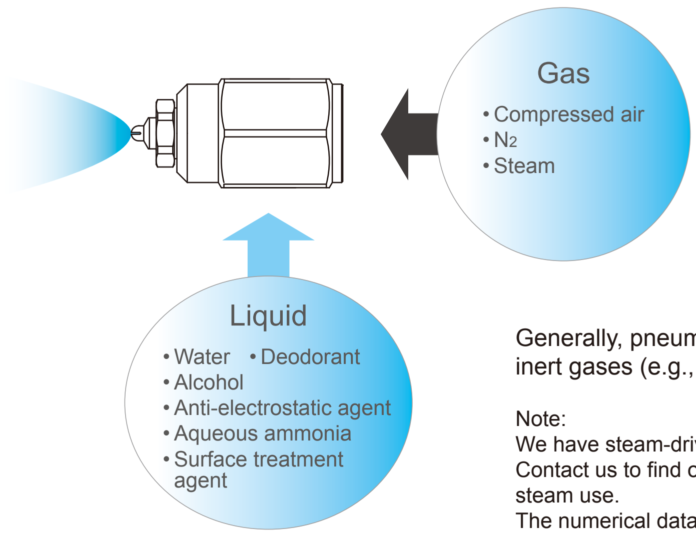
For Effective Use of Pneumatic Spray Nozzles

Pneumatic spray nozzles utilize a high-velocity flow of compressed air for atomizing liquids, and there are various types of pneumatic spray nozzles. Select optimal spray nozzles that meet your purpose.

Mechanism of Pneumatic Spray Nozzles



Generally, pneumatic spray nozzles are driven by compressed air, but inert gases (e.g., N_2) or steam can also be used.

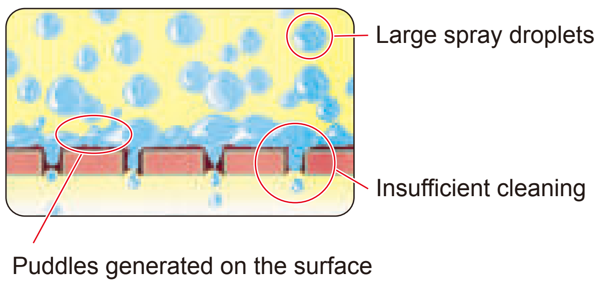
Note:
We have steam-driven pneumatic spray nozzles, JOKIJet series available.
Contact us to find out whether each series other than JOKIJet is compatible with steam use.
The numerical data in this catalog are based on compressed air and tap water at room temperature, unless otherwise specified.

Various Applications

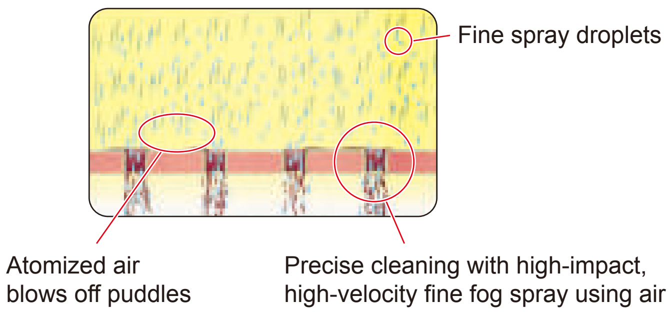
When fine atomization is required

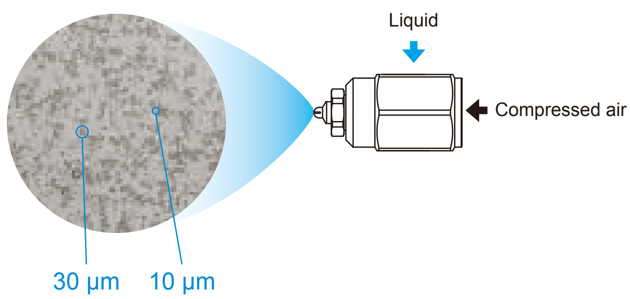
■ **In cleaning process**

●Cleaning with hydraulic nozzles



●Cleaning with pneumatic nozzles





Advantages of Pneumatic Spray Nozzles

Excellent atomizing performance

Pneumatic spray nozzles are capable of producing fine atomization with a mean droplet diameter of 10 μm or less.*1

*1 See pages 7–8 for droplet sizes and their measuring methods.

Large turn-down ratio

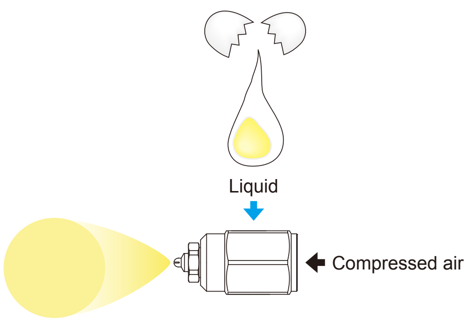
Pneumatic spray nozzles have a large turn-down ratio of spray flow rate*2 with little variation in spray droplet size and flow distribution, which is ideal for spray flow adjustable nozzles.

*2 Spray flow rate is expressed as spray capacity in this catalog. See page 4 for the turn-down ratio.

