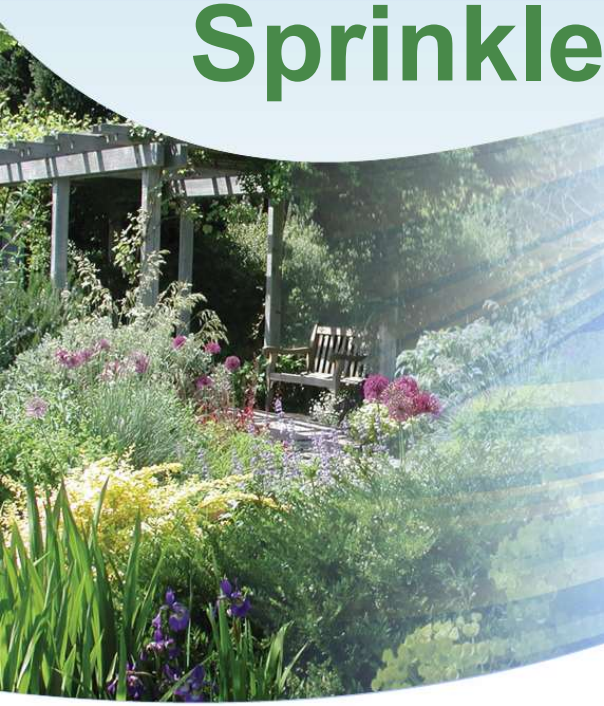
WaterSense® Public Meeting

Notice of Intent (NOI) for Spray Sprinkler Nozzles



Stephanie Tanner
EPA WaterSense

Joanna Kind and Kathleen Onorevole
Eastern Research Group, Inc.
December 14, 2022

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 stephanie.buckley@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!

Meeting Purpose

At this meeting, we will:

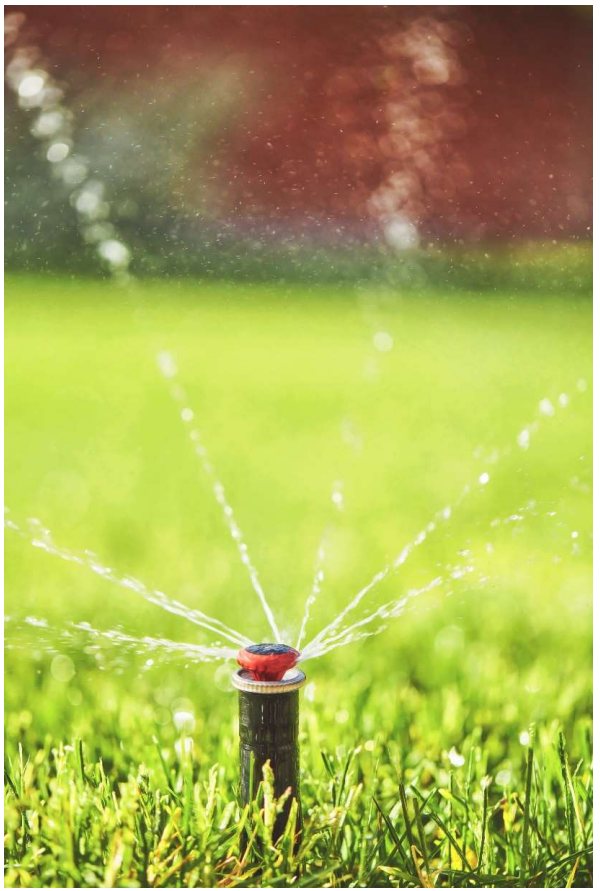
- Explain the research and findings about the product category
- Answer questions about the material so that interested parties can provide more precise comments
- Begin to gather information on how to fill data gaps or on additional information that may be available
- Explain WaterSense's specification 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 specification or provide a timeline for its completion

Agenda

- Introduction to WaterSense
- Spray Sprinkler Nozzles Background
- WaterSense NOI and Outstanding Data Gaps
  - Estimated Water Savings
  - Scope
  - Water Efficiency Criteria
  - Performance and Product Testing
  - Product Marking, Documentation, and Marketing
  - Communicating Savings
- Next Steps

