

# Technical Information

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**TECHNICAL INFORMATION**  
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### 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.



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
AF-5	20-50	0.1-2.0

\* When ordering the licensed product, contact us in advance.

**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%)	<ul style="list-style-type: none"> <li>· Pb contained in glass for cathode ray tubes, electronic parts, and fluorescent tubes</li> <li>· Pb in high-melting-point solder (Sn and Pb eutectic solder with Pb content of 85% or more)</li> <li>· Pb of up to 0.35 wt% contained in steel materials as an alloy</li> <li>· Pb of up to 0.4 wt% contained in aluminum materials</li> <li>· Pb of up to 4 wt% contained in copper materials</li> </ul>
Cr <sup>+6</sup> Hexavalent chromium	1000 ppm (0.1%)	Cr <sup>+6</sup> used for rust prevention of carbon steel cooling systems in absorption type refrigerators
Hg Mercury	1000 ppm (0.1%)	<ul style="list-style-type: none"> <li>· Hg of less than 5 mg per small-sized fluorescent lamp</li> <li>· Hg contained in striplights for special applications, etc.</li> </ul>
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.

## Technical Information

## Yoshitake Product with Regard to RoHS

Yoshitake has a wide variety of products that comply with RoHS Directive as shown in the list below, with the parts in which the level of the restricted 6 substances are below the threshold.

Please note that the packing and supplementary materials (including grease and adhesive) are out of scope of RoHS Directive compliance warranty.

If you have some request for Yoshitake product with regard to RoHS, please contact us.



Category	Model	Nominal size	Material
Pressure reducing valve	GP-1000AS	15A-100A	SCS
	GP-1000TAS	15A-50A	SCS
	GD-20	15A-100A	SCS
	GD-26S	20A-50A	SCS
	GD-27S	20A-100A	SCS
	GD-28S	20A-50A	SCS
	GD-29S	20A-100A	SCS
	GD-26GS	20A-50A	SCS
	GD-27GS	20A-100A	SCS
	GD-41, 41G	15A-25A	SCS
Drain separator	GD-43, 43G	15A-25A	SCS
	DS-1	15A-50A	FCD
Safety relief valve · Relief valve	DS-2	65A-100A	FCD
	AL-140	15A-50A	SCS
	AL-140H	15A-50A	SCS
	AL-140T	15A-50A	SCS
	AL-250	15A-50A	SCS
	AL-250R	15A-50A	SCS
	AL-31	15A-50A	SCS
	AL-31H	15A-50A	SCS
Strainer	SY-2	200A	FCD
	SY-40	15A-300A	FCD
	SY-40C-N	15A-150A	FCD
	SY-40H	15A-150A	FCD
	SY-5	10A-50A	FCD
	SY-17	15A-50A	SCS
	SY-37	15A-50A	SCS
	SY-8	10A-150A	SCS
	SY-38	10A-150A	SCS
	SY-10	10A-250A	SCPH
	SY-20	15A-150A	SCPH
	SU-10	20A-150A	SCS
	SU-10S	20A-150A	SCS
	SU-20	20A-150A	FCD
	SU-20S	20A-150A	FCD
	SU-20C	20A-150A	FCD
	SU-20H	200A	FCD
	SU-50	50A-150A	FCD
	SU-50H	50A-150A	FCD
	SU-50S	50A-150A	FCD
Flexible joint	ST-1	25A-300A	SUS
	SY-10H	15A-100A	SCPH
	SY-10HS	15A-100A	SCS
	SY-13	200A-650A	STPG/SS
	SY-13SS	200A-650A	SUS
	SU-6	200A-650A	STPG/SS
	SU-6SS, 6AS	200A-650A	SUS
	SU-12	20A-150A	SCPH

Category	Model	Nominal size	Material
Solenoid valve	DP-100, 100-C, 100-D	10A-50A	SCS
	DP-100F, 100F-C, 100F-D	15A-65A	SCS
	DD-2, DD-2-8	10A-20A	SCS
	DD-3, DD-3-8	10A-20A	SCS
Motor valve	MD-35R	15A-25A	C3771BE
	MD-36R	15A-25A	C3771BE
	MD-53	15A-50A	SUS
	MD-54	15A-50A	SUS
Air operated valve	PD-3	15A-50A	SUS
Sight glass	150L-13S	15A-50A	SCS
	150L-13F	15A-100A	SCS
	150F-13S	15A-50A	SCS
	150F-13F	15A-100A	SCS
	SB-1S	32A-50A	FCD
	FS-B	10A-80A	FC/FCD
Air vent valve	FSJ-B	10A-25A	SUS
	TA-16	15A-25A	SUS
Vacuum relief valve	VB-7S	15A-50A	SUS
Noiseless heater	MS-3	15A-50A	SCS
	MS-4	15A-50A	SCS
	MS-6	15A-50A	SUS
Expansion joint	EB-1J, 2J	20A-250A	SPHC/SS
	EB-11, 12	20A-250A	SPHC/SS
Ball joint	UB-1	20A-50A	FC
	UB-2	50A-250A	SCPH
	UB-10, 11	50A-250A	FC/SCPH
Smart plate	SP-1	15A-100A	SUS
Steam trap	TB-20F	15A-25A	FCD
	TB-5	15A-50A	FCD
	TD-10NA	15A-25A	FCD
	TD-30NA	15A-25A	FCD
	TSD-42	10A-25A	SCS
	TSF-10	15A-25A	FCD
	TSF-10F	15A-25A	FCD
	TSF-11	25A-50A	FCD
Check valve	TSF-11F	25A-50A	FCD
	SCV-2	15A-25A, 40A, 50A	SCS
Flexible joint	SCV-3	15A-100A	SCS
	YBF-1E	15A-50A	SUS
	YBF-2E	15A-250A	SUS
	YBF-2EM	20A-300A	SUS

