



ENVIRONMENT - WE CARE!



Spraying Systems

Experts in Spray Technology

SPRAYING SYSTEMS

FOR CLEAN AIR



THE PRODUCTS YOU NEED AND PERFORMANCE YOU CAN COUNT ON

You'll find a wide variety of handheld spray guns in this catalog but you can also visit spray.com to see tens of thousands additional spray products. Featured products on spray.com include hydraulic spray nozzles, air atomizing nozzles, automatic hydraulic and pneumatic nozzles, tank cleaning equipment, air nozzles and nozzles for specialized operations like descaling, trim squirt, spray drying, fire protection and more. We offer nozzles in more sizes and materials than any other supplier, so you're sure to find a product that delivers the performance you need.

PRECISE, DEPENDABLE PRODUCT QUALITY

Your satisfaction is important to us. Our products are manufactured to exacting standards to deliver the promised performance each and every time you order. We are ISO 9001:2008 and 14001:2004 certified. Products ship only after undergoing our rigorous quality control and testing programs. If you have any concerns about the quality of any of our products, contact us immediately. We will address your issues and take corrective action as needed.

PRODUCTS WHEN YOU NEED THEM

Most of our spray nozzles are readily available and will be shipped within days of your order. If you need expedited service, let us know. Our ten manufacturing locations are strategically located around the world to help ensure we can get our products where they are needed quickly and cost-effectively.

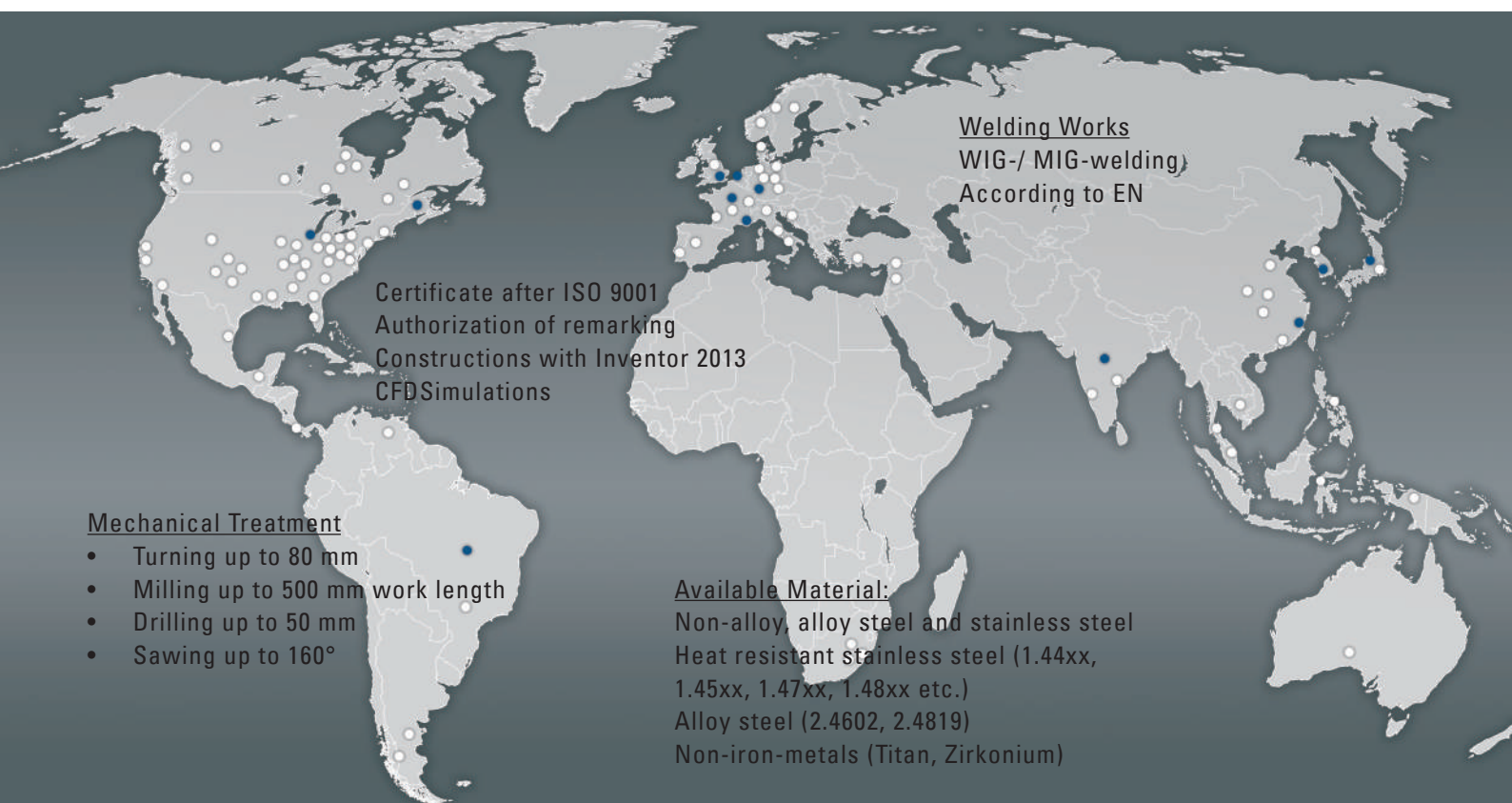
SPECIAL REQUIREMENTS? TELL US WHAT YOU NEED

If one of our standard products isn't quite right for your equipment, just let us know. Customization can range from simple changes in materials to specially-designed nozzles to meet exacting performance requirements.

We work with hundreds of OEMs and provide services like these:

- Special nozzle designs
- Private labeling with unique part numbers
- Special packaging
- Customized maintenance and operating instructions

MANUFACTURE POSSIBILITIES OF SPRAYING SYSTEMS



Welding Works
WIG-/ MIG-welding
According to EN

Certificate after ISO 9001
Authorization of remarking
Constructions with Inventor 2013
CFDSimulations

Mechanical Treatment

- Turning up to 80 mm
- Milling up to 500 mm work length
- Drilling up to 50 mm
- Sawing up to 160°

Available Material:

Non-alloy, alloy steel and stainless steel
Heat resistant stainless steel (1.44xx,
1.45xx, 1.47xx, 1.48xx etc.)
Alloy steel (2.4602, 2.4819)
Non-iron-metals (Titan, Zirkonium)



Introduction



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Spray Drop Size (Atomization)

Accurate drop size information is an important factor in optimizing spray nozzle performance, particularly in industrial applications such as gas cooling, gas conditioning, fire suppression and spray drying.

Drop size refers to the size of the individual spray drops that comprise a nozzle's spray pattern. Each spray provides a range of drop sizes; this range is referred to as drop size distribution. Drop size distribution is dependent on the spray pattern type and varies significantly from one type to another. The smallest drop sizes are achieved by air atomizing nozzles while the largest drops are produced by full cone hydraulic spray nozzles.

ACTUAL DROP SIZES

- 500 µm
- 1200 µm
- 5500 µm

One inch = 25,400 µm
One millimeter = 1,000 µm
µm = micrometers

Liquid properties, nozzle capacity, spraying pressure and spray angle also affect drop size. Lower spraying pressures provide larger drop sizes. Conversely, higher spraying pressures yield smaller drop sizes. Within each type of spray pattern the smallest capacities produce the smallest spray drops, and the largest capacities produce the largest spray drops.

DROP SIZE BY SPRAY PATTERN TYPE AT VARIOUS PRESSURES AND CAPACITIES

Spray Pattern Type	10 psi (0.7 bar)			40 psi (2.8 bar)			100 psi (7 bar)		
	Capacity		VMD	Capacity		VMD	Capacity		VMD
	gpm	lpm	microns	gpm	lpm	microns	gpm	lpm	microns
Air Atomizing	.005 .02	.02 .08	20 100	.008 8	.03 30	15 200	12	45	400
Fine Spray	.22	.83	375	.03 .43	.1 1.6	110 330	.05 .69	.2 2.6	110 290
Hollow Cone	.05 12	.19 45	360 3400	.10 24	.38 91	300 1900	.16 38	.61 144	200 1260
Flat Fan	.05 5	.19 18.9	260 4300	.10 10	.38 38	220 2500	.16 15.8	.61 60	190 1400
Full Cone	.10 12	.38 45	1140 4300	.19 23	.72 87	850 2800	.30 35	1.1 132	500 1720

Based on a sampling of nozzles selected to show the wide range of possible drop sizes available.

RELATIVE DROP SIZE

General drop size categories are used throughout this catalog. Actual drop size will vary based on flow rate and pressure, so for some nozzles, more than one drop size category is shown. If drop size is critical in your application, contact us for specific information.

IN MICRONS





Drop Size Terminology

Terminology is often a major source of discrepancy and confusion in understanding drop size. To accurately compare drop sizes from one nozzle to another, the same diameters have to be used. Drop size is usually expressed in microns (micrometers). Following are the most popular characteristic diameters and their definitions.

D_{V0.5} : VOLUME MEDIAN DIAMETER (VMD)

A means of expressing drop size in terms of the volume of liquid sprayed. The Volume Median Diameter drop size when measured in terms of volume is a value where 50% of the total volume of liquid sprayed is made up of drops with diameters larger than the median value and 50% with smaller diameters.

D_{V0.9}

A value where 90% of the total volume of liquid sprayed is made up of drops with diameters smaller or equal to this value. This measurement is best suited when complete evaporation of the spray is required.

D₃₂ : SAUTER MEAN DIAMETER (SMD)

A means of expressing the fineness of a spray in terms of the surface area produced by the spray. The Sauter Mean Diameter is the diameter of a drop having the same volume-to-surface area ratio as the total volume of all the drops to the total surface area of all the drops.

Impact

Impact, is the measure of force imparted on a surface by a spray pattern at a given distance. It can be expressed in several ways. All definitions are derived from the most basic equation of total impact force. This is the force that any flow, at any pressure, is capable of making on a surface. This does not account for orifice shape, nozzle type, fluid properties and other factors.

$$I = K \times Q \times \sqrt{P}$$

Total theoretical impact = constant (based on units)
x flow (at pressure P) x square root of pressure (P)

I	lbs.(f)	kg(f)	Newtons	Newtons
K	.0526	.024	.24	.745
Q	gpm	lpm	lpm	lpm
P	psi	kg/cm ²	bar	MPa

I = total theoretical
spray impact

K = constant

Q = flow rate

P = liquid pressure

The constant (K), is a unit conversion based on the measurement system used. The conversions are listed in the chart above.

Example:

$$I = .0526 \times 3.5 \text{ gpm} \times \sqrt{150 \text{ psi}}$$

I = 2.25 lbs(f) is available for distribution
throughout the pattern





Viscosity

Absolute (dynamic) viscosity is the property of a liquid which resists change in the shape or arrangement of its elements during flow. Liquid viscosity is a primary factor affecting spray pattern formation and, to a lesser degree, capacity.

High viscosity liquids – 100 cp or higher – require a higher minimum pressure to begin formation of a spray pattern and provide narrower spray angles as compared to those of water.

Temperature

The values given in this catalog are based on spraying water at 70°F (21°C). Although liquid temperature changes do not affect the spray performance of a nozzle, they often affect viscosity, surface tension and specific gravity which do influence spray nozzle performance.

Surface Tension

The surface of a liquid tends to assume the smallest possible size; acting, in this respect, like a membrane under tension. Any portion of the liquid surface exerts a tension upon adjacent portions or upon other objects with which it is in contact. This force is in the plane of the surface and its amount per unit of length is surface tension. Its value for water is about 73 dynes per cm at 70°F (21°C). The main effects of surface tension are on minimum operating pressure, spray angle and drop size.

The property of surface tension is more apparent at low operating pressures. A higher surface tension reduces the spray angle, particularly on hollow cone and flat fan spray nozzles. Low surface tensions can allow a nozzle to be operated at a lower pressure.

Summary of Spray Performance Considerations

The factors below can affect a spray nozzle's performance, and the effects can vary based on nozzle type and size. In some applications, there are interrelated factors which may counteract certain effects. For instance, in the case of a hollow cone spray nozzle, increasing the temperature of the liquid decreases the specific gravity, thereby producing a greater flow rate while at the same time decreasing the viscosity which reduces the flow.

Nozzle Characteristics	Increase in Operating Pressure	Increase in Specific Gravity	Increase in Viscosity	Increase in Fluid Temperature	Increase in Surface Tension
Pattern Quality	Improves	Negligible	Deteriorates	Improves	Negligible
Drop Size	Decreases	Negligible	Increases	Decreases	Increases
Spray Angle	Increases then decreases	Negligible	Decreases	Increases	Decreases
Capacity	Increases	Decreases	Full/hollow cone – increases Flat – decreases	Depends on fluid sprayed and nozzle used	No effect
Impact	Increases	Negligible	Decreases	Increases	Negligible
Velocity	Increases	Decreases	Decreases	Increases	Negligible
Wear	Increases	Negligible	Decreases	Depends on fluid sprayed and nozzle used	No effect





Flow of water through schedule 40 steel pipe - pressure drop

Flow	Pressure Drop in bar for Various Pipe Diameters 10 m Length Pipe															
lpm	1/8"	1/4"	3/8"	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"	8"
1	.07															
1.5	.16	.04														
2	.26	.06														
2.5	.40	.08														
3	.56	.12	.03													
4	.96	.21	.05	.02												
6	2.0	.45	.10	.03												
8	3.5	.74	.17	.05	.01											
10		1.2	.25	.08	.02											
12		1.7	.35	.11	.03											
15		2.6	.54	.17	.04	.01										
20			.92	.28	.07	.02										
25			1.2	.45	.11	.03										
30			2.1	.62	.15	.04	.01									
40				1.1	.25	.08	.02									
60					.54	.16	.04	.02	.006							
80					.93	.28	.07	.03	.009							
100						.43	.12	.05	.01							
115						.58	.14	.06	.015							
130						.72	.18	.08	.02	.01						
150							.23	.10	.03	.012						
170							.29	.13	.04	.016						
190							.36	.16	.05	.02						
230							.50	.23	.07	.03	.009					
260								.32	.09	.04	.01					
300								.38	.11	.04	.02	.007				
340								.50	.14	.06	.02	.009				
380								.61	.18	.07	.03	.01				
470									.28	.11	.04	.02	.009			
570									.39	.15	.05	.03	.01			
750									.64	.26	.09	.04	.02	.007		
950											.14	.06	.03	.01		
1150											.19	.09	.05	.02		
1500												.16	.08	.03	.01	
1900													.13	.04	.02	
2800														.09	.03	.009
3800														.16	.06	.02
7500															.23	.06

Recommended capacity range for each size is shown in shaded areas.

For pipe lengths greater than 10 ft. (3 m), the pressure loss is proportional to the length.

For 15 m of pipe, the pressure drop is approximately 5 times the value in the table.



Table of Equivalents

Volumetric Unit

	Cubic Centimeter	Fluid Ounce	Pound of Water	Liter	US Gallon	Cubic Foot	Cubic Meter
Cubic Centimeter	•	.034	2.2×10^{-3}	.001	2.64×10^{-4}	3.53×10^{-5}	1.0×10^{-6}
Fluid Ounce	29.4	•	.065	.030	7.81×10^{-3}	1.04×10^{-3}	2.96×10^{-5}
Pound of Water	454	15.4	•	.454	.12	.016	4.54×10^{-4}
Liter	1000	33.8	2.2	•	.264	.035	.001
US Gallon	3785	128	8.34	3.785	•	.134	3.78×10^{-3}
Cubic Foot	28320	958	62.4	28.3	7.48	•	.028
Cubic Meter	1.0×10^6	3.38×10^4	2202	1000	264	35.3	•

Liquid Pressure

	lb/in ² (psi)	Ft Water	Kg/Cm ²	Atmosphere	Bar	Inch Mercury	kPa (kilopascal)
lb/in ² (psi)	•	2.31	.070	.068	.069	2.04	6.895
Ft Water	.433	•	.030	.029	.030	.882	2.99
Kg/Cm ²	14.2	32.8	•	.968	.981	29.0	98
Atmosphere	14.7	33.9	1.03	•	1.01	29.9	101
Bar	14.5	33.5	1.02	.987	•	29.5	100
Inch Mercury	.491	1.13	.035	.033	.034	•	3.4
kPa (kilopascal)	.145	.335	.01	.009	.01	.296	•

Linear Unit

	Micron	Mil	Millimeter	Centimeter	Inch	Foot	Meter
Micron	•	.039	.001	1.0×10^{-4}	3.94×10^{-5}	—	—
Mil	25.4	•	2.54×10^{-2}	2.54×10^{-3}	.001	8.33×10^{-5}	—
Millimeter	1000	39.4	•	.10	.0394	3.28×10^{-3}	.001
Centimeter	10000	394	10	•	.394	.033	.01
Inch	2.54×10^4	1000	25.4	2.54	•	.083	.0254
Foot	3.05×10^5	1.2×10^4	305	30.5	12	•	.305
Meter	1.0×10^6	3.94×10^4	1000	100	39.4	3.28	•

Miscellaneous Equivalents

Unit	Equivalent
Ounce	28.35 g
Pound	.4536 kg
Horsepower	.746 kW
British Thermal Unit	.252 kcal
Square Inch	6.452 cm ²
Square Foot	.09290 m ²

Miscellaneous Formulas

Unit	Formula
Fahrenheit (°F)	= 9/5 (°C) + 32
Celsius (°C)	= 5/9 (°F) – 32
Circumference of a Circle	= 3.1416 x Dia.
Area of a Circle	= .7854 x (Dia.) ²
Volume of a Sphere	= .5236 x (Dia.) ³
Area of a Sphere	= 3.1416 x (Dia.) ²

Dimensions

The catalog tabulations show orifice dimensions as “Nom.” (nominal).

Operating Pressure

The values given in the tabulation sections of this catalog indicate the most commonly used pressure ranges for the associated spray nozzle or accessory. The given pressures are relative pressure in bar

Contact your local Spraying Systems Co. sales engineer if your application requires pressure ranges beyond those stated in this catalog.





Read the following instructions:



WARNING:

All safety related and operating instructions should be read before the nozzle is operated. Follow all operating instructions. Failure to do so could result in serious or fatal injury.



WARNING:

It is important to recognize proper safety precautions when using a pressurized spray system. Fluids under pressure can penetrate skin and cause severe injury. Seek medical attention immediately.



WARNING:

When dealing with pressure applications, the system pressure should never exceed the lowest rated component. Always know your system and all component capabilities, maximum pressures and flow rates.



WARNING:

Before performing any maintenance, make sure all liquid supply lines to the machine are shut off and/or disconnected and chemicals/fluids are drained and not pressurized.



WARNING:

The use of any chemicals requires careful control of all worker hygiene. Follow all MSDS or safety precautions provided by the manufacturer.



WARNING:

Spraying Systems Co. does not manufacture or supply any of the chemicals used with our nozzles and is not responsible for their effects. Because of the large number of chemicals that could be used and their different chemical reactions, the buyer and user of this equipment should determine compatibility of the materials used and any of the potential hazards involved.



WARNING:

Spraying Systems Co. strongly recommends the use of appropriate safety equipment when working with potentially hazardous chemicals.

This equipment includes but is not limited to:

- Protective hat
- Safety glasses or face shield
- Chemical-resistant gloves and apron
- Long sleeve shirt and long pants



WARNING:

Before use, be sure appropriate connections are secure and made to withstand weight and reaction forces of the operating unit.

NOTE: Always remember to carefully read the chemical manufacturer's label and follow all directions.



WARNING:

It is important to operate equipment within the temperature range of all components. Also, insure appropriate time lapse or proper safety equipment is used when handling components after they're exposed to high temperatures.



WARNING:

Do not use any equipment outside the intended purposes of the product. Misuse can result in personal injury or product damage.



Spraying Systems Material Codes

GERMANY		USA	JAPAN	UNIFIED NUMBERING SYSTEM
MATERIAL NO.	DIN	AISI	JIS	UNS
1.4305	X8CRNIS18-9	303	SUS 303	S 30300
1.4401	X5CRNIMO17-12-2	316	SUS 316	S 31600
1.4404	X2CRNIMO17-12-2	316 L	SUS 316 L	S 31603
1.4435	X2CRNIMO18-14-3	316 L	SUS 316L	S 31603
1.4571	X6CRNIMOTI17-12-2	316 Ti	SUS 316 Ti	S 31635
1.4841	X15CRNIS125-20	310	SUH 310	S 31000
2.4602	NICR21MO14W	C22		NO 06022
2.4819	NIMO16CR15W	C276		

NOZZLE MATERIALS

For each nozzle there is a selection of “standard” materials that have been determined to meet the usual requirements of the applications most commonly associated with that type of nozzle. Standard materials include brass, steel, various stainless steels, hardened stainless steels, many plastics and various carbides. Spray nozzles can also be supplied in other materials upon special request including:

- AMPCO® 8
- CARPENTER® 20 (Alloy 20)
- Ceramics
- CUPRO® NICKEL
- Graphite
- HASTELLOY®
- INCONEL®
- MONEL®
- Nylon
- Polypropylene, PVC and CPVC
- REFRAK®
- Silicon carbide
- Stellite®
- Titanium
- Zirconium





Nozzle Wear

Nozzle wear is typically characterized by an increase in nozzle capacity, followed by a general deterioration of the spray pattern. Flat fan spray nozzles with elliptical orifices experience a narrowing of the spray pattern. In other spray pattern types, the distribution within the spray pattern deteriorates without substantially changing the coverage area. The increase in nozzle capacity can sometimes be recognized by a decrease in system operating pressure, particularly when using positive displacement pumps.

Materials having harder surfaces generally provide longer wear life. The chart below provides standard abrasion resistance ratios for different materials to help you determine if you should consider a different material for your nozzles, orifice inserts and/or spray tips.

Materials that offer better corrosion resistance are also available. However, the rate of chemical corrosion on specific nozzle materials is dependent on the solution being sprayed. The corrosive properties of the liquid being sprayed, its percent concentration and temperature, as well as the corrosion resistance of the nozzle material to the chemical must all be considered.

Approximate Abrasion Resistance Ratios

Spray Nozzle Material	Resistance Ratio
Aluminum	1
Brass	1
Polypropylene	1 - 2
Steel	1.5 - 2
Monel	2 - 3
Stainless Steel	4 - 6
Hastelloy	4 - 6
Hardened Stainless Steel	10 - 15
Stellite	10 - 15
Silicon Carbide (Nitride Bonded)	90 - 130
Ceramics	90 - 200
carbides	180 - 250
Synthetic Ruby or Sapphire	600 - 2000

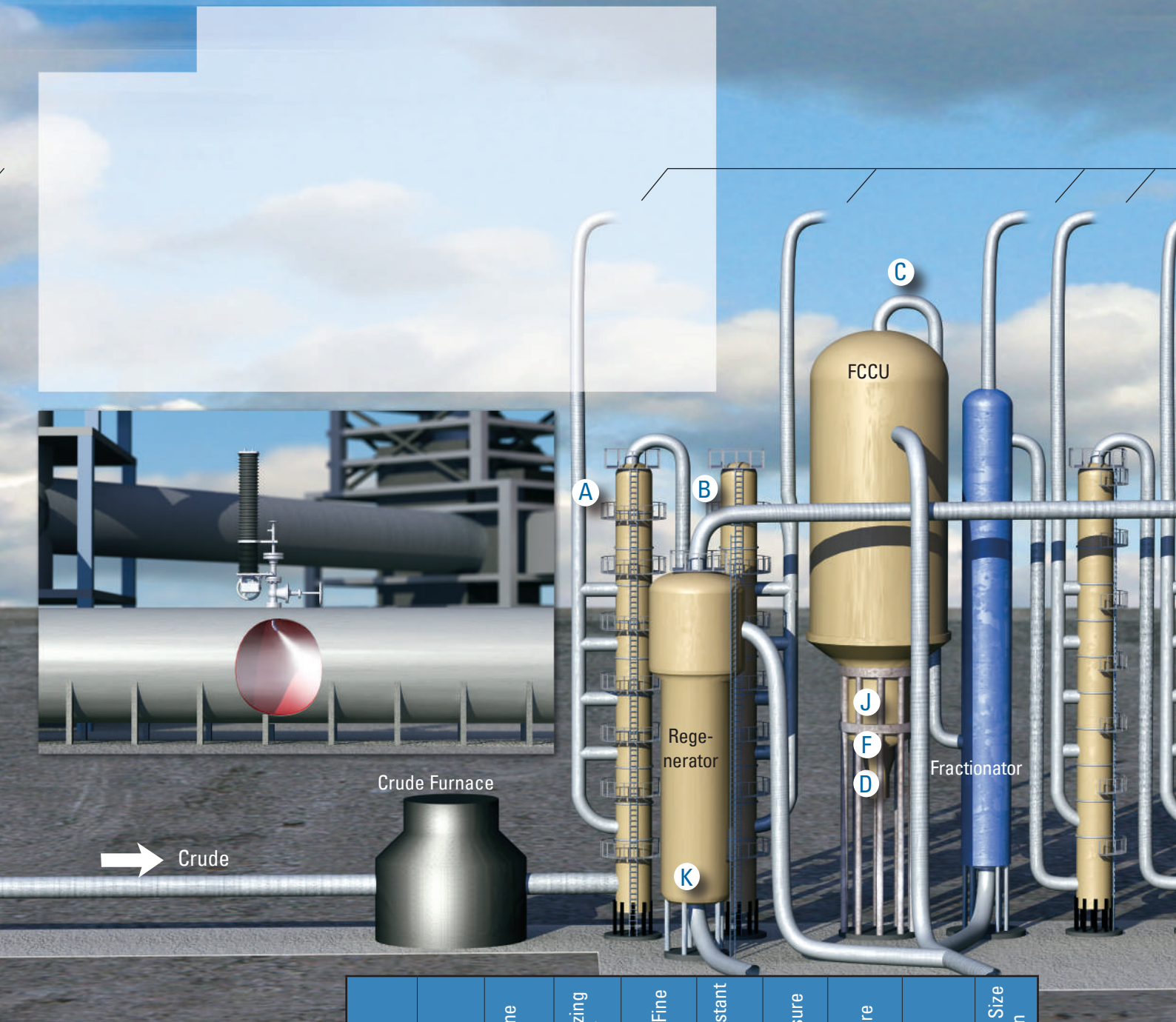
See Trademark Registration and Ownership, page 0.08.



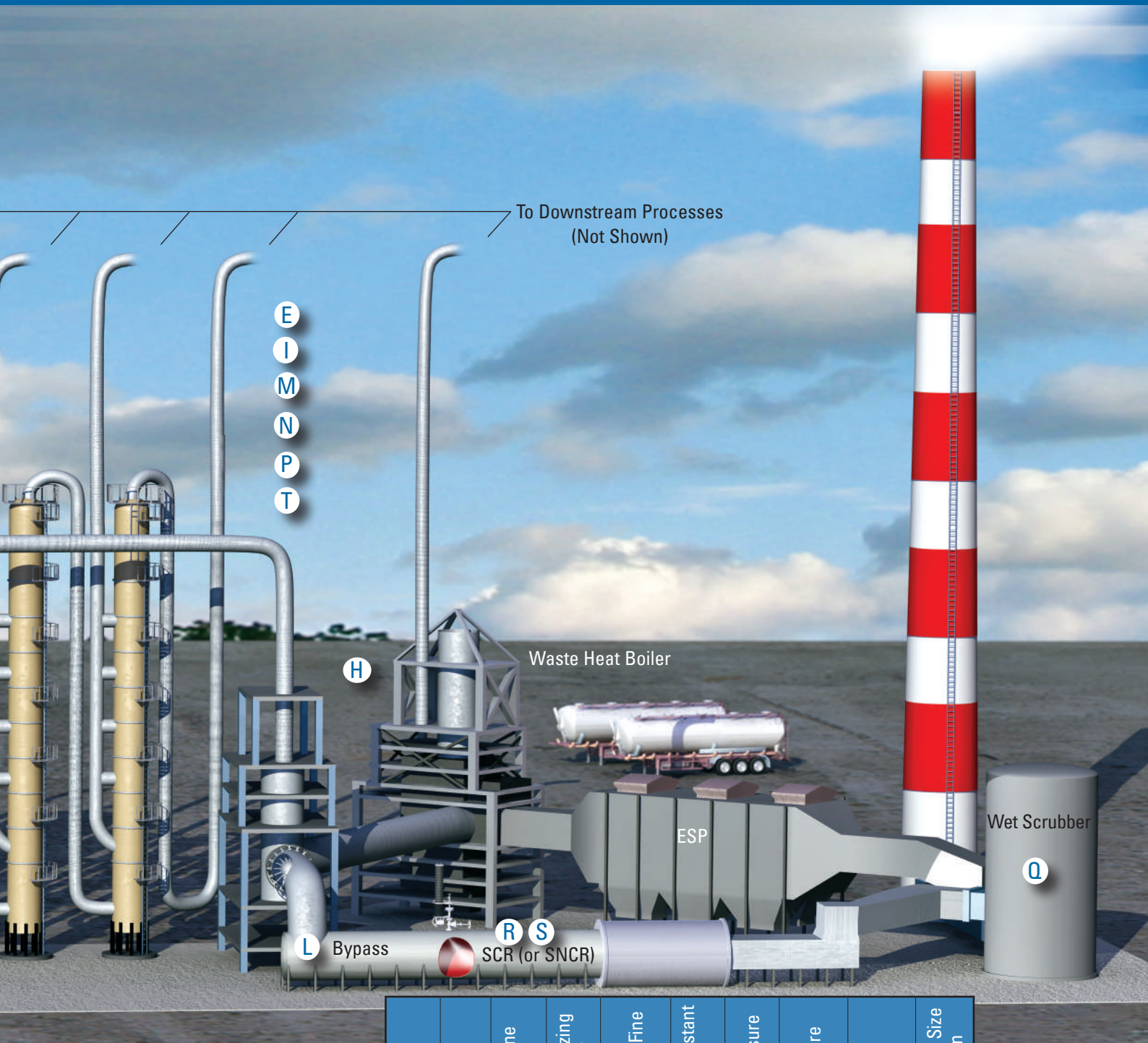


OPTIMIZING SPRAY NOZZLES, LANCES & INJECTORS

FOR VARIOUS GAS CONDITIONING APPLICATIONS



Injector Type	Key Design Features									
	Flat Fan Pattern	Full Cone Pattern	Hollow Cone Pattern	Gas Atomizing Fine Spray	Hydraulic Atomizing Fine Spray	Wear Resistant Materials	High Pressure	High Temperature Alloys	Corrosion Resistant Materials	Tight Drop Size Distribution
Defoaming		X			X				X	
Distillation Column		X			X				X	
FCCU Overhead Water Wash		X	X		X	X				
FCCU Feed Injector				X		X		X	X	X
Steam Quench Injector	X	X		X		X				X
Slurry Backflush Injector	X		X	X		X		X	X	X
Packed Tower Headers		X								
Heat Exchanger Bundle Sprays		X					X			X
Additive Injection				X	X				X	
Mix Temperature Control	X		X	X		X		X	X	



Injector Type	Key Design Features									
	Flat Fan Pattern	Full Cone Pattern	Hollow Cone Pattern	Gas Atomizing Fine Spray	Hydraulic Atomizing Fine Spray	Wear Resistant Materials	High Pressure	High Temperature Alloys	Corrosion Resistant Materials	Tight Drop Size Distribution
Torch Oil	X	X		X		X		X		
Regenerator Bypass		X		X		X		X		X
Catalyst Reformer Gas Cooling	X		X	X				X	X	
Chloride Injection		X			X				X	
Fractionator Water Wash Injection		X			X				X	X
Coker Off-Gas Cooling		X	X	X		X		X	X	X
Flue Gas Desulfurization			X			X				X
SNCR NO _x Control	X	X	X		X			X		X
SCR NO _x Control	X	X		X						X
Desuperheating	X	X			X		X	X		X

Refinery injectors need to meet exacting performance requirements. And to achieve those performance goals, injector designs are typically complex, comply with extreme engineering standards for safety and necessitate the use of special materials and coatings to withstand harsh environments. While each injector is unique, there are many common design attributes.