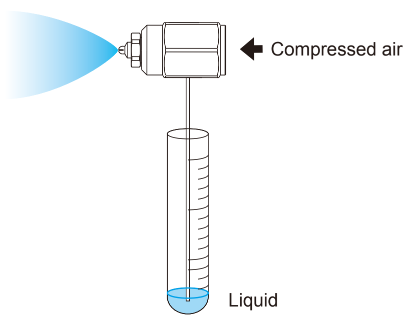
Large free passage diameter

Pneumatic spray nozzles have a larger free passage diameter than hydraulic spray nozzles, which is effective for clog prevention.

When spraying viscous liquid



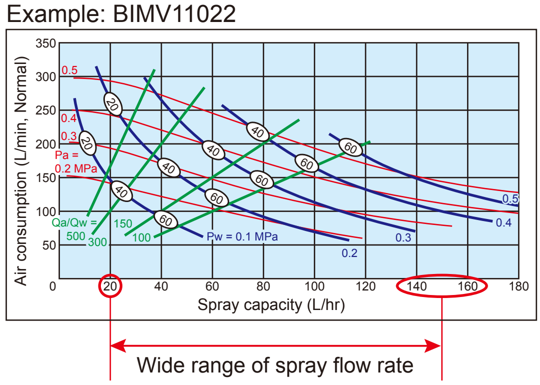
When extremely small spray capacity is required



When a large turn-down ratio is required

One spray nozzle can cover a wide range of spray capacity.

Example: BIMV11022



●Contact us for HACCP compliance.

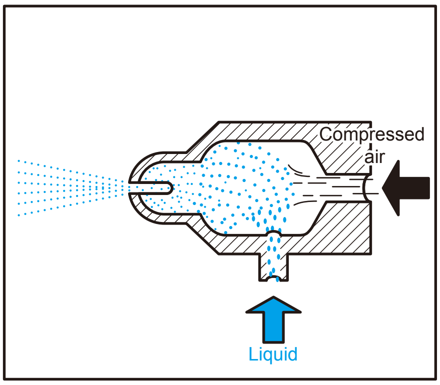
Advantages of Pneumatic Spray Nozzles

Air-liquid Mixing Systems for Excellent Atomization

There are three types of air-liquid mixing systems for atomizing liquid: internal mixing type, external mixing type, and impinging type, depending on the mixing method of compressed air and liquid.

Internal Mixing Type

Compressed air and liquid are mixed inside the nozzle and atomized. Generally, this type has excellent atomizing performance.
Internal mixing type is further classified into the following three types.



Inner air type

Inside the nozzle, compressed air flows in the center while liquid flows along its circumference. Its larger liquid passage diameter effectively prevents clogs.

Outer air type

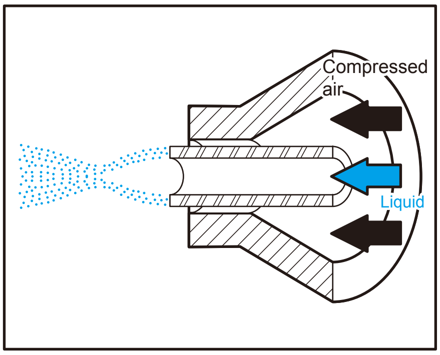
Inside the nozzle, liquid flows in the center while compressed air flows along its circumference. This common type can have a larger orifice size, resulting in slightly coarser spray droplet sizes.

Pre-mix type

Air and liquid mix before reaching the orifice. Even at low air-water ratios, droplet velocity accelerates prior to the orifice, resulting in a stronger impact force. Additionally, this nozzle type has a larger turn-down ratio, making it suitable for cooling objects at high temperatures.

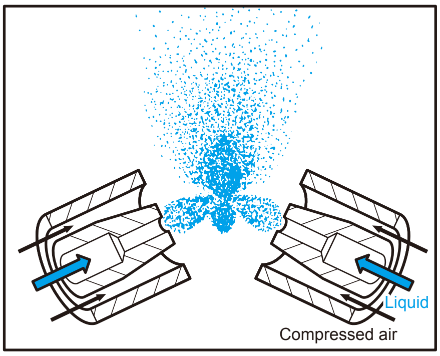
External Mixing Type

Compressed air and liquid are mixed outside the nozzle. In general, this type of nozzle is highly resistant to clogging.
External mixing type is further classified into the inner air type and the outer air type.



Impinging Type

Air-stream entraining fine fog jets out from the nozzle and impinges against another air-stream of the same property, shattering the fog into even finer, more uniform droplets.
This is IKEUCHI's unique system.

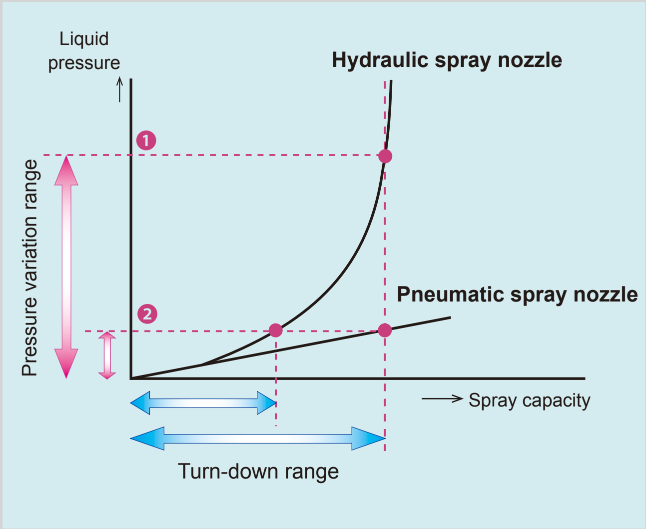


Turn-down Ratio

The turn-down range is a range of adjustable spray capacity, and the ratio of its minimum to maximum spray capacity is referred to as the turn-down ratio.