**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/m <sup>2</sup> , kgw/m <sup>2</sup> , kg/m <sup>2</sup> ) Meter of mercury (mHg) *2 Meter of water (mH <sub>2</sub> O, mAq) Torr *3	Pascal (Pa)	1 kgf/m <sup>2</sup> ≈ 9.8 Pa 1 mHg ≈ 133 kPa 1 mH <sub>2</sub> O (mAq) ≈ 9.8 kPa 1 Torr ≈ 133 Pa
		Bar (bar)	1 kgf/m <sup>2</sup> ≈ 9800 bar 1 mHg ≈ 1.33 bar 1 mH <sub>2</sub> O (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 ( $\mu$ )	Meter (m)	1 $\mu$ = 1 $\mu$ m

\*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/cm <sup>2</sup>	(Convert conventional unit by new value system) → MPa	(Convert SI unit to conventional unit by converted value system) → kgf/cm <sup>2</sup>

**■Indication of gauge pressure and absolute pressure**

Category	Conventional unit	SI unit
Indication of gauge pressure	kgf/cm <sup>2</sup> G	MPa
Indication of absolute pressure	kgf/cm <sup>2</sup> abs	MPa·A
Indication of atmospheric pressure	1.033 kgf/cm <sup>2</sup> abs	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/cm <sup>2</sup> )
-50 mmHg = -0.068 kgf/cm <sup>2</sup>	-6.8 kPa	-0.0693
-160 mmHg = -0.218 kgf/cm <sup>2</sup>	-21.8 kPa	-0.222
-360 mmHg = -0.489 kgf/cm <sup>2</sup>	-48.9 kPa	-0.499
-600 mmHg = -0.816 kgf/cm <sup>2</sup>	-81.6 kPa	-0.823
-0.10 kgf/cm <sup>2</sup>	-10.0 kPa	-0.1020

## ■Conversion table for positive pressure

Conventional unit (kgf/cm <sup>2</sup> )	SI unit (MPa)	SI unit (kPa)	Converted value (kgf/cm <sup>2</sup> )
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/cm <sup>2</sup> )	SI unit (MPa)	SI unit (kPa)	Converted value (kgf/cm <sup>2</sup> )
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

**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 <sup>2</sup>	Square centimeter cm <sup>2</sup>	Square Inch in <sup>2</sup>	Square Foot ft <sup>2</sup>	Square Yard yd <sup>2</sup>
1	10000	1 550	10.76	1.196
0.064 52 *	6.452	1	0.069 44	0.0377 16
0.092 90	929	144	1	0.111 1
0.836 1	8361	1 296	9	1

\* Example: 0.06452 is short for 0.0006452.

**■ Conversion table for volume**

Cubic meter m <sup>3</sup>	Cubic Inch in <sup>3</sup>	Cubic Foot ft <sup>3</sup>	Cubic Yard yd <sup>3</sup>
1	61 024	35.31	1.308
0.016 39	1	0.0357 87	0.021 43
0.028 32	1 728	1	0.037 04
0.764 6	46 656	27	1

Liter L	Cubic meter m <sup>3</sup>	Imperial gallon gal (UK)	US gallon gal (US)	Cubic inch in <sup>3</sup>
1	0.001	0.220 0	0.264 2	61.02
1000	1	220.0	264.2	66020
4.546	0.004546	1	1.201	277.4
3.785	0.003785	0.832 7	1	231
0.016 39	0.0001629	0.036 05	0.043 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	0.098 42	0.011 02
0.064 80	1	0.2286	0.014 29	0.064 80	0.063 78	0.071 43
0.028 35	437.5	1	0.062 5	0.028 35	0.0427 90	0.031 25
0.453 6	7 000	16	1	0.045 36	0.044 64	0.000 5
1 000	$1.543 \times 10^7$	35 274	2 205	1	0.984 2	1.102
1 016	$1.568 \times 10^7$	35 840	2 240	1.016	1	1.12
907.2	$1.4 \times 10^7$	32 000	2 000	0.907 2	0.892 9	1

**■ Conversion table for density**

Kilogram per cubic meter kg/m <sup>3</sup>	Gram per cubic centimeter g/cm <sup>3</sup>	Pound per cubic inch lb/in <sup>3</sup>	Pound per cubic foot lb/ft <sup>3</sup>
1	$1 \times 10^{-3}$	$3.613 \times 10^{-5}$	$6.243 \times 10^{-2}$
$1.000 \times 10^3$	1	$3.613 \times 10^{-2}$	$6.243 \times 10$
$2.7680 \times 10^4$	$2.7680 \times 10$	1	$1.728 \times 10^3$
$1.602 \times 10$	$1.602 \times 10^{-2}$	$5.787 \times 10^{-4}$	1