A. Defoaming Injectors

These injectors are used to uniformly disperse defoaming agents into the process stream or onto a surface.

B. Distillation Column Injectors

Water wash injections, typically continuous and low volume, are used to avoid salt build-up or reduce corrosiveness in the distillation column overheads.

C. FCCU Overhead Water Wash Injectors

Used to minimize corrosion, cracking or hydrogen blistering from exposure to ammonia and cyanide, these devices inject water wash or corrosion inhibitors into ductwork above the FCCU.

D. FCCU Feed Injectors

Fresh feed is injected into catalyst-laden gas stream in the FCCU to atomize the feed for best cracking. These injectors are designed to operate for several years without maintenance.

E. Steam Quench Injectors

Light cycle oil is injected into the gas stream prior to entry into a cracking or reforming heater to lower temperature and stop the cracking process.

F. Slurry Backflush Injectors

Hydrocarbons entrained with catalyst are re-injected into the FCCU via robust, wear resistant injectors.

G. Packed Tower Headers

Injectors distribute fluid evenly to thoroughly clean packing material.

H. Heat Exchanger Injectors

To prevent corrosion problems, glycol or other inhibitors are injected onto the ends of heat exchanger tubes.

I. Additive Injectors

Small volumes of chemicals, inhibitors and/or detergents are injected into petroleum products to improve quality or add special characteristics.

J. Mix Temperature Control (MTC) Injectors

Positioned above the fresh feed injectors in the riser, these injectors are used to control riser outlet temperature. Light cycle oil is injected on a continuous basis.

The list below and illustration to the right show some of the more common applications in refineries where spray injectors are used. There are many others so be sure to contact us for additional information. We have wide ranging experience with dozens of different injector types for dozens of refinery operations.

K. Torch Oil Injectors

For heat during start-up, shutdown, or feed-outage conditions, liquid oil is injected and burned in FCC regenerators.

L. Regenerator Bypass Injectors

When the waste heat steam generator is offline, these injectors are used to cool gases prior to SCR NO_x reduction equipment.

M. Catalyst Reformer Gas Cooling Injectors

Injectors are used to cool the exterior of the catalytic reformers to control temperature.

N. Chloride Injectors

Used for propylene dichloride and alcohol injection into naphtha feed line for corrosion resistance.

O. Fractionator Water Wash Injectors

Water wash injections, typically continuous and low volume, are used to avoid salt build-up or reduce corrosiveness in the fractionator overheads.

P. Coker Off-Gas Cooling Injectors

Steam atomizing injectors are used to cool coker gas with 100% evaporation prior to entry to downstream particulate collection devices.

Q. Flue Gas Desulfurization Injectors

Injectors equipped with clog-resistant nozzles constructed of silicon carbide or other ceramic materials are used to neutralize gas or liquid in a tower.

R. SNCR NO_x Control Injectors

Injection of aqueous ammonia is used to act as a reagent and mix with molecular NO_x at high temperatures to reduce NO_x emissions.

S. SCR NO_x Control Injectors

Injection of aqueous ammonia is used to act as a reagent and mix with molecular NO_x at high temperatures to reduce NO_x emissions.

T. Desuperheating Injectors

Injection of a fine spray of feed water into superheated steam provides cooling so the steam can be used in lower pressure processes downstream.



Size of duct, vessel, tower

- Impacts the size of the injector, number of nozzles, spray pattern, spray angle, placement of nozzles and drop size/residence time of the spray

Bends, miters and elbows in ducts

- Impacts flow profiles, placement of injectors to avoid erosion of process equipment and wall wetting

Proximity to upstream or downstream equipment

- Impacts spray plume shape, pattern and velocity

Operating conditions such as gas and liquid properties, temperature, corrosiveness

- Impacts materials of construction, coatings, spray distance

Liquid composition

- Impacts materials of construction, spray pattern, maximum free passage

Fluid service category

- Impacts safety design requirements per ASME® and other construction codes

Co-current or counter-current sprays

- Impacts residence times, drop size, spray angles, build-up, vibration, stress

Connection types

- Impacts safety, other design standards, current field connections

Physical restrictions on injector placement

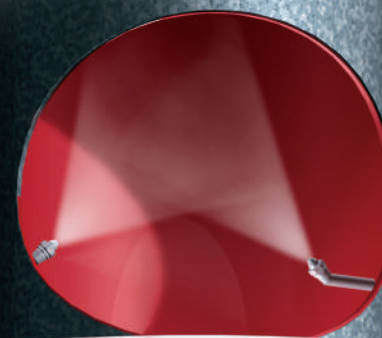
- Impacts flexible or rigid design, weight limitations

Service life requirements

- Impacts materials of construction, design requirements

Maintenance requirements

- Impacts design features such as mechanical retraction devices



DeNO_x CONTROL

METHOD, APPLICATIONS & EXAMPLES

Dry flue gas denitrification process

- DeNOx = Flue gas denitrification
- SCR = Selective Catalytic Reduction, low temperature $\leq 360-600$ The reduction thus achieved with a catalyst.
- SNCR = Selective non-catalytic reduction, high temperature > 840

Here the reduction without the catalyst takes place;

Low operating and installation costs for efficiency (40 ... 60%) is lower than SCR (70 ... 95%)

Ammonia water - Aqua ammonia

- Reducing agent (NH_3)
- Most of the time 25% Solution
- High security requirements
- Easy Dosage

Urea solution - Urea Water Mixture

- Reduction agent urea (NH_2CO)
- Most of the time 32 to 40 Solution
- Safe dosage
- Additional supply of heat for decomposition

Method of DeNOx

1. Combustion Control

- Low Temp. Combustion by Low NOx Boiler
- Flue Gas Recirculation
- Redesign combustion chamber
- Reduce Excess Air
- Spraying water or steam
- Changing fuel
- Combustion is one of important key factor for DeNOx, and customer's struggle

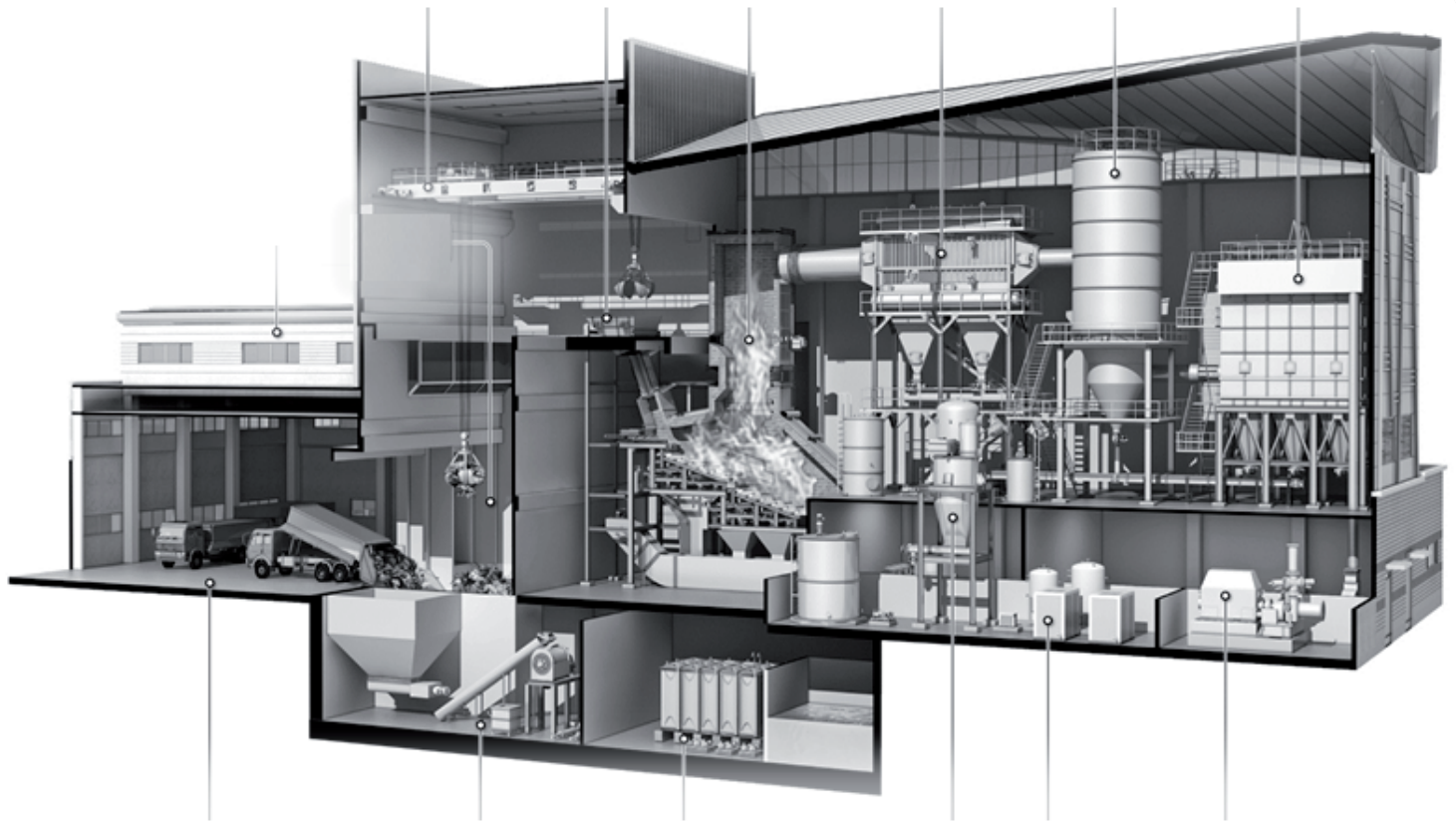
2. Flue Gas treatment Dry Type

- SCR
- SNCR
- Adsorption,
- Electron Beam

3. Flue Gas treatment Wet Type

- Absorption via Water or H_2SO_4 , $\text{Ca}(\text{OH})_2$, FeSO_4

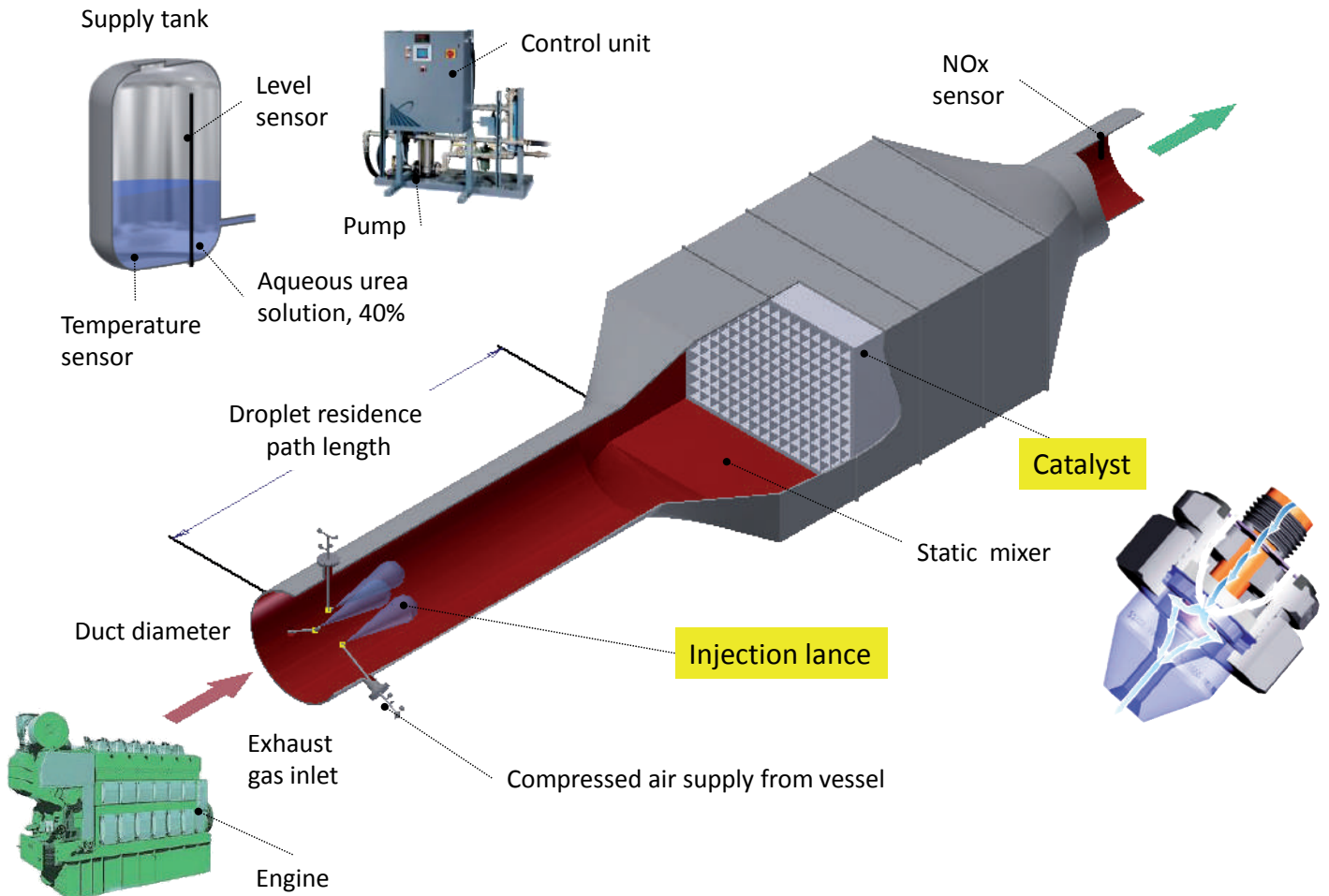
Waste Incineration



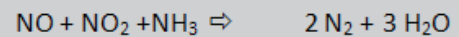
SNCR: Injection above the combustion zone

- Temperature 900°C
- High dust loading

Ship Technology - Selective Catalytic Reduction (SCR)

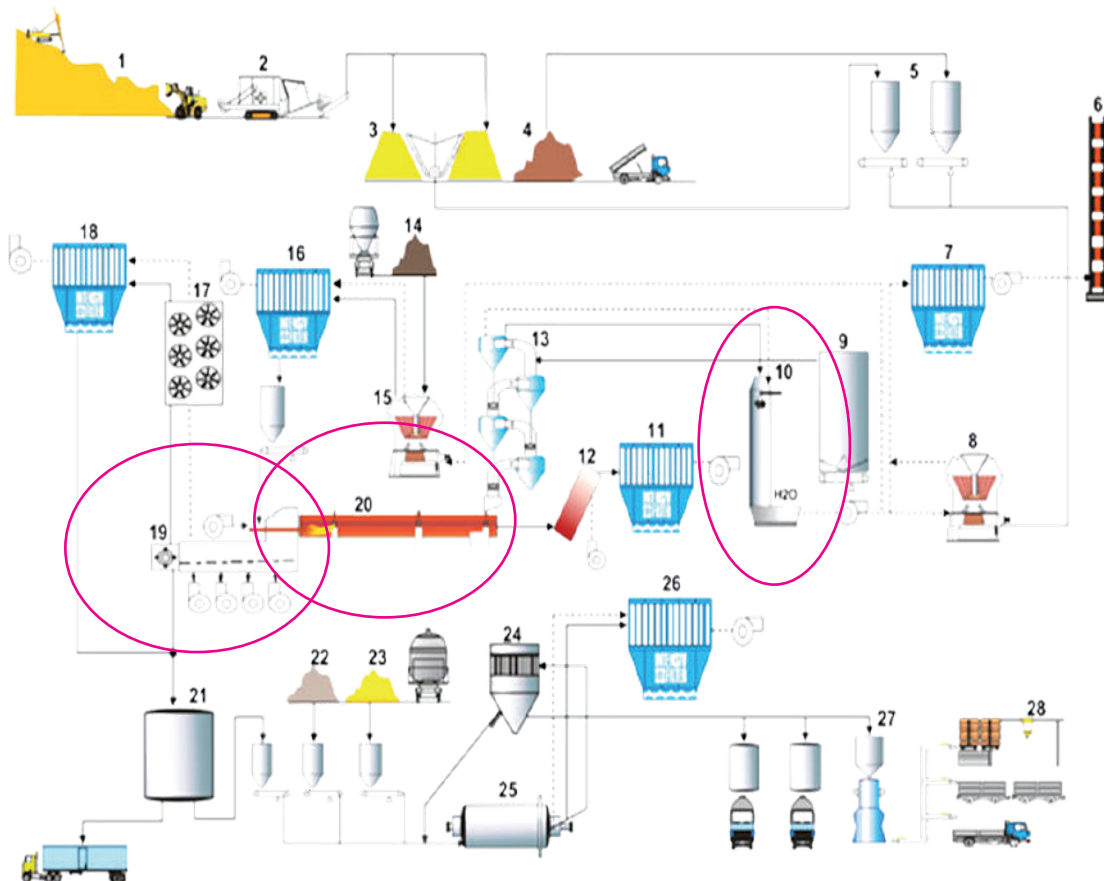


The chemistry to reduce nitrogen oxides is



Selective Catalytic Reduction (SNCR) nozzles should be installed cyclone preheater in low zone nearly sub-burner. Temperature in preheater:

- High zone about 350 ... 400 °C
- Low zone ≥ 900 °C
- High dust load



- | | | |
|----------------------|---------------------------------|-------------------------------|
| 1. Quarry | 10. Evaporative Cooler | 19. Clinker Cooler |
| 2. Crusher | 11. Filters for Bypass to Kilns | 20. Rotating Kiln |
| 3. Raw Material | 12. Bypass Kiln | 21. Clinker Silo |
| 4. Material Conveyor | 13. Cyclones Preheater | 22. |
| 5. Additives | 14. Coal | 23. Minerals |
| 6. Silos | 15. Coal Crushing Plant | 24. Screens |
| 7. Chimney | 16. Filter for Coal Crusher | 25. Cement Crusher |
| 8. Crusher Filter | 17. Tuber Cooler | 26. Filter for Cement Grinder |
| 9. Silos | 18. Clinker Cooler for Filter | |

Gas Cooling with FloMax or FlowBack Nozzles

- Temperature inlet 350 ... 400 °C (peak 500 °C)
- Temperature outlet 130 ... 150 °C

NO_x CONTROL

METHOD, APPLICATIONS & EXAMPLES

Effective NOx Control requires superior Air Atomizing Nozzles

Spray nozzles are critical components in a NOx control system. If drop size and spray coverage aren't precisely right, problems like these can occur:

- Insufficient NOx reduction
- Ammonia slip
- Odor and plume visibility
- Formation of ammonium bisulfate
- Increased energy consumption

All air atomizing nozzles are not alike

In fact, very few are suitable for NOx control applications. High efficiency nozzles provide tight control of drop size and spray coverage. Very small drop sizes cannot be achieved with a single-step atomization process. A multi-stage process is required.

FloMax nozzles use a patented atomization principle to produce a highly focused air stream that shears the liquid with minimal air. The result of the unique processes is that FloMax nozzles use less air and produce smaller drops than competitive nozzles.

The benefits of small drop size are many:

- Energy costs are lowered
- Compressor life is extended
- Dwell time for complete reaction is reduced
- The liquid being sprayed generates more surface area per gallon (liter)

The uniformity of drop size distribution produced by our nozzles ensures precise, tight control of drop size. This is another unique attribute – our nozzles provide a narrower Relative Span Factor (RSF) than many other air atomizing nozzles at most air pressures.

Spray Nozzles for NOx Control

A wide range of nozzles can be used for ammonia and urea injection. The operating conditions and requirements of the chemical reaction will determine which nozzles will provide the proper performance.

Nozzles typically used for SCR and SNCR NOx control include:

- Air atomizing nozzles
- 1/4J Series nozzles
- FMX FloMax® nozzles
- Standard and Anti-Bearding FloMax Nozzles
- Hydraulic spray nozzles
- FullJet® full cone nozzles
- WhirJet® hollow cone nozzles
- Computational Fluid Dynamics (CFD) modeling is recommended to validate nozzle selection and placement. The model accounts for tower/duct/boiler structure, gas composition, temperature, velocity and flow to determine the effect on nozzle performance and identify possible problems such as wall wetting. This data is then used along with the chemical mixing efficiency to determine the expected reduction in NOx and ammonia or urea slip.

Precise Injection of Ammonia or Urea:

An Effective and Efficient NOx Control Solution

Regulations for nitrogen oxides (NOx) emission are stringent and likely to become even more so in the future. Spray technology is widely used in waste incinerators, steel mills, cement kilns, power plants, pulp & paper recovery boilers and other manufacturing operations to control NOx. Dual-fluid atomization, where ammonia or urea is mixed with compressed air and injected into the gas stream, is the preferred approach in both Selective Catalytic Reduction (SCR) and Selective Non-Catalytic Reduction (SNCR) systems.

However, there are many differences in dual-fluid systems and it is important to partner with a company that has a full range of services to ensure the desired system performance and emission reductions are achieved.

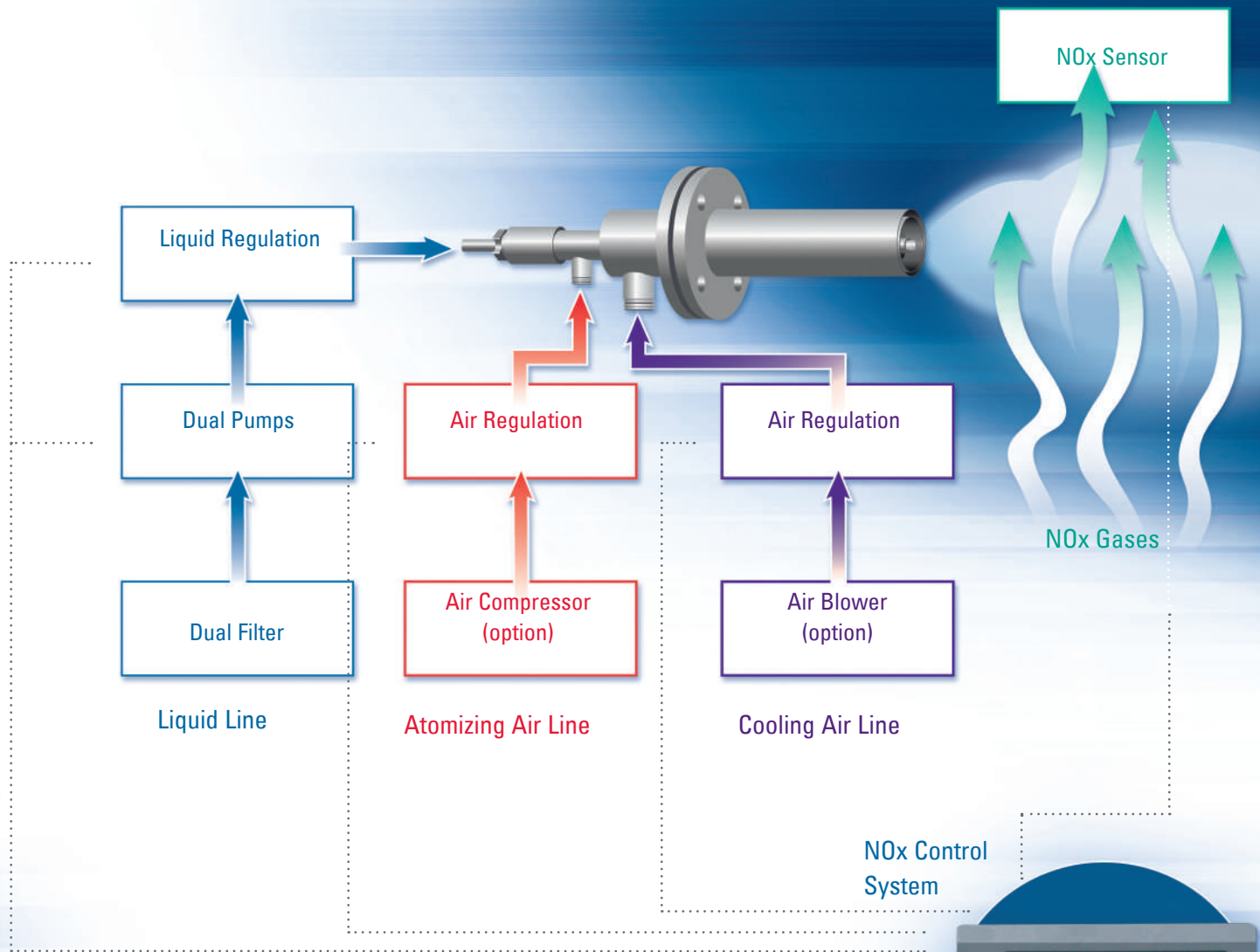
Spraying Systems Co. is uniquely qualified to help you with your NOx control needs. More than 75 years of spray technology experience has enabled us to develop the broadest product line of spray nozzles and lances in the industry.

AutoJet® Spray Controllers provide precise, closed-loop control for our turnkey spray systems. Our industry-leading research and testing services allow us to evaluate your requirements and help ensure your performance goals are met.



Selective catalytic reduction (SCR) NOx control
Precise control of urea injection and distribution
using air atomizing nozzles improves chemical
reaction, reduces ammonia slip and prevents fouling
of the catalyst grid.

NOx control using aqueous ammonia injection
To ensure uninterrupted process operation, two custom-built
retractable injectors equipped with air atomizing nozzles are
placed permanently in the process stream. Only one injector is
in use at a time. When the operational injector requires service,
the other injector is used and the process is unaffected.



A Closer Look at How the AutoJet® NOx Control System Works

The AutoJet Spray Controller, equipped with powerful SprayLogic™ software, continuously monitors feedback from the NOx sensor(s) and regulates the system response by proportionally adjusting liquid and air flow to the injector nozzles. This “closed loop” system provides the highest level of control possible. The system is easy to install and requires minimum installation space. Once installed, the system provides maximum operational reliability and minimizes air consumption and operating costs.

NOx control software features:

- Multiple PID regulation for controlling ammonia/urea injection with dual-fluid nozzles
- Fast response time and minimum energy consumption
- Dual VFD pump management and dual filtration
- Intelligent error detection and continuous system integrity checking
- Multiple protection levels with password
- Ammonia/urea supply reservoir management (optional)
- Proportional liquid regulation valve or VFD pumps
- Electromagnetic flow meter and liquid and atomization air pressure sensors
- Optional OPC/SCADA support and IP54 control panel
- Nozzles, complete with flexible and quick connections for coupling with fixed utilities



AutoJet® NOx Control Systems

Optimized performance and total automation

If you think of nozzles as the heart of your NOx reduction operation, the AutoJet NOx Control System is the brain. It controls all system components and ensures optimized performance without operator intervention.