To cover a wide range of spray capacity with a single nozzle, it is not practical to use a hydraulic spray nozzle because it requires a huge pressure increase (❶ in the figure).
Pneumatic spray nozzles are adjustable in both air and liquid pressures, allowing adjustment of the spray capacity with minimum pressure change (❷ in the figure).

Thus, pneumatic spray nozzles are suitable for cooling combustion gases and other applications that require nozzles with small spray droplet sizes and a large turn-down ratio.

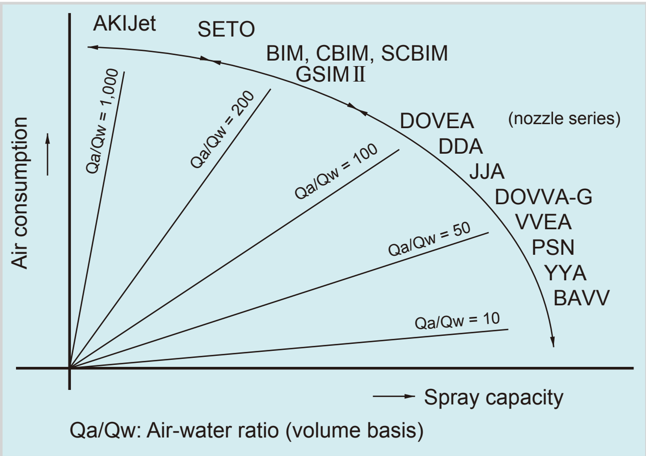


Select a pneumatic spray nozzle to obtain a large turn-down range under the same pressure range.

Air-water Ratio

Air-water ratio is the rate of air consumption divided by spray capacity. The ratio can be expressed in both volume and weight ratios.
For the same nozzle, a higher air-water ratio will result in a smaller spray droplet size.

The air-water ratio in this catalog is expressed as the volume ratio unless otherwise specified.



Nozzle Selection Factors

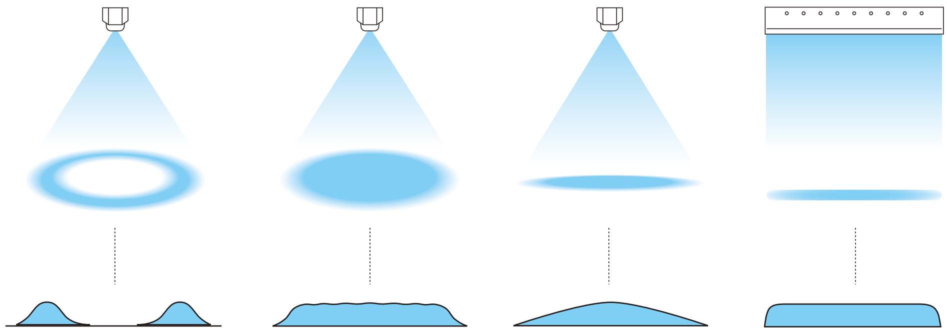
Spray Pattern

The spray pattern refers to the cross-sectional shape of the spray and is available in cone spray (hollow cone and full cone spray), flat spray, and liquid film-like spray.
Hollow cone and full cone spray patterns are suitable for applications such as humidification, gas cooling, chemical reactions, and moisture control, while flat spray and film-like spray patterns for cooling and coating.
To optimize nozzle performance and effects, it is important to select a spray pattern suited for each application.
Please note that the spray patterns of pneumatic spray nozzles deform significantly as the distance from the nozzle becomes greater.

Spray Pattern

Spray pattern is defined as the horizontal cross sectional shape of the spray.

Hollow Cone Spray | Full Cone Spray | Flat Spray | Film-like Spray



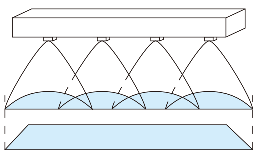
Spray Distribution

Spray distribution is defined as the distribution of the spray flow in the direction of spray width.

Ring-shaped distribution | Even spray distribution | Mountain-shaped distribution | Uniform distribution

Multi-nozzle Arrangement

A mountain-shaped distribution is useful for producing a uniform spray distribution across the entire spray width in a multi-nozzle arrangement by overlapping patterns. On the other hand, an even spray distribution is suitable for applications that require a uniform spray distribution with a single nozzle. The spray distribution varies depending on the spray height and pressure.

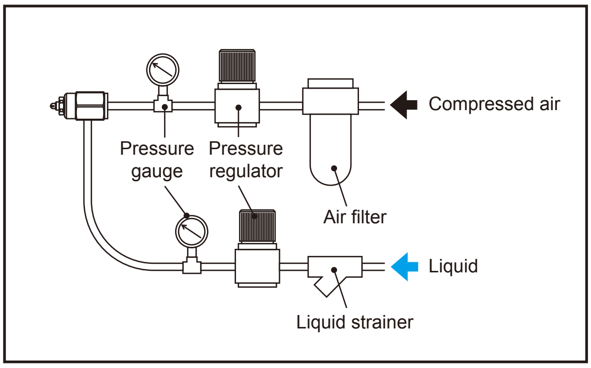


When installed at proper spacing in a multi-nozzle arrangement, flat spray nozzles with a mountain-shaped distribution can achieve a uniform distribution across the entire area.