## ■ 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 <sup>2</sup>	Pound-force per square inch lbf/in <sup>2</sup> or PSI	Atmosphere atm	Millimeter of mercury mmHg or Torr	Inch of mercury inHg	Millimeter of water mmH <sub>2</sub> 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 × 10 <sup>3</sup>
100	0.1	1	1.0197	14.50	0.9869	750	29.53	10.21 × 10 <sup>3</sup>
98.0665	0.098067	0.98067	1	14.223	0.9678	735.5	28.96	10.01 × 10 <sup>3</sup>
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 × 10 <sup>3</sup>
0.13332	0.133322 × 10 <sup>-3</sup>	0.133322 × 10 <sup>-2</sup>	1.3596 × 10 <sup>-3</sup>	19.34 × 10 <sup>-3</sup>	1.316 × 10 <sup>-3</sup>	1	39.37 × 10 <sup>3</sup>	13.61
3.3864	0.003386	0.03386	0.03453	0.4912	0.03342	25.40	1	345.6
9.8067 × 10 <sup>-3</sup>	0.009807 × 10 <sup>-3</sup>	0.009807 × 10 <sup>-2</sup>	0.09991 × 10 <sup>-3</sup>	1.421 × 10 <sup>-3</sup>	0.0967 × 10 <sup>-3</sup>	0.07349	2.893 × 10 <sup>3</sup>	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 <sup>2</sup> /s	Centistokes cSt	Stokes St
1	1 000 000	10 000
0.051	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	0.023 89	0.102 0	0.737 6	0.027 78	0.094 80
4.186 × 10 <sup>3</sup>	1	426.9	3 087	0.001 163	3.968
9.807	0.002 343	1	7.233	0.027 24	0.009 297
1.356	0.032 39	0.138 3	1	0.037 66	0.001 285
3.6 × 10 <sup>6</sup>	860.0	3.671 × 10 <sup>5</sup>	2.655 × 10 <sup>6</sup>	1	3 413
1.055 × 10 <sup>3</sup>	0.252 0	107.6	778.0	0.0293 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	0.032 39	0.138 3	1	0.001 285
1.055	0.252 0	107.6	778.0	1

## ■ Conversion table for temperature

Conversion formula  ${}^{\circ}\text{C} = 5/9 \times ({}^{\circ}\text{F} - 32)$   ${}^{\circ}\text{F} = 9/5 \times {}^{\circ}\text{C} + 32$

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 |
-459.7	-273.2	-0.4	-18	-27.8
-450	-267.8	+3.2	-16	-26.7
-440	-262.2	6.8	-14	-25.6
-430	-256.7	10.4	-12	-24.4
-420	-251.1	14.0	-10	-23.3
-410	-245.6	17.6	-8	-22.2
-400	-240.0	21.2	-6	-21.1
-390	-234.4	24.8	-4	-20.0
-380	-228.9	28.4	-2	-18.9
-370	-223.3	32.0	0	-17.8
-360	-217.8	35.6	+2	-16.7
-350	-212.2	39.2	4	-15.6
-340	-206.7	42.8	6	-14.4
-330	-201.1	46.4	8	-13.3
-320	-195.6	50.0	10	-12.2
-310	-190.0	53.6	12	-11.1
-300	-184.3	57.2	14	-10.0
-290	-178.9	60.8	16	-8.9
-280	-173.3	64.4	18	-7.8
-459.7	-273.2	68.0	20	-6.7
-454	-270	-167.8	71.6	22
-436	-260	-162.2	75.2	24
-418	-250	-156.7	78.8	26
-400	-240	-151.1	82.4	28
-382	-230	-145.6	86.0	30
-364	-220	-140.0	89.6	32
-346	-210	-134.4	93.2	34
-328	0	-128.9	96.8	36
-310	-190	-123.3	100.4	38
-292	-180	-117.8	104.0	40
-274	-170	-112.2	107.6	42
-256	-160	-106.7	111.2	44
-238	-150	-101.1	114.8	46
-220	-140	-95.6	118.4	48
-202	-130	-90.0	122.0	50
-184	-120	-84.4	125.6	52
-166	-110	-78.9	129.2	54
-148	-100	-73.3	132.8	56
-130	-90	-67.8	136.4	58
-112	-80	-62.2	140.0	60
-94.0	-70	-56.7	143.6	62
-76.0	-60	-51.1	147.2	64
-58.0	-50	-45.6	150.8	66
-40.0	-40	-40.0	154.4	68
-36.4	-38	-38.9	158.0	70
-32.8	-36	-37.8	161.6	72
-29.2	-34	-36.7	165.2	74
-25.6	-32	-35.6	168.8	76
-22.0	-30	-34.4	172.4	78
-18.4	-28	-33.3	176.0	80
-14.8	-26	-32.2	179.6	82
-11.2	-24	-31.1	183.2	84
-7.6	-22	-30.0	186.8	86
-4.0	-20	-28.9	190.4	88





**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. $\phi$ 75- $\phi$ 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  $v = 15 \text{ m/s} \cdot t = 20^\circ\text{C}$** 