Seven benefits the AutoJet System can bring to your NOx control application

1. **Optimal performance:** Our AutoJet Spray Controller, with patented SprayLogic® software, monitors and automatically adjusts the closed loop system. By regulating liquid and air flow to the nozzles based on data gathered from the NOx sensor, the controller offers the highest level of reactivity and accuracy for the system.
2. **Plug and spray convenience:** AutoJet Spray Controllers will save you time and money during installation because they are equipped with complete “spray knowledge” and are pre-programmed with parameters and function screens specific to NOx control applications.
3. **Total automation minimizes labor and downtime:** The AutoJet Spray Controller controls all system components – nozzles, pumps, sensors and other hydraulic/pneumatic components. If a problem is detected that the controller can't resolve automatically, operator warnings will be displayed or sounded.
4. **Built for reliability:** Emergency modes, system redundancy, intelligent fault sensing and patent-pending continuous system integrity checking are just a few of the reasons why you can count on long-term, trouble-free performance.
5. **Reduced energy costs:** Variable Frequency Drive (VFD) pumps provide proportional liquid regulation. In addition, energy-efficient proportional air regulation reduces air consumption and operating costs.
6. **Easy integration:** You can easily integrate the AutoJet NOx System with other systems through direct wiring and current splitters for access to critical data. For full control of all available data, an optional OPC communication link is available.
7. **Single source convenience:** Should you have a question about your system, just give us a call. No need to contact multiple suppliers and coordinate their efforts should a problem occur.



Computational Fluid Dynamics (CFD) and NOx control

Some spray operations cannot be replicated in our labs. While we can spray solutions other than water, there are some gases and liquids that are not safe to use during testing. Plus, it is not always feasible to reproduce some mixing conditions and chemical reactions. That's when we rely on our extensive library of proprietary spray characterization data and CFD.

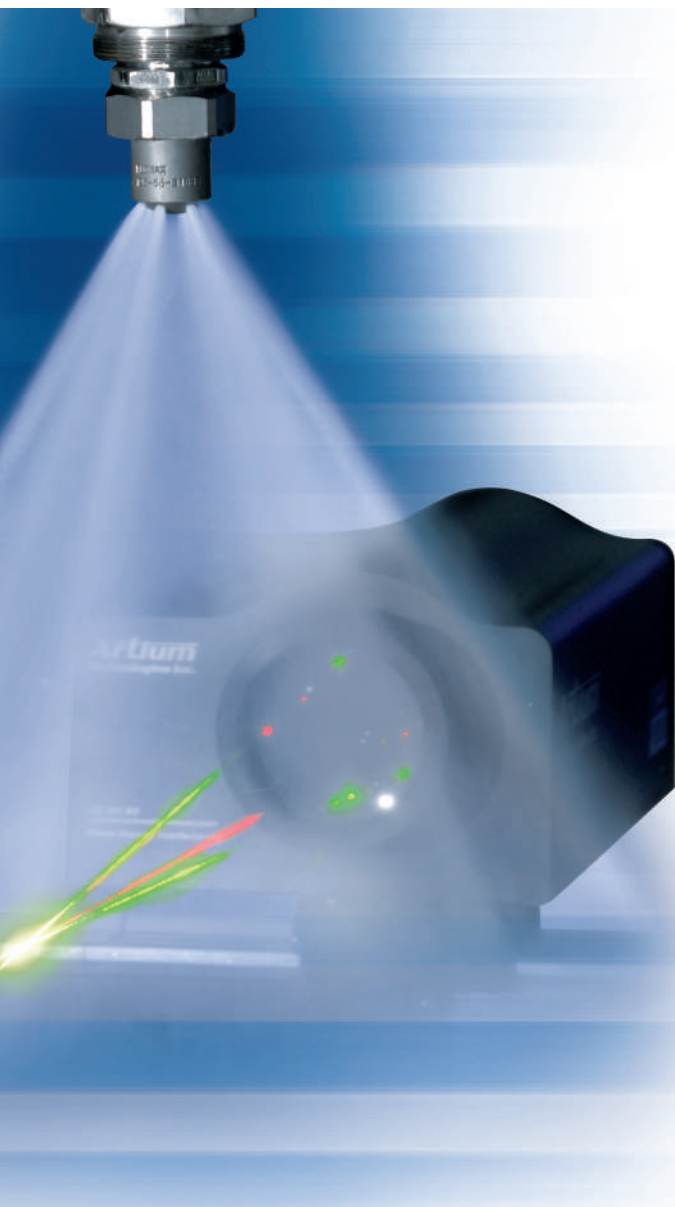
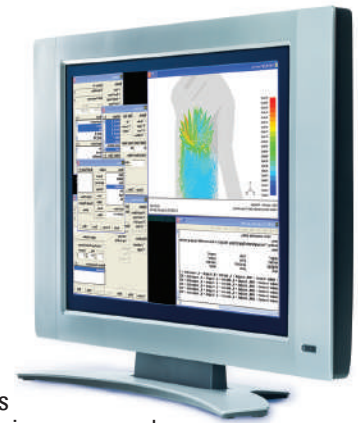
CFD is the science of predicting:

- Fluid flow
- Mass transfer
- Heat transfer
- Chemical reactions

CFD uses numerical methods and algorithms to solve and analyze problems involving fluid flows. Sophisticated software performs the millions of calculations required to simulate the interaction of fluids and gases with related physical phenomena.

We use CFD to predict:

- Liquid and gas flow in scrubbers, towers and ducts
 - Internal flow characteristics in spray nozzles
 - Gas and liquid mixing in dual-fluid nozzles
- CFD models illustrate flow patterns, velocity, temperature, gas/liquid distributions, droplet trajectories, pressures within the entire system and impact forces and stress caused by liquid flow.



Spray Testing and Modeling

Understanding drop size in NOx control is critical

Many problems can result from improper drop size. Drops that are too small don't mix well with in the gas stream. Drops that are too large require a longer dwell time for a complete reaction to take place.

Running sophisticated gas cooling calculations provides a starting point to determine the type of nozzles and the number of nozzles required and how they need to be positioned. However, with complicated gas flows, unusual operating conditions or a typical duct work or tower shape, gas cooling calculations alone may not tell the entire story. This is when we head to our spray laboratories and conduct spray characterization studies to determine dwell time simulating actual operating conditions.

Typically these studies include:

- Drop size testing to determine the optimal drop size and drop size distribution
- Determination of gas velocity and density and the resulting impact on drop size

Spray Analysis and Research Services, a service of Spraying Systems Co., is our research and testing group that operates the most fully equipped spray laboratory in the world. Phase Doppler Particle Analyzers, Laser Imaging, Particle/Image Analyzers and Laser Diffraction Analyzers are among the instruments we use to measure drop size.

WET FDG OPERATIONS

METHOD, APPLICATIONS & EXAMPLES



Dozens of Options to Optimize Wet FGD Operations

The requirements for nozzles used in FGD are extensive and include precise performance, trouble-free operation and long service life. But, that's where the commonality ends and why we have such a broad product line. Many customer requests can be satisfied by our standard product line. When that's not possible, we can usually quickly modify an existing product to meet specific requirements.



Choose from many nozzle types

- WhirlJet® nozzles provide a hollow cone pattern.
- FullJet® nozzles provide a full cone spray pattern.
- SpiralJet® nozzles are available with either a full cone or hollow cone spray pattern.

Choose from several materials

- Nitride-bonded silicon carbide is most widely used in FGD applications.
- Other high performance alloys such as HASTELLOY® and Stellite® are common as well.
- While the service life of our nozzles will vary based on installation-specific variables, most of our FGD nozzles operate for tens of thousands of hours in extremely harsh operating environments. Evaporation Cooling Tower

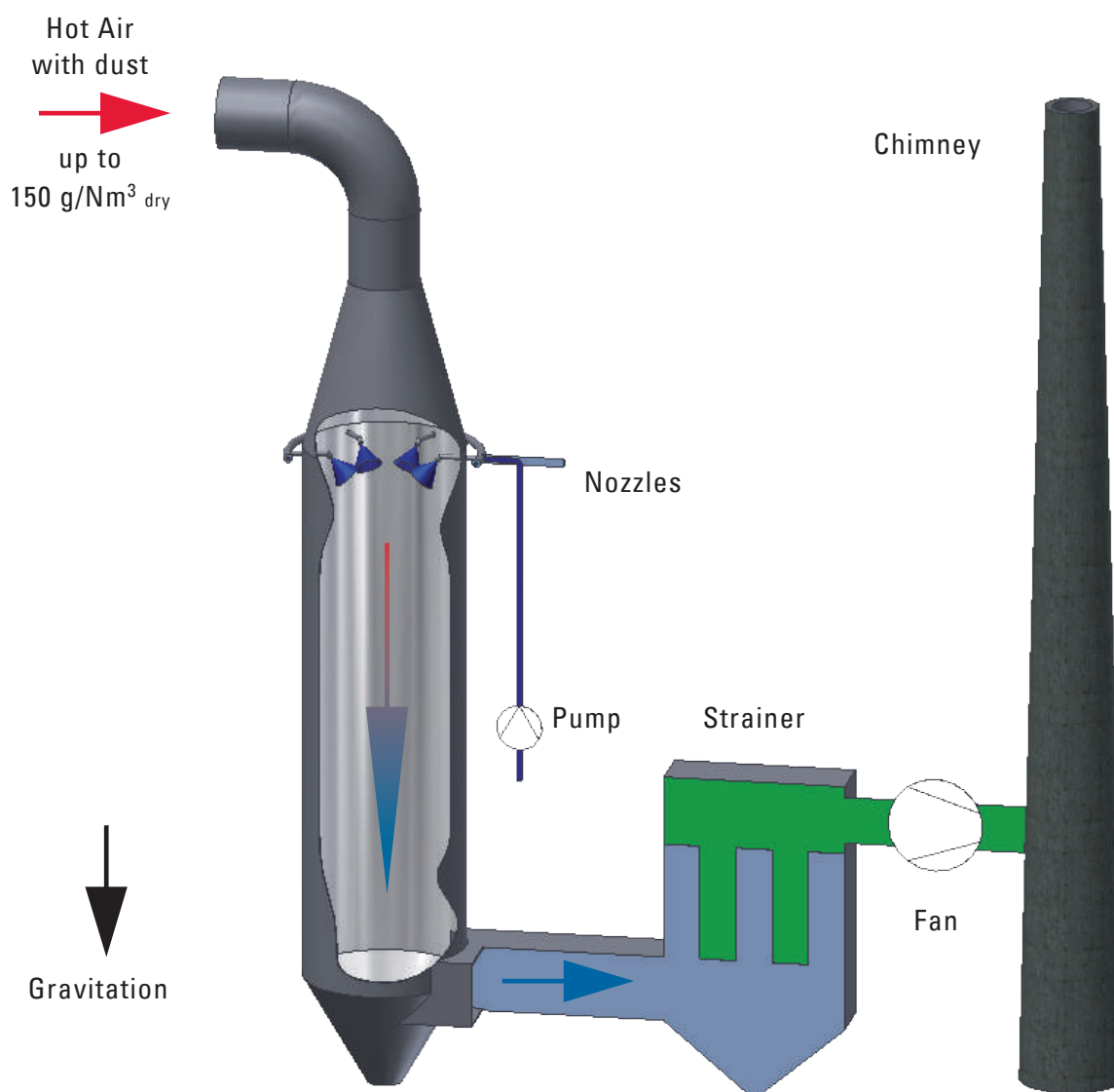


* Wet FGD = Wet flue-gas desulfurization

GAS COOLING

METHOD, APPLICATIONS & EXAMPLES

Gas Cooling



Nozzles and Lances

Gas Cooling: A patented multi-stage atomization process that produces small drops using minimal air is why FloMax® nozzles offer superior performance. Spray lances are available in both standard and custom configurations. If you're looking for a completely automated solution, our AutoJet® Gas Cooling System provides total system control and optimizes the performance of FloMax nozzles.

If you're maintaining a hydraulic gas conditioning system, our Flowback nozzles can help improve system performance. Flowback nozzles deliver consistent drop size and feature a unique two-piece design to make installation and maintenance quick and easy.

Reduce Emissions, Boost Production by Precise Control of Gas Temperature and Volume

The nozzles of choice in gas conditioning are our FloMax® A Series. FloMax nozzles outperform all others when it comes to drop size, evaporation, spray pattern uniformity and efficiency. And, that's why FloMax nozzles are the key component in our automated gas conditioning system.

Our turnkey system from AutoJet® Technologies, the systems division of Spraying Systems Co., optimizes the performance of FloMax nozzles and controls all other system components including pumps, sensors and other hydraulic and pneumatic components. The AutoJet Spray Controller monitors and automatically adjusts the closed-loop system. By regulating liquid and air flow to the nozzles based on data gathered from temperature sensors, the controller offers the highest level of reactivity and accuracy for the system.

AutoJet® Gas Conditioning System Benefits

- Plug and spray convenience – the spray controller is pre-programmed ensuring quick set-up.
- Total automation minimizes labor and downtime.
- Multiple lance zones can be configured to allow greater turndown of flow rate under variable system conditions.
- Reliable operation is ensured by emergency modes, system redundancy, intelligent fault sensing and more.
- Reduced energy costs are the result of Variable Frequency Drive (VFD) pumps that provide proportional liquid regulation.
- Easy integration with other systems.
- Single source convenience – eliminate integration issues and the need to contact multiple suppliers if you have questions.

Spraying Liquids and Air to Lower Temperatures

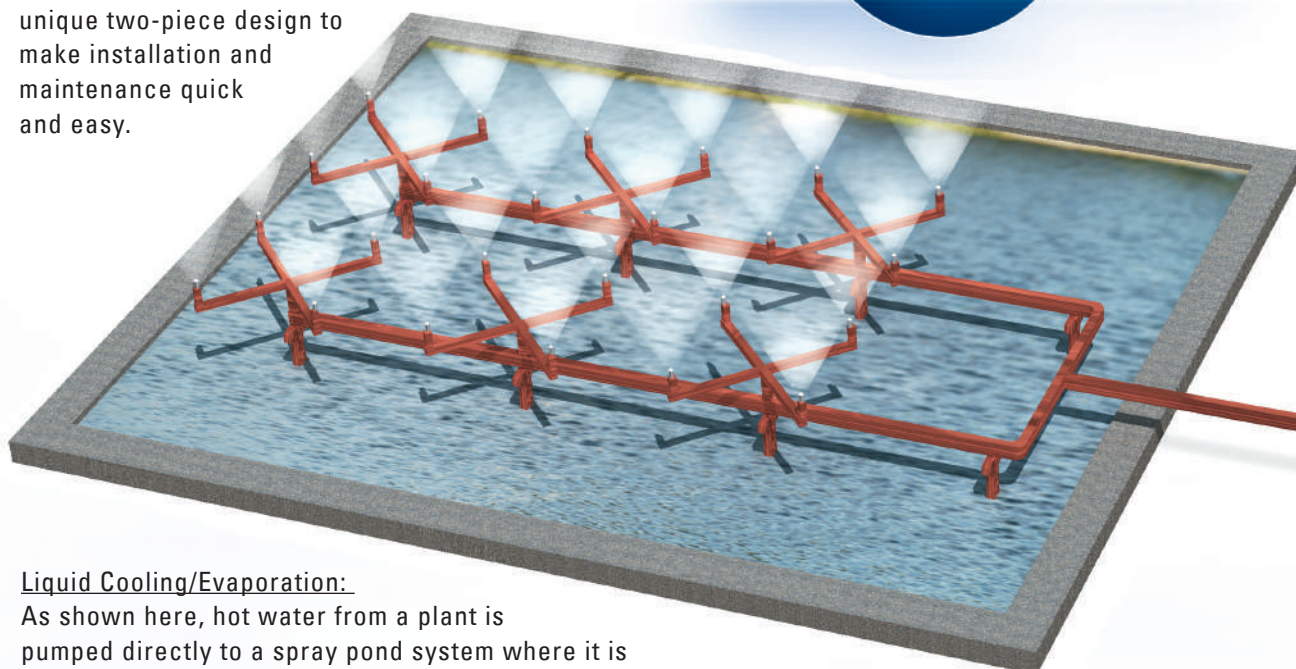
Gas Cooling:

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Gas Cooling:

If you're maintaining a hydraulic gas conditioning system, our Flowback nozzles can help improve system performance. Flowback nozzles deliver consistent drop size and feature a unique two-piece design to make installation and maintenance quick and easy.



Liquid Cooling/Evaporation:

As shown here, hot water from a plant is pumped directly to a spray pond system where it is sprayed into the pond basin.

The cooled water is pumped back to the plant. Finely atomized drops provide quick heat transfer. Nozzle junction boxes and piers are used to strategically position the nozzles above the pond.

Spray evaporation ponds look similar to spray ponds but operate differently. Polluted water is continually re-sprayed until the bulk of the water has been evaporated and only sludge remains. Dyes and heat exchange equipment can be added to the spray system to accelerate evaporation.

Liquid Cooling/ Evaporation:

CX WhirlJet® spray nozzles, shown right, produce small drops with large surface areas to facilitate evaporation and minimize drift. A special whirlchamber design extends nozzle life – an important feature because of the debris often found in recirculated plant water and spray ponds.



Spray evaporation ponds typically require smaller capacity nozzles such as the AX and BX WhirlJet nozzles, shown bottom right. These nozzles feature a two-piece design with removable caps and the same wear-resistant design as the CX WhirlJets.

Eliminate Guesswork with Performance Testing and CFD

In pollution control applications, there's no room for guesswork. That's why our spray laboratories are so critical to effectively serving customers with sophisticated applications.

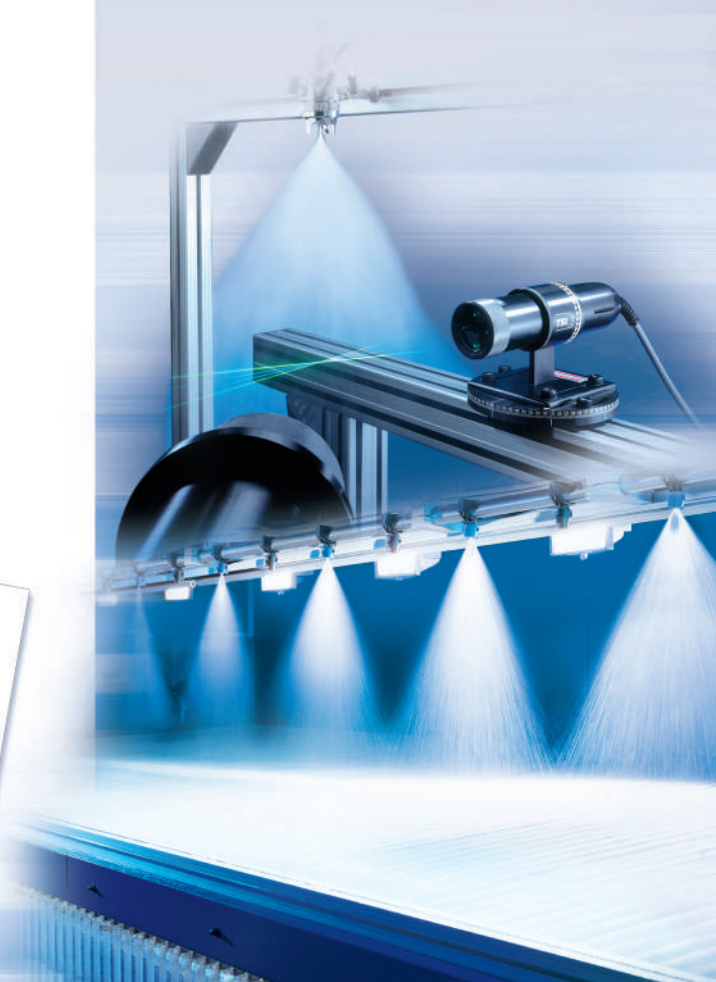
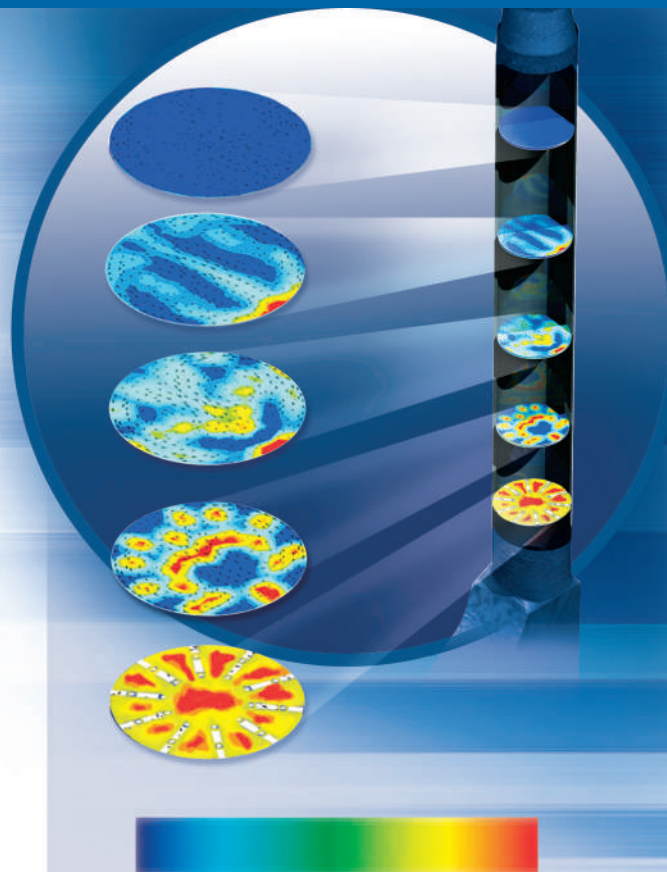
To assist with nozzle specification, we routinely conduct testing in our labs to determine the optimal drop size/distribution and best nozzle placement, spray pattern type and angle.

When performance testing isn't feasible, we use Computational Fluid Dynamics (CFD) and proprietary drop distribution functions to determine spray performance in ducts or cooling towers.

Our labs are also instrumental in our quality control program and allow us to provide documentation on our nozzles to comply with customer requests.

Lab capabilities

- All our major manufacturing facilities have spray laboratory protocols.
- Instruments include several different types of drop size analyzers, patternators, custom wind tunnel, PMS probe for laser imaging and more.
- Typical testing conducted on pollution control nozzles:
 - Spray characterization
 - Spray impact
 - Spray coverage
 - Evaporation rate
 - Drop size distribution
 - Spray pattern
 - Spray angle
 - Velocity
 - (residence and dwell time)
- CFD studies that utilize data collected in our labs to verify precise nozzle performance.





HYDRAULIC NOZZLES



Use this general guide as a starting point if you're not sure which type of nozzle to use in your spray operation. However, keep in mind that performance varies based on operating conditions, so be sure to contact your local representative for assistance.

ABSORBER TOWERS

FullJet®, SpiralJet® and DistributorJet® full cone nozzles

WhirlJet® hollow cone nozzles



AIR WASH

FullJet and SpiralJet full cone nozzles

WhirlJet hollow cone nozzles



COOLING: IN PROCESS

FullJet and SpiralJet full cone nozzles

FloodJet® flat spray nozzles

WhirlJet hollow cone nozzles



COOLING: GAS

SpiralJet full cone nozzles

SpiralJet and WhirlJet hollow cone nozzles

See spray.com for additional information on two-fluid nozzles for gas cooling and turnkey gas cooling and pollution control systems.



DUST CONTROL

WhirlJet® hollow cone nozzles

SpiralJet® full cone nozzles

Fine spray nozzles

**SCRUBBERS: GAS CONDITIONING**

See spray.com for information on two-fluid nozzles for gas cooling, spray injectors for gas conditioning and turnkey gas cooling and pollution control systems.

**SCRUBBERS – WET**

WhirlJet and SpiralJet hollow cone nozzles

FullJet and SpiralJet full cone nozzles

**SPRAY PONDS – EVAPORATING AND COOLING**

WhirlJet and SpiralJet hollow cone nozzles

FullJet and SpiralJet full cone nozzles



In each product section, you'll find ordering examples. Start by reviewing the example and then create the part number by indicating the inlet connection, material and capacity size.

Inlet
Conn.

Nozzle
Type

—

Material
Code

Capacity
Size

Example

1/4

G

—

SS

10



CHOOSE FROM THE INDUSTRY'S LARGEST SELECTION

Styles:

- Conventional
- Quick-connect
- Maximum free passage

Spray patterns:

- Standard
- Wide angle
- Narrow angle
- Square
- Wide angle square
- Oval

Spray angles: 15° to 170°

Flow rate range: .05 to 8728 gpm (.19 to 32530 lpm)

Operating pressure range: up to 400 psi (25 bar)

Connections:

- 1/8" to 12" pipe sizes
- Female and male NPT and BSPT
- Flange

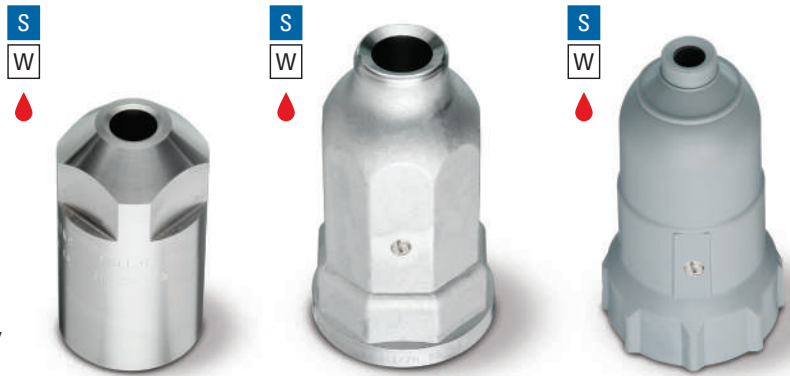
Materials:

- Brass
- Mild steel
- 303 stainless steel
- 316 stainless steel
- Polyvinyl chloride
- Hardened stainless steel
- Kynar®
- Polypropylene
- ProMax®
- PTFE
- Other specialty materials available

See Trademark Registration and Ownership.

FULLJET H NOZZLES

- Spray angles: Standard – 43° to 94°, Narrow – 15° or 30°, Wide – 102° to 125°
- Uniform spray distribution from .07 to 5324 gpm (.29 to 19842 lpm)
- Operating pressures up to 300 psi (20 bar)
- Wall-mount versions for installation on room exterior, vessel or pipeline
- Certain nozzles available with UL listing



H – 3/4" to 1" female conn.

One-piece body

H – 1-1/4" to 8" female conn.

Removable vane/cast body

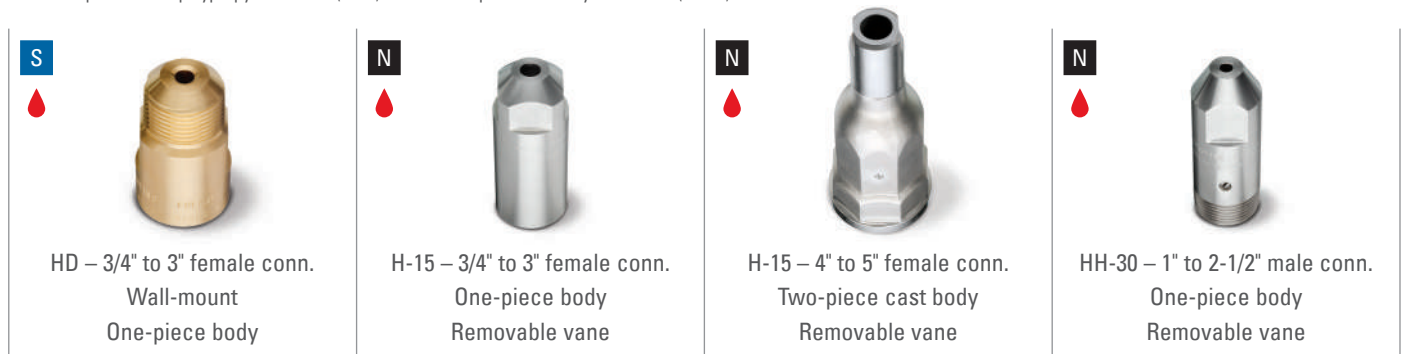
H – 1-1/2" to 2" female conn.

Removable vane/
polypropylene*

FULLJET H OPTIONS

HH – 1/8" to 1" male conn.
One-piece bodyD-HH – 1/2" to 3/4" male conn.
One-piece body/plastic**HF – 4" to 10" flange conn.
Removable vane/cast body

*Max. temperature for polypropylene: 150°F (66°C). ** Max. temperature for Kynar®: 212°F (100°C).

HD – 3/4" to 3" female conn.
Wall-mount
One-piece bodyH-15 – 3/4" to 3" female conn.
One-piece body
Removable vaneH-15 – 4" to 5" female conn.
Two-piece cast body
Removable vaneHH-30 – 1" to 2-1/2" male conn.
One-piece body
Removable vane

ORDERING INFORMATION

FULLJET G, GD, GA, G-15, G-30, H, HF, HD, H-15 AND HH-30

Inlet Conn.	Nozzle Type	Material Code	Capacity Size
-------------	-------------	---------------	---------------

Example

1/4	G	-	SS	10
-----	---	---	----	----

BSPT connections require the addition of a "B" prior to the inlet connection.

