



OPTIMIZING PERFORMANCE IN SPRAY OPERATIONS

CONFIRM THAT YOU ARE USING THE BEST NOZZLES AVAILABLE FOR YOUR OPERATION

The nozzle is the heart of your spray operation. They are precision-engineered components designed to deliver very specific performance. Choosing the correct nozzles for your operation is critical, so it is important to understand the differences between various types.

The descriptions and images below provide an overview of the attributes and typical applications for the different types of nozzles. The images on right side of the page are spray pattern images taken in our spray laboratory using laser sheet imaging. The light intensity in the spray is directly proportional to the volume of liquid. Red indicates the highest light intensity, which corresponds to the heaviest volume in the spray. Black is the lowest or no light intensity.

FULL CONE NOZZLES

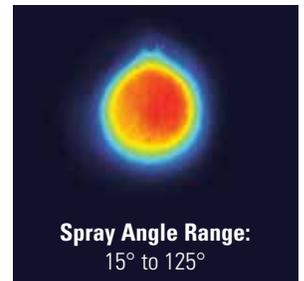


- Solid cone-shaped spray pattern
- Medium to large drops

Typical applications:

- Chemical injection
- Cooling
- Dust suppression
- Fire protection
- Rinsing
- Washing

LASER SHEET IMAGE



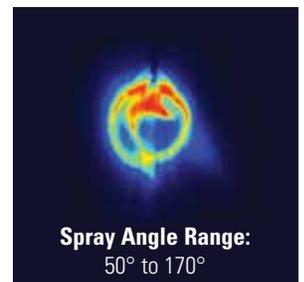
FULL CONE (SPIRAL-TYPE)



- Solid cone-shaped spray pattern
- Coarse drops
- Coverage not as uniform as conventional nozzle with an internal vane type

Typical applications:

- Air and gas cooling
- Dust suppression
- Fire protection
- Quenching



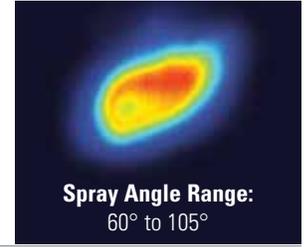


FULL CONE (OVAL-TYPE)

- Solid cone-shaped spray pattern with oval impact area with a width approximately one-half its length
- Medium to large drops

Typical applications:

- Air and gas cooling
- Dust suppression
- Fire protection
- Quenching

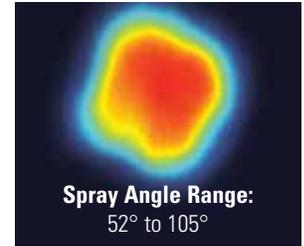


FULL CONE (SQUARE-TYPE)

- Solid cone-shaped spray pattern with square impact area
- Medium to large drops

Typical applications:

- Air and gas cooling
- Dust suppression
- Fire protection
- Quenching

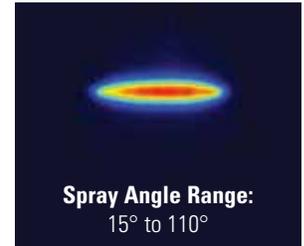


FLAT SPRAY (TAPERED)

- Thin, tapered-edge rectangular spray pattern
- Medium drops
- Higher impact spray than other flat sprays

Typical applications:

- Descaling
- High-pressure washing
- Label removal

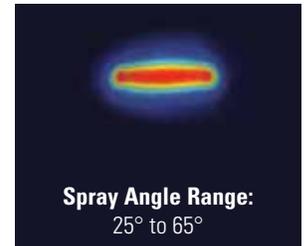


FLAT SPRAY (EVEN)

- Thin, rectangular spray pattern
- Medium to large drops
- Typically used on a spray header for edge-to-edge pattern contact

Typical applications:

- Coating
- Cooling
- Moisturizing
- Washing



FLAT SPRAY (DEFLECTED-TYPE)

- Thin, even rectangular spray pattern
- Small to large drops
- Large free passage design reduces clogging
- Narrow spray angles provide higher impact; wide-angle versions provide lower impact

Typical applications:

- Cleaning
- Washing



SOLID STREAM

- Solid stream nozzles provide the highest impact per unit area
- Medium to large drops

Typical applications:

- Cleaning products when complete removal of dirt and debris is required
- Decorative spray ponds
- Laminar flow operations



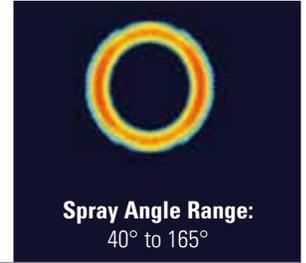
HOLLOW CONE (WHIRLCHAMBER-TYPE)



