$: Relieving coefficient
Lift type:0.864※
Full bore type:0.777

$K_b$: Back pressure compensation coefficient (Depending on $P_2/P_1$ and κ . See Tab.6 in Page 89 )

M: Molecular weight of air (See Tab.4 in Page 88 )

## 4. ELECTRICITY BUSINESS ACT (Technical Standard for Thermal Equipments for Power Generation) (Formula source: JIS B8210-1994)

■ **Applicable for boilers and supporting equipments**

### (1) For Steam

$Qm=5.246CK_d'A(P+0.1)\times 0.9$

Qm: Relieving capacity (kg/h)

A : Seat opening area ($mm^2$)

Lift type: $A=\pi D\ell$

Full bore type: $A=\frac{\pi d^2}{4}$

D: Seat opening diameter (mm)

ℓ: Lift (mm)

d: Throat diameter (mm)

P: Relieving pressure (MPa)
Set pressure≦0.1 MPa: Set pressure + 0.02
Set pressure >0.1 MPa: Set pressure × 1.03

C: Coefficient determined according to the property of steam (See Tab.1 in Page 87)
Set pressure is<0.5MPa·A, at saturated pressure:1
Set pressure is≧0.5MPa·A, at saturated pressure:0.98
Superheated steam: Please contact our agent in your area.

$K_d'$: Rated discharge coefficient
Lift type:0.96※
Full bore type:0.864

### (2) For Gases

$Qm=C'Kd'AP_1\sqrt{\frac{M}{ZT}}\times 0.9$

Qm: Relieving capacity (kg/h)

A : Seat opening area ($mm^2$)

Lift type: $A=\pi D\ell$

Full bore type: $A=\frac{\pi d^2}{4}$

D: Seat opening diameter (mm)

ℓ: lift (mm)

d: throat diameter (mm)

Z: Compression coefficient: 1※ (See Fig.1 in Page 90)

T: Absolute temperature (K) of gases at absolute relieving pressure

C': Coefficient determined according to κ and $P_2/P_1$ (See Fig.3 in Page 90)

κ : Adiabatic exponent ($C_\rho/C_\upsilon$) (See Tab.4 in Page 88)
The value is considered as 1 if it is not clear.

$P_2$: Absolute back pressure (MPa·A)

$K_d'$: Relieving coefficient
Lift type:0.96※
Full bore type:0.864

$P_1$: Absolute relieving pressure (MPa·A)
(Absolute value of "set pressure×1.1")

M: Molecular weight of gas (See Tab.4 in Page 88)

# Applicable Laws & Regulations and Formulas for Calculating Relieving Capacity

Coefficients assigned to equations may be those specified in applicable laws/regulations or in-house data (※).

※In-house data

## 5. IN-HOUSE STANDARDS (for liquids other than water and hot water)

$$W=161\times AK\sqrt{PG}$$

W: Relieving capacity (kg/h)
A: Seat opening area ($mm^2$)
Lift type: $A=\pi D\ell$
Full bore type: $A=0.785d^2$
D: Seat opening diameter (mm)
ℓ: Lift (mm)
d: Throat diameter (mm)

G: Specific gravity upon the inlet side temperature
P: Relieving pressure (MPa)
K: Flow coefficient
Lift type: 0.55 for upper guide type
0.45 for blade type [ The value may be different depending on type and accumulation ]
Full bore type: 0.60