FULLJET D-HH

Nozzle Prefix	Inlet Conn.	Nozzle Type	Material Code	Spray Angle	Capacity Size
---------------	-------------	-------------	---------------	-------------	---------------

Example

D	1/2	HH	-	PP	70	24
---	-----	----	---	----	----	----

BSPT connections require the addition of a "B" prior to the inlet connection.

RELATIVE DROP SIZE

10 to 100

100 to 500

500 to 1000

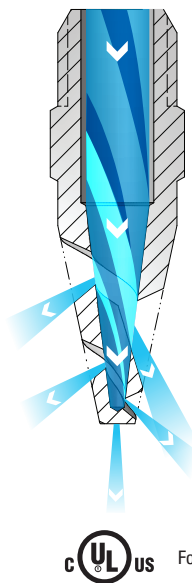
1000 to 5000

IN MICRONS

Drop size will vary based on flow rate and pressure.

OVERVIEW: SPIRALJET

- Solid cone-shaped spray pattern
- Open passages ideal for use with fluids with particulates
- Maximum liquid throughput for a given pipe size
- Spray angles from 60° to 170°
- Uniform spray distribution from .7 to 3320 gpm (2.7 to 11967 lpm)
- Operating pressures up to 400 psi (25 bar)
- Compact size enables easy installation or retrofit on most pipe systems
- Certain nozzles available with UL listing for fire protection applications



SpiralJet HHSJ and HHSJX Nozzles
The liquid enters the nozzle and passes through the orifice. The liquid exits the nozzle through the voids in the spiral. As it deflects off the spiral surface, a full cone pattern is formed.

For other certifications, contact your sales engineer.

SPIRALJET OPTIONS

HHSJ
1/4" to 2" male conn.
Hex. body style/316 stainless steel

Other body styles, connection sizes and materials available.

See Quick Reference Guide.



HHSJX
3/8" to 2" male conn.
Extra large free passage design
Hex. body style/brass

Other body styles, connection sizes and materials available.

See Quick Reference Guide.

ORDERING INFORMATION**SPIRALJET**

Inlet Conn.	Nozzle Type	—	Material Code	Spray Angle	Capacity Size
-------------	-------------	---	---------------	-------------	---------------

Example

1/4	HHSJ	—	SS	120	07
-----	------	---	----	-----	----

BSPT connections require the addition of a "B" prior to the inlet connection.

RELATIVE DROP SIZE

IN MICRONS

10 to 100

100 to 500

500 to 1000

1000 to 5000

Drop size will vary based on flow rate and pressure.

QUICK REFERENCE GUIDE

Model	Connection/ Type	Connection Size (in.)	Materials	Page Number	
				Performance Data	Dimensions and Weights
HHSJ	M, Hex.	1/4 to 2	Brass, 316 stainless steel (316SS)	B25	B26
	M, Flats, Cast	1/4 to 4	316 stainless steel (SS)		
	M, Round	1/4 to 4	Polyvinyl chloride (PVC), PTFE (TEF)		
HHSJX	M, Hex.	3/8 to 2	Brass	B26	
	M, Flats, Cast	3/8 to 2	316 stainless steel (SS)		
	M, Round	3/8 to 2	Polypropylene (PP), Polyvinyl chloride (PVC)		

M = male thread. There is no material code for brass. Leave material code blank when ordering. Other materials available upon request.

For more dimensions and sizes, contact your sales engineer.

S

PERFORMANCE DATA:
STANDARD ANGLE SPRAY

Inlet Conn. (in.)	Nozzle Type	Spray Angle at 0.7 bar					Capacity Size	Orifice Dia. Nom. (mm)	Max. Free Passage Dia. (mm)	Flow Rate Capacity (liters per minute)				
		60°	90°	120°	150°	170°				0.7 bar	1.5 bar	3 bar	7 bar	25 bar
1/4	•	•	•	•			07	2.4	2.4	2.7	3.9	5.5	8.4	16.0
	•	•	•	•	•	•	13	3.2	3.2	5.0	7.3	10.3	15.7	30
	•	•	•	•	•	•	20	4.0	3.2	7.6	11.2	15.8	24	46
3/8	•	•					07	2.4	2.4	2.7	3.9	5.5	8.4	16.0
	•	•					13	3.2	3.2	5.0	7.3	10.3	15.7	30
	•	•					20	4.0	3.2	7.6	11.2	15.8	24	46
	•	•	•	•	•	•	30	4.8	3.2	11.4	16.8	24	36	68
	•	•	•	•	•	•	40	5.6	3.2	15.3	22	32	48	91
	•	•	•	•	•	•	53	6.4	3.2	20	30	42	64	121
	•	•	•	•	•	•	82	7.9	3.2	31	46	65	99	187
1/2	•	•	•	•	•	•	120	9.5	4.8	46	67	95	145	274
	•	•	•	•	•	•	164	11.1	4.8	63	92	129	198	374
	•					•	210	12.7	4.8	80	117	166	253	479
3/4	•	•	•	•	•	•	210	12.7	4.8	80	117	166	253	479
1	•	•	•	•	•	•	340	15.9	6.4	130	190	268	410	775
	•	•	•	•	•	•	470	19.1	6.4	179	262	371	567	1071
1-1/2	•	•	•	•	•	•	640	22.2	7.9	244	357	505	772	1459
	•	•	•	•	•	•	820	25.4	7.9	313	458	647	989	1869
	•	•	•	•	•	•	960	28.6	7.9	366	536	758	1158	2188
2	•	•	•	•	•	•	1400	34.9	11.1	534	782	1105	1689	3191
	•	•	•	•	•	•	1780	38.1	11.1	679	994	1406	2147	4057
3	•	•	•	•			2560	44.5	14.3	976	1429	2021	3088	5835
	•	•	•	•			3360	50.8	14.3	1282	1876	2653	4053	7659
4	•	•	•	•			5250	63.5	15.9	2002	2931	4145	6332	11967

Maximum Free Passage Diameter is the maximum diameter as listed of foreign matter that can pass through the nozzle without clogging.

Highlighted column shows the rated pressure.


**PERFORMANCE DATA:
STANDARD ANGLE SPRAY**

Inlet Conn. (in.)	Nozzle Type	Spray Angle at 0.7 bar		Capacity Size	Orifice Dia. Nom. (mm)	Max. Free Passage Dia. (mm)	Flow Rate Capacity (liters per minute)				
	HHSJX	90°	120°				0.7 bar	1.5 bar	3 bar	7 bar	25 bar
3/8	●	●	●	30	4.8	4.8	11.4	16.8	24	36	68
	●	●	●	40	5.6	5.6	15.3	22	32	48	91
	●	●	●	53	6.4	6.4	20	30	42	64	121
	●	●	●	82	7.9	7.9	31	46	65	99	187
1/2	●	●	●	120	9.5	9.5	46	67	95	145	274
	●	●	●	164	11.1	11.1	63	92	129	198	374
3/4	●	●	●	210	12.7	12.7	80	117	166	253	479
1	●	●	●	340	15.9	15.9	130	190	268	410	775
	●	●	●	470	19.1	19.1	179	262	371	567	1071
1-1/2	●	●	●	640	22.2	22.2	244	357	505	772	1459
	●	●	●	820	25.4	25.4	313	458	647	989	1869
	●	●	●	960	28.6	28.6	366	536	758	1158	2188
2	●	●	●	1400	34.9	34.9	534	782	1105	1689	3191
	●	●	●	1780	38.1	38.1	679	994	1406	2147	4057

Maximum Free Passage Diameter is the maximum diameter as listed of foreign matter that can pass through the nozzle without clogging.

Highlighted column shows the rated pressure.

DIMENSIONS AND WEIGHTS

Nozzle	Nozzle Type	Inlet Conn. (in.)	L (mm)	Hex. (in.)	Net Weight (kg)
	HHSJ (M)	1/4	54.0	9/16	0.03
		3/8	60.3	11/16	0.05
		1/2	79.4	7/8	0.10
		3/4	87.3	1-1/16	0.15
		1	115.9	1-3/8	0.28
		1-1/2	171.5	2	0.77
		2	174.6	2-1/2	0.99
		3	301.6	3-3/4	2.61
		4	336.6	4-1/2	4.65

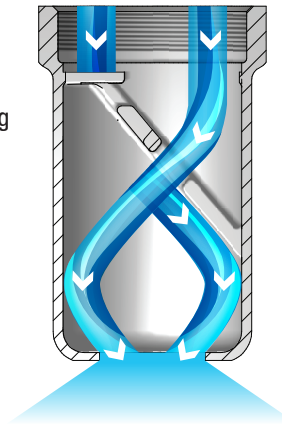
Based on the largest/heaviest version of each type.

Nozzle	Nozzle Type	Inlet Conn. (in.)	L (mm)	Hex. (in.)	Net Weight (kg)
	HHSJX (M)	3/8	69.9	7/8	0.09
		1/2	85.7	1-1/16	0.13
		3/4	117.5	1-3/8	0.23
		1	130.2	1-3/4	0.51
		1-1/2	171.5	2	0.85
		2	279.4	3	2.49

Based on the largest/heaviest version of each type.

OVERVIEW: DISTRIBOJET EXTRA LARGE FREE PASSAGE

- Solid cone-shaped spray pattern with round impact area
- Extra large flow passages and large open orifice eliminate clogging
- Internal vane is cast as part of the nozzle
- Uniform spray distribution from 27 to 8728 gpm (122 to 32530 lpm)
- Operating pressures up to 60 psi (4 bar); full cone pattern develops at 1 psi (.07 bar)
- 50°, 60°, 80° and 95° spray angles; 50° and 65° styles feature specially designed grooved orifices for accurate flow rates and spray angle control



DistriboJet R, RF and RR Nozzles

The liquid comes in contact with the vane cast inside the nozzle as it enters. This contact causes the liquid to swirl. As the liquid flows through the extra large flow passages, the liquid continues to swirl. The liquid breaks up as it exits the large open orifice producing a deluge-like cone pattern.

DISTRIBOJET EXTRA LARGE FREE PASSAGE OPTIONS

S



R

2" to 8" female conn.

S



RF

4" to 12" flange conn.

S



RR

2" to 8" male conn.

ORDERING INFORMATION

DISTRIBOJET EXTRA LARGE FREE PASSAGE DESIGN

Inlet Conn.	Nozzle Type	Material Code	Spray Angle	Capacity Size
-------------	-------------	---------------	-------------	---------------

Example

2	RR	SS	50	45
---	----	----	----	----

BSPT connections require the addition of a "B" prior to the inlet connection.

RELATIVE DROP SIZE

IN MICRONS

10 to 100

100 to 500

500 to 1000

1000 to 5000

Drop size will vary based on flow rate and pressure.

QUICK REFERENCE GUIDE

Model	Connection/ Type	Connection Size (in.)	Materials	Page Number	
				Performance Data	Dimensions and Weights
R	F, Cast	2 to 8	Brass, 316 stainless steel (SS)	B28, B29	B29
RR	M, Cast	2 to 8			
RF	Flange, Cast	4 to 12			

F = female thread; M = male thread. There is no material code for brass. Leave material code blank when ordering. Other materials available upon request.
For more dimensions and sizes, contact your sales engineer.

S

PERFORMANCE DATA:
STANDARD ANGLE SPRAY



S

Inlet Conn. (in.)	Nozzle Type												Capacity Size	Flow Rate Capacity (liters per minute)							
	R				RR				RF					0.1 bar	0.2 bar	0.4 bar	0.5 bar	0.7 bar	1.5 bar	3 bar	4 bar
	Spray Angle																				
	50°	65°	80°	95°	50°	65°	80°	95°	50°	65°	80°	95°									
2	●	●		●	●	●		●					45	122	168	231	256	298	424	583	665
		●		●		●		●					60	163	224	308	341	398	565	777	887
2-1/2	●	●		●	●	●		●					70	190	261	359	398	464	659	907	1035
		●		●		●		●					90	244	335	461	511	597	848	1166	1331
3	●	●		●	●	●		●					110	298	410	564	625	730	1036	1425	1627
		●		●		●		●					140	379	522	718	795	929	1318	1814	2070
4	●	●	●		●	●	●		●	●	●		160	434	596	820	909	1061	1507	2073	2366
	●	●		●	●	●		●	●	●		●	190	515	708	974	1079	1260	1789	2461	2809
		●		●		●		●		●		●	250	677	932	1282	1420	1658	2354	3238	3697
5	●	●	●		●	●	●		●	●	●		250	677	932	1282	1420	1658	2354	3238	3697
	●	●		●	●	●		●	●	●		●	280	759	1044	1436	1591	1857	2637	3627	4140
		●		●		●		●		●		●	380	1030	1416	1948	2159	2520	3579	4922	5619
6	●	●	●		●	●	●		●	●	●		360	975	1342	1846	2045	2388	3390	4663	5323
	●	●		●	●	●		●	●	●		●	400	1084	1491	2051	2273	2653	3767	5181	5915
		●		●		●		●		●		●	560	1517	2087	2871	3182	3714	5274	7254	8280
8	●	●	●		●	●	●		●	●	●		650	1761	2423	3333	3693	4311	6121	8420	9611
	●	●		●	●	●		●	●	●		●	750	2032	2795	3845	4261	4974	7063	9715	11090
		●		●		●		●		●		●	850	2303	3168	4358	4829	5637	8005	11011	12569
				●				●				●	1000	2710	3727	5127	5681	6632	9417	12954	14787

For orifice information, contact your sales engineer.
Highlighted column shows the rated pressure.



PERFORMANCE DATA: STANDARD ANGLE SPRAY

Inlet Conn. (in.)	Nozzle Type												Capacity Size	Flow Rate Capacity (liters per minute)								
	R				RR				RF					0.1 bar	0.2 bar	0.4 bar	0.5 bar	0.7 bar	1.5 bar	3 bar	4 bar	
	Spray Angle																					
	50°	65°	80°	95°	50°	65°	80°	95°	50°	65°	80°	95°										
12												●		1400	3794	5218	7178	7954	9285	13184	18135	20701
													●	1600	4335	5964	8203	9090	10612	15067	20726	23658
													●	1700	4606	6336	8716	9658	11275	16009	22021	25137
													●	1800	4877	6709	9229	10226	11938	16951	23317	26616
													●	2000	5419	7455	10254	11363	13265	18834	25907	29573
													●	2200	5961	8200	11279	12499	14591	20718	28498	32530

For orifice information, contact your sales engineer.

Highlighted column shows the rated pressure.

DIMENSIONS AND WEIGHTS

Nozzle	Nozzle Type	Inlet Conn. (in.)	L (mm)	D (Dia.) (mm)	Net Weight (kg)
	R (F)	2	112.7	74.6	1.36
		2-1/2	138.9	88.1	2.49
		3	165.1	104.8	3.40
		4	206.4	127.0	6.12
		5	254.8	161.9	14.97
		6	300.0	193.7	17.46
		8	388.9	241.3	34.02
	RR (M)	2	82.6	60.3	0.91
		2-1/2	101.6	73.0	2.38
		3	123.8	88.9	2.61
		4	165.1	114.3	4.54
		5	211.1	141.3	11.34
		6	247.7	168.3	13.15
		8	330.2	219.1	25.40
	RF (Flange)	4	166.7	225.4	10.43
		5	223.8	250.8	17.69
		6	249.2	276.2	20.41
		8	330.2	339.7	38.56
		12	495.3	482.6	91.17

Based on the largest/heaviest version of each type.



WIDE RANGE OF CAPACITIES, CONNECTIONS AND MATERIALS TO MATCH YOUR APPLICATION

Styles:

- Conventional
- Quick-connect

Spray patterns:

- Standard
- Extra wide angle
- Wide angle

Spray angles: 43° to 180°

Flow rate range: .05 to 3320 gpm (.19 to 12568 lpm)

Operating pressure range: up to 2000 psi (138 bar)

Connections:

- 1/8" to 6" pipe sizes
- Flange
- Female and male NPT and BSPT

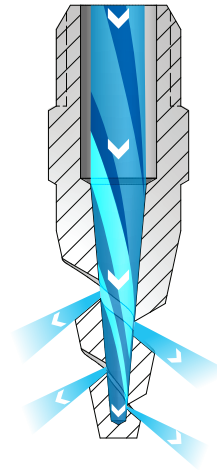
Materials:

- Brass
- Mild steel
- 303 stainless steel
- 309 stainless steel
- 316 stainless steel
- Hardened stainless steel
- Polypropylene
- Polyvinyl chloride
- PTFE
- Other specialty materials available

See Trademark Registration and Ownership.

OVERVIEW: SPIRALJET

- Hollow cone spray pattern with a circular impact area
- Minimal clogging – maximum flow through passages of any nozzle of comparable size
- Spray angles: Standard – 50° to 180°
- Uniform spray distribution from .49 to 3320 gpm (2.0 to 11967 lpm)
- Operating pressures up to 400 psi (25 bar)
- Precision impact blade angles distribute drops and provide excellent coverage – ideal for washing, rinsing and cooling
- Compact size
- BSFJ flange-type nozzles available with reaction-bonded silicon carbide tips on FRP flanges available upon request



SpiralJet BSJ Nozzles
The liquid entering the nozzle passes through the orifice and exits the voids in the spiral. As it exits, the fluid deflects off the spiral surfaces to form the hollow cone pattern.

SPIRALJET OPTIONS

BSJ – 1/4" to 2" male conn.
Threaded/Hex. body style/brass



BSJ – 1/4" to 4" male conn.
Threaded/Round or flat body style/stainless steel

Custom sizes and other abrasion-resistant materials available. See Quick Reference Guide.

SPIRALJET**ORDERING INFORMATION**

Inlet Conn.	Nozzle Type	–	Material Code	Spray Angle	Capacity Size
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Example

1/4	BSJ	–	SS	120	07
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BSPT connections require the addition of a "B" prior to the inlet connection.

QUICK REFERENCE GUIDE

Model	Connection/Type	Connection Size (in.)	Materials	Page Number	
				Performance Data	Dimensions and Weights
BSJ	M, Hex.	1/4 to 2	Brass, 316 stainless steel (316SS)	D19	D19
	M, Flats	1/4 to 4	316 stainless steel (316SS)		
	M, Flats, Cast	1/4 to 4	316 stainless steel (SS)		
	M, Round	1/4 to 4	PTFE (TEF), Polyvinyl chloride (PVC)		

M = male thread. There is no material code for brass. Leave material code blank when ordering. Other materials available upon request. For more dimensions and sizes, contact your sales engineer.

RELATIVE DROP SIZE

IN MICRONS



10 to 100



100 to 500



500 to 1000



1000 to 5000

Drop size will vary based on flow rate and pressure.

PERFORMANCE DATA:
STANDARD ANGLE SPRAY

Inlet Conn. (in.)	Nozzle Type	Spray Angle at 0.7 bar					Capacity Size	Orifice Dia. Nom. (mm)	Max. Free Passage Dia. (mm)	Flow Rate Capacity (liters per minute)					
		BSJ	50°	60°	90°	120°				180°	0.4 bar	0.7 bar	1.5 bar	3 bar	7 bar
1/4	●	●	●	●	●		07	2.4	2.4	2.0	2.7	3.9	5.5	8.4	16.0
	●	●	●	●	●	●	13	3.2	3.2	3.7	5.0	7.3	10.3	15.7	30
	●	●	●	●	●	●	20	4.0	3.2	5.8	7.6	11.2	15.8	24	46
3/8	●	●	●	●	●	●	30	4.8	3.2	8.6	11.4	16.8	24	36	68
	●	●	●	●	●	●	40	5.6	3.2	11.5	15.3	22	32	48	91
	●	●	●	●	●	●	53	6.4	3.2	15.3	20	30	42	64	121
	●	●	●	●	●	●	82	7.9	3.2	24	31	46	65	99	187
1/2	●	●	●	●	●	●	120	9.5	4.8	35	46	67	95	145	274
	●	●	●	●	●	●	164	11.1	4.8	47	63	92	129	198	374
3/4	●	●	●	●	●	●	210	12.7	4.8	61	80	117	166	253	479
1	●		●	●	●	●	340	15.9	6.4	98	130	190	268	410	775
	●		●	●	●	●	470	19.1	6.4	136	179	262	371	567	1071
1-1/2	●		●	●	●	●	640	22.2	7.9	185	244	357	505	772	1459
	●		●	●	●	●	820	25.4	7.9	236	313	458	647	989	1869
	●		●	●	●	●	960	28.6	7.9	277	366	536	758	1158	2188
2	●		●	●	●	●	1400	34.9	11.1	404	534	782	1105	1689	3191
	●		●	●	●	●	1780	38.1	11.1	513	679	994	1406	2147	4057
3	●		●	●	●		2560	44.5	14.3	738	976	1429	2021	3088	5835
	●		●	●	●		3360	50.8	14.3	969	1282	1876	2653	4053	7659
4	●		●	●	●		5250	63.5	15.9	1514	2002	2931	4145	6332	11967

Maximum Free Passage Diameter is the maximum diameter as listed of foreign matter that can pass through the nozzle without clogging.

For all 1/4" and 3/8" connections, optimum spray angle is achieved at 40 psi (2.8 bar).

*Maximum operating pressure depends on material, size and application. Contact your local sales engineer for specific recommendations.
Highlighted column shows the rated pressure.

DIMENSIONS AND WEIGHTS

Nozzle	Nozzle Type	Inlet Conn. (in.)	L (mm)	Hex. / flats (in.)	Net Weight (kg)
	BSJ (M)	1/4	49.2	9/16	0.03
		3/8	47.6	11/16	0.05
		1/2	63.5	7/8	0.09
		3/4	69.9	1-1/16	0.14
		1	92.1	1-3/8	0.31
		1-1/2	111.1	2	0.77
		2	174.6	2-1/2	1.36
		3	203.2	3-3/4	3.63
		4	228.6	4-1/2	5.67

Based on the largest/heaviest version of each type.

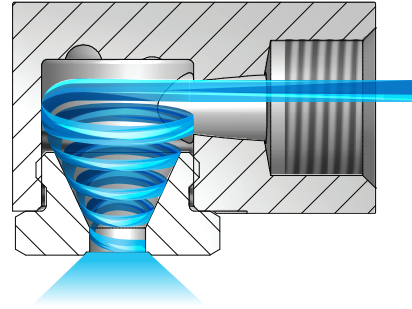


OVERVIEW: WHIRLJET STANDARD, WIDE AND EXTRA WIDE ANGLE NOZZLES

- Hollow cone spray pattern with a circular impact area
- Large, unobstructed flow passages minimize clogging
- Good atomization of liquids at lower pressures – ideal for fluid cooling applications
- Removable caps for easy inspection and cleaning on some models
- Slope-bottom design models reduce the drilling effect of the fluid vortex in the fluid chamber and premature wear
- AX and BX nozzles form smaller drops; ideal for use in air washers and dust suppression applications
- CX, CF, CRC and D nozzles feature higher flow rates; ideal for use in larger, evaporative cooling spray ponds
- AP, LAP and LBP nozzles are constructed of polypropylene and feature excellent corrosion resistance at temperatures up to 160°F (71°C); patented center post design provides extended wear life of the nozzle
- Standard, wide and extra wide spray angles

WhirlJet Nozzles

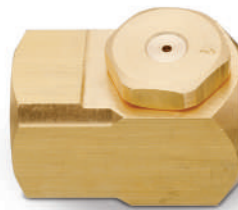
As liquid enters the nozzle, it passes into a whirlchamber and begins to spin in a circle at high speed. The rotation forces the liquid away from the center toward the edges of the whirlchamber. This causes the liquid to exit the orifice in a hollow cone pattern. Some WhirlJet nozzles have a slope bottom in the whirlchamber that helps extend wear life.



WHIRLJET AX, BX, CX AND D NOZZLES

- Spray angles: Standard – 43° to 91°, Wide – 112° to 120°
- Uniform spray distribution:
 - AX and BX nozzles – from .03 to 38 gpm (.19 to 145 lpm)
 - CX, CRC, CF and D nozzles – from 2.0 to 2362 gpm (7.3 to 9010 lpm)
- Operating pressures from 3.0 to 100 psi (0.2 to 7.0 bar)

Contact your local sales engineer for information about junction boxes.



AX
1/8" to 3/4" female conn.
Slope-bottom design
Removable cap



CX
1" to 2-1/2" female conn.
Slope-bottom design
One-piece cast-type

WHIRLJET OPTIONS



BX – 1/8" to 3/4" male conn.
Slope-bottom design
Removable cap



CRC
1-1/4" to 4" female conn.
Two-piece cast-type



CF
4" to 6" flange conn.
Two-piece cast-type



D
1/2" to 3/4" male conn.
One-piece cast-type

RELATIVE DROP SIZE

IN MICRONS



10 to 100



100 to 500



500 to 1000



1000 to 5000

Drop size will vary based on flow rate and pressure.

PERFORMANCE DATA:
EXTRA WIDE ANGLE SPRAY

Inlet Conn. (in.)	Nozzle Type	Capacity Size	Inlet Dia. Nom. (mm)	Orifice Dia. Nom. (mm)	Flow Rate Capacity (liters per minute)											Spray Angle (°)		
	E Styles				0.2 bar	0.4 bar	0.5 bar	0.7 bar	1 bar	1.5 bar	2 bar	3 bar	4 bar	6 bar	7 bar	0.5 bar	1.5 bar	6 bar
3/8	●	8	2.8	12.3	1.6	2.3	2.6	3.1	3.6	4.5	5.2	6.3	7.3	8.9	9.6	164	160	157
	●	10	3.2	12.3	2.0	2.9	3.2	3.8	4.6	5.6	6.4	7.9	9.1	11.2	12.1	164	160	157
	●	15	4.4	12.3	3.1	4.3	4.8	5.7	6.8	8.4	9.7	11.8	13.7	16.8	18.1	165	163	155
	●	20	5.2	12.3	4.1	5.8	6.4	7.6	9.1	11.2	12.9	15.8	18.2	22	24	162	152	147
	●	25	5.9	12.3	5.1	7.2	8.1	9.5	11.4	14.0	16.1	19.7	23	28	30	162	158	154
	●	33	6.7	16.3	6.7	9.5	10.6	12.6	15.0	18.4	21	26	30	37	40	162	154	148
	●	53	9.5	16.3	10.8	15.3	17.1	20	24	30	34	42	48	59	64	159	152	149
1/2	●	25	5.6	16.3	5.1	7.2	8.1	9.5	11.4	14.0	16.1	19.7	23	28	30	162	158	154
	●	30	6.4	16.3	6.1	8.6	9.7	11.4	13.7	16.8	19.3	24	27	34	36	163	155	148
	●	40	7.5	16.3	8.2	11.5	12.9	15.3	18.2	22	26	32	36	45	48	160	152	144
	●	53	9.5	16.3	10.8	15.3	17.1	20	24	30	34	42	48	59	64	159	152	149

Highlighted column shows the rated pressure.

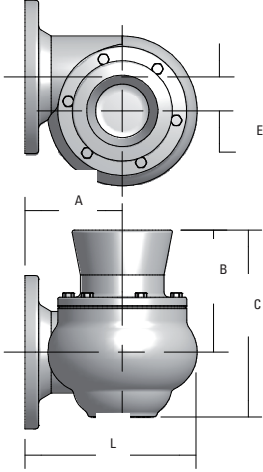
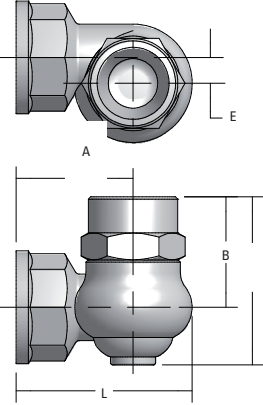
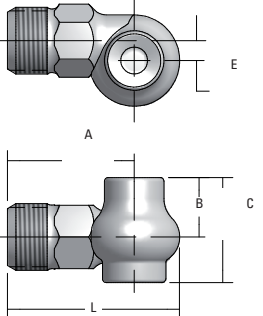
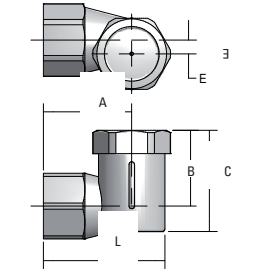
DIMENSIONS AND WEIGHTS

Nozzle	Nozzle Type	Inlet Conn. (in.)	L (mm)	A (mm)	B (mm)	C (mm)	E (mm)	Net Weight (kg)
	AX (F) AX-W (F)	1/8	25.4	17.5	11.9	19.8	—	0.04
		1/4	31.8	22.2	13.5	23.0	—	0.08
		3/8	37.3	26.2	17.5	28.6	—	0.12
		1/2	49.2	34.9	21.4	39.8	—	0.25
		3/4	55.6	34.9	39.7	31.8	—	0.31
	BX (M) BX-W (M)	1/8	30.2	22.2	16.6	34.9	—	0.04
		1/4	34.9	25.4	13.5	39.7	—	0.07
		3/8	39.7	28.6	17.5	39.7	—	0.11
		1/2	49.2	34.9	21.4	49.2	—	0.20
		3/4	57.2	41.3	39.7	31.8	—	0.30
	CX (F)	1	66.7	44.5	31.8	46.8	8.7	0.31
		1-1/4	77.8	52.4	33.3	55.6	11.1	0.57
		1-1/2	93.7	61.9	38.1	73.0	14.3	0.79
		2	115.1	93.7	53.6	93.7	18.3	1.36
		2-1/2	140.5	88.9	68.0	114.3	11.9	1.93

Based on the largest/heaviest version of each type.



