



Spraying Systems Co.[®]
Experts in Spray Technology



Spray
Nozzles



Spray
Control



Spray
Analysis



Spray
Fabrication



FloMax[®] Air Atomizing Nozzles:

**High Efficiency Nozzles Offer Tight Control of Drop Size
and Spray Coverage, Provide Precise Performance**

For Applications Demanding Precision and Efficiency, FloMax® Nozzles Outperform all Others

If your application requires a finely atomized, controlled spray, you won't find a more effective or efficient solution than our high-efficiency FloMax air atomizing nozzles.

FloMax nozzles are not traditional air atomizing nozzles. Using patented multi-stage atomization processes, FloMax nozzles produce very small drops with exceptional efficiency. Compressed air and energy consumption are low. The nozzles also offer significantly higher turndown ratios than standard air atomizing nozzles for maximum operating flexibility.

There are many other FloMax nozzle features that result in better spray performance and lower operating costs than competitive nozzles. In the sections that follow, you'll find more detailed information on the FloMax A Series and the smaller capacity FloMax X Series and how these nozzles can help you optimize the performance of your spray system.

Typical applications and industries

FloMax A Series:

- Gas cooling and conditioning
 - Cooling prior to baghouse, ESP, heat exchanger, kilns
 - Cooling towers
 - Induct cooling
 - NOx control
 - SO₂ removal

Small capacity FloMax X Series:

- Gas cooling and conditioning
 - Induct cooling
 - NOx control
- Chemical injection

Industries:

- Aluminum
- Cement
- Chemical
- Lime
- Petrochemical
- Power generation
- Pulp and paper
- Refinery
- Steel
- Waste incineration

Overview of the FloMax air atomizing nozzle line

FloMax A Series	FloMax X Series	Options
FM5A: 0.7 to 7.0 gpm (2.6 to 26.5 l/min) 55° spray angle standard, 20° spray angle optional	FMX015: 0.03 to 0.25 gpm (0.11 to 0.94 l/min) 20° spray angle	Standard and custom spray lances available in a wide range of materials and configurations. Compatible with AutoJet® Gas Conditioning System for a fully automated, turnkey solution. Pre-assembled Valve Regulation Packages to save engineering and installation time.
FM10A: 1.3 to 13.0 gpm (4.9 to 49.2 l/min) 55° spray angle standard, 20° spray angle optional	FMX030: 0.05 to 0.5 gpm (0.19 to 1.89 l/min) 20° spray angle	
FM25A: 10.0 to 30.0 gpm (37.8 to 114 l/min) 55° spray angle standard, 20° spray angle optional	FMX090: 0.5 to 1.5 gpm (1.89 to 5.67 l/min) 20° and 55° spray angles	



If your application involves gas conditioning, consider our automated AutoJet®

Gas Conditioning System

The performance of FloMax® air atomizing nozzles can be maximized and total system automation achieved with the AutoJet Gas Conditioning System. The system uses the AutoJet Spray Controller, with patent-pending SprayLogic® firmware and software, to monitor and automatically adjust 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.

All system components – nozzles, pumps, sensors and other hydraulic and pneumatic devices – are controlled by the AutoJet Spray Controller. If a problem is detected the controller can't resolve automatically, operator warnings will be displayed or sounded.

Other key features include:

- Multiple lance zones can be configured to allow greater turndown of flow rate under variable system conditions.
- Variable Frequency Drive (VFD) pumps provide proportional liquid regulation and significant electricity savings.
- Energy-efficient proportional air regulation reduces air consumption and operating costs.
- The AutoJet Spray Controller is easy to use and is equipped with complete spray "knowledge" for easy configuration.
- Operates independently or can be integrated with other plant control systems.



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 l/min). This drop size cannot be achieved with a single-step atomization process. A multi-stage process is required.

FloMax nozzles use a patented three-stage atomization principle to produce a highly 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 l/min)}. 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 uniformity of drop size distribution produced by FloMax A Series nozzles ensures precise, tight control of drop size. This is another unique attribute – FloMax nozzles provide a narrower Relative Span Factor (RSF) than many other air atomizing nozzles at most air pressures.

See page 7 for more information on drop size and performance data.