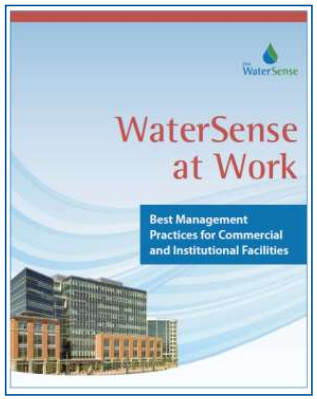


Introduction to WaterSense

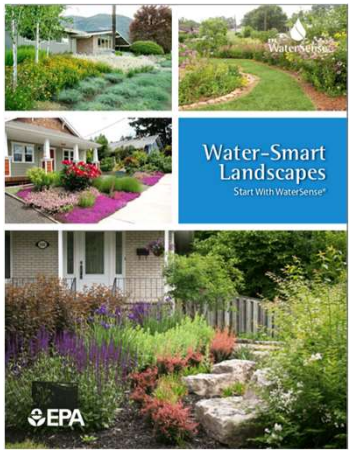
What Is WaterSense?

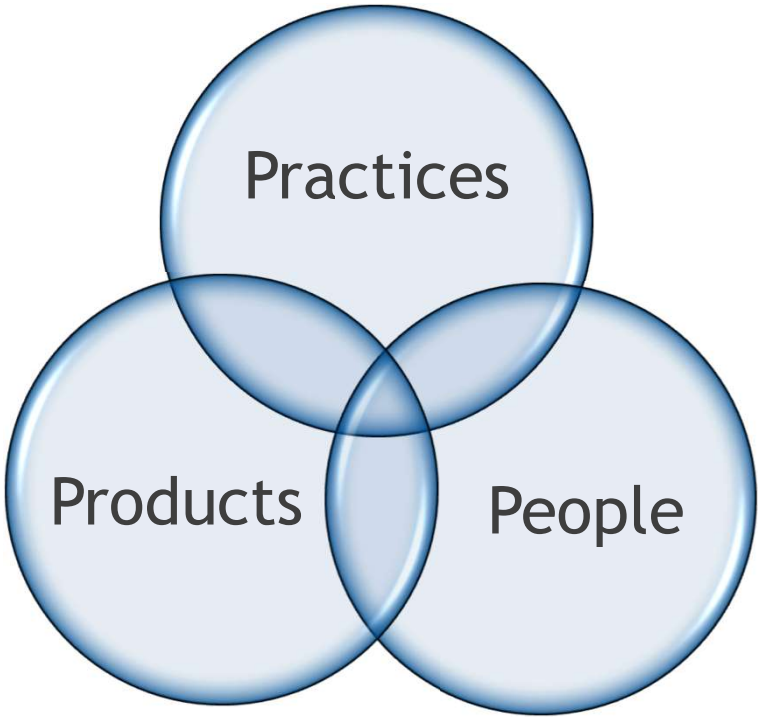
- WaterSense is a voluntary partnership program launched by EPA in 2006 that provides a simple way to identify water-efficient:
  - Products
  - Programs
  - Practices
  - Homes
- Products are independently certified for water efficiency **and** performance

WaterSense Program Overview



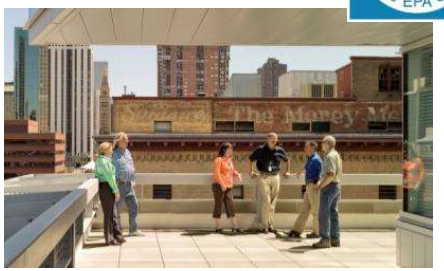
Actions can be taken to reduce water use—at home, outdoors, and at work





Fixtures and technologies save water

Partners reach users to change behavior



WaterSense Labeled Products

Lavatory Faucets
Labeled since 2007
20,760 labeled models

Weather-Based Irrigation Controllers
Labeled since 2011
970 labeled models

Tank-Type Toilets
Labeled since 2007
5,090 labeled models

Flushometer-Valve Toilets
Labeled since 2015
1,730 labeled models

Flushing Urinals
Labeled since 2009
920 labeled models

Spray Sprinkler Bodies
Labeled since 2017
570 labeled models

Showerheads
Labeled since 2010
13,000 labeled models

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

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.

