WaterSense® Public Meeting

Draft Specification for Spray Sprinkler Nozzles

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ERG

December 12, 2023

Housekeeping

- All attendees are muted to minimize background noise.
- Please type questions into the Zoom chat. We will have a dedicated time for Q&A at the end of each section and at the end of the presentation as time allows.
- If you experience technical difficulties, please email kyra.hall@erg.com.
- This PowerPoint presentation will be posted on the public website following the call.
- Submit written comments to: watersense-products@erg.com
- This meeting is meant to be an open discussion. All questions, comments, and concerns are welcome!

Poll

What type of organization do you work for? (single answer)

- Manufacturer
- NGO, institution, or trade association
- Retailer/distributor
- Service provider (e.g., builder) or other
- Utility/state or local government
- Other

Meeting Purpose

At this meeting, we will:

- Review the draft specification
- Answer questions about the material so that interested parties can provide more precise comments
- Explain WaterSense's specification development process and next steps

Generally, we do not:

- Provide resolution to comments or concerns
- Agree on specifics of a specification such as scope, criteria, or test methods
- Guarantee that WaterSense will develop a final specification or provide a timeline for its completion

Agenda

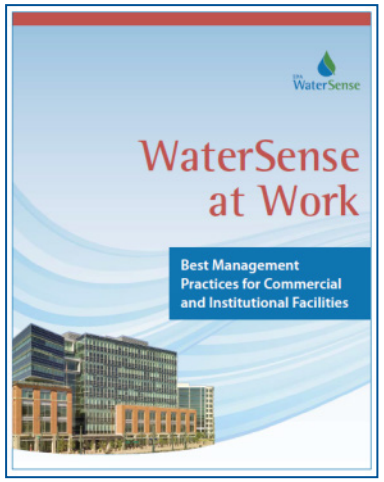
- Introduction to WaterSense
- Spray Sprinkler Nozzles Background
  - Estimated Water Savings
- Specification
  - Scope
  - General Requirements
  - Water Efficiency and Performance Criteria
  - Product Marking, Documentation, and Marketing
- Partnership, Certification, and Product Listing
- Next Steps

Introduction to WaterSense

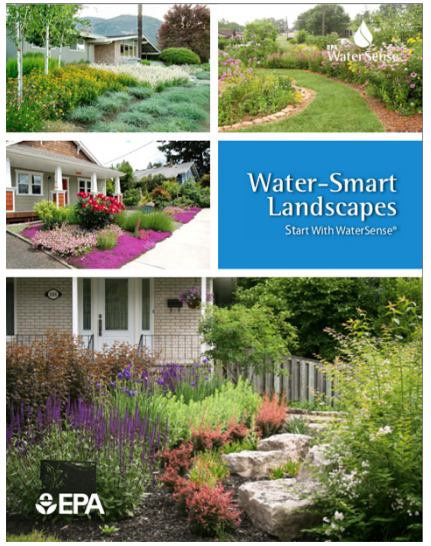
What Is WaterSense?

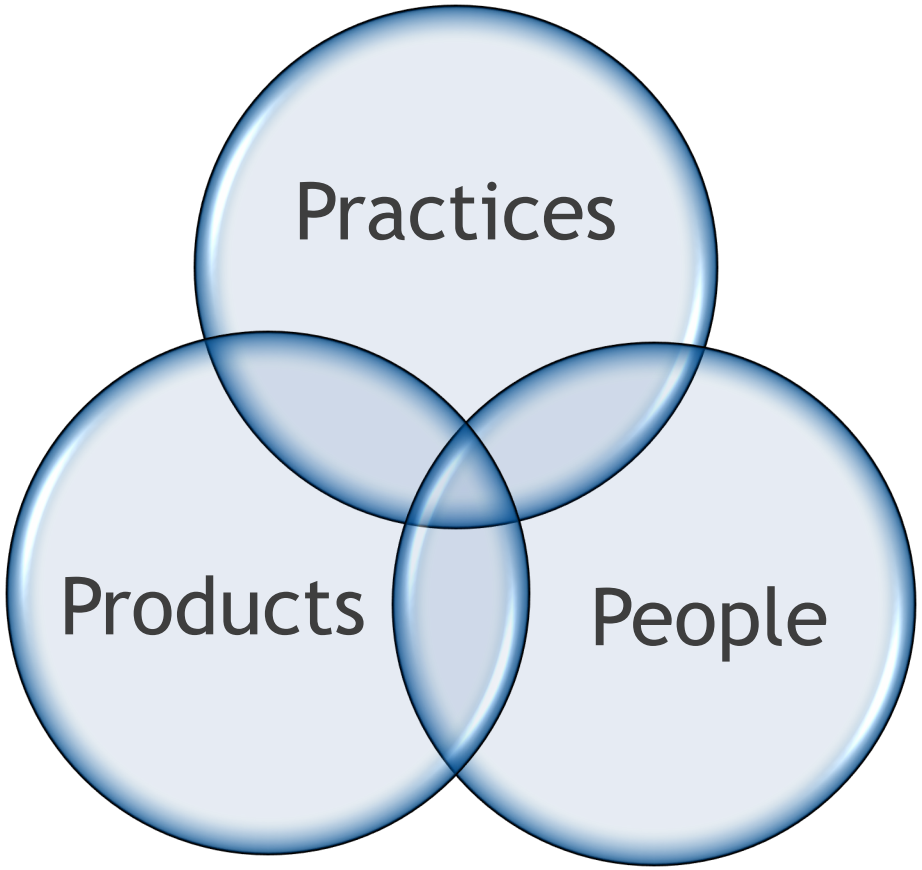
- WaterSense is a voluntary partnership program launched by EPA in 2006 that provides a simple way to identify water-efficient:
  - Products
  - Programs
  - Practices
  - Homes
- Products are independently certified for water efficiency **and** performance

WaterSense Program Overview



Actions can be taken to reduce water use—at home, outdoors, and at work





Fixtures and technologies save water

Partners reach users to change behavior

WaterSense Labeled Products

Lavatory Faucets
Labeled since 2007
20,550 labeled models

Weather-Based Irrigation Controllers
Labeled since 2011
990 labeled models

Tank-Type Toilets
Labeled since 2007
5,280 labeled models

Flushometer-Valve Toilets
Labeled since 2015
1,640 labeled models

Flushing Urinals
Labeled since 2009
800 labeled models

Spray Sprinkler Bodies
Labeled since 2017
630 labeled models

Showerheads
Labeled since 2010
14,440 labeled models

Soil Moisture-Based Irrigation Controllers
Labeled since 2021
4 labeled models

Data as of November 2023

What's Special About WaterSense?