DIMENSIONS AND WEIGHTS

Nozzle	Nozzle Type	Inlet Conn. (in.)	L (mm)	A (mm)	B (mm)	C (mm)	E (mm)	Net Weight (kg)
	CF (Flange)	4	209.6	111.9	235.0	314.3	39.7	51.71
		6	311.2	174.6	220.7	338.1	61.9	57.15
	CRC (F)	1-1/4	86.5	54.0	53.2	77.8	10.3	1.02
		2	123.0	81.0	77.8	118.3	18.3	2.27
		3	176.2	112.7	150.8	213.5	28.6	8.62
		4	228.6	141.3	231.8	311.2	39.7	18.14
	D (M)	1/2	58.7	44.5	18.3	33.3	6.4	0.14
		3/4	69.1	50.8	23.8	42.1	7.9	0.21
	AP (F) AP-W (F)	1/4	36.5	25.4	22.0	29.4	4.0	0.01
		3/8	37.3	27.8	22.0	29.4	4.0	0.01

Based on the largest/heaviest version of each type.



FULL RANGE OF HYDRAULIC ATOMIZING NOZZLES — SMALL DROPS WITHOUT COMPRESSED AIR

Styles:

- Conventional

Spray patterns:

- Standard
- Narrow
- Wide angle

Spray angles: 30° to 165°

Flow rate range: 49.2 to 8,160 gph (186 to 30,948 lph)

Operating pressure range: up to 1000 psi (69 bar)

Connections:

- 1/4" to 1-1/2" pipe sizes
- Female and male NPT and BSPT

Materials:

- Brass
- 303 stainless steel
- 316 stainless steel
- Polyvinyl chloride
- Other specialty materials available

See Trademark Registration and Ownership.

ORDERING INFORMATION**HYDRAULIC ATOMIZING LN, LND, N AND M**

Inlet Conn.	Nozzle Type	—	Material Code	Capacity Size	Example
					1/4 LN — SS 8

BSPT connections require the addition of a "B" prior to the inlet connection.
To order M with strainer, use ML as Nozzle Type.

HYDRAULIC ATOMIZING LN AND N

Inlet Conn.	Nozzle Type	—	Material Code	Capacity Size	Example
					1/4 LN — SS 8W

BSPT connections require the addition of a "B" prior to the inlet connection.

QUICK REFERENCE GUIDE

Model	Connection/Type	Connection Size (in.)	Materials	Page Number	
				Performance Data	Dimensions and Weights
LN	F	1/4	Brass, 303 stainless steel (SS), 316 stainless steel (316SS)	E6	E7
LNN	M	1/4			
LND	F, Wall-mount	1/4	Brass, 303 stainless steel (SS)		
LNND	M, Wall-mount	1/4			
N	F	1/4	Brass, 303 stainless steel (SS), 316 stainless steel (316SS), Polyvinyl chloride (PVC)		
NN	M	1/4	Brass, 303 stainless steel (SS), 316 stainless steel (316SS)		
M	M	1/4	Brass, 303 stainless steel (SS), 316 stainless steel (316SS), Polyvinyl chloride (PVC)		
LN-W	F	1/4	Brass, 303 stainless steel (SS), 316 stainless steel (316SS)	E7	
LNN-W	M	1/4			
N-W	F	1/4			
NN-W	M	1/4			

F = female thread; M = male thread. There is no material code for brass. Leave material code blank when ordering. Other materials available upon request.
For more dimensions and sizes, contact your sales engineer.

PERFORMANCE DATA:
STANDARD ANGLE SPRAY

Inlet Conn. (in.)	Nozzle Type							Capacity Size	Orifice Dia. Nom. (mm)	Core No.	Flow Rate Capacity (liters per hour)										Spray Angle (°)		
	LN	LNN	LND	LNND	N	NN	M				2 bar	3 bar	4 bar	7 bar	15 bar	20 bar	35 bar	45 bar	80 bar	3 bar	6 bar	20 bar	
1/4	●	●						.30	.41	106	—	—	—	—	—	3.1	4.0	4.6	6.1	—	—	51	
	●	●						.40	.41	108	—	—	—	—	—	4.1	5.4	6.1	8.2	—	—	58	
	●							.50	.41	109	—	—	—	—	4.4	5.1	6.7	7.6	10.2	—	—	63	
	●	●	●	●	●	●	●	.60	.41	206	—	—	—	3.6	5.3	6.1	8.1	9.2	12.2	—	35	65	
	●	●	●	●	●	●	●	1	.51	210	—	3.9	4.6	6.0	8.8	10.2	13.5	15.3	20	45	62	72	
	●	●	●	●	●	●	●	1.5	.51	216	4.8	5.9	6.8	9.0	13.2	15.3	20	23	31	65	70	72	
	●	●	●	●	●	●	●	2	.71	216	6.4	7.9	9.1	12.1	17.7	20	27	31	41	70	75	77	
	●	●	●	●	●	●	●	3	.71	220	9.7	11.8	13.7	18.1	26	31	40	46	61	65	70	73	
	●	●	●	●	●	●	●	4	1.1	220	12.9	15.8	18.2	24	35	41	54	61	82	72	81	84	
	●	●	●	●	●	●	●	6	1.1	225	19.3	24	27	36	53	61	81	92	122	73	79	81	
	●	●	●	●	●	●	●	8	1.5	225	26	32	36	48	71	82	108	122	163	85	89	91	
	●	●	●	●	●	●	●	10	1.6	420	32	39	46	60	88	102	135	153	204	82	84	86	
	●	●	●	●	●	●	●	12	1.9	420	39	47	55	72	106	122	162	183	245	78	82	85	
	●	●	●	●	●	●	●	14	1.9	421	45	55	64	84	124	143	189	214	285	85	88	90	
					●	●		16	2.2	421	52	63	73	96	141	163	216	245	326	83	86	88	
	●	●	●	●	●	●	●	18	1.9	422	58	71	82	109	159	183	243	275	367	81	84	86	
	●						●	20	2.1	422	64	79	91	121	177	204	270	306	408	75	78	80	
	●	●	●	●	●	●	●	22	1.9	625	71	87	100	133	194	224	297	336	449	70	72	75	
	●	●	●	●	●	●	●	26	2.2	625	84	103	119	157	230	265	351	398	530	73	74	77	

Maximum operating pressure depends on material and application. Contact your sales engineer for details.

Highlighted column shows the rated pressure.



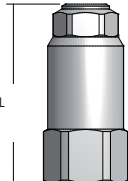
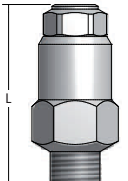
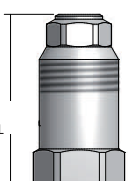
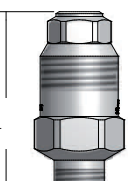
W

PERFORMANCE DATA:
WIDE ANGLE SPRAY

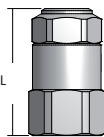
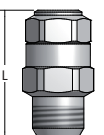
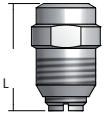
Inlet Conn. (in.)	Nozzle Type				Capacity Size	Orifice Dia. Nom. (mm)	Core No.	Flow Rate Capacity (liters per hour)				Spray Angle (°)	
	LN-W	LNN-W	N-W	NN-W				1.5 bar	2 bar	3 bar	6 bar	3 bar	6 bar
1/4	●	●	●	●	2W	.99	210	—	6.4	7.9	11.2	165	158
	●	●	●	●	3W	.99	216	8.4	9.7	11.8	16.8	157	152
	●	●	●	●	4W	1.5	220	11.2	12.9	15.8	22	156	155
	●	●	●	●	8W	1.5	225	22	26	32	45	152	153

Highlighted column shows the rated pressure.

DIMENSIONS AND WEIGHTS

Nozzle	Nozzle Type	Inlet Conn. (in.)	L (mm)	Body Hex. (in.)	Cap Hex. (in.)	Net Weight (kg)
	LN (F) LN-W (F)	1/4	49.1	13/16	5/8	0.10
	LNN (M) LNN-W (M)	1/4	53.1	13/16	5/8	0.09
	LND (F)	1/4	47.6	7/8 dia.	5/8	0.09
	LNND (M)	1/4	51.6	7/8 dia.	5/8	0.09

Based on the largest/heaviest version of each type.

Nozzle	Nozzle Type	Inlet Conn. (in.)	L (mm)	Body Hex. (in.)	Cap Hex. (in.)	Net Weight (kg)
	N (F) N-W (F)	1/4	33.3	11/16	5/8	0.05
	NN (M) NN-W (M)	1/4	35.7	11/16	5/8	0.05
	M (M)	1/4	21.4	9/16	—	0.02

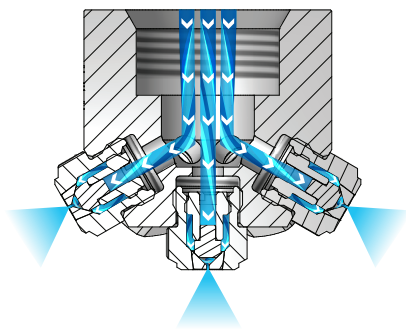
Based on the largest/heaviest version of each type.

OVERVIEW: FOGJET

- Finely atomized sprays without use of compressed air; ideal for fogging a larger area with a single nozzle
 - 7N and 7G nozzles produce a shower-like full cone wide angle spray pattern
 - FF nozzles produce a dense, narrow, hollow cone spray pattern
- 7N and 7G assemblies include a nozzle body and seven removable caps. Each cap has an internal core or vane which is easily removed for cleaning
- Widely used in fire protection, dust control and rain simulation applications
- Uniform spray distribution from .11 to 136 gpm (.42 to 505 lpm)
- Operating pressures from 20 to 150 psi (1.5 to 10 bar)

FogJet Nozzles

The liquid passes through slots in the core component in each individual nozzle cap. The slots make the liquid spin in a circle at a very high speed. The energy from the spinning action causes the liquid to break up into very small droplets and form a hollow cone pattern as it exits the orifice.

**FOGJET OPTIONS**

W

**7G**

3/4" to 1-1/2" female conn.
Optional TWD strainer

W

**7N**

1" female conn.
Optional TWD strainer

N

**FF**

3/4" to 1-1/4" female conn.
One-piece

ORDERING INFORMATION**FOGJET 7G AND 7N**

Inlet Conn.	Nozzle Type	Material Code	Capacity Size
Example	Example	Example	Example
1-1/2	7G	SS	30

BSPT connections require the addition of a "B" prior to the inlet connection.

FOGJET FF

Inlet Conn.	Nozzle Type	Material Code	Capacity Size
Example	Example	Example	Example
3/4	FF	SS	4.8

BSPT connections require the addition of a "B" prior to the inlet connection.

RELATIVE DROP SIZE

IN MICRONS



10 to 100



100 to 500



500 to 1000



1000 to 5000

Drop size will vary based on flow rate and pressure.



QUICK REFERENCE GUIDE

Model	Connection	Connection Size (in.)	Materials	Page Number	
				Performance Data	Dimensions and Weights
7N	F	1	Brass, 303 stainless steel (SS), 316 stainless steel (316SS)	E9	E12
7G	F	3/4 to 1-1/2		E10	
FF	F	3/4 to 1-1/4	Brass, 303 stainless steel (SS)	E11–E12	

F = female thread. There is no material code for brass. Leave material code blank when ordering. Other materials available upon request.
For more dimensions and sizes, contact your sales engineer.

W PERFORMANCE DATA: WIDE ANGLE SPRAY  												
Inlet Conn. (in.)	Nozzle Type	Capacity Size	Dimensions			Flow Rate Capacity (liters per minute)						
	7N		A (m)	B (m)	C (m)	1.5 bar	3 bar	4 bar	6 bar	7 bar	8 bar	10 bar
1	●	.60	1*	1.1	.5	—	—	—	—	.42	.45	.50
	●	1	1*	1.2	.6	—	.46	.56	.65	.70	.75	.84
	●	1.5	1*	1.4	.8	—	.69	.85	.98	1.0	1.1	1.3
	●	2	1*	1.4	.8	—	.92	1.1	1.3	1.4	1.5	1.7
	●	3	1*	1.7	1.1	1.1	1.4	1.7	2.0	2.1	2.3	2.5
	●	4	1*	1.7	1.1	1.5	1.8	2.2	2.6	2.8	3.0	3.4
	●	6	1*	1.8	1.2	2.2	2.8	3.4	3.9	4.2	4.5	5.0
	●	8	1*	1.8	1.2	2.9	3.7	4.5	5.2	5.6	6.0	6.7
	●	10	1*	2.1	1.4	3.7	4.6	5.6	6.5	7.0	7.5	8.4
	●	12	1*	2.4	1.4	4.4	5.5	6.7	7.8	8.4	9.0	10.1
	●	14	1	2.4	1.4	5.1	6.4	7.9	9.1	9.8	10.5	11.8
	●	16	1 2*	2.4 2.6	1.5 1.7	5.9	7.4	9.1	10.4	11.2	12.0	13.5
	●	18	1 2*	2.4 2.7	1.5 1.8	6.6	8.3	10.2	11.7	12.6	13.5	15.1
	●	22	1 2*	2.9 3.4	1.7 2.1	8.0	10.1	12.4	14.3	15.3	16.5	18.5
	●	26	1 2*	3 3.7	1.8 2.4	9.5	12.0	14.7	16.9	18.1	19.6	22

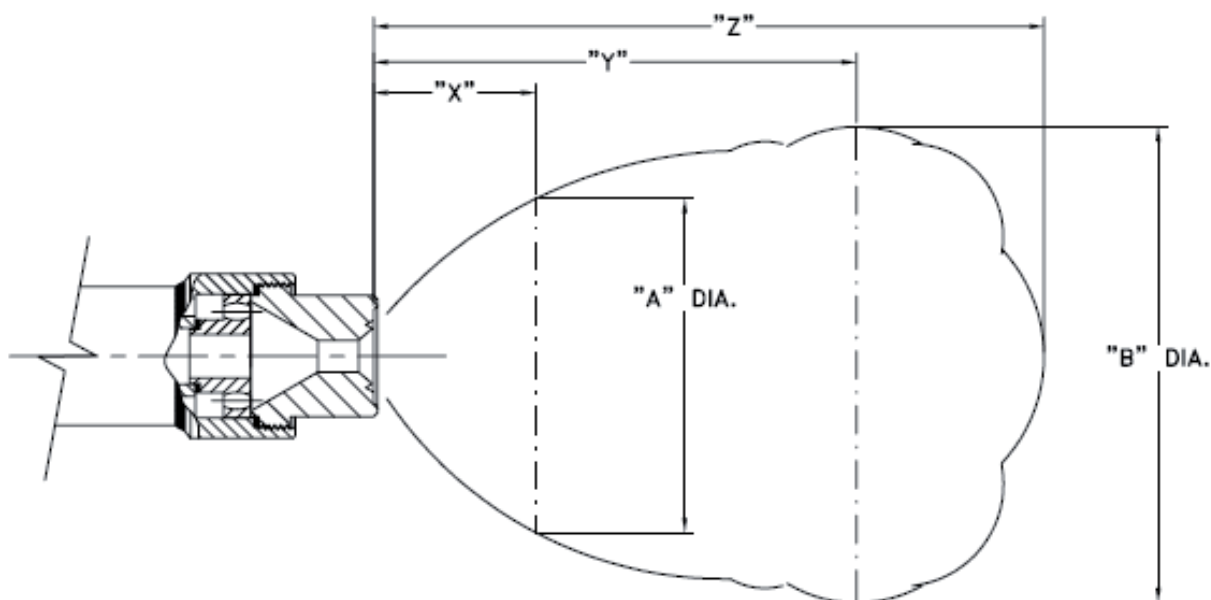
*And higher.

Highlighted column shows the rated pressure.

SELECTION GUIDE

NOZZLE SIZE (L/MIN)	INLET PRESSURE (BAR)	FLOWBACK PRESSURE (BAR)	SPRAY DIMENSIONS (IN METERS) AT INDICATED DISTANCE FROM NOZZLE				
			X	A	Y	B	Z
1.2	20	10,76	1	1,12	2	0,91	2,06
	30	16,06	1	0,89	2	0,43	2,67
	40	21,30	1	0,76	2	4,69	3,12
1.5	20	8,55	1	1,55	2	0,84	2,97
	30	12,82	1	1,32	2	0,76	3,96
	40	16,75	1	0,99	2	0,46	4,88
3.0	20	9,03	1	1,78	2	0,79	4,34
	30	13,65	1	1,45	2	0,74	4,85
	40	18,20	1	1,01	2	0,90	6,25
5.0	20	9,45	1	1,68	2	1,24	5,49
	30	14,07	1	1,40	2	0,89	3,78
	40	18,82	1	1,00	2	0,81	3,89
7.0	20	9,51	1	1,52	2	1,22	3,66
	30	14,07	1	1,22	2	0,61	4,57
	40	18,62	1	0,91	2	0,61	5,18

* Data based on spraying water (under laboratory conditions)



SELECTION GUIDE HI-FLOW NOZZLES

Hi-Flow Nozzle Assembly p/n	l/min at 41,4 bar	Ø A (mm)	ØB (mm) *
30045-10-316SS	37,8	7,2	2,8
30045-15-316SS	56,8	8,1	3,4
30045-20-316SS	75,7	8,4	3,8
30045-25-316SS	94,6	9,4	4,3
30045-30-316SS	113,5	10,3	4,7
30045-35-316SS	132,5	11,1	5,1
30045-40-316SS	151,4	11,5	5,4
30045-45-316SS	170,3	12,2	5,5

* Maximum free passage diameter

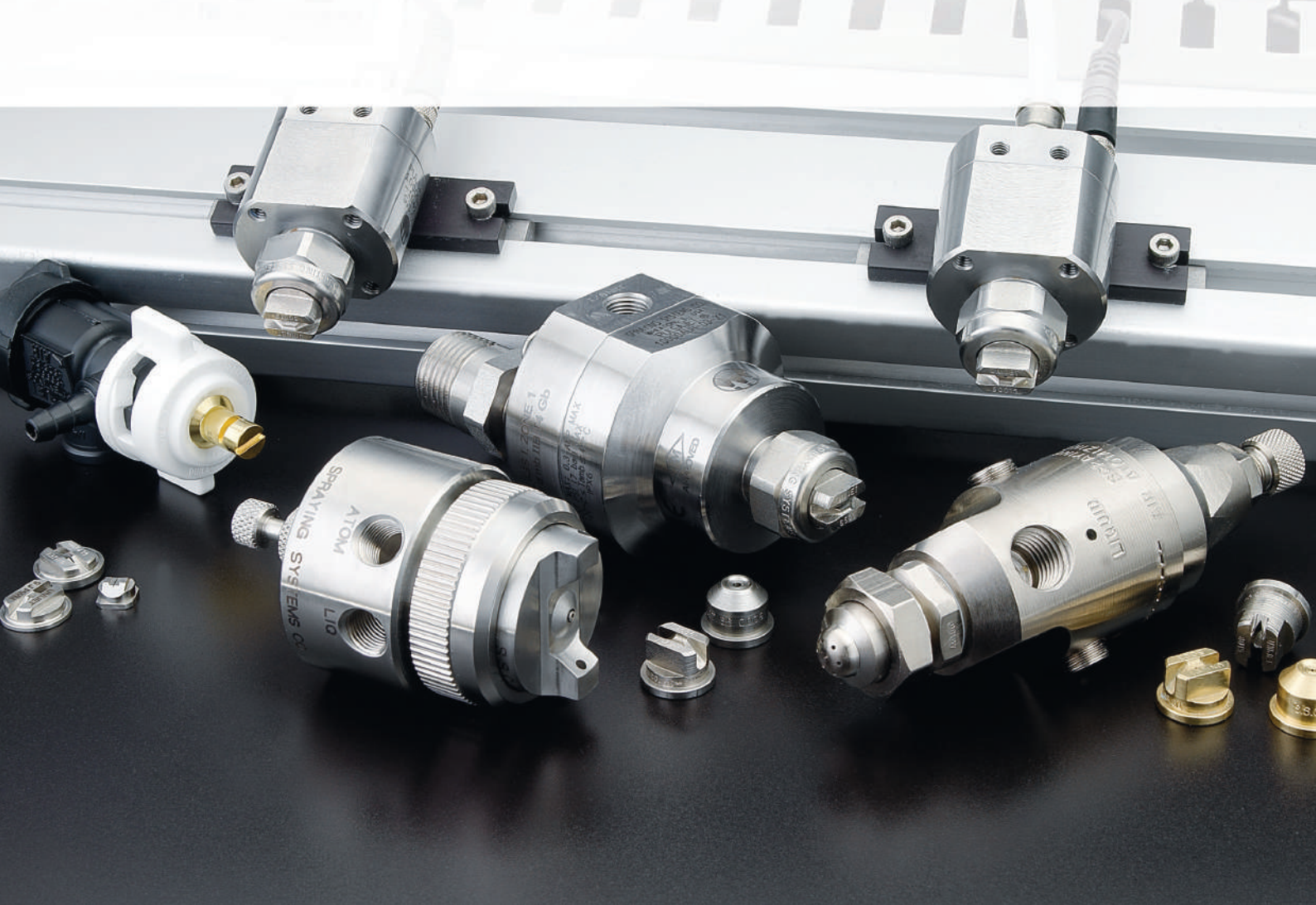
To maintain constant performance replace swirl disk and orifice disk at the same time.

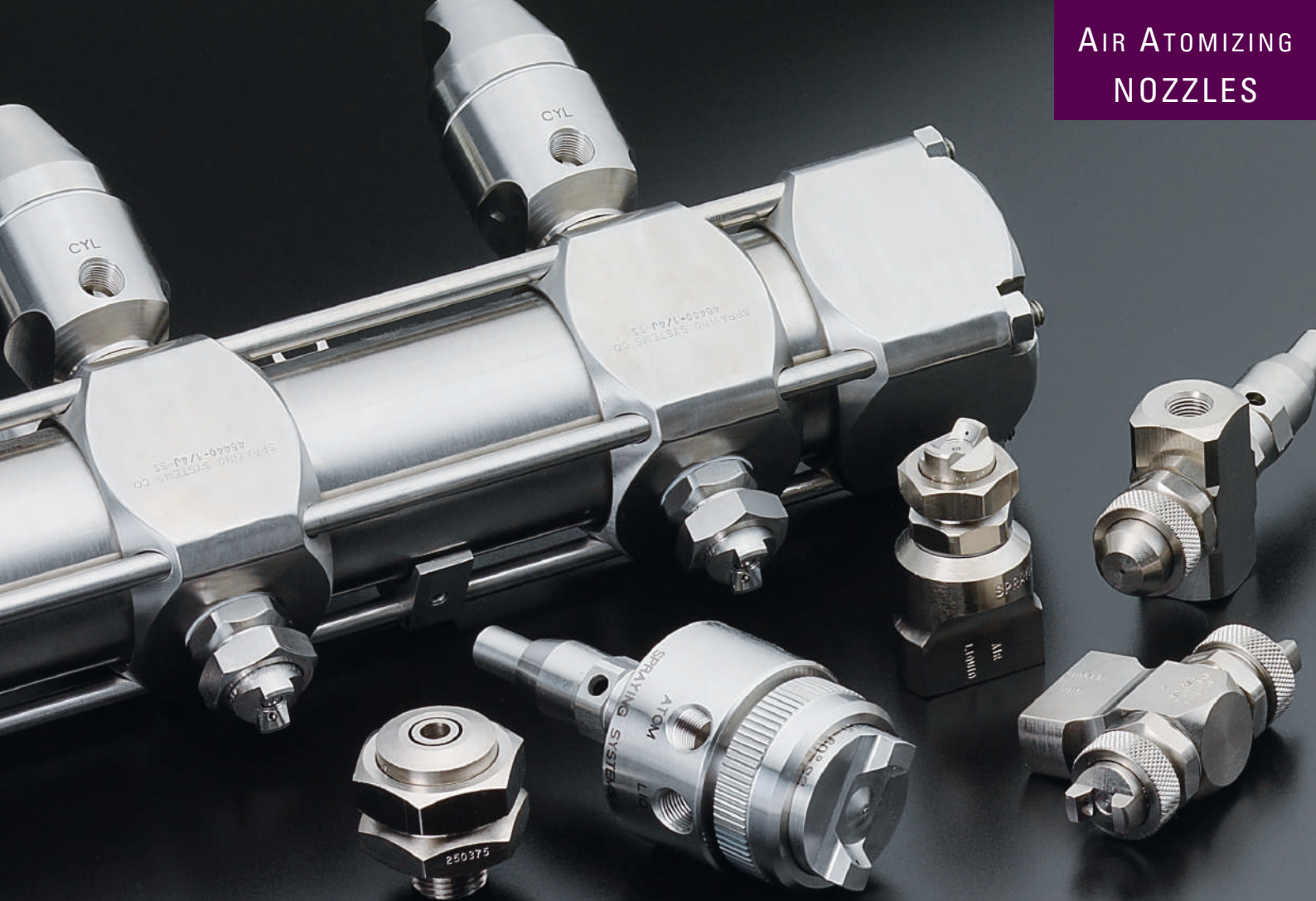
PERFORMANCE DATA FOR FLOWBACK LANCES SERIES 64354 & 64355

Lance Type	64354-					64355-		
	100	150	200	250	300	300	400	500
Normal Operating Pressure (bar)	35	35	35	35	35	35	35	35
Max. Pressure (bar)	40	40	40	40	40	40	40	40
Flow Rate (m³/h) ±10%	10	15	20	25	30	35	40	50
Flow Rate (l/min) ±10%	167	250	333	417	500	500	667	833
Total Weight (kg)	96	120	127	135	144	150	150	150
Flange Connecting Lance to Tower	DN150				DN200	DN 200		
Flange for Liquid Inlet & Flowback	DN40	DN50	DN65	DN65	DN80	DN80		
Flange Distance + Liq Inlet & Flowback	250	250	300	300	330	350		
Total Length (mm)	1600	1717	1819	1991	2075	2200	2300	2300
Protection Tube Dia. (mm)	141,3							
Protection Tube Length (mm)	1150	1250	1300	1470	1520	1700		
Built-in Length (mm)	800	900	950	1100	1100	1300		
Adjustable Build-in Length (mm)	200	200	200	200	250	250		



AIR ATOMIZING NOZZLES





LARGEST SELECTION OF NOZZLES IN THE INDUSTRY

INTRODUCTION

If your application requires air atomizing – or “two-fluid” – nozzles, you’ll find information on the largest selection available in the industry in this section. Choose from a wide variety of nozzle assemblies and spray set-ups to get the precise performance you require.

Fluid lines for air atomizing nozzles can be pressurized or supplied using a siphon- or gravity-fed configuration. Nozzles equipped with clean-out and/or shut-off needles may require an additional air line. All air and fluid lines should be equipped with the proper filters, regulators and valves.

Air atomizing nozzles require spray set-ups, which consist of an air cap and fluid cap. Hundreds of spray set-ups are available to provide the precise performance you require.

PRODUCT RANGE

J Series Nozzles

Available in many configurations with flow rates up to 29 gpm (110 lpm).

JJ Compact Series Nozzles

Available with clean-out needles and shut-off needles; flow rates range up to 33 gph (126 lph).

QMJ Series Nozzles

Quick-connect convenience for spray set-up installation and flow rates up to 26 gpm (98 lph).

Variable Spray Nozzles

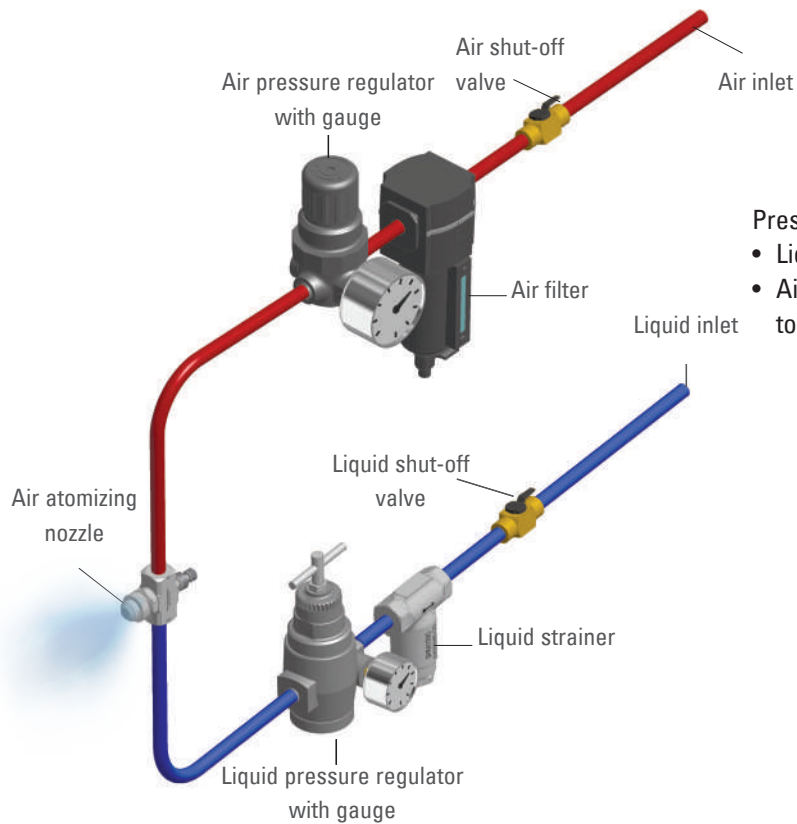
Independent control of liquid, atomizing air and fan air pressures enables fine tuning of spray performance.