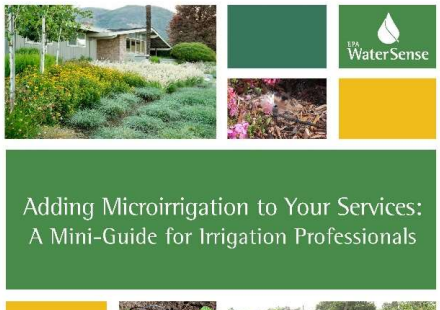
www.epa.gov/watersense/spray-sprinkler-bodies

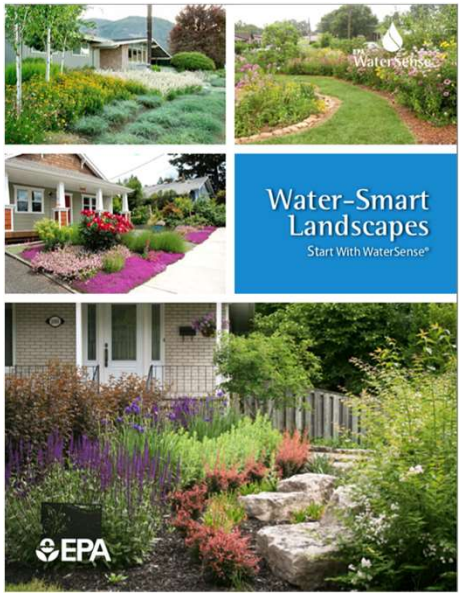
Professional Certification Programs

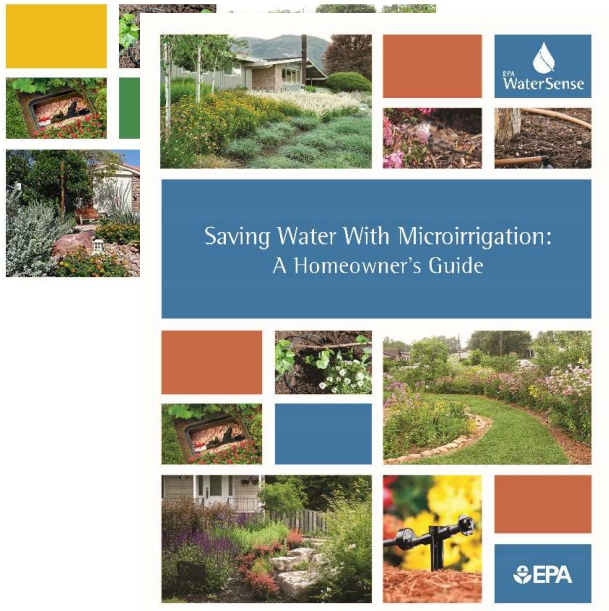
- Three specifications for professional certification programs covering
  - Irrigation system designers
  - Irrigation system auditors
  - Irrigation system installation and maintenance professionals
- Programs range from local to national:
  - Auditor: 6 (plus 20 that have adopted QWEL)
  - Installation and maintenance: 1
  - Design: 1
- Over 3,500 irrigation professionals certified by a WaterSense labeled program (~2,000 in California alone)

www.epa.gov/watersense/professional-certification

Beyond Labeling







Background on Specification Development

Specification Development Process

We are here

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

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

WaterSense Labeled Product Evaluation Factors

WaterSense uses the following factors in determining which products to label. Products must:

- Offer equivalent or superior performance to conventional models
- Be at least 20 percent more water-efficient than conventional models
- Realize water savings on a national level
- Provide measurable results
- Achieve water efficiency through several technology options
- Be effectively differentiated by the WaterSense label
- Be tested and independently certified

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

Spray Sprinkler Nozzles Background

Spray Sprinkler Nozzles Background

- In 2014, WaterSense released its *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.