A label with integrity

- Third parties independently certify that products and homes meet EPA criteria
- Backed by the credibility of EPA

Simple to understand

- Label tells consumer that a product is more efficient
- Manufacturers can compete on degree of efficiency or other features

Smart use of resources

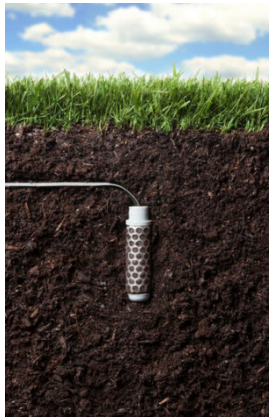
- EPA provides national standardization and outreach for water efficiency
- Manufacturers absorb product research, testing, and branding costs
- Licensed certifying bodies certify the products and police the label
- EPA, manufacturers, retailers, and other partners help market/incentivize purchase of labeled products

WaterSense Outdoor Programs

WaterSense Labeled Outdoor Products

Weather-based irrigation controllers use local weather and landscape conditions to tailor watering schedules to actual conditions on the site, instead of irrigating using a controller with a clock and a preset schedule.

www.epa.gov/watersense/irrigation-controllers



Soil moisture-based irrigation controllers can detect the amount of moisture in the ground beneath the landscape and override scheduled irrigation when plants don't need water, reducing water waste and promoting plant health.

www.epa.gov/watersense/soil-moisture-based-irrigation-controllers

Spray sprinkler bodies with integral pressure regulation can reduce water waste by providing a constant flow at the sprinkler nozzle regardless of incoming pressure.

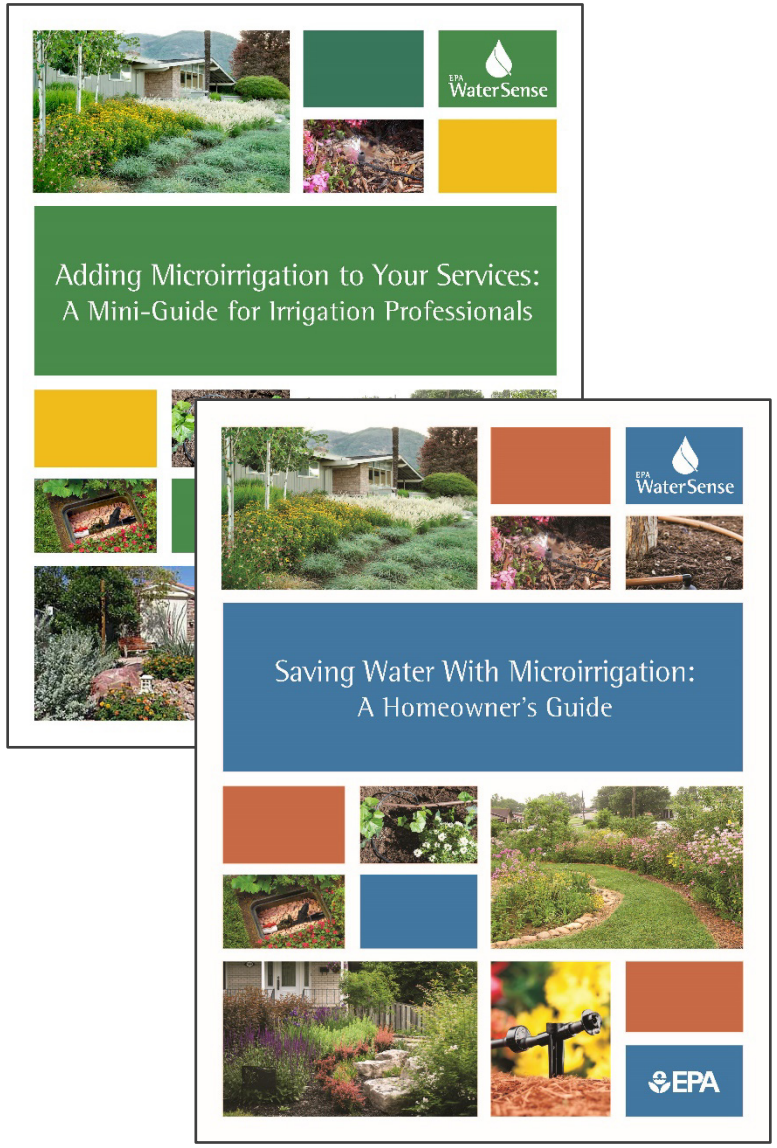
www.epa.gov/watersense/spray-sprinkler-bodies

Professional Certification Programs

- Three specifications for professional certification programs covering
  - Irrigation system designers
  - Irrigation system auditors
  - Irrigation system installation and maintenance professionals
- Programs range from local to national:
  - Auditor: 6 (plus 20 that have adopted QWEL)
  - Installation and maintenance: 1
  - Design: 1
- Over 3,500 irrigation professionals certified by a WaterSense labeled program

www.epa.gov/watersense/professional-certification

Beyond Labeling



Background on Specification Development

Specification Development Process

Product Research
- Evaluates product differentiation in the marketplace, availability of performance standards/specifications, water, energy, and cost savings potential, stakeholder support

Notice of Intent
- Identifies a potential path forward and outstanding data gaps and research needs
- Invites participation and requests feedback/data from stakeholders

We are here

Draft Spec
- Invites public comment on proposed water efficiency and performance criteria for products that will be eligible for the WaterSense label

Final Spec
- Provides final water efficiency and performance criteria for eligible WaterSense labeled products
- Establishes third-party infrastructure for certifying products

Spray Sprinkler Nozzles Background

Spray Sprinkler Nozzles Background

- In 2014, EPA released its *WaterSense Notice of Intent (NOI) to Develop a Draft Specification for Landscape Irrigation Sprinklers*, which considered specification development for both spray sprinkler bodies and nozzles.
- Based on feedback received on the NOI indicating a lack of real-world water savings data and concerns about nozzle performance criteria, EPA only proceeded with specification development for spray sprinkler bodies at that time.
- The *WaterSense Specification for Spray Sprinkler Bodies* was released in September 2017.

Spray Sprinkler Nozzles Background

- EPA renewed its interest in specification development for spray sprinkler nozzles based on the following developments:
  - Recent water savings studies have indicated that certain types of spray sprinkler nozzles can result in reduced water use.
  - Many water utilities offer rebate programs for this product and are interested in more easily identifying spray sprinkler nozzle models that save water compared to standard nozzles.
  - Many manufacturers currently market some models of spray sprinkler nozzles as water-efficient or higher efficiency.
  - Dr. Michael Dukes of the University of Florida has tested nozzles to differentiate various models on the market.