FLOMAX A SERIES: PRINCIPLE OF OPERATION

1. Stage One: Primary Fluid Breakup

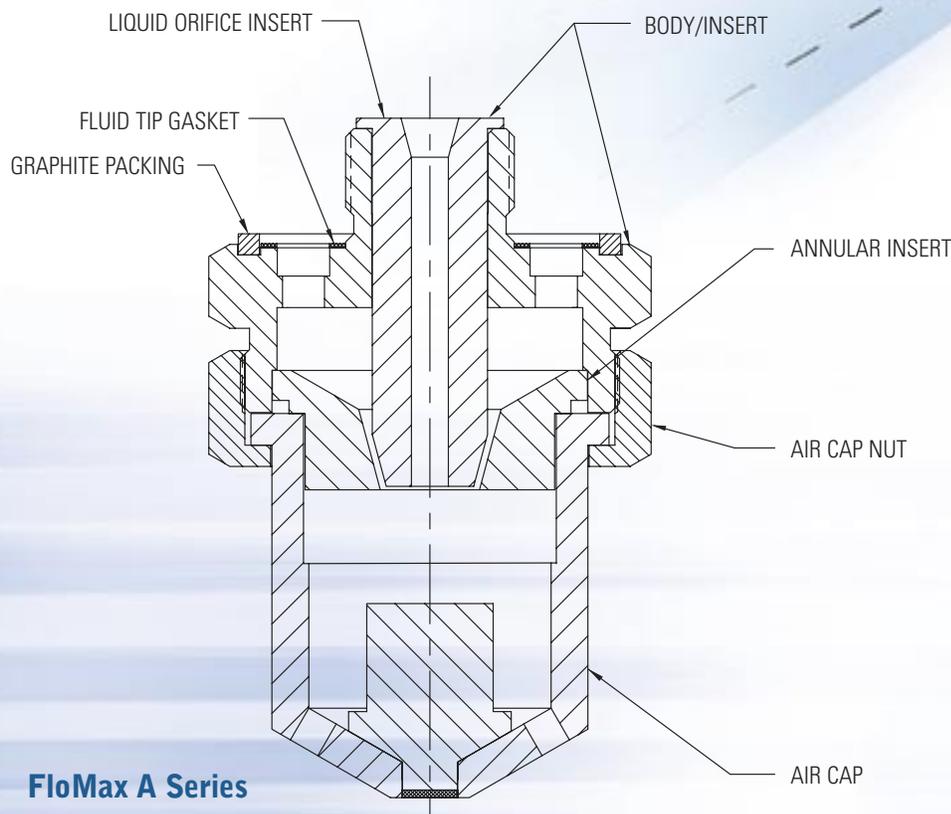
Air and liquid converge at the annulus allowing high velocity air to shear the liquid column.