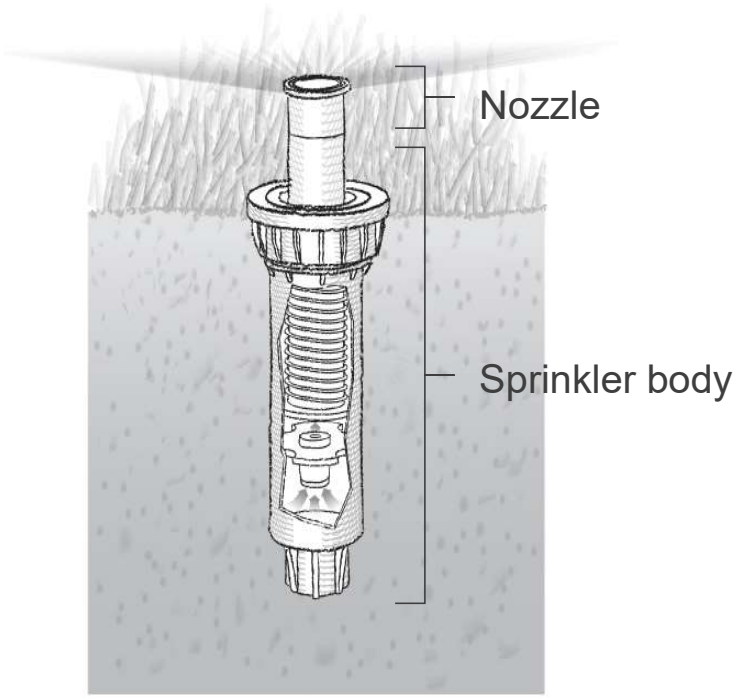


Image courtesy of Irrigation Association, Smart Water Application Technologies.

Spray Sprinkler Nozzles Background

- WaterSense is reconsidering 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 been developing a test method to evaluate how to differentiate spray sprinkler nozzles.

WaterSense NOI and Outstanding Data Gaps

WaterSense NOI: Estimated Water Savings

- Researchers have published several studies demonstrating real-world water savings associated with high-efficiency spray (HES) sprinkler nozzles.
- Based on these studies, WaterSense estimates that HES sprinkler nozzles 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.

WaterSense NOI: Estimated Water Savings

- Assuming 10 percent savings, the average household could save approximately 2,400 gallons of water annually by replacing standard spray nozzles with HES sprinkler nozzles.
  - WaterSense bases this figure on an average household outdoor water use of 50,500 gallons and conservatively assumes that 50 percent of outdoor water use is attributable to spray irrigation.
  - If the assumption of 50 percent is low, homes would likely experience greater savings from installing HES sprinkler nozzles as a retrofit.

WaterSense NOI: Estimated Water Savings

NOI Questions and Data Gaps

WaterSense is interested in feedback from stakeholders on whether the estimated percentage of outdoor water used for spray irrigation is accurate, or whether spray irrigation typically accounts for more than 50 percent of outdoor water use in residential properties.

WaterSense NOI: Estimated Water Savings

- Based on WaterSense's current calculations, the average household could save approximately $32 annually per landscape (using the average water and wastewater rate) by replacing standard spray nozzles with HES sprinkler nozzles.
- Approximate payback period is 3 years and 5 months, which is comparable to the average product warranty period for spray sprinkler nozzles marketed as more water-efficient (multi-stream, multi-trajectory [MSMT] nozzles).
- WaterSense uses product warranties as an indicator for product lifespan in its calculations of payback period.

WaterSense NOI: Estimated Water Savings

NOI Questions and Data Gaps

WaterSense is interested in stakeholder feedback on spray sprinkler nozzle replacement behaviors. For example, do stakeholders typically replace nozzles after a designated period of time, or do they wait until they need to fix malfunctioning spray sprinkler nozzles in the event of a problem?