Liquid Feeding System

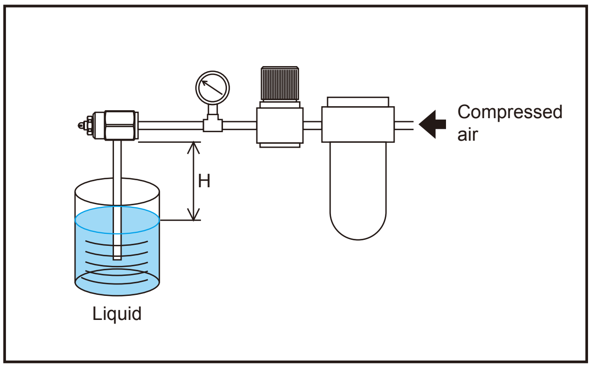
There are two types of liquid feeding systems: the liquid pressure type (feeding pressurized liquid to the nozzle) and the liquid siphon type (feeding liquid sucked up by compressed air).

Liquid Pressure Type



By changing the compressed air and liquid pressures, spray capacity can be changed over a wide range from small to large flows.

Liquid Siphon Type



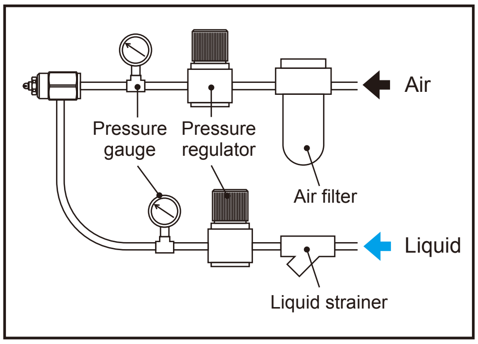
Spray capacity differs depending on liquid siphon height (H).

Measurement Standard

Each pneumatic spray nozzle series has a spray capacity inspection standard at each standard pressure.
We only ship the nozzles that pass the inspection.

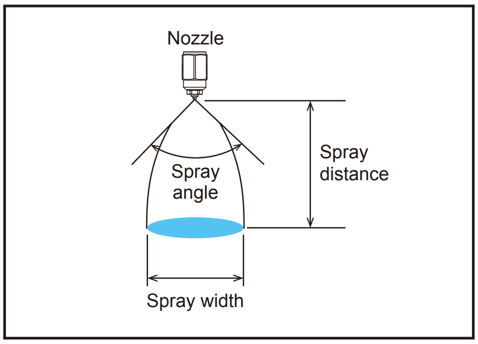
Spray Pressure

Each series of pneumatic spray nozzles is designed based on the standard pressure, which is either the pressure most commonly used or the pressure that maximizes the characteristics of each nozzle series. The air and liquid pressures in this catalog are measured immediately before the nozzle, using compressed air and room temperature tap water.



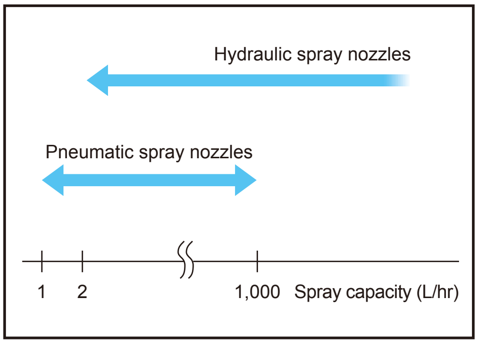
Spray Angle

The spray angle is defined as the angle of spray near the nozzle outlet. The flow velocity of pneumatic spray nozzles is so high that the above-mentioned spray angle is maintained only near the nozzle outlet.
When designing a nozzle layout, please refer to the spray width data in the performance table of each nozzle series.



Spray Capacity

The spray capacity refers to the volume of water flow rate sprayed from the nozzle.
One of the features of pneumatic spray nozzles is their ability to produce a spray capacity as small as 0.1 L/hr (1.7 cc/min).
The numerical values of spray capacity in this catalog are based on tap water at room temperature. (The air consumption is the value under atmospheric pressure.)

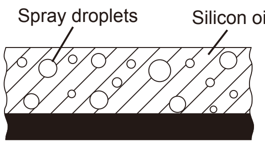


Methods of Measuring Spray Droplet Diameter

Measuring method / Principle and features	Range of measured droplet size

Immersion Sampling Method

Droplets are collected on a glass plate coated with silicon oil and a magnified photo is taken immediately for subsequent scanning. The collected droplets remain suspended as perfect circles. This method is less affected by distance and droplet concentration. However, ultra-fine droplets are unable to break the surface tension of the oil and evaporate. This results in an average droplet size larger than the actual value.

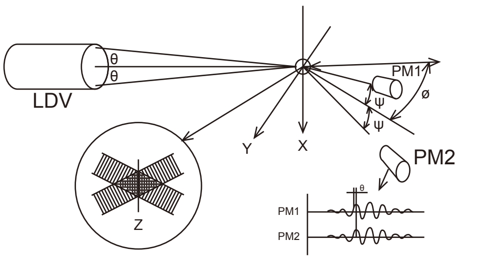


Range of measured droplet size: 10–5,000 μm

Laser Analyzer

1. Laser Doppler Method

This method forms interference fringes by crossing two laser beams. Then, the spray droplet size is calculated from the phase difference at the time of detecting scattered light, which has resulted from droplets having passed through these interference fringes, by multiple photo detectors provided at a given distance. This method is less affected by droplet concentration because each droplet is measured one by one, while enabling simultaneous measurement of droplet velocity. However, measurement is only possible at a single point in the spray.