## TABLE1. COEFFICIENT ACCORDING TO PROPERTY OF STEAM C' (JIS B8210-2009)

| Absolute pressure (MPa) \ Temp. (℃) | Saturated temperature | 200 | 220 | 240 | 260 | 280 | 300 | 320 | 340 | 360 | 380 | 400 | 420 | 440 | 460 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| 1.0 | 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 |
| 1.5 | 0.976 | 0.975 | 0.969 | 0.969 | 0.946 | 0.925 | 0.906 | 0.888 | 0.871 | 0.855 | 0.843 | 0.826 | 0.813 | 0.800 | 0.788 |
| 2.0 | 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 |
| 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 |
| 3.0 | 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 |
| 4.0 | 0.964 | | | | 0.957 | 0.953 | 0.939 | 0.915 | 0.895 | 0.875 | 0.857 | 0.841 | 0.826 | 0.811 | 0.798 |
| 5.0 | 0.965 | | | | | 0.955 | 0.952 | 0.929 | 0.905 | 0.884 | 0.865 | 0.847 | 0.831 | 0.816 | 0.802 |
| 6.0 | 0.968 | | | | | 0.962 | 0.953 | 0.943 | 0.917 | 0.893 | 0.873 | 0.854 | 0.837 | 0.821 | 0.807 |
| 7.0 | 0.971 | | | | | | 0.959 | 0.954 | 0.930 | 0.904 | 0.881 | 0.861 | 0.843 | 0.826 | 0.811 |
| 8.0 | 0.975 | | | | | | 0.968 | 0.956 | 0.944 | 0.915 | 0.890 | 0.869 | 0.849 | 0.832 | 0.816 |
| 9.0 | 0.980 | | | | | | | 0.963 | 0.960 | 0.927 | 0.900 | 0.877 | 0.856 | 0.837 | 0.820 |
| 10.0 | 0.987 | | | | | | | 0.972 | 0.962 | 0.941 | 0.911 | 0.885 | 0.863 | 0.843 | 0.825 |
| 12.0 | 1.000 | | | | | | | | 0.977 | 0.973 | 0.935 | 0.904 | 0.878 | 0.856 | 0.836 |
| 14.0 | 1.019 | | | | | | | | 1.005 | 0.982 | 0.964 | 0.926 | 0.896 | 0.870 | 0.848 |
| 16.0 | 1.039 | | | | | | | | | 1.005 | 1.001 | 0.952 | 0.916 | 0.886 | 0.861 |
| 18.0 | 1.068 | | | | | | | | | 1.044 | 1.007 | 0.977 | 0.933 | 0.903 | 0.875 |
| 20.0 | 1.100 | | | | | | | | | | 1.036 | 1.011 | 0.958 | 0.917 | 0.890 |

* When pressure/temperature is an intermediate value, it is necessary to take the minimum value of absolute pressure/temperature division and do not apply the proportional method. When absolute pressure is below 0.5 MPa·A, then 0.5 MPa·A should be used as absolute pressure. For example, when relieving pressure (absolute pressure) is 1.6 MPa·A and temperature is 245°C, C' = 0.946.

## TABLE2. HOT WATER SPECIFIC GRAVITY $\gamma_t$(kg/L)

(Source: Interpretation of Boiler Structure Standard)

| Temp.℃ \ Pressure MPa・A | 0.1 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | 0.992 | 0.992 | 0.992 | 0.993 | 0.993 | 0.993 | 0.993 | 0.993 | 0.993 | 0.993 | 0.993 | 0.993 | 0.993 |
| 50 | 0.998 | 0.988 | 0.988 | 0.988 | 0.988 | 0.988 | 0.989 | 0.989 | 0.989 | 0.989 | 0.989 | 0.989 | 0.989 |
| 60 | 0.983 | 0.983 | 0.983 | 0.983 | 0.983 | 0.984 | 0.984 | 0.984 | 0.984 | 0.984 | 0.984 | 0.984 | 0.984 |
| 70 | 0.978 | 0.978 | 0.978 | 0.978 | 0.978 | 0.978 | 0.978 | 0.978 | 0.978 | 0.978 | 0.979 | 0.979 | 0.979 |
| 80 | 0.972 | 0.972 | 0.972 | 0.972 | 0.972 | 0.972 | 0.972 | 0.972 | 0.972 | 0.972 | 0.973 | 0.973 | 0.973 |
| 90 | 0.965 | 0.965 | 0.965 | 0.965 | 0.965 | 0.966 | 0.966 | 0.966 | 0.966 | 0.966 | 0.966 | 0.966 | 0.966 |
| 100 | | 0.958 | 0.958 | 0.958 | 0.958 | 0.959 | 0.959 | 0.959 | 0.959 | 0.959 | 0.959 | 0.959 | 0.959 |
| 110 | | 0.951 | 0.951 | 0.951 | 0.951 | 0.951 | 0.951 | 0.951 | 0.951 | 0.951 | 0.952 | 0.952 | 0.952 |
| 120 | | 0.943 | 0.943 | 0.943 | 0.943 | 0.943 | 0.943 | 0.943 | 0.944 | 0.944 | 0.944 | 0.944 | 0.944 |
| 130 | | | 0.935 | 0.935 | 0.935 | 0.935 | 0.935 | 0.935 | 0.935 | 0.935 | 0.935 | 0.936 | 0.936 |
| 140 | | | 0.926 | 0.926 | 0.926 | 0.926 | 0.926 | 0.926 | 0.927 | 0.927 | 0.927 | 0.927 | 0.927 |
| 150 | | | | 0.917 | 0.917 | 0.917 | 0.917 | 0.917 | 0.917 | 0.918 | 0.918 | 0.918 | 0.918 |
| 160 | | | | | 0.907 | 0.908 | 0.908 | 0.908 | 0.908 | 0.908 | 0.908 | 0.908 | 0.908 |
| 170 | | | | | 0.897 | 0.897 | 0.898 | 0.898 | 0.898 | 0.898 | 0.898 | 0.898 | 0.898 |
| 180 | | | | | | | 0.887 | 0.887 | 0.887 | 0.887 | 0.888 | 0.888 | 0.888 |
| 190 | | | | | | | | 0.876 | 0.876 | 0.876 | 0.877 | 0.877 | 0.877 |
| 200 | | | | | | | | | 0.865 | 0.865 | 0.865 | 0.865 | 0.865 |
| 210 | | | | | | | | | | | 0.853 | 0.853 | 0.853 |
| 220 | | | | | | | | | | | | | 0.841 |