Specifically, are there data indicating how long spray sprinkler nozzles are installed in the field before being replaced, and/or how long spray sprinkler nozzles typically last in residential settings?

WaterSense NOI: Scope

- WaterSense has identified three relevant industry standards:
  - The American Society of Agricultural Biological Engineers (ASABE)/International Code Council (ICC) 802-2020 *Landscape Irrigation Sprinkler and Emitter Standard*.
  - ASAE/ASABE S398.1 *Procedure for Sprinkler Testing and Performance Reporting*.
  - International Organization for Standardization (ISO) Standard 15886-2:2021 *Agriculture irrigation equipment – Sprinklers*.

WaterSense NOI: 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.
- ASABE/ICC 802-2020 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.

WaterSense NOI: Scope

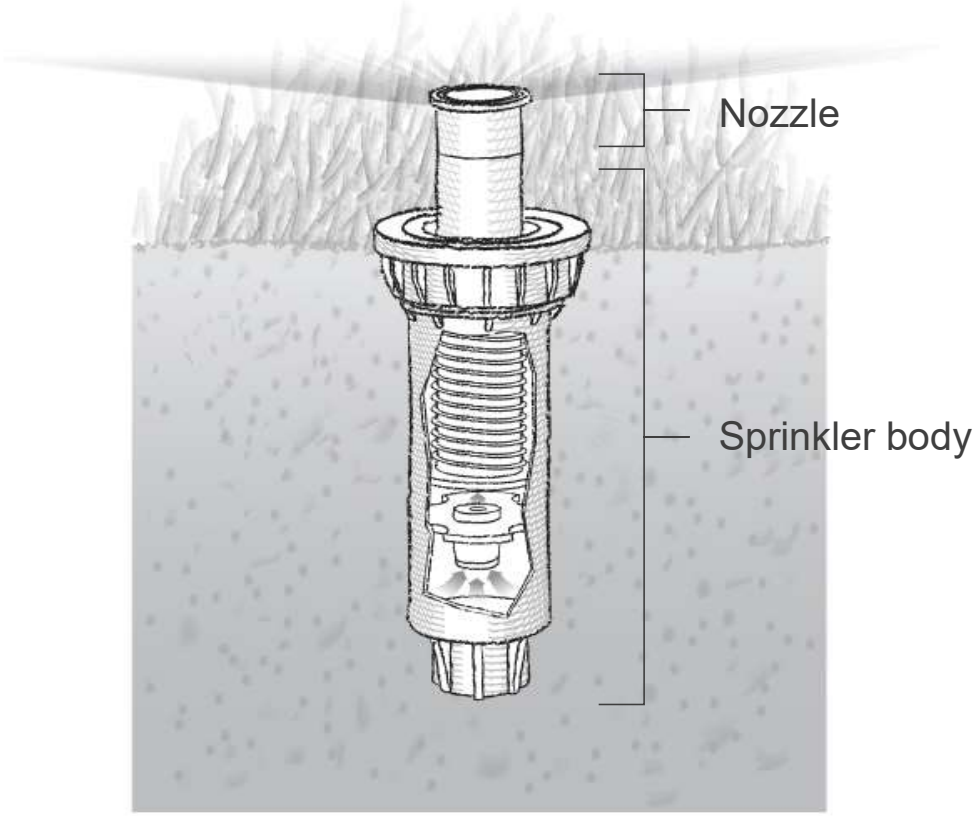


Image courtesy of Irrigation Association, Smart Water Application Technologies.

WaterSense NOI: Scope

- ASABE/ICC 802-2020 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.

WaterSense NOI: Scope

- Because there is no definition for spray sprinkler nozzles within ASABE/ICC 802-2020, WaterSense 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.
- ASABE/ICC 802-2020 defines one specific type of spray sprinkler nozzle:
  - **Multi-stream, multi-trajectory (MSMT) nozzles:** Nozzles designed to distribute discharge water in a number of individual streams, of varying trajectories, which rotate across the distribution area.
- MSMT nozzles are only available as rotating models. The rotation is driven by the nozzle, not the spray sprinkler body.