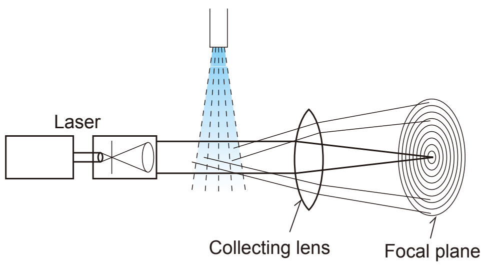


(LDV: Laser Doppler Velocimeter PM: Phase monitor)

Range of measured droplet size: 0.5–2,500 μm

2. Fraunhofer Diffraction Method

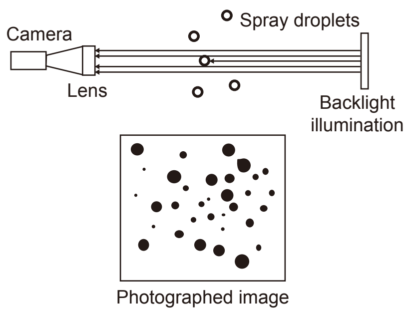
A laser beam scatters at the surface of droplets to form a diffracted image behind the droplets due to the interference of the scattered light (Fraunhofer diffraction).
This method can simultaneously measure all droplets on the laser beam path, but if the droplet concentration is too high, the laser beam once scattered may be scattered again by other droplets (multiple scattering). This phenomenon may cause the measured droplet size to be smaller than the actual droplet size.



Range of measured droplet size: 1–1,000 μm

Shadowgraph Method

Backlight illuminated shadows of droplets in various sizes are photographed and converted to circular shapes, from which the droplet diameters are calculated.
This method enables the measurement of non-spherical coarse droplets that cannot be measured by the laser analyzer.
However, it is not suitable for measuring fine droplets due to the low magnification of the camera. Also, when the droplets are dense, the overlapped multiple droplets could be measured as a single droplet, thus its droplet size may appear larger than the actual size.



Range of measured droplet size: 10–8,000 μm

Mean Droplet Diameter

Mean droplet diameter is one of the important factors in selecting nozzles and designing nozzle-related equipment.

Generally, the following average value models are used for mean droplet sizes:

- Sauter Mean Diameter ($\bar{d}_{32}$) ············ $\Sigma nd^3/\Sigma nd^2$
- Volume Mean Diameter ($\bar{d}v$) ·········· $(\Sigma nd^3/\Sigma n)^{1/3}$
- Mass Median Diameter ($Dv_{.5}$) ········· $\int_0^{Dv.5} dv/v = \int_{Dv.5}^{\infty} dv/v = 50\%$

In chemical processes such as cooling, evaporation, combustion and drying, the surface-to-volume ratio, i.e. specific surface area, is used to determine the efficiency. Because the rate of reaction is influenced more by a small number of large droplets than a large number of small droplets, it is advisable to use the Sauter Mean Diameter as a representative value for the droplet size.

The Sauter Mean Diameter is used most often and is the one used in this catalog.

■ Example of calculation of Sauter mean diameter

Range (μm)	Median d (μm)	Quantity n	nd^2	nd^3
0–100	50	1,664	4,160,000	208,000,000
100–200	150	2,072	46,620,000	6,993,000,000
200–300	250	444	27,750,000	6,937,500,000
300–400	350	161	19,722,500	6,902,875,000
400–500	450	73	14,782,500	6,652,125,000
500–600	550	35	10,587,500	5,823,125,000
600–700	650	17	7,182,500	4,668,625,000
700–800	750	4	2,250,000	1,687,500,000
	Total	4,470	133,055,000	3.987275×10^{10}

$$\bar{d}_{32} = \frac{\Sigma nd^3}{\Sigma nd^2} = 300\ \mu m$$

Correlation Between Measuring Methods in Droplet Diameter

Results will differ, depending on the method used to measure. If the Sauter mean droplet diameter measured with the immersion sampling method equals 1, as relative coefficient number, this value will be different when measured with other methods, as shown on the right.

Nozzle type \ Measuring method	Immersion sampling method	Fraunhofer diffraction method	Laser Doppler method	Shadow-graph method
Hydraulic spray nozzles	1	0.45	0.7–0.9	0.8–0.9
Pneumatic spray nozzles				

Evaluation of Droplet Diameter

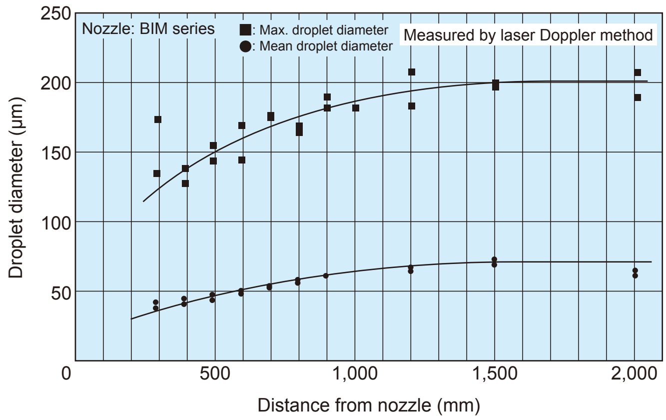
Good care must be exercised in evaluating droplet diameters because droplet diameters differ depending on each measuring method as described above.