Estimated Water Savings

- Researchers have published several studies demonstrating real-world water savings associated with several sprinkler nozzles on the market.
- Based on these studies, EPA estimates these sprinkler nozzle models have the potential to use approximately 10 percent less water than standard spray sprinkler nozzles.
  - This estimate is a weighted average based on the number of landscapes in the savings studies that WaterSense reviewed.
  - The weighted average was heavily influenced by one study that had the largest number of landscapes. Many other studies reported water savings close to, or exceeding, 20 percent. WaterSense has developed specifications for other irrigation products with estimated water savings below 20 percent that may still have national applicability and potential for significant water savings.

Estimated Water Savings

- Assuming 10 percent savings, the average household with an in-ground irrigation system could save more than 2,400 gallons of water annually by replacing standard spray nozzles with WaterSense labeled sprinkler nozzles.
  - Assumptions:
    - Average annual household outdoor water use of 50,500 gallons.
    - Conservatively, 50 percent of outdoor water use is attributable to spray irrigation.
  - If the assumption of 50 percent water use for spray irrigation is low, homes would likely experience greater savings from installing WaterSense labeled sprinkler nozzles as a retrofit.

Questions and Discussion

Questions on Spray Sprinkler Nozzle Background?

WaterSense Draft Specification

Draft Specification: Scope

- A spray sprinkler nozzle is a component of a sprinkler used for landscape irrigation. It is provided in combination with a sprinkler body to distribute water to the landscape.
- The scope of the specification includes nozzles intended for use in spray sprinklers.
- The product category only applies to sprinkler nozzles that connect to spray sprinkler bodies, which do **not** have components that drive rotation.

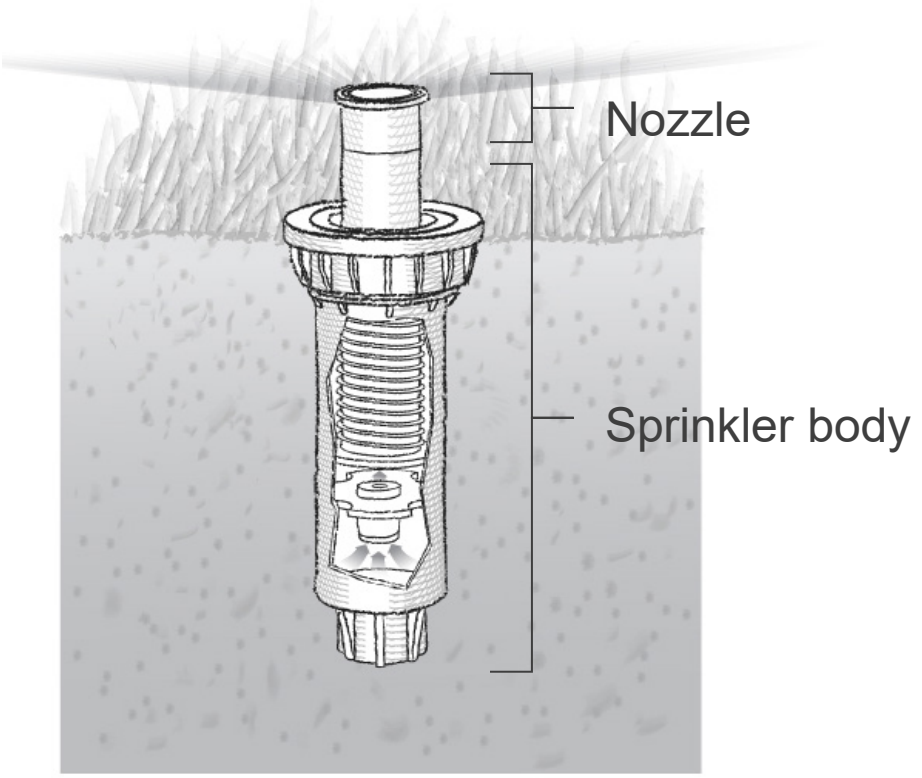


Image courtesy of Irrigation Association, Smart Water Application Technologies.

Draft Specification: Scope

- ASABE/ICC 802 includes the following definitions:
  - **Sprinkler:** An emission device consisting of a sprinkler body with one or more orifices to convert irrigation water pressure to high-velocity water discharge through the air, discharging a minimum of 0.5 gallons per minute (gpm) at the largest area of coverage available for the nozzle series when operated at 30 pounds per square inch (psi) or more with a full-circle pattern.
  - **Sprinkler body:** The exterior case or shell of a sprinkler incorporating a means of connection to the piping system, designed to convey water to a nozzle or orifice.
  - **Nozzle:** The discharge opening of a sprinkler used to control the volume of discharge, distribution pattern and droplet size.

Draft Specification: Scope

- ASABE/ICC 802 includes the following definitions regarding sprinkler bodies:
  - **Spray sprinkler body:** A sprinkler body that does not contain components to drive the rotation of the nozzle or orifice during operation and lacks an integral control valve.
  - **Rotor sprinkler body:** A sprinkler body that contains components to drive the rotation of the nozzle or orifice during operation and lacks an integral control valve.
  - **Valve-in-head sprinkler body:** A sprinkler body that contains an integral control valve.

Draft Specification: Scope

- Because there is no definition for spray sprinkler nozzles within ASABE/ICC 802, EPA has developed the following definition based on related definitions included in the standard:
  - **Spray sprinkler nozzle:** The discharge opening of a spray sprinkler used to control the volume of discharge, distribution pattern, and droplet size. These nozzles are attached to spray sprinkler bodies that do not contain components to drive the rotation of the nozzle during operation and lack an internal control valve.

Draft Specification: Scope

- The scope excludes the following related product categories:
  - Gear-driven rotor sprinklers
  - Valve-in-head sprinklers
  - Sprinkler nozzles used exclusively in agricultural irrigation systems
  - Other irrigation emission devices, such as bubblers, hose-end water products, and microirrigation emission devices (including drip emitters, drip line emitters, and point-source emitters, as well as micro sprays)

Questions and Discussion

Questions on the Scope of the Specification?

General Requirements

Nozzles shall be tested in accordance with Section 303.1 of ASABE/ICC 802, Sprinkler and Bubbler Performance Requirements and Test Methods, General, including:

- 302.1. Rated temperature
- 302.2. Inlet connections
- 302.3. Filters and strainers
- 302.4. Servicing
- 302.5. Adjustments

Water Efficiency and Performance Criteria

3.2 Distance of throw (i.e., radius)

3.3 Application rate (also referred to as precipitation rate)

3.4 Distribution uniformity

3.5 Matched Precipitation

EPA is only requiring each test to be conducted at the recommended operating pressure.