Note: Intermediate value should be calculated using the proportional method.
* Water density should be "1" when temperature is lower than 40°C.

## TABLE3. SPECIFIC HEAT AND EXPANSION COEFFICIENT OF HOT WATER

(Source: Interpretation of Boiler Structure Standard)

| Temp.℃ | Specific heat of water at constant pressure C kJ/kg℃ | Expansion coefficient ε 1/℃ |
|---|---|---|
| Below 40℃ | 4.150 | 0.00039 |
| 40 | 4.179 | 0.00039 |
| 50 | 4.181 | 0.00046 |
| 60 | 4.185 | 0.00053 |
| 70 | 4.190 | 0.00060 |
| 80 | 4.197 | 0.00066 |
| 90 | 4.205 | 0.00072 |
| 100 | 4.216 | 0.00079 |
| 110 | 4.229 | 0.00085 |
| 120 | 4.245 | 0.00090 |
| 130 | 4.263 | 0.00097 |
| 140 | 4.285 | 0.00103 |
| 150 | 4.310 | 0.00110 |
| 160 | 4.339 | 0.00118 |
| 170 | 4.371 | 0.00126 |
| 180 | 4.408 | 0.00134 |
| 190 | 4.449 | 0.00145 |
| 200 | 4.497 | 0.00155 |
| 210 | 4.551 | 0.00165 |
| 220 | 4.613 | 0.00179 |

Note: Intermediate value should be calculated using the proportional method.

# Applicable Laws & Regulations and Formulas for Calculating Relieving Capacity

## TABLE4. GAS PROPERTY

(JIS B8210-2009)