In comparing spray droplet diameters of different spray nozzles, a standardized measuring method should be used. Likewise, when using the laser method, measurement distance, droplet concentration, etc. should be as consistent as possible.

Too high a concentration may cause multiple scattering both in the Fraunhofer laser diffraction method and in the laser Doppler method, which would not allow a correct evaluation of the droplet diameter.

Therefore, it is desirable to avoid measuring near the nozzle, and measure at a given distance from the nozzle.

■ Droplet diameters at various distances from the nozzle



At 0.49 MPa air pressure and 0.46 MPa liquid pressure

Pneumatic Spray Nozzle Lineup

Air type	Nozzle type	Spray pattern	Liquid feeding system	Series	Air-liquid mixing system
Compressed air	Low flow rate fine fog nozzles	Flat spray	Liquid pressure	BIMV, CBIMV, SCBIMV	Internal mixing inner air type
			Liquid siphon	BIMV-S, CBIMV-S, SCBIMV-S	
		Hollow cone spray	Liquid pressure	BIMK, CBIMK	
			Liquid siphon	BIMK-S, CBIMK-S	
		Full cone spray	Liquid pressure	BIMJ, CBIMJ, SCBIMJ	
	Clog-resistant fine fog nozzles	Flat spray	Liquid pressure	YYA	External mixing type
			Liquid pressure & Liquid siphon	SETOV	External mixing
				SETOV-C	
		Full cone spray		SETOJet	
				SETOJet-R	
				SETO-SP	
				SETO-SD	External mixing outer air type*4
	Medium capacity fine fog nozzles	Full cone spray	Liquid pressure	AKIJet	Internal mixing & Impinging type
	Large capacity fine fog nozzles	Full cone spray	Liquid pressure	GSIM II	Internal mixing outer air type
	Semi-fine/ Semi-coarse fog nozzles	Flat spray	Liquid pressure	DOVEA	Internal mixing pre-mix type
				DDA	
				DOVVA-G	
				VVEA, INVVEA	
		Full cone spray		JJA	
	Slit laminar nozzles	Film-like spray		PSN	
Blower air	Ultra-low pressure nozzles	Flat spray	Liquid pressure	BAVV	Internal mixing inner air type
		Full cone spray		LSIM	Internal mixing outer air type
Steam	Steam driven nozzles	Full cone spray	Liquid pressure	JOKIJet	External mixing outer air type

Note: Check the respective product pages for the air and liquid pressures (measurement conditions of the above) and other details including adaptor type.
*1) Sauter mean diameter, measured by laser Doppler method unless otherwise specified. *2) Measured by the Immersion sampling method. *3) Measured by the Fraunhofer

Spray Nozzle Materials

The standard and optional materials available for nozzles are shown in the material section of each nozzle series, using the material codes listed below.
If you need a specific nozzle material that is not mentioned in each series page, please contact us.

Metals

[Material code··········Material]

S303······················Stainless steel 303

S304······················Stainless steel 304

S316······················Stainless steel 316

S316L····················Stainless steel 316L

S321······················Stainless steel 321

SCS13···················Die-cast stainless steel equivalent to S304

SCS14···················Die-cast stainless steel equivalent to S316

Oil-free options are available at additional cost.
Contact us for details.

Plastics

[Material code··········Material]

PP ·························Polypropylene

PPS·······················Polyphenylene sulfide

PVC ······················Polyvinyl chloride

HTPVC··················Heat-treated polyvinyl chloride

PTFE·····················Polytetrafluoroethylene

PA·························Polyamide

PE ·························Polyethylene

Rubbers

[Material code··········Material]

NBR·······················Nitrile rubber

FKM·······················Fluororubber

FEPM·····················Tetrafluoroethylene-propylene rubber

Mean droplet diameter*1 (μm)	Spray capacity	Unit	Spray angle (°)	Air consumption (L/min, Normal)	Adaptor type	Page
20–100	0.25–107	L/hr	110, 80, 45	2.6–245	N, T, NDB, UNDB, SNB, USNB, SPB, USPB	13, 32, 41
	0.1–4.7		80	3.75–92		15, 37, 42
	2.0–107		60	13–245		17, 34
	1.8–4.7		60	27–92		19, 38
	0.25–107		70, 20	2.6–245		21, 35, 41
15–30	2.2–10.0	L/hr	80	27–45	–	59
15–40	1.7–10.6		65, 55	27–75	T, SN, SP	53
–	1.2–25.9		–	33–151	SP	55
20–60	2.0–111		–	38–290	T	46
15–40	2.0–26.4		–	36–200	T	48
15–25	1.5–5.1		–	18–30	CSP	51
15–25	0.9–26.4		–	36–200	–	57
10–120*2	10–450	L/hr	–	340–2,150	T, H	92
40–80	15–2,000	L/hr	60, 20	150–4,000	T, SN, flange connection	61
50–200*3	0.42–40	L/min	110, 95, 70, 55	30–630	T	70
15–200*3	0.14–57.3		125, 110, 100, 80, 75	17–610	T	75
80–120	1–25		70, 55	100–1,700	Flange connection	81
20–400	0.23–3.0		80, 60	14–128	T*5	85, 87
150–650*2	1.1–24		–	70–720	Flange connection	78
–	8–28		–	520–1,700	–	89
30–100	9.0–123	L/hr	60	76–254	T	95
40–80	0–1,000		20	1,500–6,000	Flange connection	97
40–200*2	10–1,200	L/hr	–	–	Flange connection	101

diffraction method. *4) Nozzle code 07503R-I+SD is internal mixing outer air type. *5) Exclusive of INVVEA Header.