(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**

(m³/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

# Technical Information

## Property of Gas

Properties Name of gas	Chemical formula	Molecular weight	Adiabatic index Cp/Cv k	Limit temperature Tc (K)	Critical pressure Pc	
					(bar)	(kgf/cm <sup>2</sup> abs)
Acetylene	C <sub>2</sub> H <sub>2</sub>	26.04	1.26	308.7	62.5	63.7
Air		28.96	1.40	—	—	—
Ammonia	NH <sub>3</sub>	17.03	1.31	405.6	114.6	116.9
Argon	Ar	39.95	1.67	150.8	49.4	50.4
Benzene	C <sub>6</sub> H <sub>6</sub>	78.12	1.12	562.8	49.6	50.6
Isobutane	iso-C <sub>4</sub> H <sub>10</sub>	58.13	1.10	408.2	37.0	37.7
n-butane	n-C <sub>4</sub> H <sub>10</sub>	58.13	1.09	425.2	37.5	38.2
Carbon disulfide	CS <sub>2</sub>	76.14	1.21	549.2	76.5	78.0
Carbon dioxide	CO <sub>2</sub>	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 <sub>2</sub>	70.91	1.36	417.2	78.3	79.8
Cyclohexane	C <sub>6</sub> H <sub>12</sub>	84.16	1.09	481.6	40.6	41.4
n-decane	n-C <sub>10</sub> H <sub>22</sub>	142.29	1.03	618.4	21.3	21.7
Ethane	C <sub>2</sub> H <sub>6</sub>	30.07	1.19	305.4	48.9	49.9
Ethyl alcohol	C <sub>2</sub> H <sub>5</sub> OH	46.07	—	516.2	63.8	65.0
Ethylene	C <sub>2</sub> H <sub>4</sub>	28.05	1.24	282.7	50.9	51.9
Helium	n-CH <sub>3</sub> (CH <sub>2</sub> ) <sub>5</sub> CH <sub>3</sub>	4.00	1.66	5.3	2.4	2.4
n-heptane	n-C <sub>7</sub> H <sub>16</sub>	100.21	1.05	540.2	27.3	27.8
n-hexane	n-C <sub>6</sub> H <sub>14</sub>	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 <sub>2</sub>	2.02	1.41	33.2	13.2	13.5
Hydrogen sulfide	H <sub>2</sub> S	34.08	1.32	373.6	91.6	93.4
Methane	CH <sub>4</sub>	16.04	1.31	190.9	47.1	48.0
Methyl alcohol	CH <sub>3</sub> OH	32.04	1.20	512.6	80.2	81.8
Methyl sulfide	CH <sub>3</sub> Cl	50.49	1.20	416.3	67.5	68.8
Nitrogen	N <sub>2</sub>	28.01	1.40	126.3	34.4	35.1
Nitrous oxide	N <sub>2</sub> O	44.01	1.30	309.3	73.9	75.4
n-nonan	n-CH <sub>3</sub> (CH <sub>2</sub> ) <sub>7</sub> CH <sub>3</sub>	128.26	1.04	594.7	23.0	23.5
Oxygen	O <sub>2</sub>	32.00	1.40	154.7	51.2	52.2
n-pentane	n-CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> CH <sub>3</sub>	72.15	1.07	470.1	33.5	34.2
n-propane	n-CH <sub>3</sub> CH <sub>2</sub> CH <sub>3</sub>	44.11	1.13	370.0	42.7	43.5
Steam	H <sub>2</sub> O	18.02	1.33	647.1	221.2	225.6
Sulfur dioxide	SO <sub>2</sub>	64.06	1.29	593.6	42.3	43.1
Toluene	C <sub>6</sub> H <sub>5</sub> CH <sub>3</sub>	92.15	1.09	593.6	32.3	43.1
Propylene	CH <sub>3</sub> CHCH <sub>2</sub>	42.08	1.15	365.1	46.0	46.9
Octane	C <sub>8</sub> H <sub>18</sub>	114	1.05	—	—	—