| Gas names | Chemical symbol | Molecular weight *M* (kg/kmol) | Adiabatic (isentropic) index κ (1.013bar a,15℃) | Critical pressure *Pc* (bar a.) | Critical temp. *Tc* (K) | Critical pressure ratio |
|---|---|---|---|---|---|---|
| Acetylene | $C_2H_2$ | 26.02 | 1.26 | 62.82 | 309.15 | 0.553 |
| Air | — | 28.96 | 1.40 | 37.69 | 132.45 | 0.528 |
| Ammonia | $NH_3$ | 17.03 | 1.31 | 112.98 | 405.55 | 0.544 |
| Argon | Ar | 39.91 | 1.66 | 48.64 | 151.15 | 0.488 |
| Normal butane | $C_4H_{10}$ | 58.08 | 1.11 | 36.48 | 426.15 | 0.583 |
| Carbon dioxide | $CO_2$ | 44.00 | 1.30 | 73.97 | 304.25 | 0.546 |
| Carbon monoxide | CO | 28.00 | 1.40 | 35.46 | 134.15 | 0.528 |
| Chlorine | $Cl_2$ | 70.91 | 1.35 | 77.11 | 417.15 | 0.537 |
| Chlorofluoromethane | $CHClF_2$ | 86.47 | 1.18 | 49.14 | 370.15 | 0.568 |
| Ethane | $C_2H_6$ | 30.05 | 1.22 | 49.45 | 305.25 | 0.561 |
| Ethylene | $C_2H_4$ | 28.03 | 1.25 | 51.57 | 282.85 | 0.555 |
| Hydrogen | $H_2$ | 2.015 | 1.41 | 12.97 | 33.25 | 0.527 |
| Hydrogen chloride | HCl | 36.46 | 1.41 | 82.68 | 324.55 | 0.527 |
| Hydrogen sulfide | $H_2S$ | 34.08 | 1.32 | 90.08 | 373.55 | 0.542 |
| Isobutane | $CH(CH_3)_3$ | 58.08 | 1.11 | 37.49 | 407.15 | 0.583 |
| Methane | $CH_4$ | 16.03 | 1.31 | 46.41 | 190.65 | 0.544 |
| Methyl chloride | $CH_3Cl$ | 50.48 | 1.28 | 66.47 | 416.25 | 0.549 |
| Nitrogen | $N_2$ | 28.02 | 1.40 | 33.94 | 126.05 | 0.528 |
| Nitrogen suboxide | $N_2O$ | 44.02 | 1.30 | 72.65 | 309.65 | 0.546 |
| Oxygen | $O_2$ | 32.00 | 1.40 | 50.36 | 154.35 | 0.528 |
| Propane | $C_3H_3$ | 44.06 | 1.13 | 43.57 | 368.75 | 0.579 |
| Propylene | $C_3H_6$ | 42.05 | 1.15 | 46.60 | 365.45 | 0.574 |
| Sulfur dioxide | $SO_2$ | 64.07 | 1.29 | 78.73 | 430.35 | 0.548 |