High Efficiency, High Flow Spray Nozzles

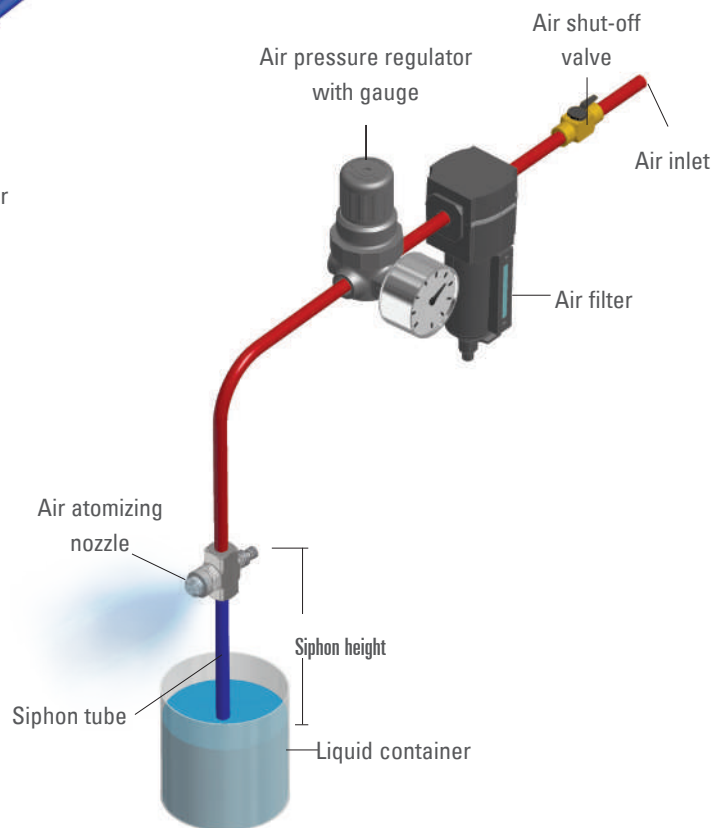
Very small droplet size with low air consumption and flow rates up to 45 gpm (170 lpm).

OVERVIEW: AIR ATOMIZING NOZZLE SET-UPS

Liquid can be supplied to the nozzle under pressure or it can be supplied through a liquid siphon or gravity-feed.

**Pressure Spray Set-Ups**

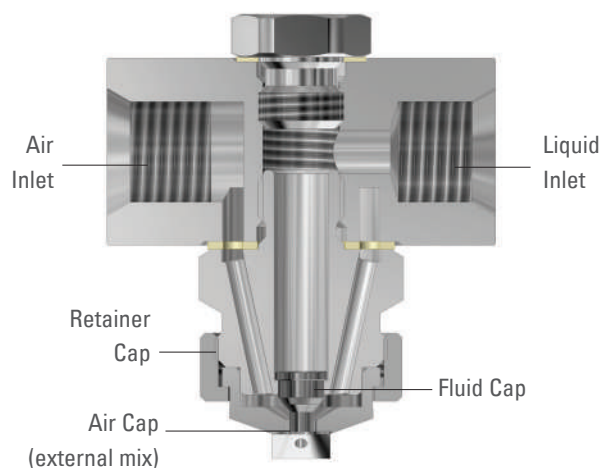
- Liquid is supplied to the nozzle under pressure
- Air and liquid can be externally or internally mixed to produce a completely atomized spray

**Siphon/Gravity-Fed Spray Set-Ups**

- Liquid is supplied via liquid siphon or is gravity-fed
- These set-ups are designed to draw liquid through the feed line into the air flow where it is atomized

OVERVIEW: J AND JJ SERIES NOZZLES

- Liquid and compressed air enter the nozzle body and are mixed by the spray set-up to produce a finely atomized spray pattern
- Spray set-ups, consisting of an air cap and a fluid cap, can mix the fluids either internally or externally
- Hundreds of spray set-ups are available to produce cone and flat spray patterns
- A wide variety of nozzle bodies are available for convenient mounting and positioning
- JJ compact nozzle bodies are available for applications where space is limited
- Models available with clean-out needles, shut-off needles, swivels and strainers to optimize performance

**1/4J Nozzle**

Air and liquid enter the air atomizing nozzle body and are combined by the spray set-up to generate finely atomized droplets.

QUICK REFERENCE GUIDE

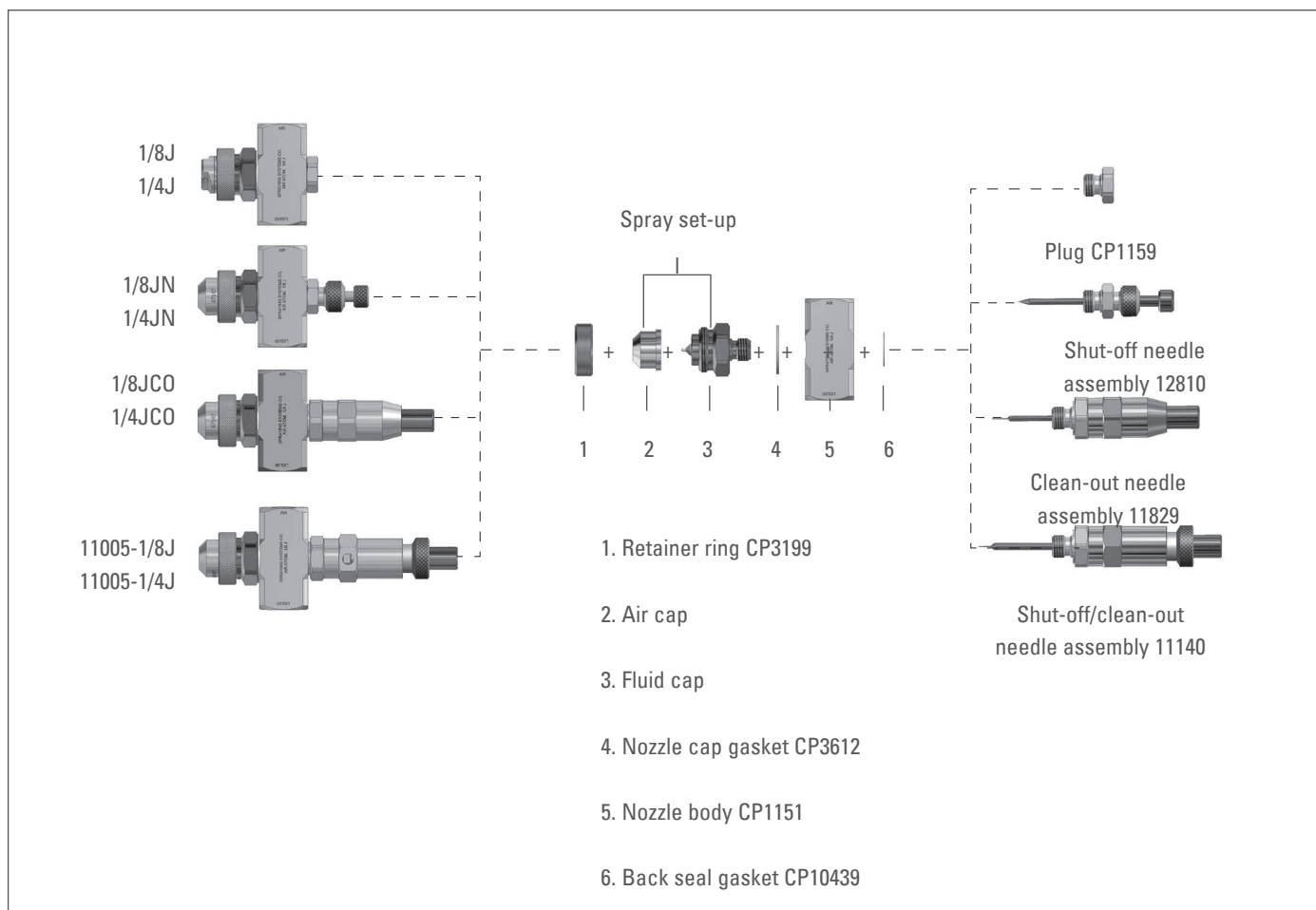
Product Number	Inlet Connection Size (in.)	Max Flow	Max Temp (liquid)	Spray Set-Ups
1/8J and 1/4J Series	1/8 , 1/4 (F) NPT or BSPT	72 gph (273 lph)	400°F (204°C)	1/8J and 1/4J set-ups (pages D30)
1/8JJ Series	1/8 (F) NPT or BSPT	33.2 gph (126 lph)	400°F (204°C)	1/8JJ set-ups (pages D33)
1/2J Series	1/2 (F) NPT or BSPT	306 gph (1158 lph)	400°F (204°C)	1/2J set-ups (pages D40)
1J Series	1 (F) NPT or BSPT	29 gpm (110 lpm)	400°F (204°C)	1J set-ups (pages D44)

1/8J AND 1/4J SERIES NOZZLES

- J Series nozzles consist of a nozzle body and a spray set-up
- A wide variety of spray set-ups are available with flow rates up to 72 gph (273 lph) in various spray patterns.
- Basic 1/8J and 1/4J bodies have liquid and air inlets on opposing sides of the nozzle bodies. Nozzle bodies include a removable plug so needle assemblies can be added in the future
- Nickel-plated brass or stainless steel construction



**1/8J and 1/4J
Nozzles**

1/8J AND 1/4J NOZZLE OPTIONS

1/8J AND 1/4J NOZZLE OPTIONS



1/8JN and 1/4JN – Manual shut-off needle to stop liquid flow



1/8JCO and 1/4JCO – Manual clean-out needle to clear obstructions from the fluid orifice



11005-1/8J and 11005-1/4J – Combination shut-off/clean-out needle



1/4JF – Built-in liquid strainer to reduce nozzle plugging



1/8JBC and 1/4JBC – Air and liquid inlets at the back of the nozzle body, in line with the spray direction



1/8-2JAC – 1/8" air and liquid inlets on the same side of the nozzle body with two opposing spray set-ups



1/4-2J – 1/4" air and liquid inlet connections on opposing sides of the nozzle body with two opposing spray set-ups



8650 – Cluster type assembly includes four or five spray set-ups



6552-1/8JAC – Miniature design is only 1/2" thick with a 1-5/32" by 1-1/4" rectangular face. The air and liquid inlets on the same side of the nozzle body – 90° to the spray direction



1/4JBCJ – Steam jacket around the nozzle body for spraying liquids too viscous to spray at room temperatures



20470 – Handheld air atomizing spray gun with 1/4" air and liquid inlets. It features a lightweight aluminum construction and a comfortable, easy-to-operate design



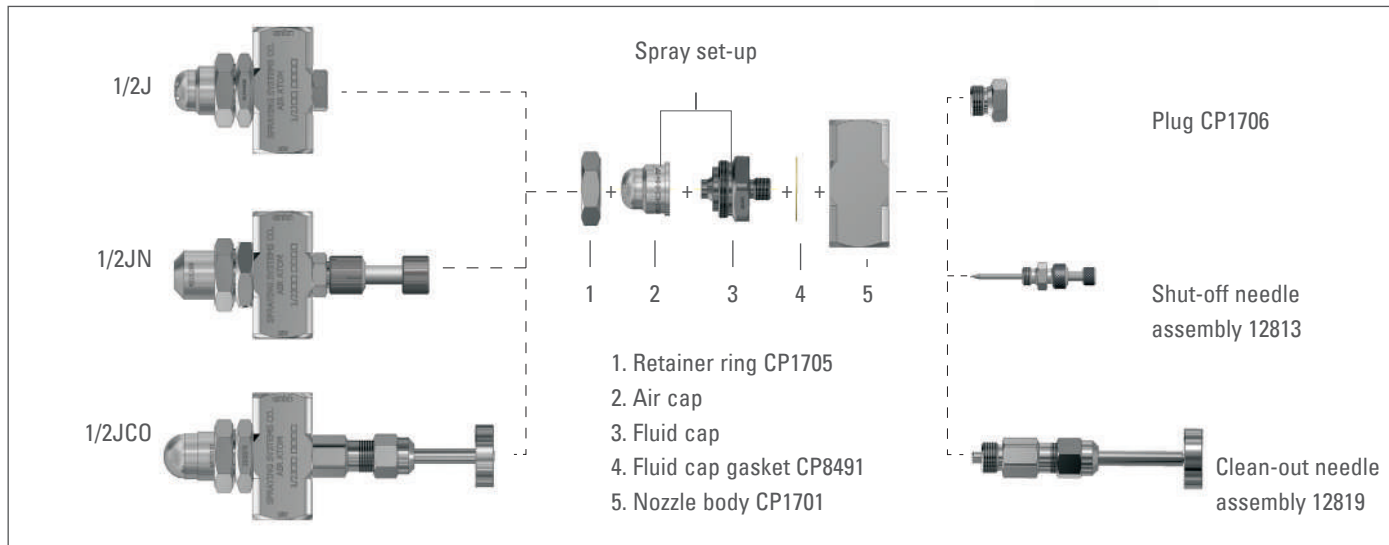
1/8JAC and 1/4JAC – Air and liquid inlets on the same side of the nozzle body – 90° to the spray direction

MORE OPTIONS

1/8JACN and 1/4JACN – Air and liquid inlets on the same side of the nozzle body – 90° to spray direction – with manual shut-off needle

1/2J SERIES NOZZLES

- J Series nozzles consist of a nozzle body and a spray set-up
- A wide variety of spray set-ups are available with flow rates up to 306 gph (1158 lph) in various spray patterns
- Basic 1/2J bodies have liquid and air inlets on opposing sides of the nozzle bodies. Nozzle bodies include a removable plug so needle assemblies can be added in the future
- Nickel-plated brass or stainless steel construction

**1/2J NOZZLE OPTIONS**

1/2JN – Manual shut-off needle to stop liquid flow



1/2JCO – Manual clean-out needle to clear obstructions from the fluid orifice



1/2JBC – Air and liquid inlets at the back of the nozzle body, in line with the spray direction



1/2JBCJ – Steam jacket around the nozzle body for spraying liquids too viscous to spray at room temperatures



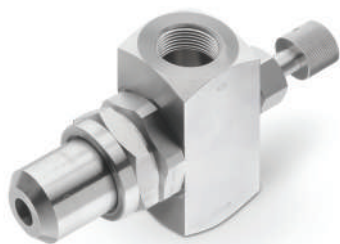
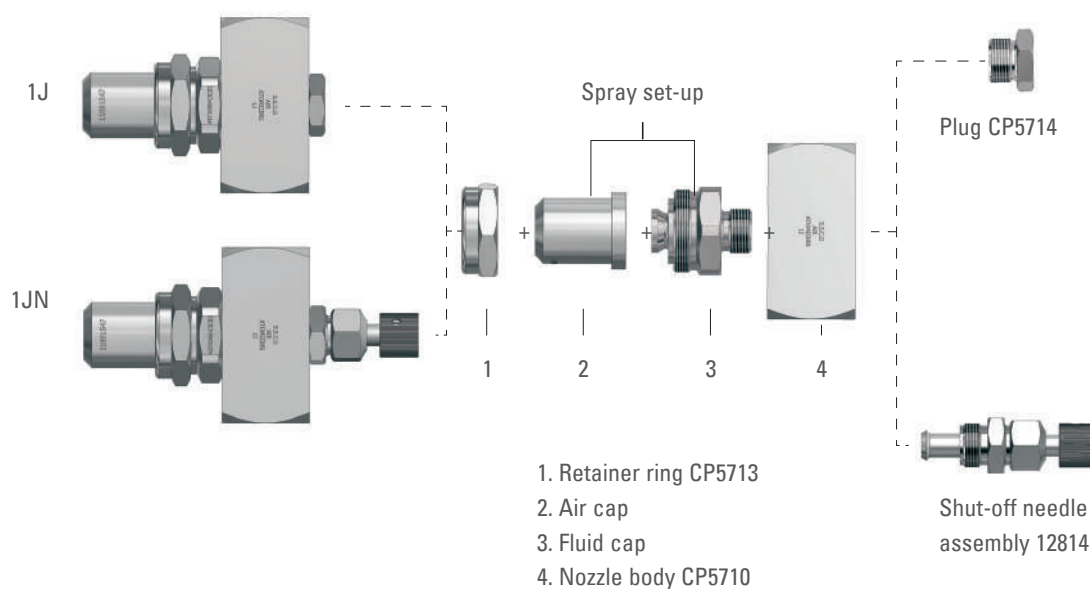
1/2-2J – 1/2" air and liquid inlet connections on opposing sides of the nozzle body with two opposing spray set-ups

1J SERIES NOZZLES

- J Series nozzles consist of a nozzle body and a spray set-up
- A wide variety of spray set-ups are available with flow rates up to 29 gpm (110 lpm) in various spray patterns
- Basic 1J bodies have liquid and air inlets on opposing sides of the nozzle bodies. Nozzle bodies include a removable plug so needle assemblies can be added in the future
- Nickel-plated brass or stainless steel construction

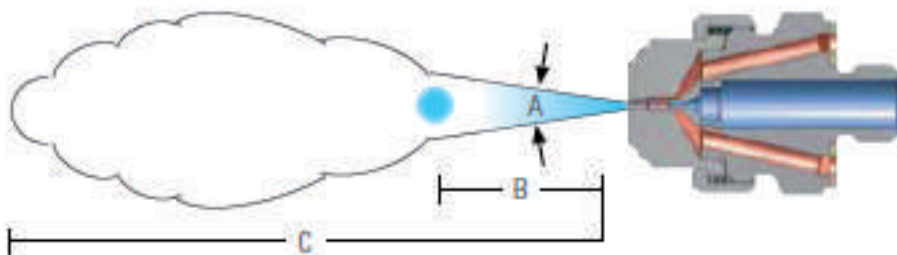


1J Nozzle

1J NOZZLE OPTIONS**1JN** – Manual shut-off needle to stop liquid flow

PRESSURE SPRAY SET-UPS | INTERNAL MIX | ROUND SPRAY

- For a round spray pattern, angle "A" is maintained throughout distance "B". Beyond "B", the spray becomes turbulent and projects out to distance "C".
- Liquid is supplied to this spray set-up under pressure.
- Liquid and compressed air or gas are mixed internally to produce a completely atomized spray.



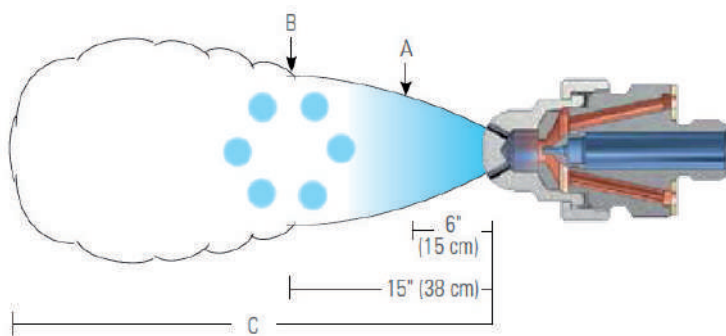
Performance Data: Pressure Spray Set-ups

Spray Set-up No.	Spray Set-up consists of Fluid and Air Cap Combi.	Liquid Capacity (liters per hour)* and Air Capacity (liters per minute)*															Spray Dimensions		
		Liquid Pressure																	
		0,7 bar			1,5 bar			2 bar			3 bar			4 bar			Spray Angle A (°)	B (cm)	C (cm)
		Air Press.	l/h	Air l/min	Air Press.	l/h	Air l/min	Air Press.	l/h	Air l/min	Air Press.	l/h	Air l/min	Air Press.	l/h	Air l/min			
SU12	Fluid Cap 2850 + Air Cap 73160	0,85	4,8	21	1,7	8,4	31	2,0	10,7	33	2,7	16,5	37	3,4	20,0	43	12-15	48-60	4,0-5,3
		1,1	4,1	27	1,8	7,5	36	2,1	9,8	37	2,8	15,4	38	3,7	14,4	47			
		1,4	3,4	33	2,0	7,0	37	2,4	8,2	42	3,1	13,6	43	3,9	16,8	50			
		1,7	3,0	39	2,5	4,8	49	3,0	5,9	55	3,7	10,4	55	4,5	13,8	60			
		2,0	2,8	44	3,1	3,6	59	3,5	4,1	65	4,2	7,9	65	4,9	11,8	68			
SU22B	Fluid Cap 40100 + Air Cap 1401110	1,5	2,9	41	2,8	4,1	54	3,2	5,0	59	3,9	9,1	61	4,8	12,4	65	18-21	66-97	4,9-9,1
		2,0	2,8	44	3,1	3,6	59	3,5	4,1	65	65	7,9	65	4,9	11,8	68			
		1,7	5,8	105	3,1	7,0	157	3,9	7,0	187	187	9,1	240	6,0	21,0	250			
		2,0	3,6	119	3,5	4,2	178	4,6	3,0	220	220	5,0	275	6,7	14,0	290			
SU42	Fluid Cap 100150+ Air Cap 1891125	1,0	44	86	1,4	125	79	2,0	123	108	2,2	199	88	3,0	250	99	19-22	89-117	6,1-9,1
		1,1	32	102	1,5	106	91	2,1	108	119	2,5	174	110	3,2	225	120			
		-	-	-	1,7	87	105	2,2	95	130	2,8	146	133	3,5	205	141			
		-	-	-	1,8	70	118	2,4	79	143	3,1	121	154	3,8	182	163			
		-	-	-	2,0	55	130	2,5	65	155	3,2	108	166	4,1	159	184			
		-	-	-	-	-	-	2,7	52	166	3,4	95	176	4,6	121	225			
		-	-	-	-	-	-	2,8	42	178	3,5	84	187	4,9	93	255			

* At the stated pressure in bar.

PRESSURE SPRAY SET-UPS | INTERNAL MIX | ROUND SPRAY

- For a wide angle round spray, dimensions "A" and "B" are the pattern widths at distances from the nozzle.
- The total distance of spray projection from the nozzle to the maximum dispersal point is represented by "C".
- Liquid is supplied to this spray set-up under pressure.
- Liquid and compressed air or gas are mixed internally to produce a completely atomized spray.



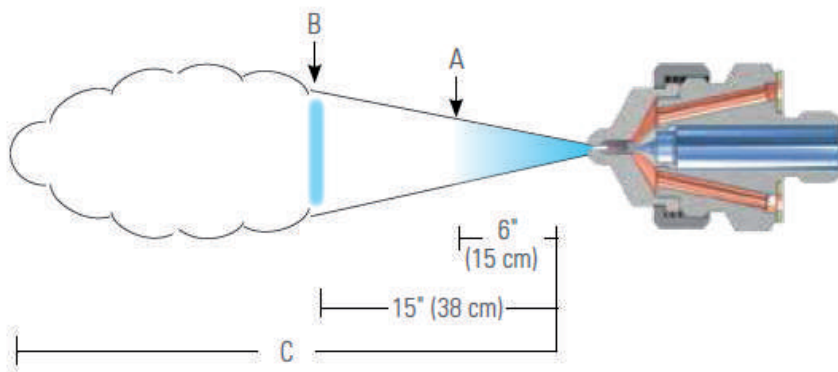
Performance Data: Pressure Spray Set-ups

Spray Set-up No.	Spray Set-up consists of Fluid and Air Cap Combi.	Liquid Capacity (liters per hour)* and Air Capacity (liters per minute)*															Spray Dimensions		
		Liquid Pressure																	
		0,7 bar			1,5 bar			2 bar			3 bar			4 bar			Spray Angle A (°)	B (cm)	C (cm)
		Air Press.	l/h	Air l/min	Air Press.	l/h	Air l/min	Air Press.	l/h	Air l/min	Air Press.	l/h	Air l/min	Air Press.	l/h	Air l/min			
SU26B	Fluid Cap 40100 + Air Cap 140-6-37-70°	0,85	7,0	50	1,7	13,2	68	2,0	10,5	68	2,8	25	84	3,7	31	96	18-21	31-37	1,8-5,9
		1,0	2,1	62	1,8	9,8	79	2,1	15,1	76	3,0	22	92	3,8	28	105			
		-	-	-	-	-	-	2,2	11,7	85	3,1	18,5	101	3,9	26	113			
		-	-	-	-	-	-	-	-	-	3,2	15,1	109	4,1	23	122			
		-	-	-	-	-	-	-	-	-	3,4	12,1	119	4,2	20	130			
		-	-	-	-	-	-	-	-	-	3,5	9,1	130	4,6	13,6	153			
		-	-	-	-	-	-	-	-	-	3,7	6,1	142	4,9	6,8	183			
SU29	Fluid Cap 60100 + Air Cap 140-6-52-70°	1,3	36	85	2,1	57	116	3,1	53	156	4,2	64	197	5,6	74	245	20-24	33-41	5,5-10,4
		1,5	29	102	2,4	51	130	3,2	50	163	4,9	51	230	6,0	68	260			
		1,8	23	117	2,7	45	143	3,4	47	170	5,6	40	265	3,6	62	280			
		2,1	16,7	133	3,2	33	170	3,9	38	194	6,3	28	300	7,0	51	315			
		2,4	11,4	149	4,2	13,6	220	4,9	18,5	245	7,0	17,8	335	-	-	-			
SU46	Fluid Cap 100150 + Air Cap 189-6-62-70°	1,7	25	156	3,0	39	230	3,4	50	250	4,6	62	320	6,0	93	395	24-33	46-58	5,5-9,8
		2,0	15,1	178	3,2	27	255	3,7	41	275	5,3	36	375	6,7	62	460			
		2,3	7,6	205	3,5	18,5	280	4,1	23	310	6,0	18,9	435	-	-	-			
		-	-	-	3,7	14,8	290	4,2	18,9	320	6,3	13,6	460	-	-	-			
		-	-	-	-	-	-	4,4	15,9	335	-	-	-	-	-	-			

* At the stated pressure in bar.

PRESSURE SPRAY SET-UPS | INTERNAL MIX | FLAT SPRAY

- For a flat spray pattern, "A" and "B" are the pattern widths at distances from the nozzle.
- The total distance of spray projection from the nozzle to the maximum dispersal point is represented by "C".
- Liquid is supplied to this spray set-up under pressure.
- Liquid and compressed air or gas are mixed internally to
- produce a completely atomized spray.

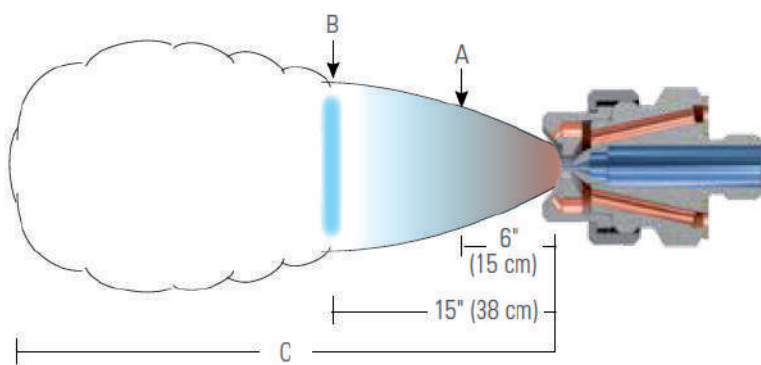
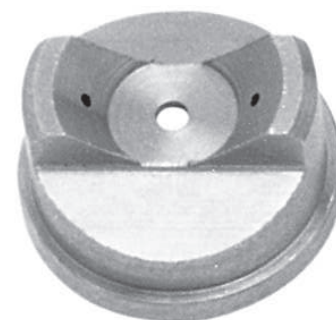
**Performance Data: Pressure Spray Set-ups**

Spray Set-up No.	Spray Set-up consists of Fluid and Air Cap Combi.	Liquid Capacity (liters per hour)* and Air Capacity (liters per minute)*															Spray Dimensions		
		Liquid Pressure																	
		0,7 bar			1,5 bar			2 bar			3 bar			4 bar			Spray Angle A (°)	B (cm)	C (cm)
		Air Press.	l/h	Air l/min	Air Press.	l/h	Air l/min	Air Press.	l/h	Air l/min	Air Press.	l/h	Air l/min	Air Press.	l/h	Air l/min			
SU23	Fluid Cap 60100 + Air Cap 125328	0,85	27	33	1,8	38	55	2,4	39	67	3,2	58	76	4,6	59	106	18-33	30-51	3,4-4,4
		1,1	15,9	45	2,2	24	71	3,0	24	87	3,8	38	97	5,6	32	145			
		1,4	10,2	56	2,5	17,8	82	3,4	15,1	103	4,2	27	113	6,3	20	172			
		1,5	7,6	62	2,7	15,1	87	3,5	12,9	109	4,6	20	126	6,7	15,9	185			
		-	-	-	-	-	-	3,7	10,6	114	4,9	14,8	140	7,0	12,7	198			
SU43	Fluid Cap 100150 + Air Cap 189351	1,0	29	90	1,8	56	117	2,1	100	119	3,0	126	140	4,1	140	181	18-36	25-58	3,4-5,2
		1,1	18,9	108	2,0	40	133	2,2	79	133	3,1	110	151	4,2	125	193			
		-	-	-	-	-	-	2,4	62	147	3,2	95	163	4,6	89	225			
		-	-	-	-	-	-	2,7	36	177	3,5	62	193	5,3	34	305			
		-	-	-	-	-	-	-	-	-	3,7	48	210	5,6	16,7	340			
		-	-	-	-	-	-	-	-	-	3,8	37	225	-	-	-			

* At the stated pressure in bar.