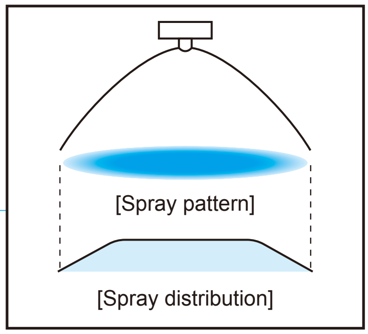
Table of Chemical and Heat Resistance

Items \ Materials		Metals				Plastics							Rubbers		
		S303	S304	S316 S316L	S321	PP	PPS	PVC	HTPVC	PTFE	PA	PE	NBR	FKM	FEPM
Chemical resistance	Hydrochloric acid	×	×	×	×	○	○	○	○	○	×	○	×	○	○
	Concentrated hydrochloric acid	×	×	×	×	△	○	○	○	○	×	○	×	○	○
	Sulfuric acid (35%)	×	×	×	×	○	○	○	○	○	×	○	×	○	○
	Concentrated sulfuric acid	×	×	○	○	×	△	○	○	○	×	△	×	○	○
	Nitric acid (35%)	○	○	○	○	×	△	○	○	○	△	○	×	○	○
	Concentrated nitric acid	△	○	△	△	×	×	×	×	○	△	×	×	○	○
	Acetic acid	△	○	○	○	○	○	○	○	○	△	△	○	○	○
	Sodium hydroxide (caustic soda)	○	○	○	○	○	○	○	○	○	○	○	○	△	○
	Aqueous ammonia	○	○	○	○	○	○	○	○	○	○	○	○	×	×
	Acetone	○	○	○	○	○	○	×	×	○	○	×	×	×	×
	Trichloroethylene	○	○	○	○	△	○	×	×	○	○	△	△	○	○
	Ethyl alcohol	○	○	○	○	○	○	○	○	○	△	△	○	○	○
Heat resistance	Suitable (°C)	400	400	400	400	80	170	40	50	100	130	60	90	150	150
	Short-term use only (°C)	800	800	800	800	90	180	50	70	150	230	80	120	200	200

○: Suitable △: Possible for short term use ×: Unusable

Note: The heat resistance (operating temperature limit) of spray nozzles varies widely depending on the operating conditions, environment, liquid sprayed, etc.

●Spray nozzle specifications are shown in the respective tables.



●Figures showing simplified spray pattern and distribution

Performance data table

●Spray angle code (110)

●Air consumption code (02)

●Estimated air consumption at the specified pressures. In this example, air consumption is 25 normal liters per minute at air pressure 0.4 MPa and liquid pressure 0.15 MPa.

●Spray width at the specified pressures (280 mm at air pressure of 0.2 MPa and liquid pressure of 0.1 MPa)

●Approx. minimum passage diameters for each flow channel (N/A for tip orifice in external mixing type nozzles. See page 3 for Air-Liquid Mixing Systems)

Spray angle code *2	Air consumption code	Air pressure (MPa)	Spray capacity (L/hr) & Air consumption (L/min, Normal) — Liquid pressure (MPa) 0.1 Liquid	0.1 Air	0.15 Liquid	0.15 Air	0.2 Liquid	0.2 Air	0.25 Liquid	0.25 Air	0.3 Liquid	0.3 Air	Spray width*3 (mm) — Liquid press. (MPa) 0.1	0.15	0.25	Mean droplet dia. (μm) Laser Doppler method	Free passage diameter (mm) Tip orifice	Adaptor Liquid	Adaptor Air
110	02	0.2	2.2	14	5.3	11	—	—	—	—	—	—	280	340	—	20–100	0.2	0.9	0.7
		0.3	1.0	20	2.5	19	4.6	17	8.3	12	14.3	7	220	250	420				
		0.4	—	—	1.4	25	2.3	24	4.0	23	6.3	20	—	230	340				
	04	0.2	4.5	25	9.5	20	17.0	13	—	—	—	—	300	360	—	20–100	0.3	0.9	0.9
		0.3	2.0	36	4.7	35	8.5	31	13.1	27	19.6	20	230	270	430				
		0.4	—	—	2.8	45	4.8	44	7.7	41	11.4	37	—	250	350				
	075	0.2	8.7	51	18.4	42	33.3	29	—	—	—	—	320	380	—	20–100	0.5	1.2	1.4
		0.3	4.0	74	8.8	71	15.5	64	24.3	54	38.5	40	240	300	450				
		0.4							[illegible]	82	21.8	74	—	270	370				
											—	—	340	400	—	20–100	0.8	1.8	1.9
												[illegible]	270	320	470				
														[illegible]	380				

●Calculated spray capacity at the specified pressures. In this example, spray capacity is 4.7 liters per hour at air pressure 0.3 MPa and liquid pressure 0.15 MPa.

●At air pressure of 0.2 MPa and liquid pressure of 0.3 MPa, defined spray pattern does not develop (with coarse droplets, wheezing, etc.)