## TABLE5. COEFFICIENT DEPENDING ON ADIABATIC (ISENTROPIC) EXPONENT ( $\kappa$ ) (C") (JIS B8210-2009)

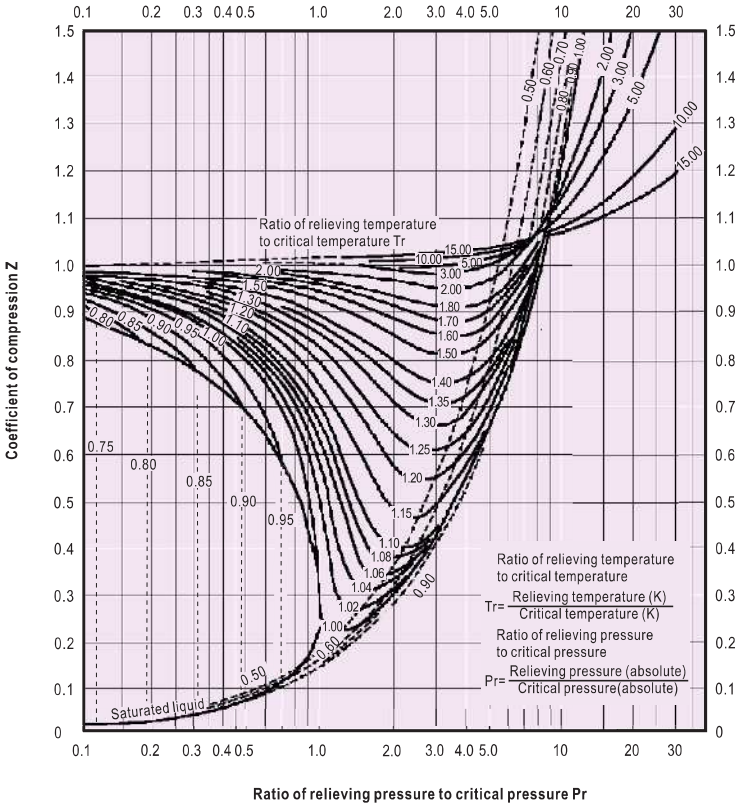
| κ | C" | κ | C" | κ | C" | κ | C" | κ | C" | κ | C" |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.41 | 16.65 | 0.71 | 20.96 | 1.01 | 24.04 | 1.31 | 26.41 | 1.61 | 28.34 | 1.91 | 29.96 |
| 0.42 | 16.82 | 0,72 | 21.08 | 1.02 | 24.12 | 1.32 | 26.49 | 1.62 | 28.40 | 1.92 | 30.01 |
| 0.43 | 17.00 | 0.73 | 21.20 | 1.03 | 24.21 | 1.33 | 26.56 | 1.63 | 28.46 | 1.93 | 30.06 |
| 0.44 | 17.17 | 0.74 | 21.31 | 1.04 | 24.30 | 1.34 | 26.63 | 1.64 | 28.52 | 1.94 | 30.10 |
| 0.45 | 17.33 | 0.75 | 21.43 | 1.05 | 24.39 | 1.35 | 26.69 | 1.65 | 28.58 | 1.95 | 30.15 |
| 0.46 | 17.50 | 0.76 | 21.54 | 1.06 | 24.47 | 1.36 | 26.76 | 1.66 | 28.63 | 1.96 | 30.20 |
| 0.47 | 17.66 | 0.77 | 21.65 | 1.07 | 24.56 | 1.37 | 26.83 | 1.67 | 28.69 | 1.97 | 30.25 |
| 0.48 | 17.82 | 0.78 | 21.76 | 1.08 | 24.64 | 1.38 | 26.90 | 1.68 | 28.74 | 1.98 | 30.30 |
| 0.49 | 17.98 | 0.79 | 21.87 | 1.09 | 24.72 | 1.39 | 26.97 | 1.69 | 28.80 | 1.99 | 30.34 |
| 0.50 | 18.13 | 0.80 | 21.98 | 1.10 | 24.81 | 1.40 | 27.03 | 1.70 | 28.86 | 2.00 | 30.39 |
| 0.51 | 18.29 | 0.81 | 22.09 | 1.11 | 24.89 | 1.41 | 27.10 | 1.71 | 28.91 | 2.01 | 30.44 |
| 0.52 | 18.44 | 0.82 | 22.19 | 1.12 | 24.97 | 1.42 | 27.17 | 1.72 | 28.97 | 2.02 | 30.49 |
| 0.53 | 18.58 | 0.83 | 22.30 | 1.13 | 25.05 | 1.43 | 27.23 | 1.73 | 29.02 | 2.03 | 30.53 |
| 0.54 | 18.73 | 0.84 | 22.40 | 1,14 | 25.13 | 1.44 | 27.30 | 1.74 | 29.08 | 2.04 | 30.58 |
| 0.55 | 18.88 | 0.85 | 22.51 | 1.15 | 25.21 | 1.45 | 27.36 | 1.75 | 29.13 | 2.05 | 30.63 |
| 0.56 | 19.02 | 0.86 | 22.61 | 1.16 | 25.29 | 1.46 | 27.43 | 1.76 | 29.18 | 2.06 | 30.67 |
| 0.57 | 19.16 | 0.87 | 22.71 | 1.17 | 25.37 | 1.47 | 27.49 | 1.77 | 29.24 | 2.07 | 30,72 |
| 0.58 | 19.30 | 0.88 | 22.81 | 1.18 | 25.45 | 1.48 | 27.55 | 1.78 | 29.29 | 2.08 | 30.76 |
| 0.59 | 19.44 | 0.89 | 22.91 | 1.19 | 25.53 | 1.49 | 27.62 | 1.79 | 29.34 | 2.09 | 30.81 |
| 0.60 | 19.57 | 0.90 | 23.01 | 1.20 | 25.60 | 1.50 | 27.68 | 1.80 | 29.40 | 2.10 | 30.85 |
| 0.61 | 19.71 | 0.91 | 23.11 | 1.21 | 25.68 | 1.51 | 27.74 | 1.81 | 29.45 | 2.11 | 30.90 |
| 0.62 | 19.84 | 0.92 | 23.20 | 1.22 | 25.76 | 1.52 | 27.80 | 1.82 | 29.50 | 2.12 | 30.94 |
| 0.63 | 19.97 | 0.93 | 23.30 | 1.23 | 25.83 | 1.53 | 27.86 | 1.83 | 29.55 | 2.13 | 30.99 |
| 0.64 | 20.10 | 0.94 | 23.39 | 1.24 | 25.91 | 1.54 | 27.93 | 1.84 | 29.60 | 2.14 | 31.03 |
| 0.65 | 20.23 | 0.95 | 23.49 | 1.25 | 25.98 | 1.55 | 27.99 | 1.85 | 29.65 | 2.15 | 31.07 |
| 0.66 | 20.35 | 0.96 | 23.58 | 1.26 | 26.05 | 1.56 | 28.05 | 1.86 | 29.71 | 2.16 | 31.12 |
| 0.67 | 20.48 | 0.97 | 23.67 | 1.27 | 26.13 | 1.57 | 28.11 | 1.87 | 29.76 | 2.17 | 31.16 |
| 0.68 | 20.60 | 0,98 | 23.76 | 1.28 | 26.20 | 1.58 | 28.17 | 1.88 | 29.81 | 2.18 | 31.21 |
| 0,69 | 20.72 | 0.99 | 23.86 | 1.29 | 26.27 | 1.59 | 28.23 | 1.89 | 29.86 | 2.19 | 31.25 |
| 0.70 | 20.84 | 1.001 | 23.95 | 1.30 | 26.34 | 1.60 | 28.29 | 1.90 | 29.91 | 2.20 | 31.29 |