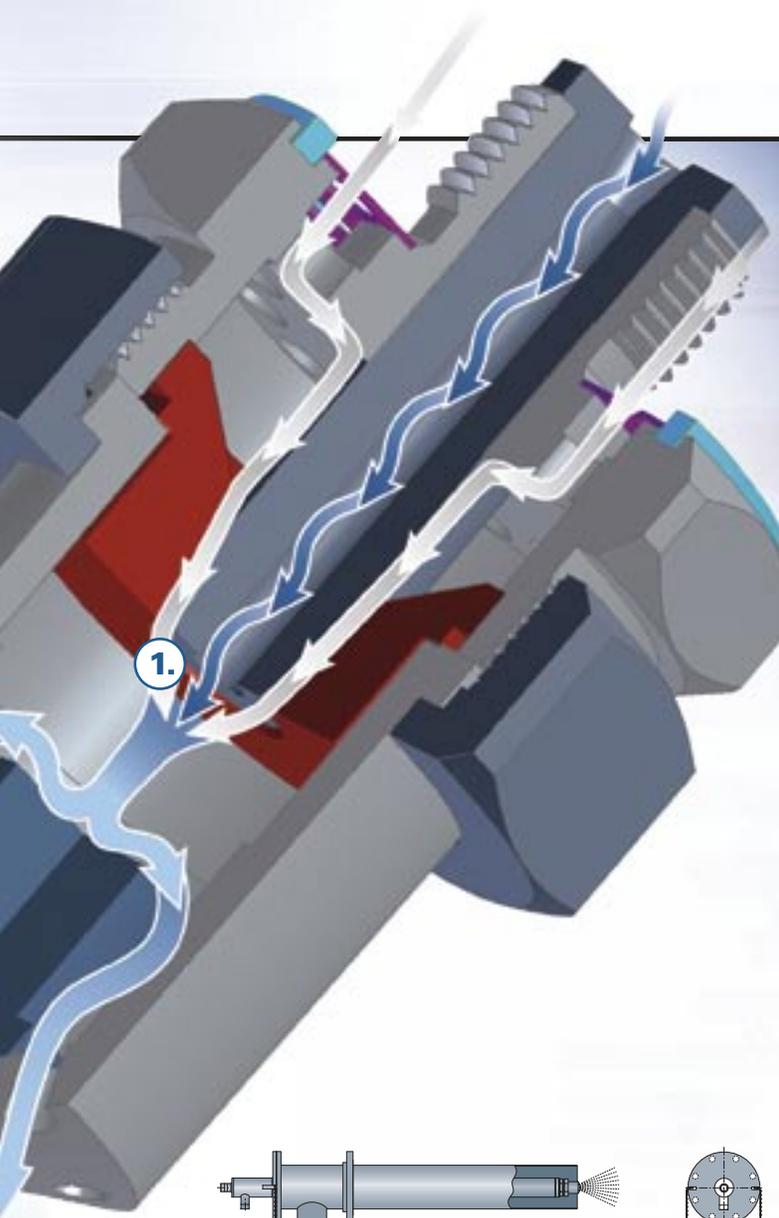
2. Stage Two: Secondary Fluid Breakup

Focused stream impacts the target bolt forcing additional mechanical breakup.

3. Stage Three: Final Mixing

Air cap acts as a final mixing chamber. As liquid crosses multiple orifices, an additional pressure drop provides the final atomization.





Six Additional Benefits FloMax® A Series Nozzles Offer

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, resulting in lower initial costs and less maintenance time on an on-going basis.

Maximum flexibility because of high turndown ratios.

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

Effective even in harsh environments.

A wide choice of materials ensures optimal nozzle performance even in high-temperature and corrosive applications. Typical materials include 316 and 310 Stainless Steel, HASTELLOY®, Stellite® and reaction-bonded silicon carbide. Others are available upon request.

Use lower quality water sources.

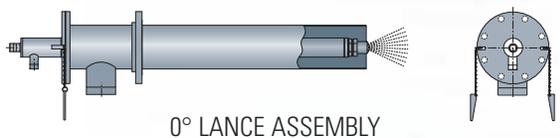
FloMax A Series nozzles feature large free passage. This means the risk of clogging is reduced, and lower cost water supplies such as river water, basins and run-off water can be used with confidence.

Reduced maintenance time.

Durable, long-wearing parts require little maintenance. But when maintenance is required, it 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 more frequent replacement because of smaller free passages and the use of higher air and liquid pressures.

Many mounting options and easy installation.

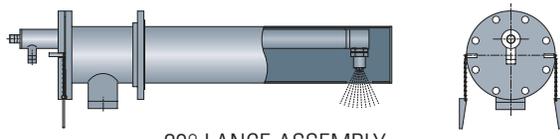
0°, 45° and 90° lightweight lances are available in standard materials with quick-release or bolt-on flanges and with quick delivery. Adapters, cooling jackets, purge tubes and protective tubes can be added. Custom lances in a wide range of materials and configurations for challenging spaces are also available.



0° LANCE ASSEMBLY



45° LANCE ASSEMBLY



90° LANCE ASSEMBLY



90° LANCE ASSEMBLY

FloMax® X Series Nozzles Offer Similar Benefits to the A Series and Outperform all Other Small Capacity Nozzles

A new multi-stage cross-hole nozzle design provides superior atomization by shearing the liquid prior to mixing with the high velocity air stream. This unique atomization process yields small drops at lower operating pressures than other nozzles. The result is tight drop size control, lower consumption of compressed air and/or use of a smaller compressor and longer compressor life.

FloMax X Series nozzles have a liquid turndown ratio of up to 10:1. This allows the air pressure to be constant while the liquid varies based on process requirements. The 10:1 turndown ratio far surpasses conventional air atomizing nozzles with ratios of 2:1 or 3:1. The wide operating range of the FloMax X Series adds significant flexibility during operation without compromising performance.

The narrow 20° spray angle is ideal for applications where tight control of drop size and spray precision is critical. 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.