●Range of Sauter mean diameters measured by laser Doppler method

Description of thread size and type

Thread type	ISO standard	Our thread code
Male tapered pipe threads	R1/4	1/4M
Female tapered pipe threads	Rc1/4	1/4F

Description of flange size

Pipe size A (nominal diameter)	Pipe size B (inch)	Our flange description
10	3/8	3/8T10
15	1/2	1/2T10
20	3/4	3/4T10
25	1	1T10
32	1 1/4	1*1/4T10
40	1 1/2	1*1/2T10
50	2	2T10
65	2 1/2	2*1/2T10
80	3	3T10
90	3 1/2	3*1/2T10
100	4	4T10

Flanges shall be in accordance with JIS 5K and JIS 10K.
(JIS: Japanese Industrial Standards)
Flange JIS 5K is described as "T5" instead of "T10" in the above description.

■Conversion of Units

	μm	mm	cm	m	in	ft
Length	1	1×10^{-3}	1×10^{-4}	1×10^{-6}	3.94×10^{-5}	3.28×10^{-6}
	1×10^{3}	1	0.1	1×10^{-3}	3.94×10^{-2}	3.28×10^{-3}
	1×10^{4}	10	1	1×10^{-2}	3.94×10^{-1}	3.28×10^{-2}
	1×10^{6}	1×10^{3}	100	1	3.94×10	3.28
	2.54×10^{4}	25.4	2.54	2.54×10^{-2}	1	8.33×10^{-2}
	3.05×10^{5}	3.05×10^{2}	3.05×10	3.05×10^{-1}	12	1

	cm^2	m^2	in^2	ft^2
Area	1	1×10^{-4}	0.155	1.08×10^{-3}
	1×10^{4}	1	1.55×10^{3}	10.8
	6.45	6.45×10^{-4}	1	6.94×10^{-3}
	9.30×10^{2}	9.30×10^{-2}	1.44×10^{2}	1

	cm^3	L (Liter)	m^3 (kL)	ft^3	Imperial gal.	U.S. gal.
Volume	1	1×10^{-3}	1×10^{-6}	3.53×10^{-5}	2.2×10^{-4}	2.64×10^{-4}
	1×10^{3}	1	1×10^{-3}	3.53×10^{-2}	0.220	0.264
	1×10^{6}	1×10^{3}	1	35.3	220	264
	2.83×10^{4}	28.3	2.83×10^{-2}	1	6.23	7.48
	4.55×10^{3}	4.55	4.55×10^{-3}	0.16	1	1.2
	3.79×10^{3}	3.79	3.79×10^{-3}	0.134	0.833	1

■Others

Viscosity	1P = 100 cP 1St = 100 cSt
Weight	1 kg ≈ 2.21 lb 1 lb ≈ 0.45 4kg
Temperature	[°F] ≈ ([°C] × 9/5) + 32 [°C] ≈ 5/9 × ([°F] − 32)

■Water flow rate and proper pipe size

Nominal size		Steel pipe		Flow rate (L/min) when pressure loss is 0.01–0.03MPa per pipe length of 10m
A	B	Inside dia. (mm)	Outside dia. (mm)	
6A	1/8B	6.5	10.5	1.3 – 2.2
8A	1/4B	9.2	13.8	3 – 5.2
10A	3/8B	12.7	17.3	7 – 12
15A	1/2B	16.1	21.7	12 – 21
20A	3/4B	21.6	27.2	22 – 38
25A	1B	27.6	34.0	38 – 65
32A	1 1/4B	35.7	42.7	70 – 120
40A	1 1/2B	41.6	48.6	120 – 210
50A	2B	52.9	60.5	215 – 370
65A	2 1/2B	67.9	76.3	410 – 700
80A	3B	80.7	89.1	680 – 1,200
100A	4B	105.3	114.3	1,200 – 2,100
125A	5B	130.8	139.8	2,100 – 3,600
150A	6B	155.2	165.2	3,300 – 5,700

	MPa	bar	kg/cm^2	psi (lb/in^2)	atm	mmHg	mmH_2O (mmAq)
Pressure	1	10	10.2	145	9.87	7.5×10^{3}	1.02×10^{5}
	0.1	1	1.02	14.5	0.987	750	1.02×10^{4}
	0.098	0.981	1	14.2	0.968	736	1×10^{4}
	6.89×10^{-3}	0.069	0.070	1	0.068	51.7	703
	0.101	1.01	1.03	14.7	1	760	1.03×10^{4}
	1.33×10^{-4}	1.33×10^{-3}	1.36×10^{-3}	0.019	1.32×10^{-3}	1	13.6
	9.81×10^{-6}	9.81×10^{-5}	1×10^{-4}	1.42×10^{-3}	9.68×10^{-5}	0.074	1

	L/min	m^3/min	m^3/hr	in^3/hr	ft^3/hr	Imperial gal./min	U.S. gal./min
Flow rate	1	1×10^{-3}	0.06	3.66×10^{3}	2.12	0.22	0.264
	1×10^{3}	1	60	3.66×10^{6}	2.12×10^{3}	220	264
	16.7	0.017	1	6.10×10^{4}	35.3	3.67	4.40
	2.73×10^{-4}	2.7×10^{-7}	1.64×10^{-5}	1	5.79×10^{-4}	6.01×10^{-5}	7.22×10^{-5}
	0.472	4.72×10^{-4}	0.028	1.73×10^{3}	1	0.104	0.125
	4.55	4.55×10^{-3}	0.273	1.66×10^{4}	9.63	1	1.20
	3.79	3.79×10^{-3}	0.227	1.39×10^{4}	8.02	0.833	1