Note: Intermediate value should be calculated using the interpolational method.

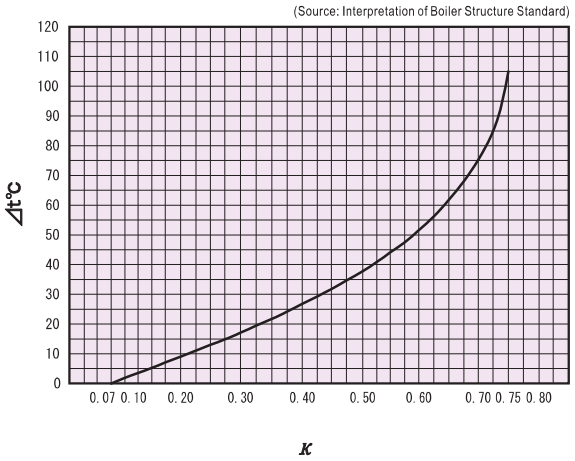
Calculation formula

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

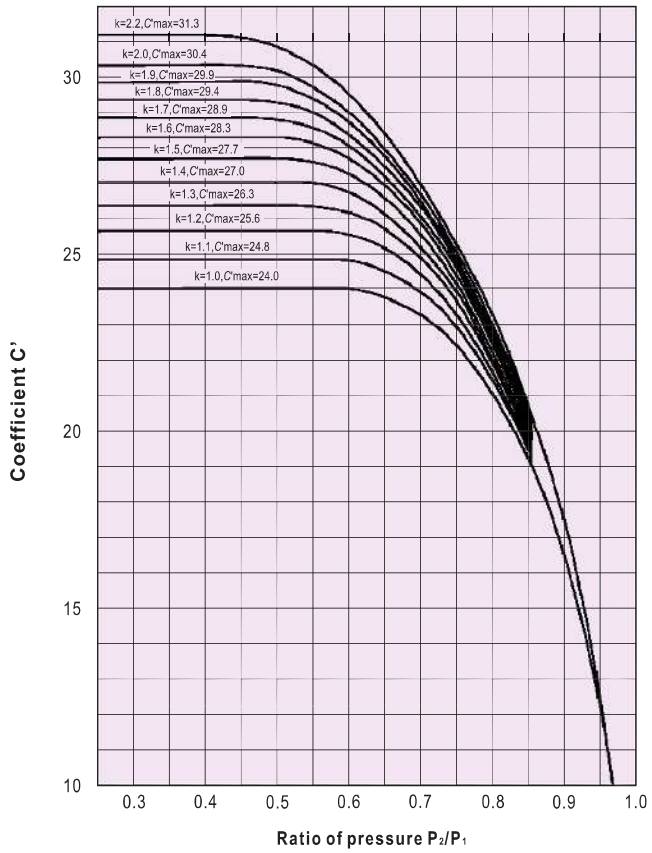
## Fig.1 Coefficient of compressibility Z (JIS B8210-2009)




## Fig.2 Δt°C correction coefficient κ




## Fig.3 Coefficient (C') based on κ and $P_2/P_1$ (JIS B8210-2009)



# Key Points for Installation of Safety Valves and Relief Valves

## 1. Installation

❶ Safety valve should be vertical to pipe. Before installation, remove scale and dust and clean the surfaces that contact with gasket.

❷ The diameter of the installation pipe should be larger than the diameter of valve. To reduce pressure loss to minimum degree, the stand pipe should be as short as possible.