PRESSURE SPRAY SET-UPS | EXTERNAL MIX | FLAT SPRAY

- For a flat spray pattern, "A" and "B" are the pattern widths at distances from the nozzle.
- The total distance of spray projection from the nozzle to the maximum dispersal point is represented by "C".
- Liquid is supplied to this spray set-up under pressure.
- The liquid and compressed air or gas are mixed externally to produce a completely atomized spray.
- For external mix spray set-ups, atomization can be controlled by
- varying the air pressure without changing liquid flow rate.to produce a completely atomized spray.



Performance Data: Pressure Spray Set-ups

Spray Set-up No.	Spray Set-up consists of Fluid and Air Cap Combi.	Liquid Capacity (liters per hour)* and Air Capacity (liters per minute)*															Spray Dimensions		
		Liquid Pressure																	
		0,7 bar			1,5 bar			2 bar			3 bar			4 bar			Spray Angle A (°)	B (cm)	C (cm)
		Air Press.	l/h	Air l/min	Air Press.	l/h	Air l/min	Air Press.	l/h	Air l/min	Air Press.	l/h	Air l/min	Air Press.	l/h	Air l/min			
SUE25B	Fluid Cap 35100 + Air Cap 134255-45°	0,70	13,4	85	1,0	16,4	102	1,4	25	116	2,5	37	178	3,2	52	212	13-16,5	25-37	1,7-4,9
		1,4	13,4	116	1,8	16,4	139	2,1	25	156	3,5	37	227	3,9	52	255			
		2,1	13,4	156	2,8	16,4	195	2,8	25	195	4,9	37	312	4,9	52	314			
		2,8	13,4	195	3,5	16,4	227	3,5	25	227	5,6	37	360	5,6	52	360			
		3,5	13,4	227	4,2	16,4	266	4,2	25	266	6,3	37	411	6,3	52	411			
SUE45	Fluid Cap 100150 + Air Cap 200278-45°	2,8	102	380	3,5	125	380	4,6	192	480	5,6	280	600	-	-	-	19-22	36-41	46-61
		3,5	102	380	4,2	125	445	5,3	192	565	6,3	280	685	-	-	-			
		4,2	102	445	4,9	125	520	6,0	192	640	-	-	-	-	-	-			
		4,9	102	520	5,6	125	600	-	-	-	-	-	-	-	-	-			

* At the stated pressure in bar.



FLOMAX® AIR ATOMIZING NOZZLES

Unique Atomization Process Provides
Unmatched Efficiency in Gas Conditioning Operations



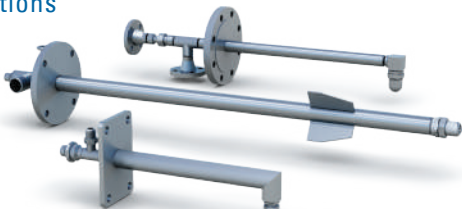
Hydraulic Nozzles	Air Atomizing Nozzles
- Drop size will vary with pressure changes. - Constant flow rate at a given pressure; change in flow requires change in inlet pressure.	- Greater control of both air and liquid enables tighter control of drop size. - Precise control of drop size as flow rate varies. - Smaller drop size reduces dwell time and risk of wetting — allows for more compact cooling tower.
Require high-pressure pumps, piping, valves, flanges, etc.	- Low pressure components require less maintenance. - Low pressure piping lowers cost.
Higher number of lances required.	One air atomizing lance can potentially replace four hydraulic lances.
Small free passage prone to clogging. Clean water supply required.	Large free passage means less clogging. Can use river water, basins and run-off water.
High maintenance costs.	Wear-resistant materials require less maintenance.
---	Higher production levels can be achieved using existing ESP or baghouse equipment.

8 more reasons why FloMax Air Atomizing Nozzles are preferred

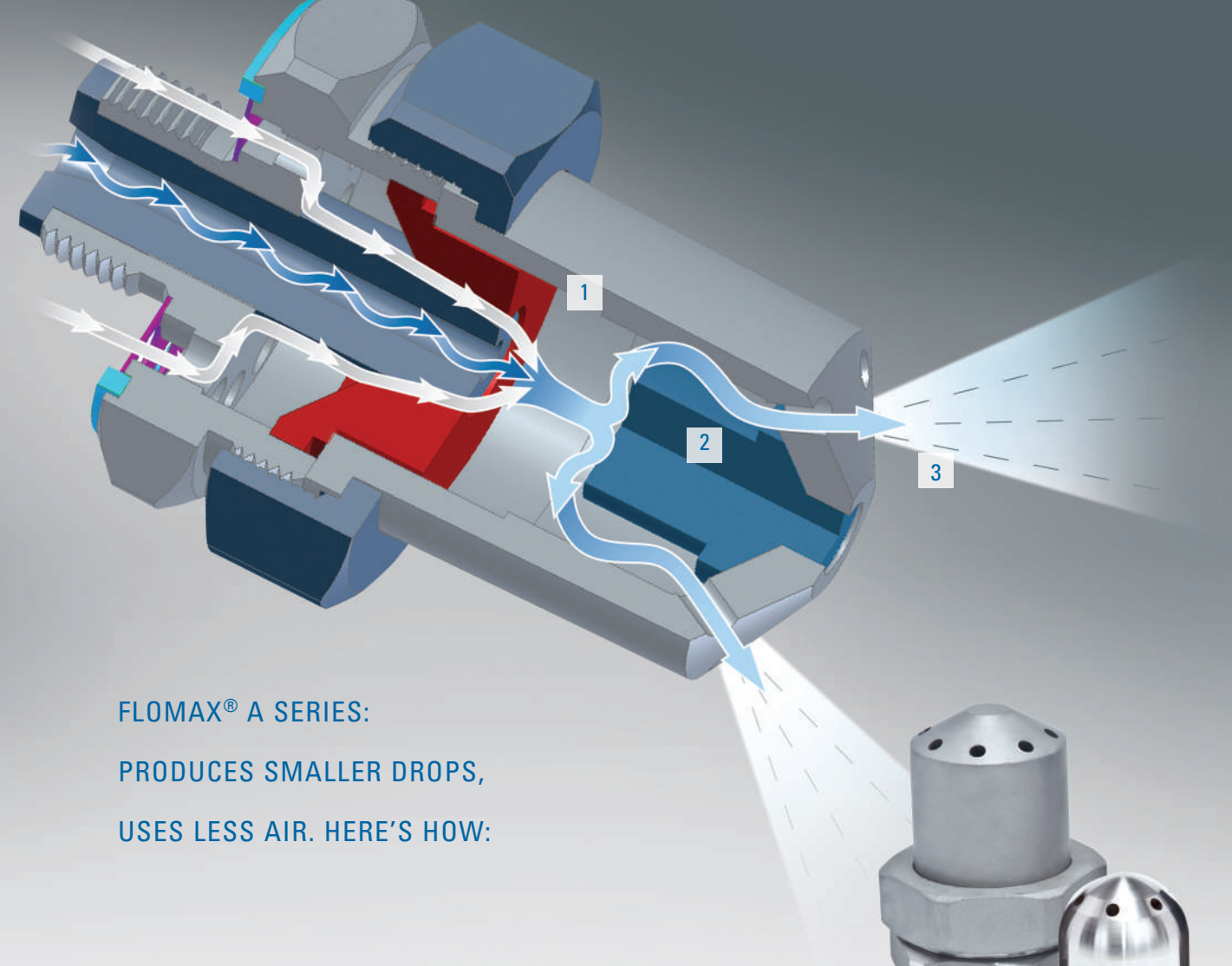
- FloMax nozzles allow a high turndown of flow rate so a set air pressure can be maintained while liquid pressure and flow varies.
- A large flow rate per nozzle means that fewer nozzles are required for cooling resulting in a lower initial purchase cost and less maintenance.
- FloMax nozzles are available in a variety of corrosion and erosion resistant materials, such as Hastelloy, Stellite and reaction-bonded silicon carbide, to ensure optional performance in harsh environment.
- Large free passage reduces clogging and allows flexibility in water sources.
- Low maintenance since FloMax nozzles operate at low pressures.
- Wide range of flow rates available – 0,5 gpm to 65 gpm (1,8 l/min to 247 l/min).
- Easy maintenance when required – no special tools are necessary.
- Lances, manifolds and headers are available as installation options along with adapters, cooling jackets, purge tubes and protective tubes as needed.



Overview of the FloMax® Air Atomizing Nozzle Line

FloMax A and FloMax Anti-Bearding Series 	FM3A and FM3A-AB*: 0.03 to 3 gpm (1.13 to 11.3 lpm) Spray angle: 20° and 55° FM5A and FM5A-AB*: 0.7 to 7.0 gpm (2.6 to 26.5 lpm) Spray angle: 20° and 55° (95° optional) FM10A and FM10A-AB*: 1.3 to 13.0 gpm (4.9 to 49.2 lpm) Spray angle: 20° and 55° (95° optional) FM25A and FM25A-AB*: 10.0 to 30.0 gpm (37.8 to 114 lpm) Spray angle: 20° and 55° (95° optional) FM40A and FM40-ABD: 20.0 to 45.0 gpm (75.7 to 170.3 lpm) Spray angle: 55° and 95°
FloMax X Series 	FMX015: 0.03 to 0.25 gpm (0.11 to 0.94 lpm) Spray angle: 20° FMX030: 0.05 to 0.5 gpm (0.19 to 1.89 lpm) Spray angle: 20° FMX090: 0.5 to 1.5 gpm (1.89 to 5.67 lpm) Spray angle: 20° and 55°
Options 	Standard and made-to-order injectors available in a wide range of materials and configurations. Pre-assembled Valve Regulation Packages to save engineering and installation time.

Anti-bearding versions not available in 20° spray angle.



FLOMAX® A SERIES:
PRODUCES SMALLER DROPS,
USES LESS AIR. HERE'S HOW:

When it comes to drop size, the goal is to minimize D_{max} and achieve a finely atomized spray with D_{32} less than 100 microns at 10 gpm (37.8 lpm). This drop size cannot be achieved with a single-step atomization process. FloMax nozzles use a patented three-stage atomization principle to produce a focused air stream that shears the liquid with minimal air. The result is a D_{32} drop size 34% smaller using 20% less air than competitive nozzles (flow rate of 10 gpm [37.8 lpm]). Each nozzle uses as little as 45 scfm (76 Nm³/hr). Energy costs are lowered and compressor life extended.

The very small drops produced by FloMax A Series nozzles reduce dwell time required for complete evaporation and reduce the risk of wetting. Plus, the liquid being sprayed generates more surface area per gallon (liter).

The uniform drop size distribution ensures precise, tight control of drop size. FloMax nozzles provide a narrower Relative Span Factor (RSF) than many other air atomizing nozzles at most air pressures.



FloMax A
Series Nozzles

FloMax A Series: Principle of Operation

- 1** Stage One: Primary Fluid Breakup
Air and liquid converge at the annulus allowing high velocity air to shear the liquid column.
- 2** Stage Two: Secondary Fluid Breakup
Focused stream impacts the target bolt forcing additional mechanical breakup.
- 3** Stage Three: Final Mixing
Air cap acts as a final mixing chamber. As the liquid/air mixture crosses multiple orifices, an additional pressure drop provides the final atomization.

FloMax Anti-Bearding Series feature 10 to 12 orifices at compound angles. These orifices produce a very full spray when leaving the air cap. The spray pulls in as it travels and provides a 55° or 95° spray angle.

FloMax® Anti-Bearding Nozzles

FloMax Anti-Bearding nozzles provide all the benefits of FloMax A nozzles but feature a patented air cap design to resist material build-up near nozzle orifices and prevent performance problems. These nozzles can last up to five times longer before maintenance is required to remove build-up and are suitable for use in high-particulate spraying applications. The largest capacity FloMax Anti-Bearding nozzle is the FMA-ABD with flow rates up to 45 gpm (170.3 lpm). It features a new, patent-pending design that includes a diffuser in the air cap that is even more effective at resisting build-up. The FMA-ABD is ideal for spraying highly abrasive slurries.



Five Additional Benefits of FloMax A and FloMax Anti-Bearding Nozzles

Fewer nozzles required for cooling.

FloMax nozzles offer a large flow rate per nozzle. Competitive nozzles with equivalent flow rates produce larger drops. Fewer FloMax nozzles can be used, reducing initial costs and maintenance time.

Maximum flexibility because of high turndown ratios.

High turndown of flow rate – up to 10:1 – allows the air pressure to be constant while the liquid varies based on process requirements.

Effective in abrasive, corrosive and high-temperature environments.

Standard nozzle materials are 316 or 310 stainless steel and Hastelloy® is available on request. Air cap material options include reaction-bonded silicon carbide, Stellite®, ceramic and tungsten carbide.

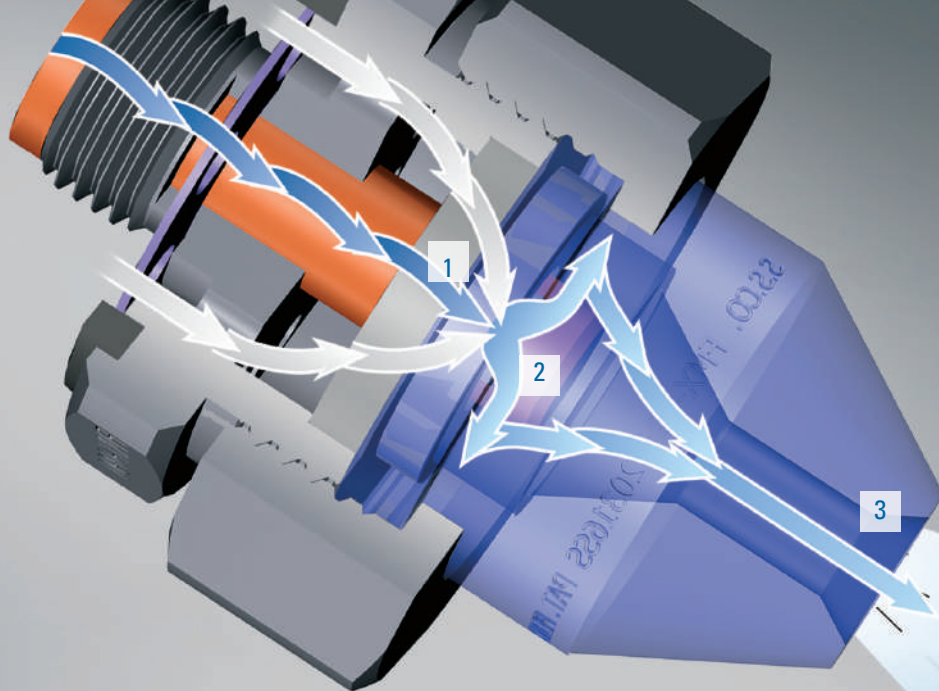
Use lower quality water sources.

The nozzles feature large free passages that reduce the risk of clogging. Lower-cost water supplies can be used.

Reduced maintenance time.

Maintenance is fast and easy. Replacement of the nozzle or just the air cap and/or air annulus can be done without special tools. Competitive nozzles require more maintenance and frequent replacement because of smaller free passages and the use of higher air and liquid pressures.





Similar to the FloMax A Series, FloMax X Series nozzles feature:

- Large free passage to minimize clogging
- A choice of mounting options and easy installation

FloMax® X Series Nozzles
offer similar benefits to the A Series
and outperform all other small
capacity nozzles

A multi-stage cross-hole nozzle design provides superior atomization by shearing the liquid prior to mixing with the high-velocity air stream. This yields small drops at lower operating pressures than other nozzles and tight drop size control. Compressed air use is reduced, smaller compressors can be used and compressor life extended.

FloMax X Series nozzles have a liquid turndown ratio of up to 10:1 and allow the air pressure to be constant while the liquid varies based on process requirements. Conventional air atomizing nozzles have ratios of 2:1 or 3:1. The high turndown ratio of FloMax X nozzles adds operating flexibility without compromising performance.

The narrow 20° spray angle is ideal for applications where spray precision is important. Multiple nozzles can be configured on a lance or in a duct or vessel to deliver targeted sprays in critical processes. FloMax X Series nozzles provide a narrower RSF than many other air atomizing nozzles at most air pressures.

A 55° spray angle is also available for applications requiring more spray coverage.

FloMax X Series nozzles are suitable for demanding applications – material options include 310 and 316 stainless steel and Hastelloy®. Other materials are available upon request.



FloMax X Series: Principle of Operation

- Stage One: Primary Fluid Breakup**
The cross holes in the liquid orifice split the flow into four smaller streams.
- Stage Two: Secondary Fluid Breakup**
The liquid – all four streams – is sheared by air as it exits the cross holes.
- Stage Three: Final Mixing**
The air cap acts as a final mixing chamber. As the liquid/air mixture exits the orifice, an additional pressure drop provides the final atomization.



SteamMax™ Nozzles

High-Efficiency Steam Atomizing Nozzles for Optimized Gas Cooling



Cold water, superheated steam, fine spray

In a lot of industrial and chemical processes it is not feasible or not cost effective to use compressed air as atomizing medium; instead superheated steam can be used or is required for atomization. With our new design of the SteamMax™ B series nozzle design, we have eliminated the need for compressed air, and it is now possible to inject large capacities of cool water and use superheated steam to create effectively a fine spray without any negative effects of condensation inside an inner mixing nozzle.

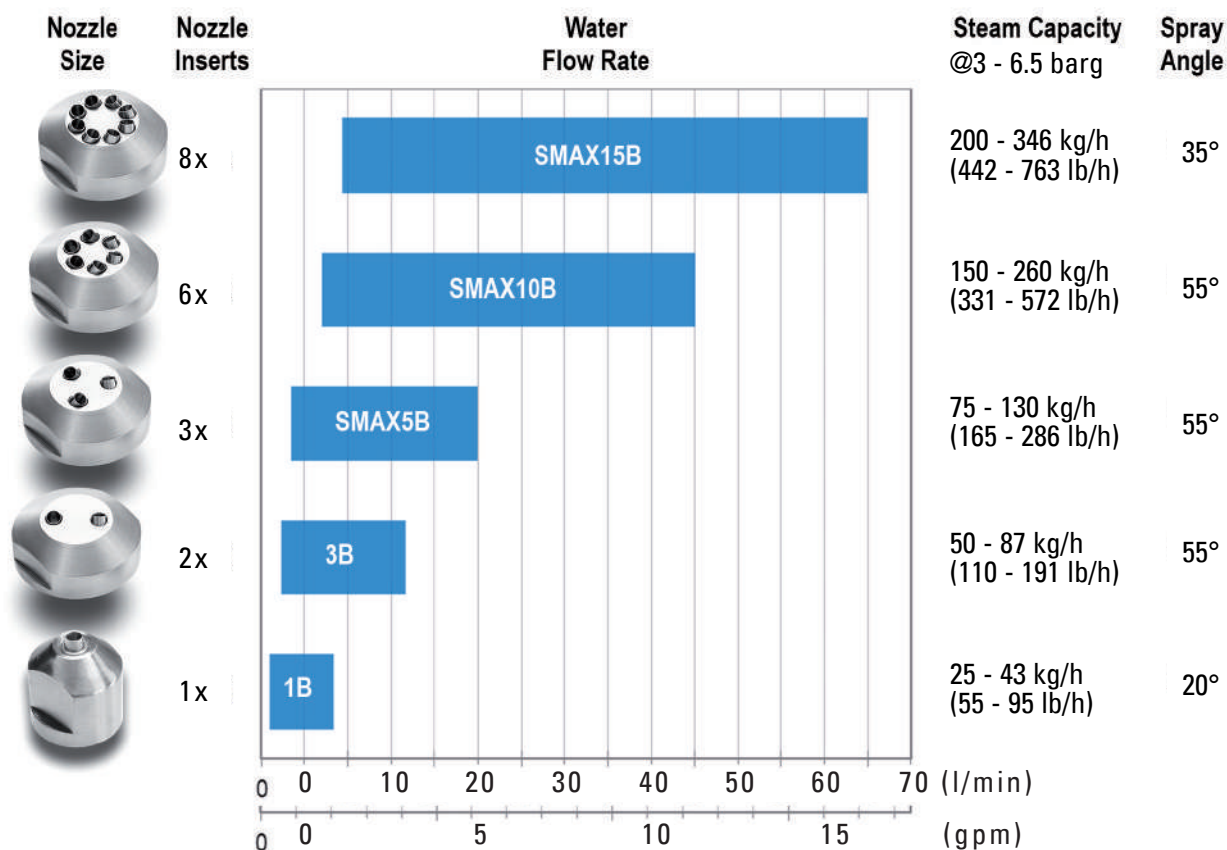
Advantages

- No need for compressed air
- No condensation inside spray nozzle
- Cold water injection
- Low steam capacity
- Fine spray
- Compact dimensions, smaller than our FloMax® nozzles
- Mounting connection, same as our FloMax® nozzles

Technical Data

- Water Capacity: 1 – 70 l/min (0.25 – 17.2 gpm)
- Steam Pressure: 3 -10 bar (40 – 145 psi)
- Spray Pattern: (Twisted) full cone
- Wide Spray Angle: 20° - 55°
- Small Droplet Size: 5 – 250 µm
- Maximum Free Passage: 1.5 mm (0.0381 inch)

Capacity



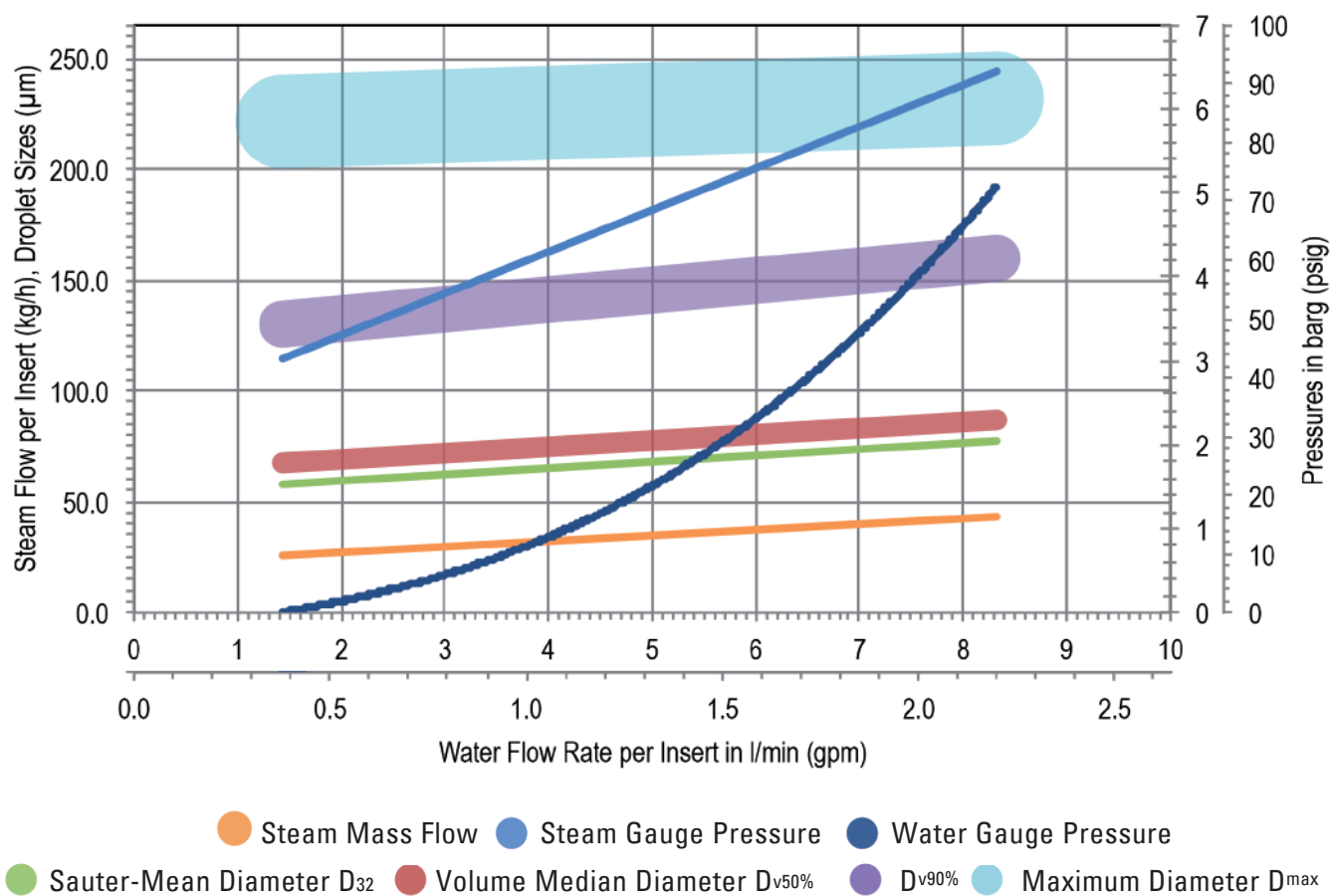
Operating Parameters

The water gauge pressure ranges from 0 to 6 barg (about 0 - 90 psi). Any liquid water temperature above > 10 °C (50 °F) will atomize. The operating gauge pressure ranges from 3 - 10 barg (about 40 - 145 psig) and the respective absolute pressure ranges from 4.013 - 11.013 bara (40 - 145 psig) for the superheated steam. The respective steam temperature for a given absolute operating pressure should be larger than the saturation temperature, see table beside.

Steam Pressure in bara (psia)	Saturation Temperature in °C (°F)
4.0 (58.2)	144 (291)
5.0 (72.7)	152 (306)
6.0 (87.2)	159 (318)
7.0 (101.7)	165 (329)
8.0 (116.2)	170 (339)
9.0 (130.7)	175 (348)
10.0 (145.2)	180 (356)
11.0 (159.7)	184 (363)

Drop Size

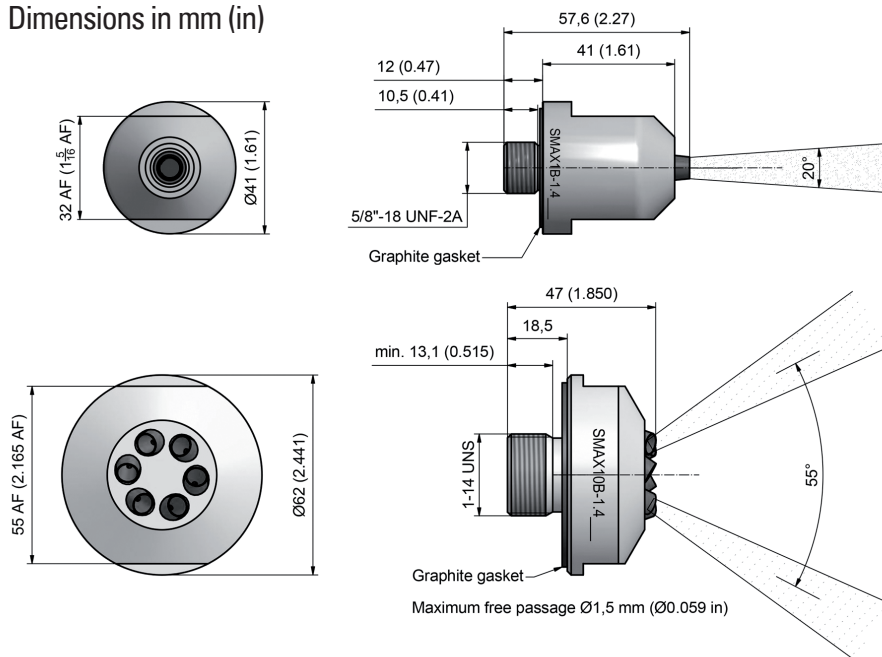
Drop size remains almost constant over a wide capacity range. Contact your local sales engineer for further performance and droplet size data.



Data is based on spraying water under laboratory conditions using the Phase Doppler Interferometry (PDI). All values are to be computed utilizing the procedures for determining spray characteristics as outlined by ASTM (Standard E799).

Dimensions

Dimensions in mm (in)

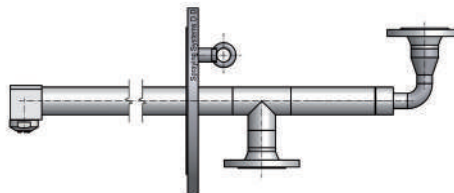


Material

- Standard: Stainless Steel 1.4571 (AISI 310TI).
- For high temperatures above 550 °C (1,022 °F): 1.4841 (AISI 310).

Optional

Lances & Dosing Systems



Advantages of using SteamMax™ B Nozzles

Innovative products for the perfect spray designed, manufactured and tested in Germany.

The SteamMax™ B nozzle series is the advancement of the SteamMax™ A nozzle series.