Remark 1 The Tc and Pc of air are 132.45 (K) and 38.433 (kg/cm<sup>2</sup>abs), 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/m <sup>3</sup>	Liquid	Temperature °C	Density kg/m <sup>3</sup>	Liquid	Temperature °C	Density kg/m <sup>3</sup>
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 <sub>3</sub> )	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 <sub>2</sub> SO <sub>4</sub> )	18	1179.6
Hydrochloric acid 10%	18	1048.2	Nitric acid (25% HNO <sub>3</sub> )	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 <sub>4</sub> )		1107
Olive oil	18	915	Cylinder oil	20	920-940	Fresh water	18	1167
Seawater	4	1026	Spindle oil	20	890-900		0	999.87
			Petroleum (kerosene)	15	790-820	"	4	1000
Caustic potash(10% KOH)	18	1091	Caustic soda (10% NaOH)	18	1109.8	"	15	999.13
" (30% " )	18	1290				"	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/m <sup>3</sup>	Specific gravity (Gas) Air = 1	Gas or steam	Chemical formula	Molecular weight	Standard density kg/m <sup>3</sup>	Specific gravity (Gas) Air = 1
Nitrous oxide	N <sub>2</sub> O	44	1.978	1.530	Oxygen	O <sub>2</sub>	32	1.43	1.105
Acetylene	C <sub>2</sub> H <sub>2</sub>	26.04	1.16	0.910	Cyanogen	(CN) <sub>2</sub>	52	2.32	1.81
Acetone	C <sub>3</sub> H <sub>6</sub> O	58	2.58	2.00	Hydrogen cyanide	CNH	27	1.22	0.95
Ammonia gas	NH <sub>3</sub>	17.03	0.76	0.596	Bromine	Br <sub>2</sub>	160	6.87	5.39
					Mercury	Hg	200	9.02	6.98
					Steam (100°C)	H <sub>2</sub> O	18.02	0.60	0.463
Sulfur dioxide	SO <sub>2</sub>	64.06	2.92	2.26	Hydrogen	H <sub>2</sub>	2.02	0.09	0.070
Alcohol (ethyl)	C <sub>2</sub> H <sub>5</sub> O	46.07	2.65	1.61	Carbon dioxide	CO <sub>2</sub>	44	1.97	1.529
Argon	Ar	39.95	1.78	1.38	Nitrogen	N <sub>2</sub>	28.01	1.25	0.967
Aldehyde	C <sub>2</sub> H <sub>4</sub> O	44	1.96	1.53	City gas		12.54	0.56	0.43
Sulfur	S <sub>2</sub>	64	2.85	2.20	Toluene	C <sub>7</sub> H <sub>8</sub>	92.15	4.10	3.18
Carbon monoxide	CO	28.01	1.250	0.967	Naphthalene	C <sub>10</sub> H <sub>8</sub>	128	5.72	4.43
Ethane	C <sub>2</sub> H <sub>6</sub>	30.07	1.34	1.049	Helium	He	4	0.178	0.138
Ethylene	C <sub>2</sub> H <sub>4</sub>	28.05	1.26	0.975	Benzene	C <sub>6</sub> H <sub>6</sub>	78.12	3.48	2.69
Ether	C <sub>4</sub> H <sub>10</sub> O	74	3.30	2.56	Propane	C <sub>3</sub> H <sub>8</sub>	44.11	1.96	1.529
Hydrogen chloride (Hydrochloric acid)	HCl	36.46	1.63	1.268	Pentane	C <sub>5</sub> H <sub>12</sub>	72.15	3.22	2.49
Carbonate chloride	COCl <sub>2</sub>	99	4.42	3.42	Methane (marsh gas)	CH <sub>4</sub>	16.04	0.717	0.555
Chlorine	Cl <sub>2</sub>	70.91	3.16	2.491	Hydrogen sulfide	H <sub>2</sub> S	34.08	1.54	1.191
Xylol	C <sub>8</sub> H <sub>10</sub>	106	4.72	3.67	Carbon disulfide	CS <sub>2</sub>	76.14	3.42	2.64
Chloroform	CHCl <sub>3</sub>	119.5	5.30	4.12	Sulfuric acid	H <sub>2</sub> SO <sub>4</sub>	98	2.78	2.15
Air		28.96	1.293	1.000	Hydrogen phosphide	PH <sub>3</sub>	34	1.53	1.18
Nitrogen oxide	NO	30	1.34	1.037					

## 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 ( $\text{kg/m}^3$ ) in the standard condition (temperature:  $0^\circ\text{C}$ , pressure:  $1 \text{ atm} \doteq 0.1 \text{ MPa}\cdot\text{A}$ ).

Explained below is how to convert the volume of a gas.

### ■ How to convert the volume [ $\text{m}^3$ ] of a gas into [ $\text{m}^3$ (standard condition)]

[Example] Assuming that the volume of the fluid, air in this example, is  $100 \text{ m}^3$  at a pressure of  $0.2 \text{ MPa}$  and a temperature of  $17^\circ\text{C}$ , 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 =  $0.1 \text{ MPa}\cdot\text{A}$

$P'$  : Pressure in the condition to be obtained (current condition) [ $\text{MPa}\cdot\text{A}$ ]

$V$  : Volume in the standard condition [ $\text{m}^3$  (standard condition)]

$V'$  : Volume in the condition to be obtained (current condition) [ $\text{m}^3$ ]

$T$  : Temperature in the standard condition =  $273 \text{ K}$  ( $0^\circ\text{C}$ )

$T'$  : 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:

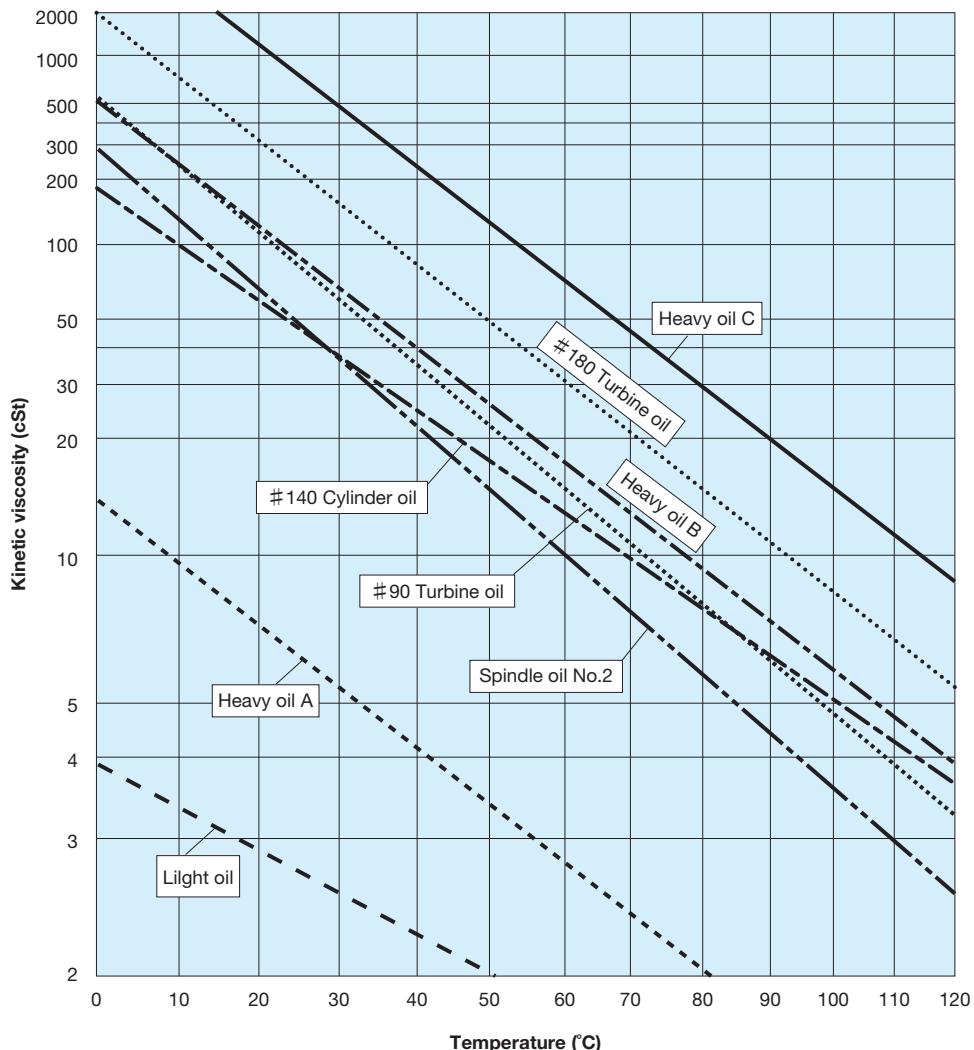
$$\frac{273}{0.1} \times \frac{(0.2 + 0.1) \times 100}{(273 + 17)} \doteq 283 \text{ m}^3 \text{ (standard condition)}$$