Water Efficiency and Performance Criteria: Section 3.1 Model Selection

- EPA intends to label a nozzle series, which it defines as a group of nozzles, as indicated by the product manufacturer, with similar operating characteristics.
- For example, a nozzle series may include nozzles that have arcs of 90°, 180°, 270°, and 360° with a radius of eight feet.
- EPA intends to test nozzles that are representative of a nozzle series, as indicated by the product manufacturer.
- The intent is to test the minimum and maximum distance of throw (i.e., radius) and minimum and maximum arc (i.e., pattern) as indicated by the manufacturer, and each combination thereof, to serve as representative models of a nozzle series.

Water Efficiency and Performance Criteria: Section 3.2 Distance of Throw

- **Distance of throw** (typically presented as a radius) refers to the distance to which the sprinkler nozzle disperses water onto the surrounding landscape.
- Used to determine the appropriate spacing between sprinklers.
- EPA is including criteria for distance of throw to ensure manufacturer reported data are accurate, allowing for a greater likelihood of head-to-head coverage when sprinklers are installed in a landscape.

Water Efficiency and Performance Criteria: Section 3.2 Distance of Throw

- Nozzles shall be tested in accordance with ASABE/ICC 802 Section 303.5.4 (Distance of throw test method), with the modification that nozzles shall only be tested at their recommended operation pressure.
- Calculation: An average distance of throw across the five samples for each nozzle/nozzle setting required for a nozzle series shall be calculated.
- Criterion: The difference between the manufacturer's rated distance of throw (or distance of throw range, as applicable) and the tested average distance of throw for each nozzle model shall not exceed the maximum allowable difference shown in Table 1.

Table 1. Maximum Allowable Difference Between Tested and Rated Distance of Throw

Rated Distance of Throw (i.e., Radius)	Maximum Allowable Difference
>1.0 foot and ≤10.0 feet	1.0 foot
>10.0 feet and ≤20.0 feet	2.0 feet
>20.0 feet and ≤39.0 feet	2.5 feet
>39.0 feet	5.0 feet

Water Efficiency and Performance Criteria: Section 3.3 Application Rate

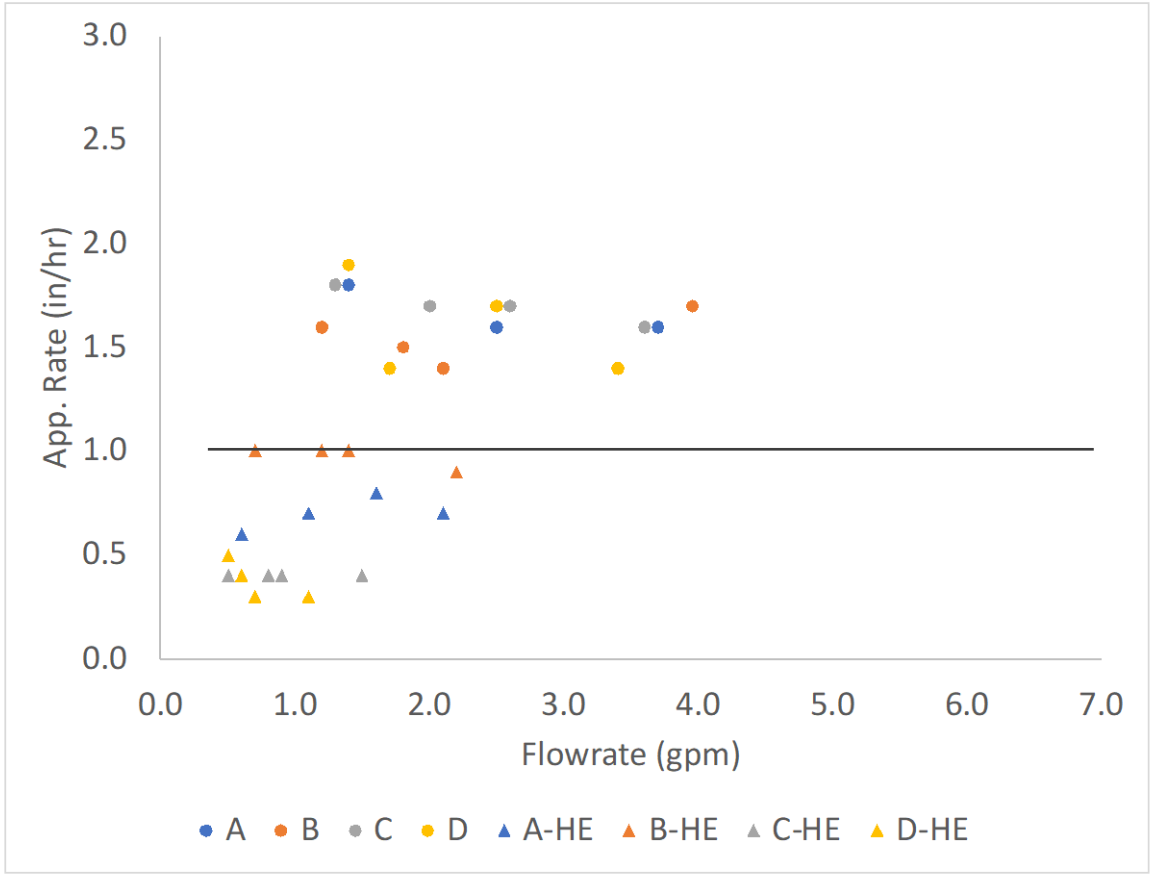
- **Application rate** (precipitation rate) is the rate at which a sprinkler applies water to a given area. As explained in ASABE/ICC 802, application rate relates to the flow rate and total irrigated area.

$$Application\ rate\ (inches\ per\ hour) = \frac{96.25\ x\ flow\ rate\ (gpm)}{total\ area\ (ft^2)}$$

  - 96.25 is a constant used to convert gallons per minute (gpm) over an area in square feet to inches per hour
  - Flow rate is the cumulative flow rate from all sprinklers in the area, measured in gpm
  - Total area is the irrigated area in square feet

Water Efficiency and Performance Criteria: Section 3.3 Application Rate

- A nozzle's application rate shall be calculated in accordance with ASABE/ICC 802 Section 303.6.1 (Application rate calculation method) at the recommended operating pressure, using the average flow rate determined according to ASABE/ICC 802 Section 303.5.3 (Flow rate test method) at the recommended operating pressure only.
- Calculation: The application rate shall be calculated for each nozzle model/nozzle setting required for a nozzle series.
- Criteria: The average application rate across the five samples shall be calculated and shall be 1.2 inches per hour (in/hr) or less.



Dukes, 2023. Sprinkler Nozzle Testing Report. Figure 14.