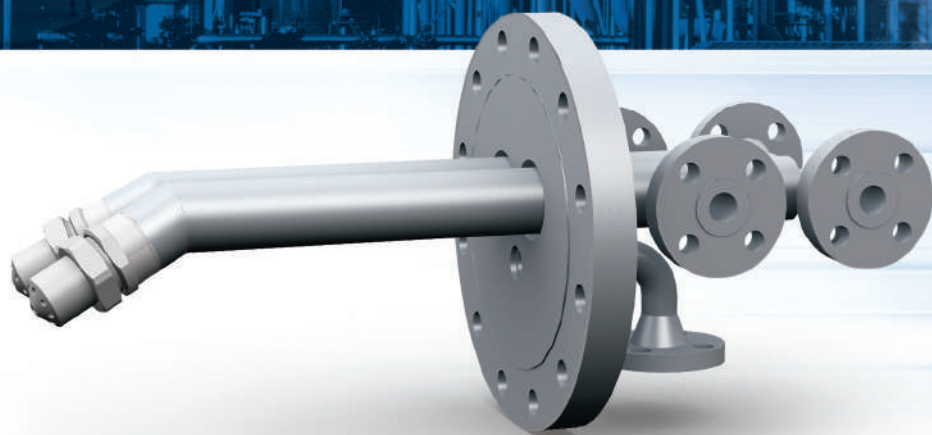
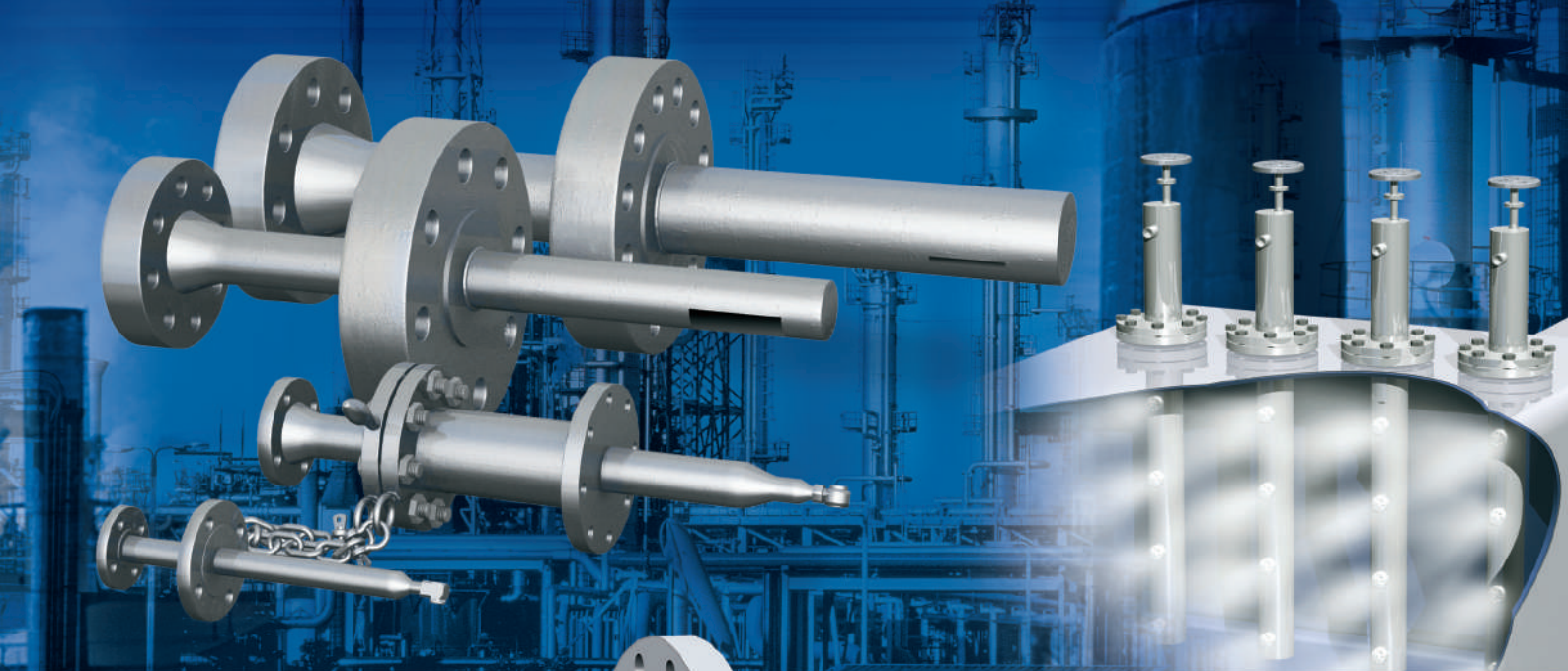
- Compact one piece design.
- Maintenance is fast and easy.
SteamMax™ B nozzles consist only of one piece and a gasket. No special tools are required.
- Almost constant spray characteristics over a wide capacity range.
We offer a complete series from 1 to 8 inserts, depending on the customer capacity demands.

Applications

- Gas cooling at power plants or steel production plants (e.g. before an E-filter)
- Gas cooling at industrial or petro chemical process plants at distant locations, where no compressed air in large amounts but superheated steam is available.
- Steam preparation (e.g. in tobacco process plants)
- Desuperheating

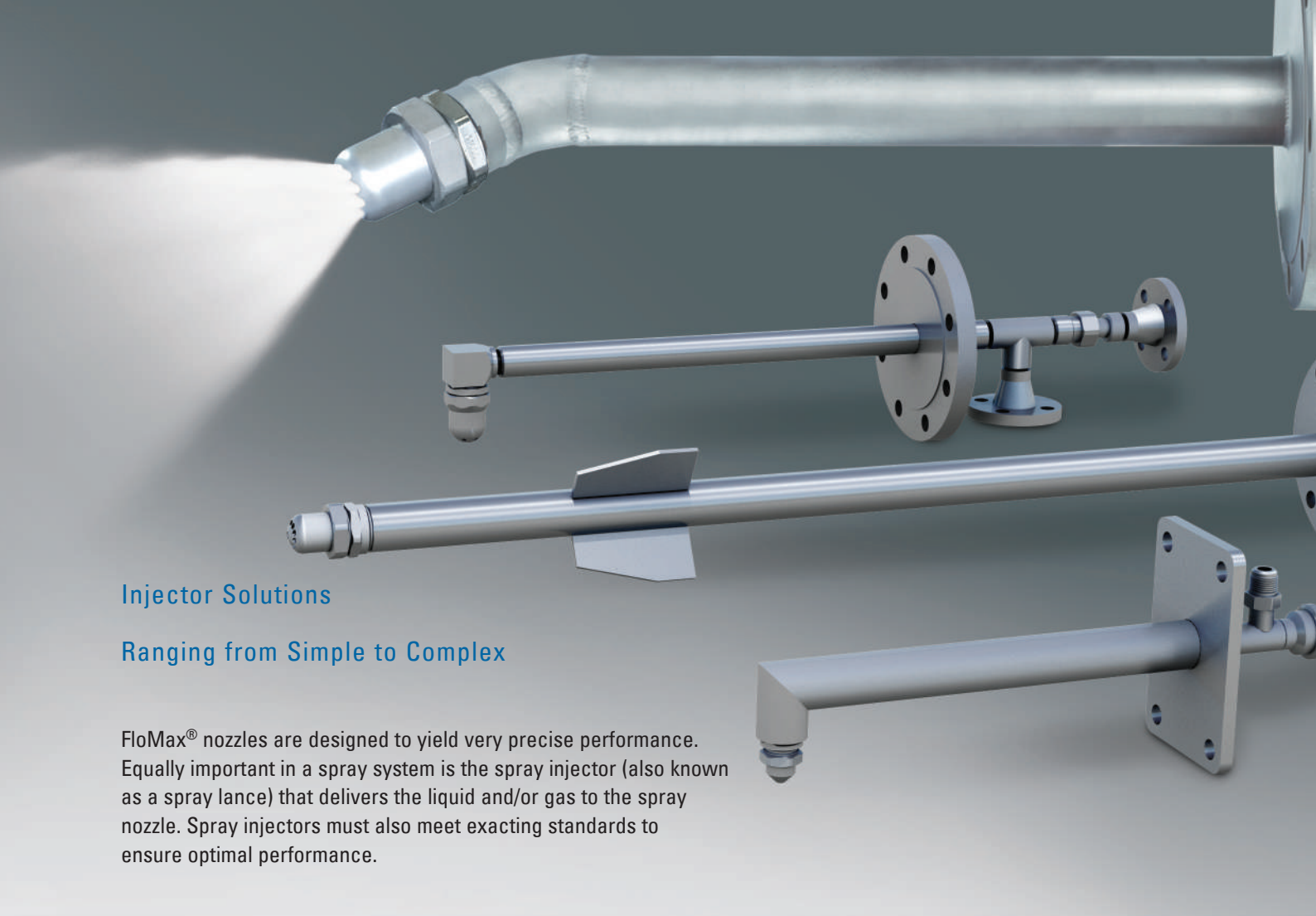
Ordering Information

SteamMax Nozzles Type	Water capacity in gpm	Code for B Series	Material Code for Stainless Steel	Example
				SMAX
				10
				B
				1.4571



LANCES & INJECTORS

METHOD, APPLICATIONS & EXAMPLES



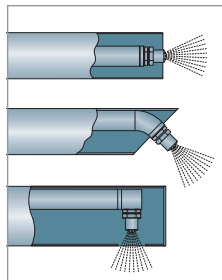
Injector Solutions

Ranging from Simple to Complex

FloMax® nozzles are designed to yield very precise performance. Equally important in a spray system is the spray injector (also known as a spray lance) that delivers the liquid and/or gas to the spray nozzle. Spray injectors must also meet exacting standards to ensure optimal performance.

We offer a full range of spray injectors:

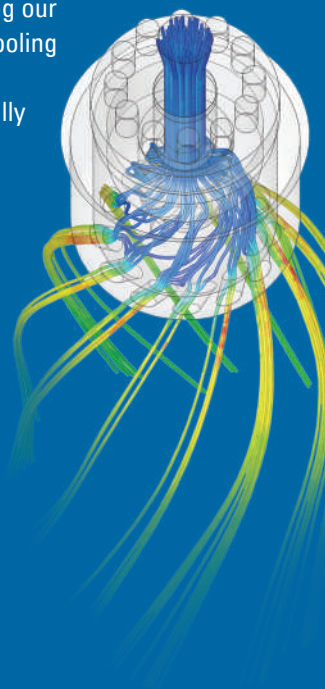
- Our standard FloMax injectors are readily available in 0°, 45° and 90° configurations with quick-release or bolt-on flanges and optional adapters, cooling jackets, purge tubes and protective tubes.
- When non-standard solutions are needed to meet challenging physical spaces or hostile environments, injectors are built to order. Common designs include insulated, water- and steam-jacketed, recirculating, retractable and/or cluster nozzle injectors in a wide range of high-temperature and corrosion-resistant materials. Manufacturing to meet B31.1 and B31.3 and other codes is available along with testing in accordance with ANSI® and ASTM® standards, material certification, magnetic particle examination, material test reports and more.



Ensure Optimal Performance with Computational Fluid Dynamics

There are dozens of variables that can affect spray performance in a gas stream. In many cases, we can predict performance by using our sophisticated, proprietary gas cooling software and conducting spray characterization testing in our fully equipped spray laboratories.

However, in some applications, we rely on Computational Fluid Dynamics (CFD) to model gas flow based on actual operating conditions.



Atomizing Nozzle Lances

Several lance designs which can be combined with our large variety of atomizing nozzle types to ensure the perfect design and selection for the demands of our customers and different operating conditions. The lance design is well proofed in operation and also can be used for extrem conditions where other systems are already operating at its limit.



Advantages

- Operating safety thru thermal and mechanical loadability
- Stable processes and operatings with the performances of the atomizing technology
- Regulation of liquid flow rate from 0-100%
- Design and selection according to process conditions with computational support and the huge variety of combination possibilities
- Maintenance friendly design for easy removal with quick coupling connections
- Numbers of different possible design options
 - Nozzle lances w/o protective tube
 - Spray angles from 0-90°
 - Lance cooling with air or water
 - Connections for liquid and air / steam also available for hoses and with quick couplings
 - Flange design with screws or as quick coupling
 - Additional air supply for purge air
 - Temperature control at the lance

* Request your personal lance template for technical specification of your needs!

Typical Applications

- Flue Gas Cleaning
- Evaporation Cooling
- Dust Suppression
- DeNO_x
- Gas Gonditioning

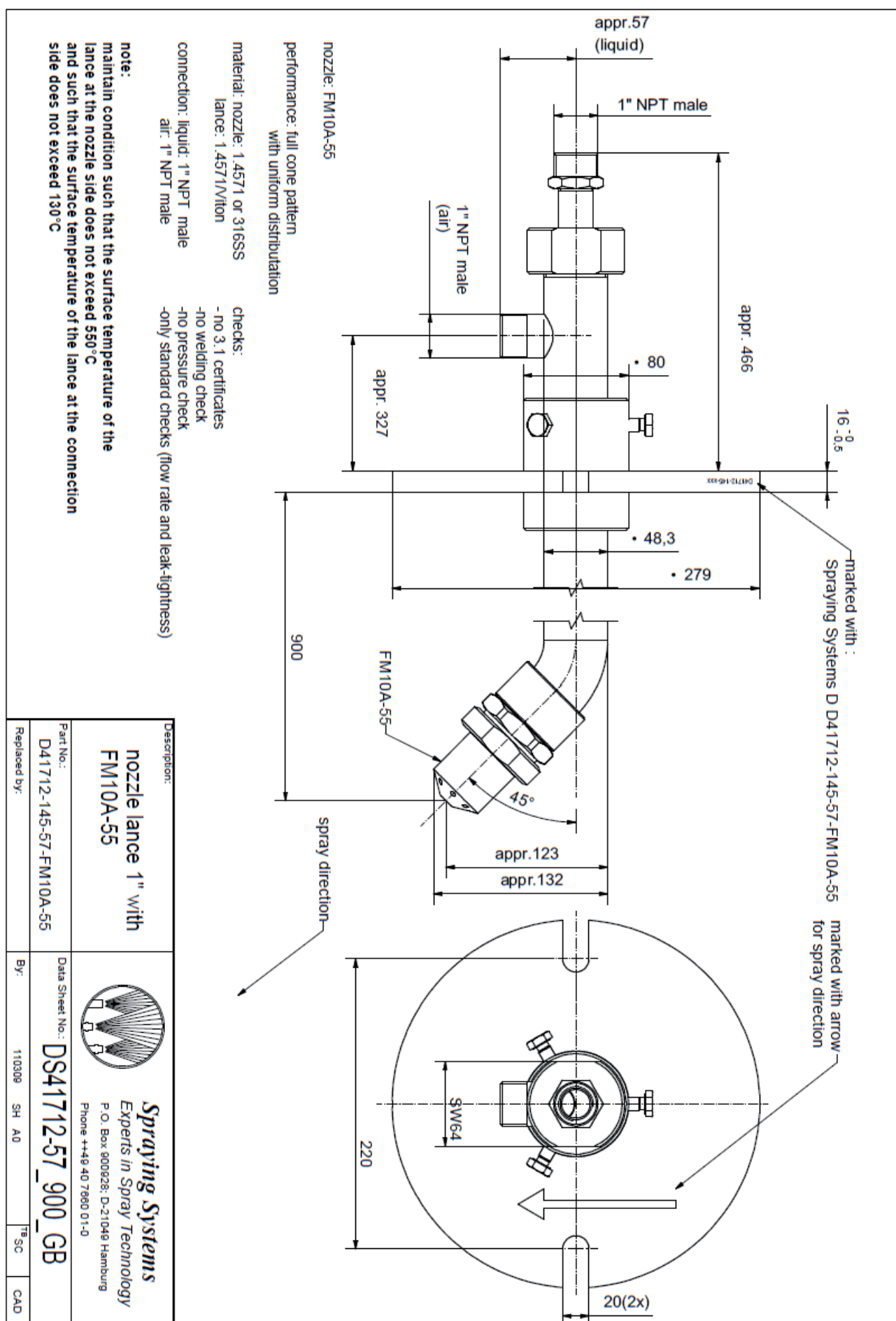
3 different nozzle system can be selected from:

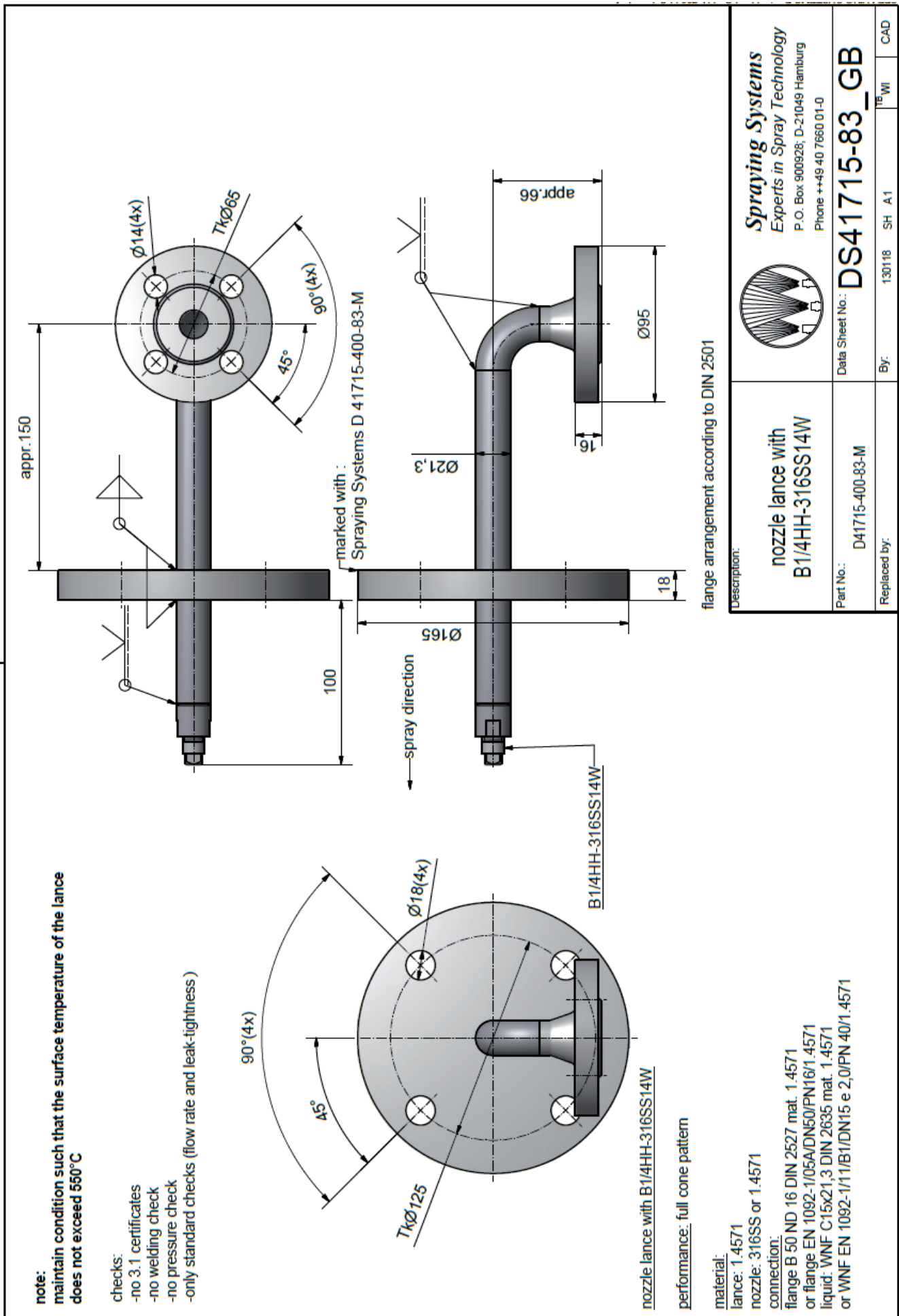
- Standard air atomizing nozzles of the series J+JJ (flow rate up to 3.900 l/h)
- FloMax air atomizing nozzles with 2-way atomization (high flow rates up to 11.400 l/h and small droplets)
- External mixing nozzles (flow rate up to 6.420 l/h - e.g. for Urea or lime milk injection)
- Operating control from 0-100 % even for flow rates up to 6.000 l/h
- Spezial designs and materials for abrasive liquids

Capacity Serie J + JJ

Nozzle Set up 		Small Flow Rate		Small Flow Rate*	Medium Flow Rate	Large Flow Rate
	Flow rate l/h	0,49 – 280 l/h		0,49 – 88 l/h	15,5 – 1.158 l/h	90 – 6.420 l/h
	Serie	1/8 J	1/4 J	1/8 JJ	1/2 JJ	1 J
	Connection	1/8" NPT	1/4" NPT	1/8" NPT	1/2" NPT	1" NPT

* Compact Series







Description: nozzle lance with 2XFM1-20	 <i>Spraying Systems</i> <i>Experts in Spray Technology</i> P.O. Box 800628; D-21048 Hamburg Phone ++49 40 7680 01-0
Part No.: D41712-290-91-2XFM1-20	Data Sheet No.: DS41712-91_GB
Replaced by:	By:
	080630 SC A1
	T ^B SC CAD

adapter to the lance (air)
Lanzenadapter (Luft)

manometer with glycerine $\varnothing 63$
0-10 bar

glycerinedämpftes Manometer $\varnothing 63$
0-10 bar

hose 1 m
Schlauch 1 m
p max. 12 bar
max. T: 70°C
with Kamlock couplings
mit Kamlockkupplungen

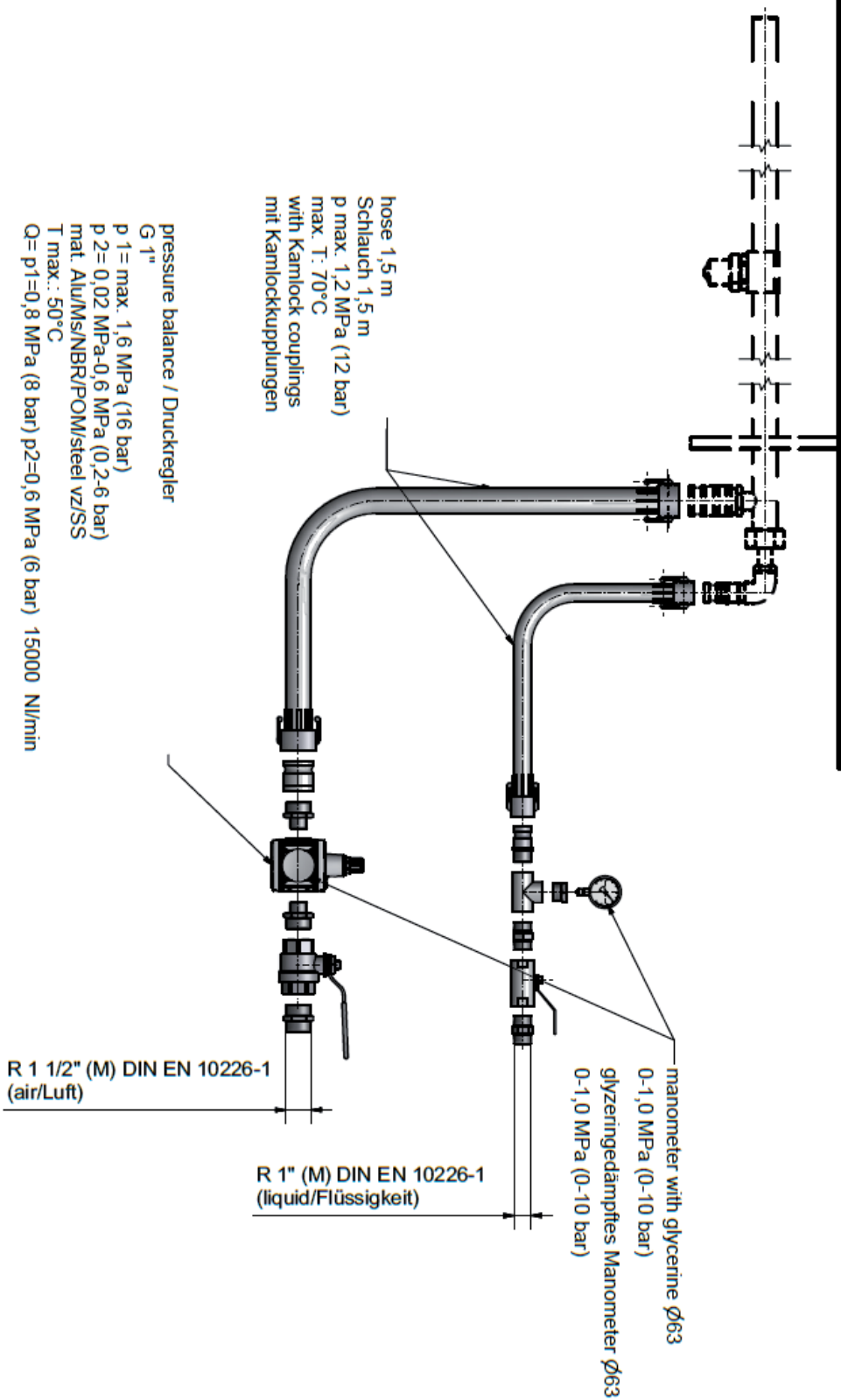
R 1 1/2" male DIN EN 10226-1
(air/Luft)

R 1" male DIN EN 10226-1
(liquid/Flüssigkeit)

fittings, couplings, ball valve
mat: stainless steel
Fittings, Kupplungen, Kugelhähne
Mat. Edelstahl

Bezeichnung/Description: Hose Kit and Mounting Tube Kit 1J Schlauchverbindingssatz 1J			
Artikel-Nr.: / Part. No. D41905-0070		Datenblatt-Nr.: Data Sheet No. DS41905-70_GB	
Ersatz für / Replaced by:		RF A0	WI
		CAD	

Unbedingt zu beachten: Erforderliche Mat., Zeugnisse, Schweißprüfungen, Tests etc. sind für die Preiskalkulation u. Lieferzeit zwingend anzugeben !!
Very important: required mat., certificates, welding checks, tests etc. are strictly necessary for calculation and delivery time !!



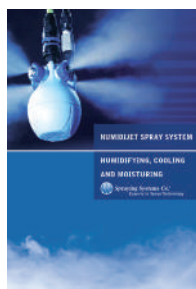
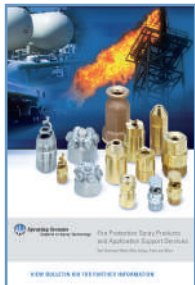
fittings, couplings, ball valve
mat: stainless steel
Fittings, Kupplungen, Kugelhähne
Mat. Edelstahl

Bezeichnung/Description:		Spraying Systems Experts in Spray Technology Postfach 900928, D-21049 Hamburg Telefon (040) 76 60 01-0	
Hose Kit and Mounting Tube Kit 1J Schlauchverbindingssatz 1J			
Artikel-Nr.: / Part. No. D41905-0061	Datenblatt-Nr.: Data Sheet No.	DS41905-61	
Ersatz für / Replacement for: By: 130318	RF A0	75	WI CAD

HumidiJet Spray System

Bulletin 1.614

4-page bulletin for Humidifying, Cooling and Moisturing



Fire Protection Spray Products and Application Support Services

Bulletin 618

4-page Bulletin for Wet Chemical, Water Mist, Deluge, Foam and More



SteamMax Nozzles

Bulletin 1.622

4-page bulletin for high-efficiency Steam Atomizing Nozzles for optimized Gas Cooling



Nozzles for Pipe and Sewer Cleaning

Catalog 217

20-page full-line catalog for Nozzles and Accessories.

FloMax® Air Atomizing Nozzles:

Bulletin 487C

8-page bulletin provides detailed performance and application information on the unmatched energy-efficient FloMax nozzles and lances.



Gas Cooling and Conditioning Guide

Bulletin 540

12-page bulletin describes how to optimize efficiency and performance in gas cooling and conditioning applications.



Improving Process and Product Quality in Chemical Production through Spray Technology

Bulletin 568

12-page bulletin provides an overview of how spray technology is used in a wide range of applications.



A Guide to Optimizing Spray Injector Performance

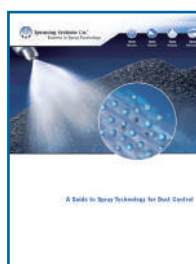
Bulletin 579A

12-page bulletin addresses key specification, design and fabrication considerations for custom injectors.

Dust Control Spray Products

Bulletin 652

20-page Guide to Spray Technology for Dust Control



Spray Technology Reference Guide: Understanding Drop Size

Bulletin 459B

36-page educational guide takes an in-depth look at atomization, drop size measurement techniques, analyzers, data collection and analysis and more.



Spraying Systems Co.®
Experts in Spray Technology

Spraying Systems Deutschland GmbH
Großmoorkehre 1
D-21079 Hamburg

Tel: +49 40-766 001-0
Fax: +49 40-766 001-233
E-Mail: info@spray.de
Internet: www.spray.de

Spraying Systems Austria GmbH
Europaplatz 4
A-4020 Linz

Tel: +43 732-776 540-0
Fax: +43 732-776 540-10
E-Mail: austria@spray.com
Internet: at.spray.com

SSCO-Spraying Systems AG
Eichenstr. 6
CH-8808 Pfäffikon SZ

Tel: +41 55-410 10-60
Fax: +41 55-410 39-30
E-Mail: info.ch@spray.com
Internet: www.scco.ch

Spraying Systems Belgium s.p.r.l.
Avenue D Poplimontlaan 16
B-1090 Brussels

Tel: +32 2-425 01 75
Fax: +32 2-425 60 32
E-Mail: info@spraying.be
Internet: www.spraying.be



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