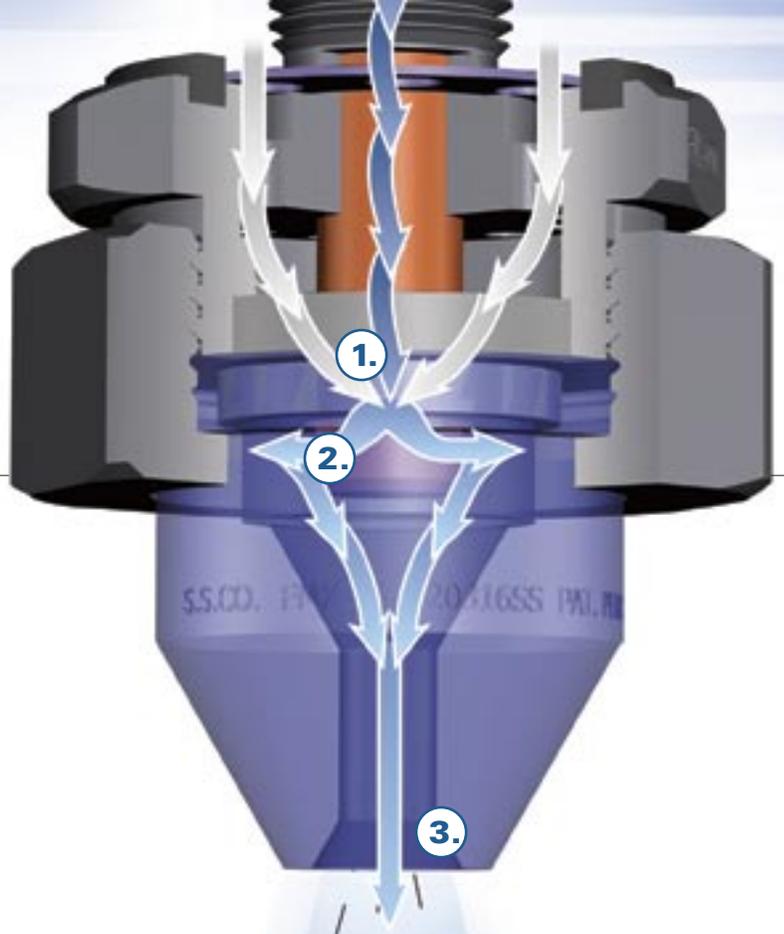
A 55° spray angle is also available for applications requiring more spray coverage.

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.

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

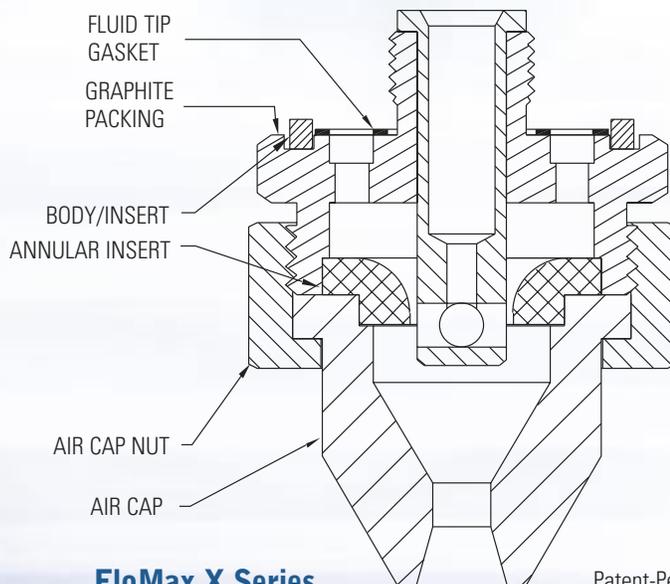
- Large free passage to minimize clogging.
- A choice of mounting options and easy installation.

See page 7 for more information on drop size and performance data.



FLOMAX X SERIES: PRINCIPLE OF OPERATION

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



FloMax X Series

Patent-Pending

A Discussion about Drop Size

Drop size is critical when it comes to air atomizing applications that require precise performance. Drops not properly sized can cause wetting, incomplete reactions, ineffective cooling and more.

Each spray consists of a range of drop sizes and is referred to as drop size distribution. Drop size distribution is dependent on the nozzle type and will vary significantly from one type to another. Other factors such as liquid properties, nozzle capacity, spraying pressure and spray angle also affect drop size.