### ■ How to convert the volume [ $\text{m}^3$ (standard condition)] of a gas into kg

When the fluid is air, its standard density is  $1.293 \text{ kg/m}^3$  (standard condition). So:

$$283 [\text{m}^3 \text{ (standard condition)}] \times 1.293 [\text{kg/m}^3 \text{ (standard condition)}] \doteq 365 \text{ (kg)}$$

Fluid name	Standard density [ $\text{kg/m}^3$ ] (standard condition)
Air	1.293
Nitrogen	1.25
Ammonia gas	0.76
Argon	1.78
Carbon dioxide	1.97

**Oil Viscosity Chart****Densities of major fuel oils**

Fluid name	Density [g/m <sup>3</sup> ]	
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.

**Conversion of viscosity unit**

$$\text{Kinetic viscosity (cSt)} = \frac{\text{Absolute viscosity (cP)}}{\text{Density (g/cm}^3)}$$

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/mm <sup>2</sup>	Minimum elongation %	Minimum 0.2%/strength N/mm <sup>2</sup>	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 <sup>*1</sup>	1.6 <sup>*1</sup>	—	—	—
			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 <sup>*1</sup>	2.0 <sup>*1</sup>	—	—	—
			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 <sup>*1</sup>	3.0 <sup>*1</sup>	—	—	—
			II	3.9	3.9	3.9	—	—	—	—	—	—
	013a	1.5	I	5.1	4.6	4.3	3.9	3.8 <sup>*2</sup>	3.6 <sup>*2</sup>	3.4 <sup>*2</sup>	3.0 <sup>*2</sup>	—
			II	3.9	3.9	3.9	3.9	3.7 <sup>*2</sup>	3.6 <sup>*2</sup>	3.4 <sup>*2</sup>	3.0 <sup>*2</sup>	—
	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 <sup>*3</sup>	3.2 <sup>*3</sup>	3.0 <sup>*3</sup>
			II	3.9	3.6	3.4	3.0	2.5	2.3	2.3 <sup>*3</sup>	2.3 <sup>*3</sup>	2.3 <sup>*3</sup>
			III	3.9	—	—	—	—	—	—	—	—
	023a-023b	2.3	I	5.1	4.6	4.3	3.9	3.8	3.6	3.4 <sup>*5</sup>	—	—
			II	3.5	3.0	2.9	2.6	2.1	2.0	2.0 <sup>*5</sup>	—	—
			III	3.5	—	—	—	—	—	—	—	—

<sup>\*1</sup> 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.

<sup>\*2</sup> The values do not apply to ASTM A 352 LC1 of material group 1.5.

<sup>\*3</sup> The values do not apply to ASTM A 351 CF3 and ISO 4991 C46 of material groups 021b and 2.1.

<sup>\*4</sup> 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.

<sup>\*5</sup> 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.

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	SS 400	JIS G 3201	SF 390A	JIS G 5101	SC 410	001
	JIS G 4051	S 20 C	JIS G 3202	SFVC1	JIS G 5151	SCPH 1	
	JIS G 4051	S 25 C	JIS G 3201	SF 440A	JIS G 5101	SC 480	002
Low-alloy steel	—	—	JIS G 3202	SFVC2A	JIS G 5151	SCPH 2	003a
	—	—	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	SUS 304	JIS G 3214	SUS F304	JIS G 5121	SCS 13A	021a
	JIS G 4305	SUS 304	—	—	JIS G 5121	SCS 19A	021b
	—	—	—	—	—	—	
	JIS G 4304	SUS 316	JIS G 3214	SUS F316	JIS G 5121	SCS 14A	022a
	JIS G 4305	SUS 316	—	—	JIS G 5121	SCS 16A	022b
	JIS G 4304	SUS 304L	JIS G 3214	SUS F304L	—	—	023a
	JIS G 4305	SUS 304L	—	—	—	—	
	JIS G 4304	SUS 316L	JIS G 3214	SUS F316L	—	—	023b
	JIS G 4305	SUS 316L	—	—	—	—	