Water Efficiency and Performance Criteria: Section 3.4 Distribution Uniformity

- **Distribution uniformity (DU)** is a measure of how evenly water is applied to a landscaped area.
- ASABE/ICC 802 includes a uniformity test for spray sprinkler nozzles conducted on individual nozzles. Uniformity is modeled using data collected during the distance of throw test. The standard indicates that the modeled uniformity will generate a value equivalent to the lower quarter DU (DU_{LQ}).

$$DU_{LQ} = \frac{V_{LQ}}{V_{avg}}$$

  - V_{LQ} is the volume of the average of lowest quarter of samples from the array of collectors used as part of the test method for determination of application rate, and
  - V_{avg} is the average recorded volume as acquired from collectors in consistent units.

Water Efficiency and Performance Criteria: Section 3.4 Distribution Uniformity

- DU_{LQ} shall be calculated in accordance with ASABE/ICC 802 Section 303.6.2 (Uniformity modeling method) at the recommended operating pressure and with rectangular or square spacing for each nozzle model/nozzle setting required for a nozzle series.
- An average DU_{LQ} shall be calculated for each nozzle and shall be greater than or equal to 0.65 (or 65 percent).

Water Efficiency and Performance Criteria: Section 3.5 Matched Precipitation

- **Matched Precipitation**: Sprinkler nozzles can be designed to apply water at the same application rate at all arcs and radii, meaning that the application rate will be equivalent across the irrigated area.
- In uniform landscapes such as turfgrass, matched precipitation nozzles help ensure that all areas of the landscape receive approximately the same amount of water during an irrigation event.

Water Efficiency and Performance Criteria: Section 3.5 Matched Precipitation

- To ensure matched precipitation, EPA is requiring that the application rate for each tested nozzle/nozzle setting shall be at least 90 percent of the highest application rate at the recommended operating pressure for the series.
- For example, if the highest application rate for the tested nozzles/nozzle settings within a series is 1.0 in/hr, the other tested nozzles/nozzle settings must have an application rate of at least 0.9 in/hr.

Questions and Discussion

Questions on Water Efficiency and Performance Criteria?

Product Marking and Documentation Requirements

- The specification requires conformance with all applicable requirements within Sections 304.1and 304.2 of ASABE/ICC 802, which describe the general product marking requirements for sprinklers. Specifically, each nozzle in a certified nozzle series shall meet subsections:
  - 304.1.1. Units
  - 304.1.2. Location
  - 304.1.3. Manufacturer name
  - 304.1.4. Connectors
  - 304.1.5. Nozzle series marking
  - 304.1.6. Instructions
  - 304.2. Marking of sprays and rotors requirements 2, 3, 4, 5, and 7

Product Marking and Documentation Requirements

- Nozzles shall not be packaged, marked, nor provided with instructions directing the user to an operational setting that would override the nozzle's intended operating characteristics, as established by the specification, and verified through testing.
- Any instruction related to the maintenance of the nozzle shall direct the user on how to maintain the nozzle's intended operating characteristics.
- Product documentation, including online and print specification sheets and sales brochures, as applicable, shall recommend that the nozzle be used in combination with a WaterSense labeled spray sprinkler body with integral pressure regulation for optimal performance.

Questions and Discussion

Questions on Product Marking and Documentation Requirements?

Partnership and Product Certification

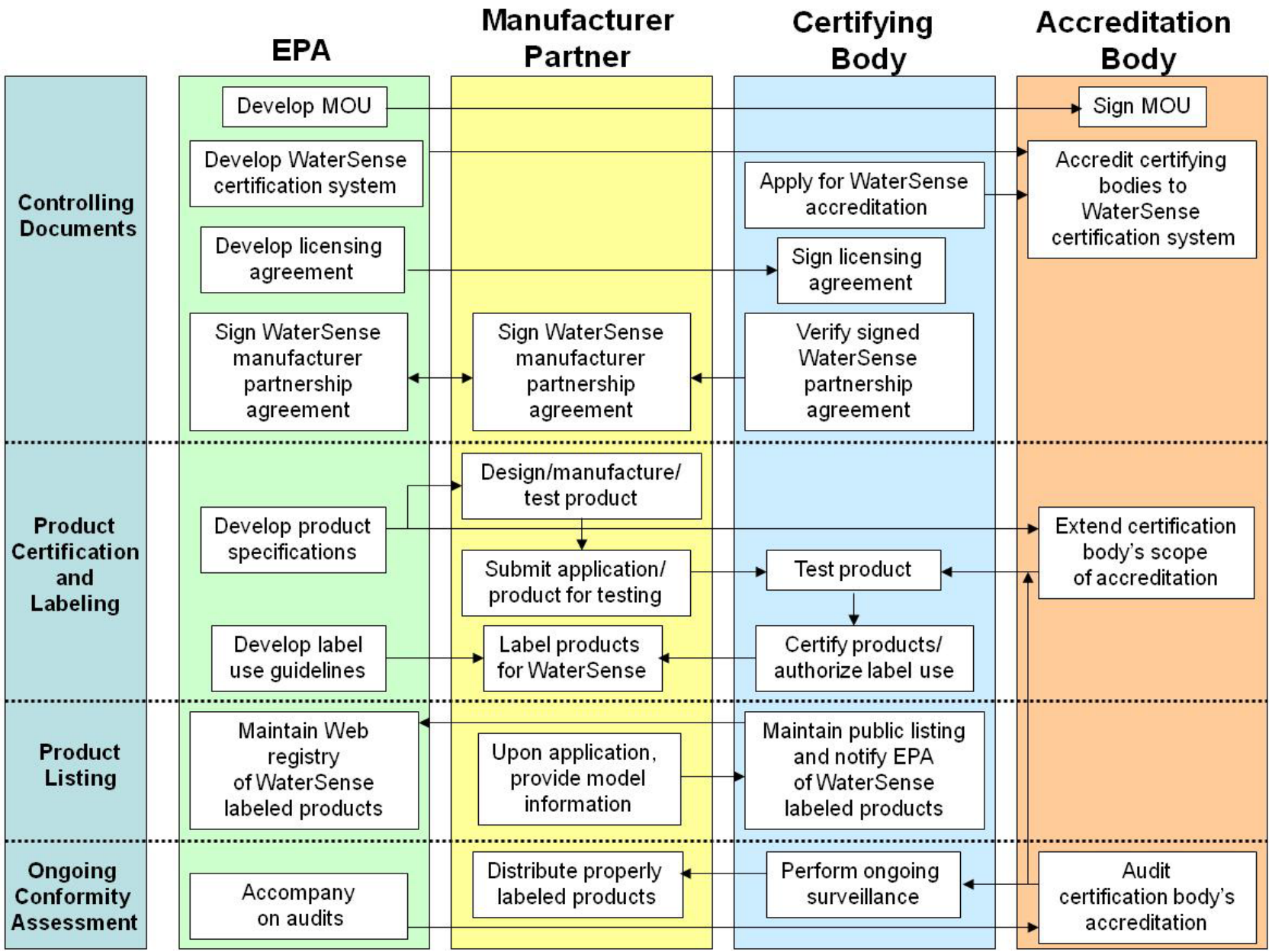
WaterSense Product Certification

Independent third-party certification is the key to bringing labeled products to market and ensuring confidence in the WaterSense brand