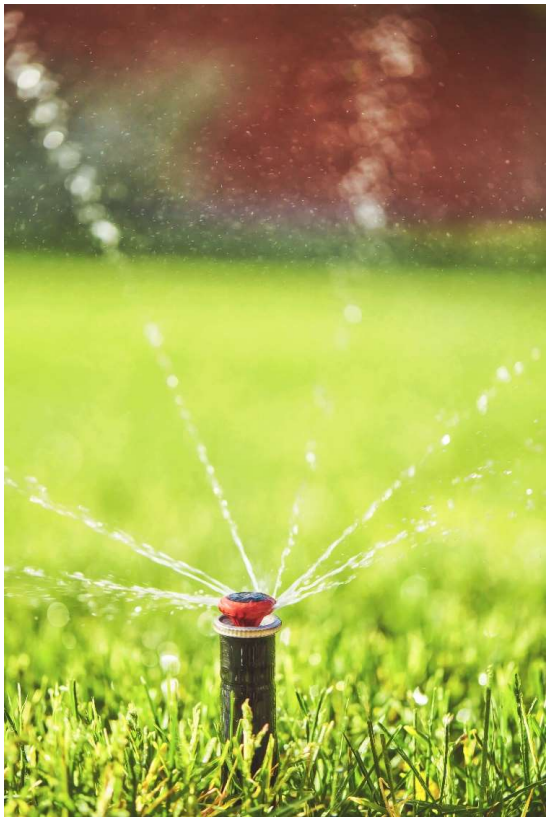
WaterSense NOI: Scope

NOI Questions and Data Gaps

WaterSense would like stakeholder input on its product category definition of “spray sprinkler nozzle.”

WaterSense NOI: Scope

- WaterSense intends to define the scope of a potential specification to include 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.