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<sup>2</sup> or more and 440 N/mm<sup>2</sup> 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	70	A 105	—	A216	WCB	1.1
	A 516	70	A 350	LF2	—	—	
	A 537	CL 1	—	—	—	—	
Low-alloy steel	A 204	A	A 182	F1	A217	WC1	1.5
	A 204	B	—	—	A352	LC1	
	A 387	11 CL2	A 182	F11 CL2 F12 CL2	A217	WC6	1.9
Stainless steel	A 240	304	A 182	F304	A351	CF3	2.1
	A 240	304H	A 182	F304H	A351	CF8	
	A 240	316	—	—	—	—	2.2
	A 240	316H	A 182	F316	A351	CF3M	
	A 240	317	A 182	F316H	A351	CF8M	
	A 240	304L	A 182	F304L	—	—	2.3
	A 240	316L	A 182	F316L	—	—	

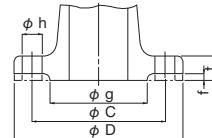
Reference table 2 ISO materials

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
		—	—		—	—		C32H	
Stainless steel	ISO 9328-5	X5 CrNi 18 9	—	ISO 2604-1	F49	—	ISO 4991	C46 C47	2.1
		X5 CrNiMo 17 12	—		F62	—		C57	
		X7 CrNiMo 17 12	—		F64	—		C60 C61	
	ISO 9328-5	X2 CrNi 18 10	—	ISO 2604-1	F46	—	—	C61LC	2.2
		X2 CrNiMo 17 12	—		—	—		—	
		X2 CrNiMo 17 13	—		F59	—		—	

**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 5K flanges**

Unit: mm

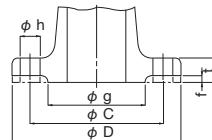
Nominal size	Outer diameter of steel piping applied	Outer diameter of flange D	Each dimension of flange				Bolt hole			Nominal size of bolt thread	
			t		f	Diameter g	PCD C	Quantity			
			Other than gray cast iron	Gray cast iron							
10	17.3	75	9	12	1	39	55	4	12	M10	
15	21.7	80	9	12	1	44	60	4	12	M10	
20	27.2	85	10	14	1	49	65	4	12	M10	
25	34.0	95	10	14	1	59	75	4	12	M10	
32	42.7	115	12	16	2	70	90	4	15	M12	
40	48.6	120	12	16	2	75	95	4	15	M12	
50	60.5	130	14	16	2	85	105	4	15	M12	
65	76.3	155	14	18	2	110	130	4	15	M12	
80	89.1	180	14	18	2	121	145	4	19	M16	
100	114.3	200	16	20	2	141	165	8	19	M16	
125	139.8	235	16	20	2	176	200	8	19	M16	
150	165.2	265	18	22	2	206	230	8	19	M16	
200	216.3	320	20	24	2	252	280	8	23	M20	
250	267.4	385	22	26	2	317	345	12	23	M20	
300	318.5	430	22	28	3	360	390	12	23	M20	
350	355.6	480	24	30	3	403	435	12	25	M22	
400	406.4	540	24	30	3	463	495	16	25	M22	
450	457.2	605	24	30	3	523	555	16	25	M22	
500	508.0	655	24	32	3	573	605	20	25	M22	
550	558.8	720	26	32	3	630	665	20	27	M24	
600	609.6	770	26	32	3	680	715	20	27	M24	

**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	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 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 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		
			Other than gray cast iron	Gray cast iron						
10	17.3	90	12	—	1	46	65	4	M12	
15	21.7	95	12	—	1	51	70	4	M12	
20	27.2	100	14	—	1	56	75	4	M12	
25	34.0	125	14	—	1	67	90	4	M16	
32	42.7	135	16	—	2	76	100	4	M16	
40	48.6	140	16	—	2	81	105	4	M16	
50	60.5	155	16	20	2	96	120	8	M16	
65	76.3	175	18	22	2	116	140	8	M16	
80	89.1	200	20	24	2	132	160	8	M20	
100	114.3	225	22	26	2	160	185	8	M20	
125	139.8	270	22	26	2	195	225	8	M22	
150	165.2	305	24	28	2	230	260	12	M22	
200	216.3	350	26	30	2	275	305	12	M22	
250	267.4	430	28	34	2	345	380	12	M24	
300	318.5	480	30	36	3	395	430	16	M24	
350	355.6	540	34	38	3	440	480	16	M30 x 3	
400	406.4	605	38	42	3	495	540	16	M30 x 3	
450	457.2	675	40	46	3	560	605	20	M30 x 3	
500	508.0	730	42	50	3	615	660	20	M30 x 3	
550	558.8	795	44	54	3	670	720	20	M36 x 3	
600	609.6	845	46	58	3	720	770	24	M36 x 3	

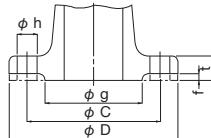
## Basic dimensions of nominal pressure 20K flanges