- EPA established the *WaterSense Product Certification System* in March 2009 (revised most recently in 2016)
- The system guides certification and labeling for all WaterSense labeled products and includes:
  - Eligibility and requirements for accreditation and product certifying bodies
  - Production inspection and testing requirements
  - Requirements for issuing the WaterSense label
  - Requirements for ongoing surveillance of labeled products
  - Procedures for handling label misuse

www.epa.gov/watersense/certification-systems#products

Product Certification Overview



Manufacturer Partnership

Partnership Background

- With the release of the draft specification, spray sprinkler nozzles manufacturers are now eligible to partner with WaterSense
- Manufacturers must have signed a WaterSense partnership agreement with EPA in order to label products
- Component manufacturers are NOT eligible for partnership

Partnership Requirements

- Commit to having at least one labeled product within 12 months of the final specification
- Abide by the *WaterSense Program Mark Guidelines*
  - Include label on product packaging and product webpages
- Submit annual data

www.epa.gov/watersense/join-watersense#Manufacturers

Licensing of Certifying Bodies

Licensing of Certifying Bodies

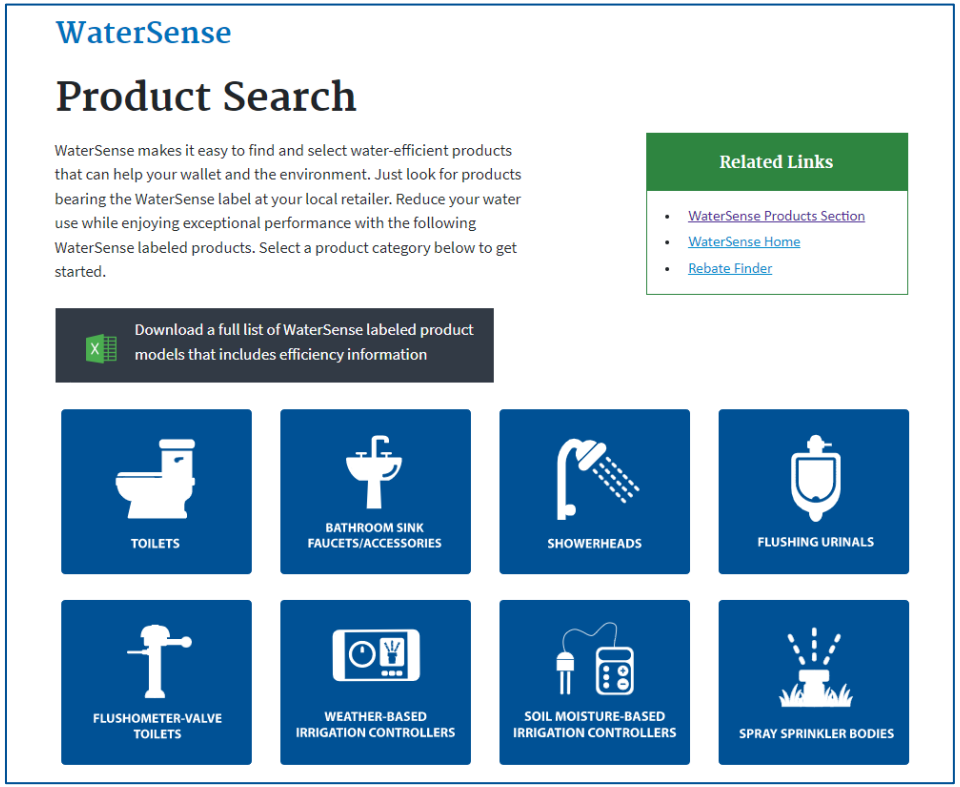
- Prior to the final specification being published, EPA will establish requirements for certifying bodies to become licensed to issue the label for spray sprinkler nozzles
- EPA will disseminate information on requirements when the specification criteria and test methods are finalized
- Typically requires competency with standards/test methods referenced in the WaterSense specification or participation in EPA training
- Existing certifying bodies will need to request extension of scope of accreditation to include spray sprinkler nozzles
- New certifying bodies will need to apply to an accreditation body for WaterSense accreditation and sign a licensing agreement with EPA
- Complete list of licensed certifying bodies (LCBs) will be posted to WaterSense website