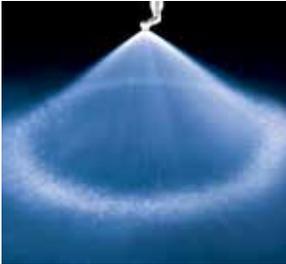
- Circular spray pattern
- Medium to large drops
- Good interface between air and drop surfaces

Typical applications:

- Cooling air and gas
- Cooling products
- Dust suppression
- Water aeration



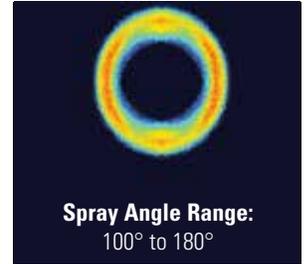
HOLLOW CONE (DEFLECTED-TYPE)



- Utilizes a deflector cap to form an umbrella-shaped hollow cone pattern
- Medium to large drops
- Good interface between air and drop surfaces

Typical applications:

- Decorative sprays
- Dust suppression
- Fire protection
- Flush cleaning tube/pipe interiors
- Water curtain



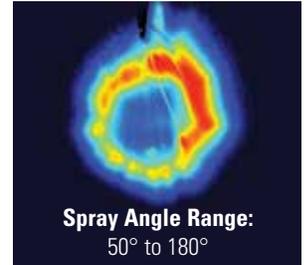
HOLLOW CONE (SPIRAL-TYPE)



- Circular spray pattern
- Coarse drops (slightly more coarse than other hollow cone nozzles)
- High flow rate in a compact nozzle size
- One-piece design features maximum throughput for a given pipe size

Typical applications:

- Cooling air and gas
- Dust suppression
- Evaporative cooling



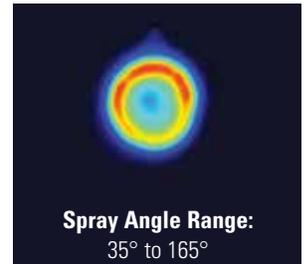
ATOMIZING/FOGGING/FINE SPRAY



- Hollow cone spray pattern
- Small drops
- Hydraulic, finely atomized, low capacity spray

Typical applications:

- Evaporative cooling
- Misting
- Moisturizing
- Spray drying



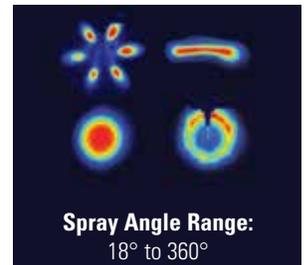
SPRAY PATTERNS – AIR ATOMIZING NOZZLES



- Wide variety of patterns: round, wide-angle round, 360° circular, deflected flat spray and flat spray
- Very small to small drops – use of compressed air increases atomization

Typical applications:

- Coating
- Cooling
- Evaporative cooling
- Humidification
- Moistening





EVALUATE NEW TECHNOLOGY AND NEW SERVICES

Even if your spray application hasn't changed and you aren't experiencing problems, you should evaluate new products periodically. Advancements in spray technology may have resulted in new nozzle designs that offer more precision, better efficiency and longer wear life.

RECENT ADVANCMENTS IN SPRAY NOZZLE TECHNOLOGY

- Alternate nozzle materials to extend wear life
- Quick-connect styles to reduce maintenance time
- Clog-resistant designs to minimize performance problems and unscheduled downtime
- Anti-bearding nozzle designs – In some air atomizing applications, fine spray droplets are drawn to the air cap, where they can dry and block the nozzle's orifices. This "bearding" phenomenon is a leading cause of poor spray distribution and clogging. New designs prevent bearding and can dramatically reduce downtime for cleaning.

EVALUATE AND VALIDATE PERFORMANCE

In some applications, it makes sense to invest in performance testing or computer modeling because of the critical nature of the spray operation. Even very slight changes to nozzle placement, position, spray direction and other characteristics can make a big difference. In applications like spray drying, tablet coating, gas cooling and descaling steel, factors such as drop size, evaporation rate and impact can be the difference between application success and failure. In some cases, operating conditions can be simulated in a laboratory environment using specialized equipment so performance testing can be conducted. In other cases, replicating operating conditions isn't possible, so advanced modeling tools are required.

EQUIPMENT USED IN SPRAY CHARACTERIZATION IN A LAB ENVIRONMENT

- Spray nozzle patternators to measure liquid distribution
- Laser diffraction equipment for measuring drop size of small capacity air atomizing and fine spray nozzles
- Devices which measure impact variations throughout the spray pattern
- Wind tunnels to test spray evaporation and spray performance in conditions that simulate a gas stream
- Air and liquid flow instrumentation for metering flow and pressure
- Phase Doppler Particle Analyzers for complete drop size evaluation, particularly where spray velocities are required
- Laser imaging analyzers for measuring drop size of large capacity nozzles and dense/opaque sprays

TYPICAL ADVANCED MODELING TOOLS

Modeling is most commonly used to evaluate liquid and gas flow in scrubbers and ducts, internal flow characteristics in spray equipment, the impact of the spray patterns on vessel walls and more.