Understanding drop size is important, as is understanding drop size testing procedures. Measurement techniques, analyzer type and sampling, data analysis and reporting techniques vary significantly. It can be difficult to compare data from various manufacturers because of these differences.

Drop size guidelines:

- Data should adhere to ASTM® Standard E799. It requires D_{max} to make up as much as 1% of the volume.

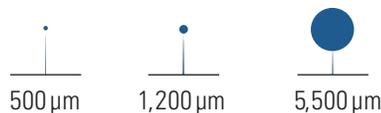
- The measurement device should use a high power laser to offset obscuration caused by high density sprays and ensure drop size and velocity data is collected for every drop in the spray.
- Report information should be consistent with ASTM Standard E1296-93 (1.3). At a minimum, D_{32} , D_{max} and D_{min} should be provided.
- The best method to determine drop size is to conduct specialized testing that simulates your environment. When that is not possible, be sure the drop size data you obtain is based on actual testing.
- *An Engineer's Practical Guide to Drop Size* is an educational handbook that takes an in-depth look at drop size measurement. It is available free of charge at www.spray.com and is filled with valuable information to help you interpret drop size data.

Performance data for the FloMax® X Series and FloMax A Series is also available at www.spray.com. See FloMax Data Pack, TM409. (See TM409M for metric data.)

Actual Drop Sizes

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

μm = micrometers



Drop Size Dictionary

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 is expressed in micrometers (μm)

One inch = 25,400 μm

One millimeter = 1,000 μm

D_{max} : This is the maximum drop size by volume present in the spray. The diameter is also used when complete evaporation of the spray is required.

D_{32} : Sauter Mean Diameter (SMD): This expresses the fineness of a spray in terms of the surface area produced by the spray. The SMD 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.

$D_{V0.9}$: This is the value where 90% of the total volume of liquid sprayed is made up of drops with diameters smaller or equal to this value.

Relative Span Factor (RSF) is a single number indicative of the uniformity of the drop size distribution. The closer the number is to 1, the more uniform the spray will be.

Single-source solution for nozzles and lances

Working with a single source for your spray nozzles and lances can save you time, eliminate integration and coordination problems and assure quality spray performance. If one of our standard lances doesn't meet your requirements, we can design and manufacture a spray lance that will – even if you have demanding environments and challenging physical spaces. Recent projects include insulated lances, water- and steam-jacketed lances, retractable lances, recirculation lances, desuperheating lances and long kiln lances with multiple nozzles.

For more information, visit www.spray.com/lance to download Bulletin 579.

Pre-assembled valve package includes all components for operation and regulation

Our Valve Regulation Package (VRP) eliminates performance problems by ensuring properly sized valves, piping, regulators, flowmeters and gauges are used. All

components are sized with the assistance of your sales engineer and then strategically placed on the rack based on the capacity of the spray nozzles. In addition to better performance, you can eliminate engineering time as well as sourcing, purchasing and installing components separately. Plus, an optional hose kit makes connecting the VRP to the lance assembly easy and fast.

Spray Analysis and Research Services can help identify the best nozzle for your application

Spray Analysis and Research Services, a service of Spraying Systems Co., offers research, testing, consulting and prototyping services to help optimize spray performance. In our fully equipped spray laboratories, we can simulate your operating environment and conduct a wide variety of tests to determine actual FloMax nozzle performance in your plant prior to installation. For more information, visit www.sprayconsultants.com.

Additional Resources

Gas Cooling and Conditioning Guide

Bulletin 540

12-page bulletin describes how using spray technology can improve efficiency and performance in gas cooling and conditioning applications.

Gas Cooling and Conditioning in Cement Manufacturing

Bulletin 556

16-page bulletin covers air atomizing and hydraulic spray nozzle options as well as automated system options for effective and efficient gas cooling in the manufacture of cement.

Improving Process and Product Quality in Chemical Production through Spray Technology

Bulletin 568

12-page bulletin discusses the use of spray technology in cooling, coating, cleaning, chemical injection and other CPI applications.

Optimizing System Performance with Precision Spray Control

Bulletin AT103

Eight-page bulletin provides an overview of the benefits of automated spray systems and includes application examples that show how to reduce overspray, improve product quality, increase throughput and more.



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