  www.epa.gov/watersense/accreditation-licensed-certifying-bodies

Product Certification and Listing

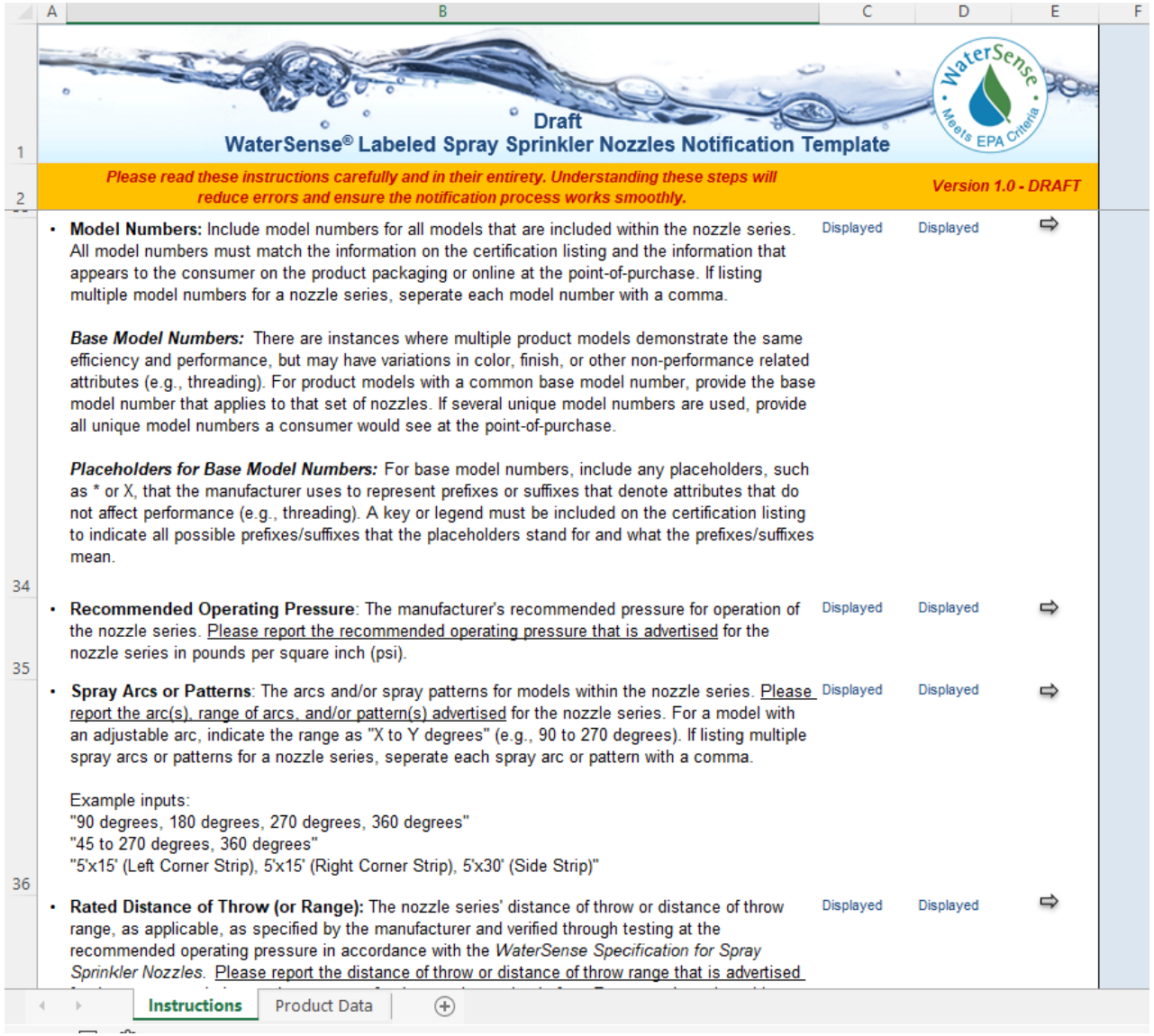
Conformity Assessment and Product Listing

- Conformance to the specification must be certified by a LCB accredited in accordance with the *WaterSense Product Certification System*
- The LCB will test product and, if it meets the specification criteria, will authorize the manufacturer to use the WaterSense label on the product
- The LCB will maintain a certification listing of all products that meet the specification and report it to EPA
- The WaterSense Product Search Tool (www.epa.gov/watersense/product-search) is an up-to-date list of all available WaterSense labeled products on the market
- The product listing makes it easy for consumers to find WaterSense labeled products that meet their needs



Product Notification Template

- Used by LCBs to report certified products to WaterSense
- Populates the product listing in the WaterSense Product Search Tool
- Includes product attributes that will be helpful to consumers:
  - Recommended operating pressure
  - Spray arcs or patterns
  - Rated distance of throw



Draft
WaterSense® Labeled Spray Sprinkler Nozzles Notification Template

Please read these instructions carefully and in their entirety. Understanding these steps will reduce errors and ensure the notification process works smoothly.

Version 1.0 - DRAFT

- **Model Numbers:** Include model numbers for all models that are included within the nozzle series. All model numbers must match the information on the certification listing and the information that appears to the consumer on the product packaging or online at the point-of-purchase. If listing multiple model numbers for a nozzle series, seperate each model number with a comma.

  Base Model Numbers: There are instances where multiple product models demonstrate the same efficiency and performance, but may have variations in color, finish, or other non-performance related attributes (e.g., threading). For product models with a common base model number, provide the base model number that applies to that set of nozzles. If several unique model numbers are used, provide all unique model numbers a consumer would see at the point-of-purchase.

  Placeholders for Base Model Numbers: For base model numbers, include any placeholders, such as * or X, that the manufacturer uses to represent prefixes or suffixes that denote attributes that do not affect performance (e.g., threading). A key or legend must be included on the certification listing to indicate all possible prefixes/suffixes that the placeholders stand for and what the prefixes/suffixes mean.

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- **Recommended Operating Pressure**: The manufacturer's recommended pressure for operation of the nozzle series. Please report the recommended operating pressure that is advertised for the nozzle series in pounds per square inch (psi).

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- **Spray Arcs or Patterns**: The arcs and/or spray patterns for models within the nozzle series. Please report the arc(s), range of arcs, and/or pattern(s) advertised for the nozzle series. For a model with an adjustable arc, indicate the range as "X to Y degrees" (e.g., 90 to 270 degrees). If listing multiple spray arcs or patterns for a nozzle series, seperate each spray arc or pattern with a comma.

  Example inputs:
  "90 degrees, 180 degrees, 270 degrees, 360 degrees"
  "45 to 270 degrees, 360 degrees"
  "5'x15' (Left Corner Strip), 5'x15' (Right Corner Strip), 5'x30' (Side Strip)"

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- **Rated Distance of Throw (or Range):** The nozzle series' distance of throw or distance of throw range, as applicable, as specified by the manufacturer and verified through testing at the recommended operating pressure in accordance with the *WaterSense Specification for Spray Sprinkler Nozzles*. Please report the distance of throw or distance of throw range that is advertised

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Instructions | Product Data

Questions and Discussion

Questions on Partnership and Certification Requirements?

Next Steps

- WaterSense is requesting input, supporting information, and data on topics related to the spray sprinkler nozzles.
- The draft specification can be reviewed at www.epa.gov/watersense/spray-sprinkler-nozzles.
- Submit written comments or additional information and data to watersense-products@erg.com by **January 12, 2024.**
- EPA will review comments and data submissions to determine next steps for developing a final specification.

Contact Us

General E-mail: watersense@epa.gov

Comment Submission E-mail: watersense-products@erg.com

Website: www.epa.gov/watersense

Helpline: (866) WTR-SENS (987-7367)

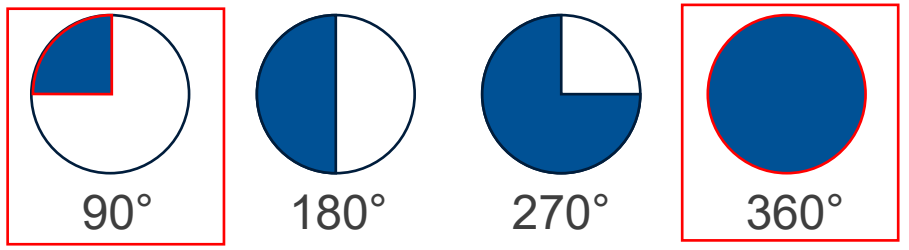
Representative Nozzle Selection and Testing

Examples: Circular Pattern Nozzle Series With a Fixed Distance of Throw

Example 1A: Fixed Arc Nozzles

A circular pattern nozzle series has four nozzle models with spray arcs of 90°, 180°, 270°, and 360°. The rated distance of throw for the series is 10 feet.