Computational Fluid Dynamics (CFD) is the science of predicting fluid flow, heat transfer, mass transfer and chemical reactions. Numerical methods and algorithms are used to 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. 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.

Fluid Structure Interaction (FSI) also uses numerical methods and algorithms, but it examines the interaction between fluid dynamics and structural integrity. Fluid dynamics studies simulate all aspects of spray performance based on pre-determined operating conditions.

Structural integrity modeling uses Finite Element Methods (FEM) to evaluate mechanical stresses on fabricated components. These studies are typically used to validate the design of spray equipment in challenging environments and optimize performance.



IF SPRAY PERFORMANCE IS CRITICAL IN YOUR OPERATION, ask your spray equipment manufacturer to evaluate if testing or modeling could help with spray system optimization.



CONSIDER THE VALUE OF SPRAY CONTROL

Automated spray control may improve the efficiency of your operation and add precision to many operations. Spray control options range from very simple systems that provide on/off control and automatic air and liquid control to sophisticated systems that provide real-time monitoring of spray performance and automatic adjustments.

AUTOMATING YOUR SPRAY SYSTEM CAN RESULT IN PRODUCTIVITY GAINS, QUALITY IMPROVEMENTS AND OPERATING COST REDUCTIONS

Spray control isn't needed in every spray operation. For example, adding spray control to a simple cooling or washing operation may have limited value. But in other operations like coating, lubricating, moisturizing and humidifying, the added expense of spray control can be offset very quickly by increased production, reduced scrap rate or decreased operating costs.

If your operation requires any of the following, the value of spray control is likely to be quite high:

- Consistent, uniform coverage of the target
- Precise spray placement on the target
- Intermittent spraying
- The use of costly coatings or chemicals
- Flexibility – the ability to adjust spray performance based on line speed, temperature, humidity or product changes
- Monitoring and supervision to ensure proper spray performance
- Frequent maintenance

PRECISION SPRAY CONTROL

In many operations, applying coatings uniformly is difficult especially when operating conditions change. Precision spray control has proven to be an effective way to ensure uniform application of coatings such as oils, lubricants and flavorings. Precision spray control is achieved by turning electrically-actuated spray nozzles on and off very quickly to control flow rate. This cycling is so fast that the flow often appears to be constant.

In the past, flow rate was typically controlled by adjusting pressure. However, adjusting pressure can result in dramatic changes to the spray angle and drop size. With precision spray control, flow rate from a single nozzle can be varied without changing pressure. Spray angle and drop size remain unchanged and uniform application of coatings is ensured.

FOR MORE INFORMATION ON
PRECISION SPRAY CONTROL

[CLICK HERE >](#)



Spray control can result in significant, measurable results.

Here are just two examples:

CASE 1: POOR SPRAY PERFORMANCE RESULTED IN MONTHLY REWORK OF 80,000 POUNDS (36,287 KG) OF ALUMINUM STRIP

Inconsistent application of oil on aluminum strip resulted in a high rejection rate of finished coils. Spray system optimization involved adding a spray controller and changing the nozzle type, to ensure that oil is applied uniformly and evenly across the full width of the strip even when line speed varies. Rework has been eliminated and other benefits experienced as well.

- Accurate application reduced oil consumption by 40% – a significant cost savings and beneficial to the environment
- The elimination of excess oil in the production area resulted in shorter maintenance times
- Production time has increased since strip rework is no longer required
- System payback was fast – less than four months

CASE 2: OVER-APPLICATION OF RELEASE AGENT BY SPRAY SYSTEM COSTS CHEMICAL PRODUCER US\$50,000 (€37,500) ANNUALLY

An expensive release agent was being applied to a conveyor belt to prevent products from sticking. The inability to control flow based on line speed resulted in a messy and unsafe work environment which required frequent maintenance. Spray system optimization included adding a spray controller and yielded dramatic results.

- Reduced release agent use and elimination of contract cleaning services save the processor US\$50,000 (€37,500) annually
- The new spray equipment paid for itself in less than two months

You'll find dozens of case studies that demonstrate the tangible results provided by spray control at spray.com/results.

FOR MORE INFORMATION ON OPTIMIZING PERFORMANCE IN SPRAY OPERATIONS:

DOWNLOAD OR REQUEST
OPTIMIZING YOUR SPRAY SYSTEM,
TECHNICAL MANUAL 410B.



REQUEST AN ON-SITE EVALUATION

The best way to determine the potential benefits of spray control is to request an on-site evaluation from a spray technology expert. Every spray operation is different and having an expert assess your application and help you estimate the equipment payback is the most expedient and accurate approach. The leading spray technology suppliers typically do not charge for on-site evaluations.





Spraying Systems Co.
Experts in Spray Technology

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