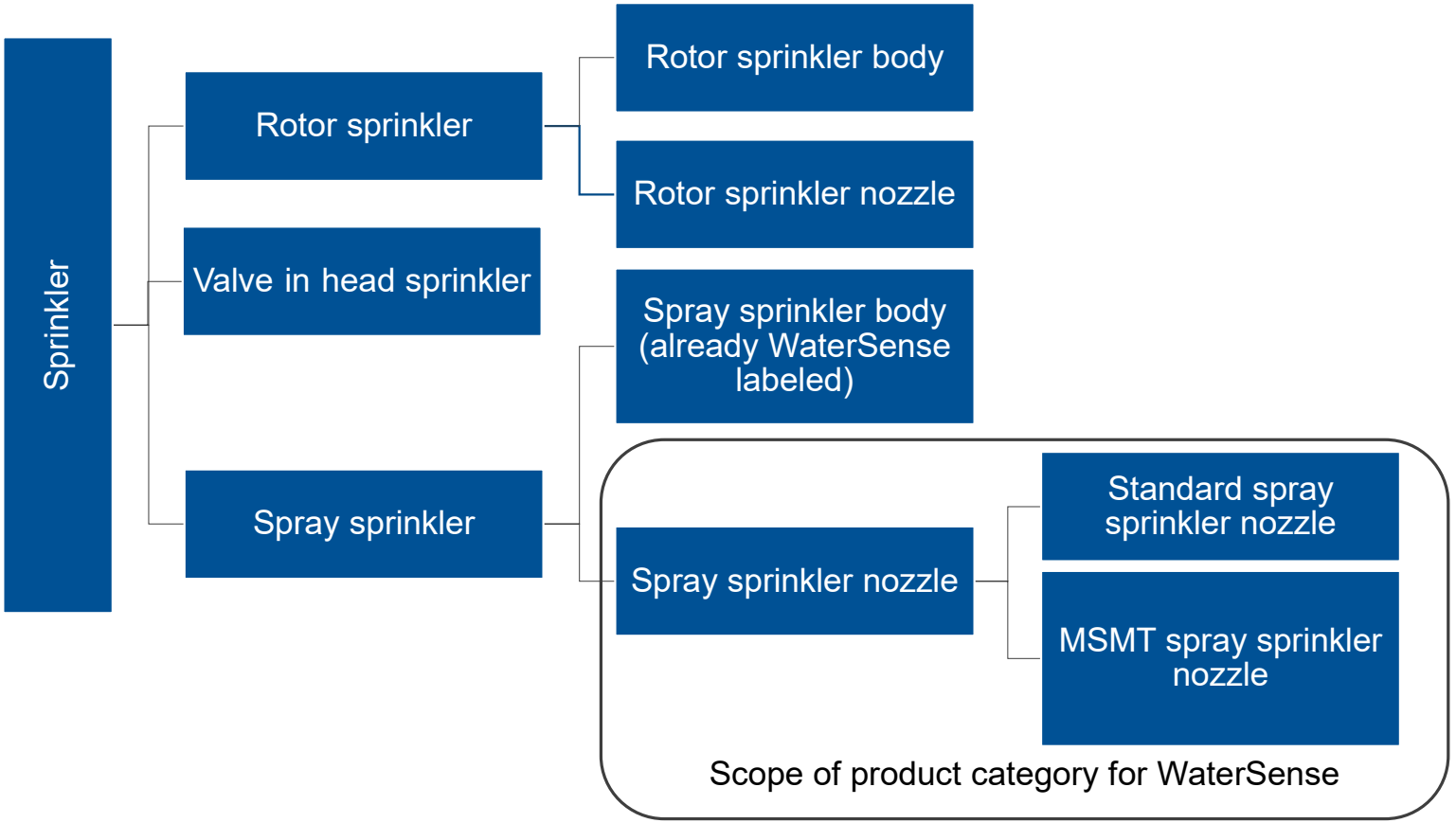
WaterSense NOI: Scope

Standard spray sprinkler nozzles create a fan-like spray pattern.

MSMT spray sprinkler nozzles emit water in multiple streams at various trajectories.

Photos courtesy of Hunter® Industries Incorporated.

WaterSense NOI: Scope



WaterSense NOI: Scope

- Currently, most spray sprinkler nozzles marketed as “high-efficiency” are MSMT nozzles that emit multiple streams of water at multiple trajectories.
  - Water utilities with rebate programs for spray sprinkler nozzles often specify MSMT nozzles.
  - All water savings studies identified to-date have focused on MSMT nozzles.
- It is possible that manufacturers could develop other types of high-efficiency spray sprinkler nozzles in the future. To be inclusive of future developments in the market, WaterSense uses the phrase **“high-efficiency spray (HES) sprinkler nozzle”** (which includes MSMT nozzles) to differentiate the products that WaterSense is considering labeling.

WaterSense NOI: Scope

- The scope of the NOI 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).

WaterSense NOI: Scope

NOI Questions and Data Gaps

WaterSense would like stakeholder feedback on the intended scope of the specification.

WaterSense NOI: Water Efficiency and Performance

- WaterSense has identified four attributes that appear to be different between HES and standard spray sprinkler nozzles:
  - Application rate
  - Distribution uniformity
  - Distance of throw
  - Droplet size and spray pattern

WaterSense NOI: Water Efficiency and Performance
Application Rate

- **Application rate** (aka precipitation rate) is the rate at which a sprinkler applies water to a given area. As explained in ASABE/ICC 802-2020, 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; and
  - Total area is the irrigated area in square feet.

WaterSense NOI: Water Efficiency and Performance
Application Rate

- Application rate is typically expressed in inches per hour. It is directly correlated with the flow rate from the sprinkler and indirectly correlated with irrigated area.
- Sprinkler nozzles with higher application rates apply more water to an area in the landscape in a given amount of time. HES sprinkler nozzles generally have lower application rates than standard sprinkler nozzles.
  - Most MSMT sprinkler nozzles have application rates equal to or less than 1.0 inch per hour, whereas standard sprinkler nozzles have application rates greater than 1.0 inch per hour.
  - Nozzles with lower application rates are considered more efficient, as they allow more water to percolate into the soil rather than flow offsite as runoff.