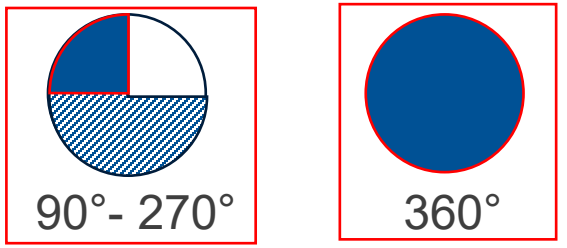
	Nozzle Arc			
Rated Distance of Throw	90° Model	180° Model	270° Model	360° Model
10'	✓			✓



Example 1B: Mixed Fixed and Adjustable Arc Nozzles

A circular pattern nozzle series has two nozzle models. One model is adjustable between 90° and 270° and one model has with a fixed spray arc of 360°. The rated distance of throw for the series is 10 feet.

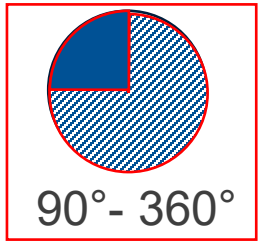
	Nozzle Arc	
Rated Distance of Throw	90° to 270° Model	360° Model
10'	✓ at 90° arc setting	✓



Example 1C: Fully Adjustable Arc Nozzle

A circular pattern nozzle series has one nozzle model with a fully adjustable arc between 90° and 360°. The rated distance of throw for the series is 10 feet.

	Nozzle Arc
Rated Distance of Throw	90° to 360° Model
10'	✓ at both 90° and 360° arc settings



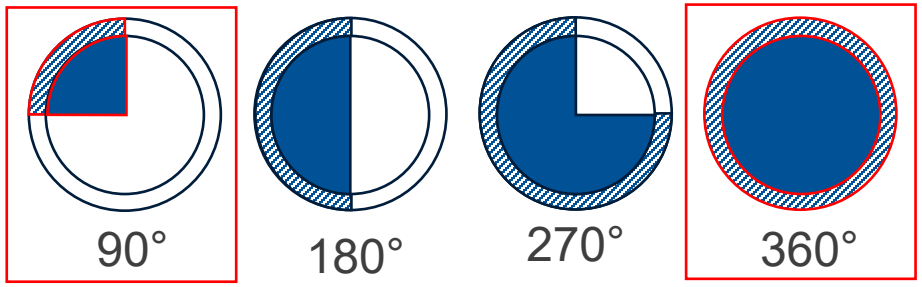
Representative Nozzle Selection and Testing

Examples: Circular Pattern Nozzle Series With an Adjustable Distance of Throw

Example 2A: Fixed Arc Nozzles

A circular pattern nozzle series has four nozzle models with spray arcs of 90°, 180°, 270°, and 360°. The distance of throw can be adjusted between 10 feet and 15 feet.

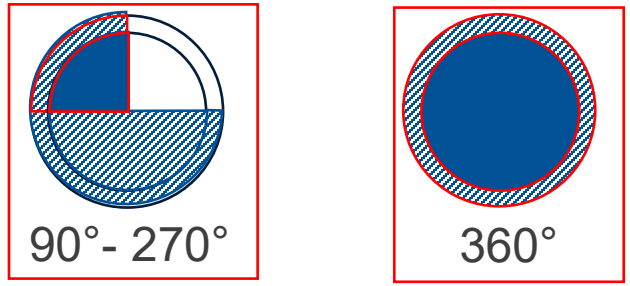
	Nozzle Arc			
Rated Distance of Throw	90° Model	180° Model	270° Model	360° Model
10'	✓			✓
15'	✓			✓



Example 2B: Mixed Fixed and Adjustable Arc Nozzles

A circular pattern nozzle series has two nozzle models. One model is adjustable between 90° and 270°, and one model has with a fixed spray arc of 360°. The distance of throw can be adjusted between 10 feet and 15 feet.

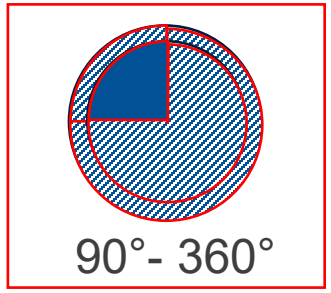
	Nozzle Arc	
Rated Distance of Throw	90° to 270° Model	360° Model
10'	✓ at 90° arc setting	✓
15'	✓ at 90° arc setting	✓



Example 2C: Fully Adjustable Arc Nozzle

A circular pattern nozzle series has one nozzle model with a fully adjustable arc between 90° and 360°. The distance of throw can be adjusted between 10 feet and 15 feet.

	Nozzle Arc
Rated Distance of Throw	90° to 360° Model
10'	✓ at both 90° and 360° arc settings
15'	✓ at both 90° and 360° arc settings



Representative Nozzle Selection and Testing

Examples: Asymmetrical or Irregular Spray Pattern Nozzle Series With a Fixed Distance of Throw

Example 3: Strip Nozzles

A strip pattern nozzle series has three nozzle models with spray pattern areas of left strip, side strip, and right strip. The spray pattern of the left and right strip models covers 5 feet in width by 15 feet in length. The side strip covers 5 feet in width and 30 feet in length.

	Spray Pattern		
Rated Distance of Throw	Left Strip Model	Side Strip Model	Right Strip Model
5' x 15' (left/right) 5' x 30' (side)	✓*	✓	

* The left or the right strip could be selected, at the discretion of the testing laboratory.

Representative Nozzle Selection and Testing

Examples: Asymmetrical or Irregular Spray Pattern Nozzle Series With an Adjustable Distance of Throw

Example 4: Strip Nozzles

A strip pattern nozzle series has three nozzle models with spray pattern areas of left strip, side strip, and right strip. The spray pattern of the left and right strip models covers 5 feet in width and can be adjusted between 10 feet and 20 feet in length. The side strip covers 5 feet in width and can be adjusted between 20 feet and 40 feet in length.

	Spray Pattern		
Rated Distance of Throw	Left Strip Model	Side Strip Model	Right Strip Model
5' x 10' (left/right) 5' x 20' (side)	✓*	✓	
5' x 20' (left/right) 5' x 40' (side)	✓*	✓	

* The left or the right strip could be selected, at the discretion of the testing laboratory.