❸ The stand pipe should be rigid and hard enough to bear the compression force, shearing force, bending stress or other counterforce caused by relieving of safety valve.

❹ Compared with the diameter of the outlet of safety valve, the diameter of the discharge pipe should be as large as possible. The discharge pipe should be as short as possible, without any bending, lead to outside of the door or other safe place, and be properly supported to avoid the occurrence of undesired stress (including thermal stress).

When deciding the place that the outlet of the discharge pipe faces, pay attention to the following issues.

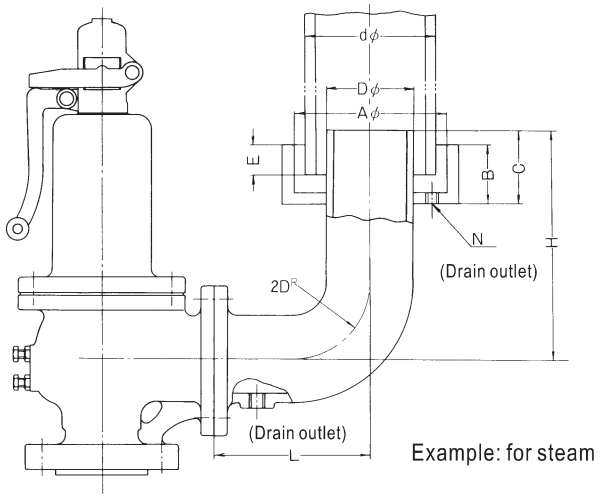
- To avoid installation place where is influenced by explosive sound and blast.
- Avoid damage to electrical equipments, machines, tools etc. in the case the fluid is steam or water.
- Avoid corrosion, poisoning, anoxia etc. in the case the fluid is harmful gas.
- In the case of screwed type safety valve or relief valve, install union joint at the discharge pipe of the outlet side to allow easy dismounting (see Fig.1 in next page).

❺ At parts of the discharge pipe where drain or rain may accumulate, install the drain outlet, which is possible to discharge drain completely,and connect to dike.

❻ In the case of full bore type safety valve for liquids or harmful gases and have faucet for adjusting back pressure, install the valve on the outlet discharge pipe (see Fig.3 in next page).

❼ To avoid adverse impact on safety valve that is caused by thermal expansion of devices or discharge pipe, install proper expansion joint at the outlet of valve and install a discharge pipe at the end (see the figure below). To limit counterforce, the distance between the axes of the valve and the center of discharge pipe should be as short as possible, and the radius of the elbow pipe should be at least 2D (D: the internal diameter of the elbow). below figure also shows the standard dimensions of the discharge pipe of safety valve.

❽ Cares should be paid on installation of valves with lever (open type). It may effuse fluid from upper cap when such valves are operating (see Fig.5 in the next page).




Example: for steam

■ **REFERENCE DIMENSION FOR EXHAUST PIPE** (mm)

| Outlet size | D | d | (A) | B | C | E | L | H | N |
|---|---|---|---|---|---|---|---|---|---|
| 40(1½″) | 40 | 65 | 130 | 60 | 80 | 30 | 130 | 220 | Rc⅜″ |
| 50(2″) | 50 | 80 | 150 | 60 | 90 | 40 | 150 | 230 | Rc½″ |
| 65(2½″) | 65 | 100 | 200 | 60 | 100 | 40 | 180 | 270 | Rc½″ |
| 80(3″) | 80 | 125 | 200 | 70 | 120 | 50 | 200 | 310 | Rc½″ |
| 100(4″) | 100 | 150 | 250 | 70 | 140 | 60 | 250 | 370 | Rc¾″ |
| 125(5″) | 125 | 200 | 300 | 80 | 160 | 70 | 300 | 430 | Rc1″ |
| 150(6″) | 150 | 200 | 300 | 80 | 180 | 70 | 350 | 500 | Rc1″ |
| 200(8″) | 200 | 250 | 380 | 100 | 220 | 80 | 450 | 610 | Rc1″ |

## 2. Maintenance and operating instructions

❶ At the installation of safety valves avoid the place where there is possibility to obstruct their functions by vibration or corrosion and do not give impact from outside.

❷ After installation, make sure the pressure of the device has reached at least 75% discharge pressure of the valve before using the test lever to start the valve.