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		
			Other than gray cast iron	Gray cast iron						
10	17.3	90	14	16	1	46	65	4	M12	
15	21.7	95	14	16	1	51	70	4	M12	
20	27.2	100	16	18	1	56	75	4	M12	
25	34.0	125	16	20	1	67	90	4	M16	
32	42.7	135	18	20	2	76	100	4	M16	
40	48.6	140	18	22	2	81	105	4	M16	
50	60.5	155	18	22	2	96	120	8	M16	
65	76.3	175	20	24	2	116	140	8	M16	
80	89.1	200	22	26	2	132	160	8	M20	
100	114.3	225	24	28	2	160	185	8	M20	
125	139.8	270	26	30	2	195	225	8	M22	
150	165.2	305	28	32	2	230	260	12	M22	
200	216.3	350	30	34	2	275	305	12	M22	
250	267.4	430	34	38	2	345	380	12	M24	
300	318.5	480	36	40	3	395	430	16	M24	
350	355.6	540	40	44	3	440	480	16	M30 x 3	
400	406.4	605	46	50	3	495	540	16	M30 x 3	
450	457.2	675	48	54	3	560	605	20	M30 x 3	
500	508.0	730	50	58	3	615	660	20	M30 x 3	
550	558.8	795	52	62	3	670	720	20	M36 x 3	
600	609.6	845	54	66	3	720	770	24	M36 x 3	

**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 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

**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 5101 CAC202 (2) (4)
10K	JIS H 5111 CAC402- CAC406 (2)-CAC407	JIS H 5111 CAC407 (5)
16K		

Note (2) Use the flanged when the temperature of the fluid is 205°C or less.

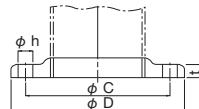
Note (3) The material of a slip-on flanged for piping to be connected by welding needs to be determined by agreement or consultation between the parties who place and receive an order.

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.

## 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.

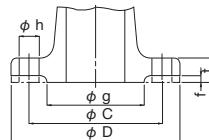
The (2) column under "Outer diameter of the pipe applied" shows outer diameters within the range specified in Table 7 (2) in JIS H 3300.

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

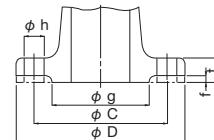
Unit: mm

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.

## Basic Dimensions of ASME (ANSI) Pipe Flanges

Excerpt from ASME B 16.42-1998



## ■ Basic dimensions of 150lb ductile iron flanges

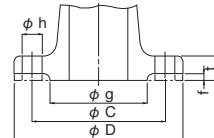
Unit: mm

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 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



## Technical Information

	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-B	A-B	A	C	A	A	A	A	A	A	A	A	
Caustic soda	< 30	< 30	B	B	A	A	A	A	B	B	A	A	A	A	A	A	A	
	< 10	< 90 boiling	B	B	A	A	A	A	B	B	A	A	A	A	A	A	A	
	10-30	< 30 < 100 boiling	B	B	A	A	A	A	B	B	A	A	A	A	A	A	A	
	30-50	< 30 < 100 boiling	B	B	A	A	A	A	C	C	A	A	A	A	A	A	-	
	50-70	< 30 < 80 boiling	C	C	B	B	-	-	B	C	A	A	A	A	A	A	-	
	70-100	< 260	C	C	-	-	-	-	C	C	A	A	A	A	A	A	-	
	100	< 480	-	-	C	C	-	-	C	-	A	B	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 boiling	C	C	A-B	A	B	A-B	A	C	A-B	A-B	A	A	A	A	A	
	Concentrated	boiling	C	C	A-B	A	B	-	A	C	-	-	A	A	-	A	-	
Creosote			A	A	A	A	A	A	A	C	A	A	A	A	A	A	-	
Chromic acid	5	< 66 boiling	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 boiling	C	C	A	A	A-B	A	A	B-C	A	A	A	A	A	A	A	
	10-20	< 60 boiling	C	C	A	A	-	-	A	-	A	-	-	A	-	A	A	
	20-50	< 60 boiling	C	C	A	A	-	-	A	-	A	A	A	A	-	A	A	
	50-99.5	< 60 boiling	C	C	A	A	-	-	A	-	-	A	A	-	A	A	A	
	Anhydrous	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	C	-	A	C	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 boiling	C	C	A-B	A-B	A-B	A-B	C	A	-	C	A-B	B	A	A	C	A
Nitric acid	≤ 0.5	≤ 30 boiling	C	C	A	A	A	A	A	C	C	C	C	C	A	A	A	A
	0.5-20	≤ 30 boiling	C	C	A	A	A	A	A	C	C	C	C	C	A	A	A	A
	20-40	≤ 30 boiling	C	C	A	A	A	A	A	C	C	C	C	C	A	A	A	A
	40-70	≤ 30 boiling	C	C	A	A	A	A	A	C	C	C	C	C	-	-	A	A
	70-80	≤ 30 boiling	C	C	B	A	A-B	A-B	A	C	C	C	C	C	-	-	A	A
	80-95	≤ 30 boiling	C	C	A	A	-	-	A	C	C	C	C	C	-	-	A	A
	> 95	< 30	A	-	A	A	-	-	A	-	-	-	-	-	-	-	A	A
Silver nitrate			C	C	A	A	A-B	A-B	A	C	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	A-B	A	A-B	A	A
	27	boiling	A-B	A-B	A	A	A-B	-	A-B	B	A	A	A	A-B	A-B	C	A	
	50	boiling	-	-	B	A	-	-	A-B	-	A	A	A	A-B	A-B	C	A	