❸ Normal working pressure of the equipment shall not exceed 90% of the blowdown pressure of the valve and 80 to 85% when pulsation is expected.

❹ If possible, remove safety valve before making water pressure test. To make water pressure test without removing safety valve, pay attention to the following below (see Fig.4 in the next page).

ⓐ To prevent valve from being damaged due to improper load, when the pressure of the device reaches 80~90% of discharge pressure, install test gag* and press lightly on the end of valve shaft. The test gag must be rotated using hand. If you rotate it using spanner or other tools, there may have excessively large pressing force, the seat may be damaged, the shaft may be bended, and the valve may not function normally.

ⓑ After water pressure test and the pressure reduces to 80~90% relieving pressure,remove test gag immediately.

※ The test gag is optional item.

# Key Points for Installation of Safety Valves and Relief Valves

## ■ PIPING EXAMPLE

**Fig.1 Example: Pressure tank installation**

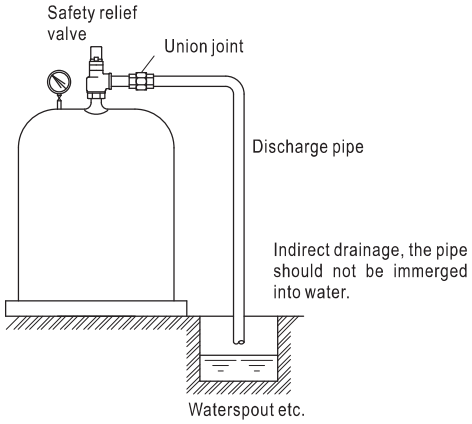



**Fig.2 Example: Installation of the secondary side of pressure reducing valve**

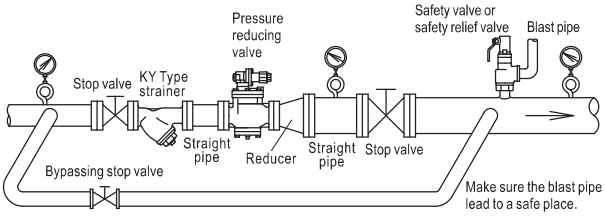



**Fig.3 Example connection of back pressure adjusting cock**

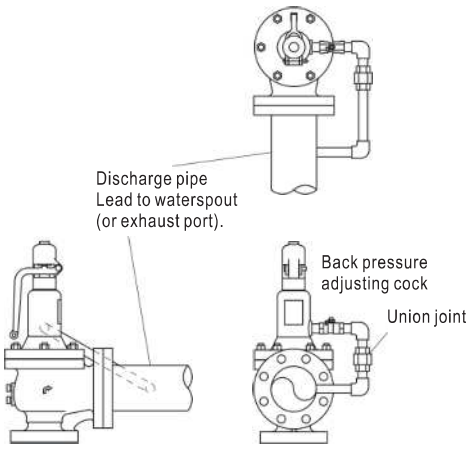



**Fig.4 Installation of test gag**

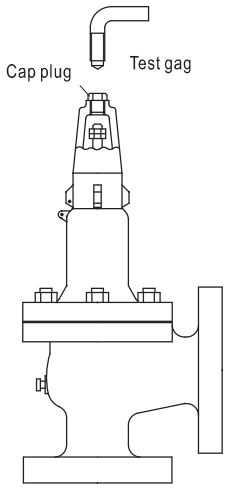
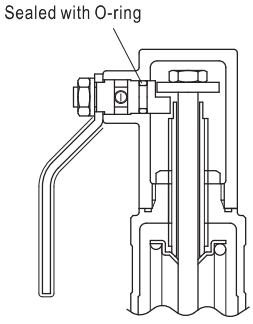
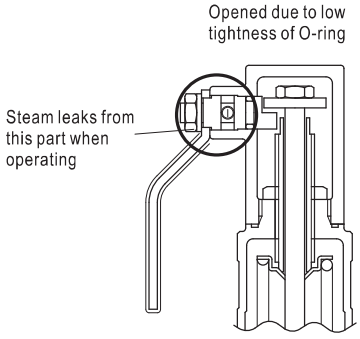



**Fig.5 Lever structure**

Lever structure of SL-37, 39, 39F,43 Type
For air, gas, or liquid




For steam




Open type lever structure