WaterSense NOI: Water Efficiency and Performance
Application Rate

- There are two published evaluation methods for application rate.
- ASABE/ICC 802-2020 provides a method to calculate the theoretical (i.e., gross) application rate as a function of pressure by dividing the average flow rate at a given pressure by the average pattern collection area for a given pressure.
- The Irrigation Association's Smart Water Application Technologies (SWAT) program published a draft protocol for spray sprinkler nozzles in 2014.
  - The draft protocol calculates gross precipitation rate by dividing flow rate by irrigated area and calculates net precipitation rate based on water measured in catchment devices.

WaterSense NOI: Water Efficiency and Performance
Application Rate

- Dr. Michael Dukes of the University of Florida conducted research to evaluate whether spray sprinkler nozzles could be differentiated based on flow rate.
- His results indicate that flow rate is substantially lower in HES sprinkler nozzles compared to their standard counterparts. Based on these findings, ASABE/ICC 802-2020 could be used to differentiate spray sprinkler nozzles.

WaterSense NOI: Water Efficiency and Performance
Application Rate

- WaterSense is considering application rate as a water efficiency criterion to identify HES sprinkler nozzles.
  - WaterSense could set two thresholds for application rates: one at the manufacturer's recommended operating pressure and one at high pressure.
  - WaterSense could establish these thresholds based on Dr. Dukes' data and reference the test method in ASABE/ICC 802-2020.
- WaterSense proposes that each radius in a model's product family be tested (e.g., 12- and 15-feet radii versions of a model) at the full-circle pattern only.
- If the nozzle has an adjustable radius, WaterSense is considering requiring it to be tested at the maximum radius.

WaterSense NOI: Water Efficiency and Performance
Application Rate

NOI Questions and Data Gaps

WaterSense is seeking stakeholder feedback on its proposal to use application rate (at recommended operating pressure and high pressure) as a water efficiency criterion for spray sprinkler nozzles.

WaterSense is also interested in whether any manufacturers currently use the ASABE/ICC 802-2020 test method for application rate and, if so, would be willing to share masked data with WaterSense.

WaterSense NOI: Water Efficiency and Performance
Application Rate

NOI Questions and Data Gaps

Additionally, WaterSense requests stakeholder opinions on using the following parameters to evaluate spray sprinkler nozzles:

- Test each radius in a model's product family at the full circle pattern only; and
- Test models with an adjustable radius at the maximum radius.

WaterSense NOI: Water Efficiency and Performance
Application Rate—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.
- Most MSMT sprinkler nozzles and some standard spray sprinkler nozzles offer matched precipitation.
- WaterSense is not aware of a test method for evaluating matched precipitation provided by spray sprinkler nozzles.

WaterSense NOI: Water Efficiency and Performance
Application Rate – Pressure Regulation

- Pressure-regulating spray sprinkler bodies create a constant flow rate to the sprinkler nozzle regardless of supply pressure. Without pressure regulation, spray sprinkler bodies may apply water at higher rates than the sprinkler nozzle's specified application rate.
- WaterSense is not aware of a test method for evaluating pressure regulation provided by spray sprinkler nozzles.

WaterSense NOI: Water Efficiency and Performance
Application Rate

- To evaluate matched precipitation, WaterSense is proposing that licensed certifying bodies evaluate application rates across an entire family of models.
  - WaterSense is not aware of an industry standard variance in application rates that constitutes matched precipitation for spray sprinkler nozzles.
  - WaterSense would need to identify an acceptable variance for the purposes of the specification.
- MSMT nozzles may provide a similar effect as pressure regulation.
  - WaterSense would not need to include a separate test method for pressure regulation but would incorporate it into the evaluation of application rate by testing at recommended and maximum pressure.

WaterSense NOI: Water Efficiency and Performance
Application Rate

NOI Questions and Data Gaps

WaterSense seeks input on whether it should require spray sprinkler nozzles to have matched precipitation to be eligible for the WaterSense label.

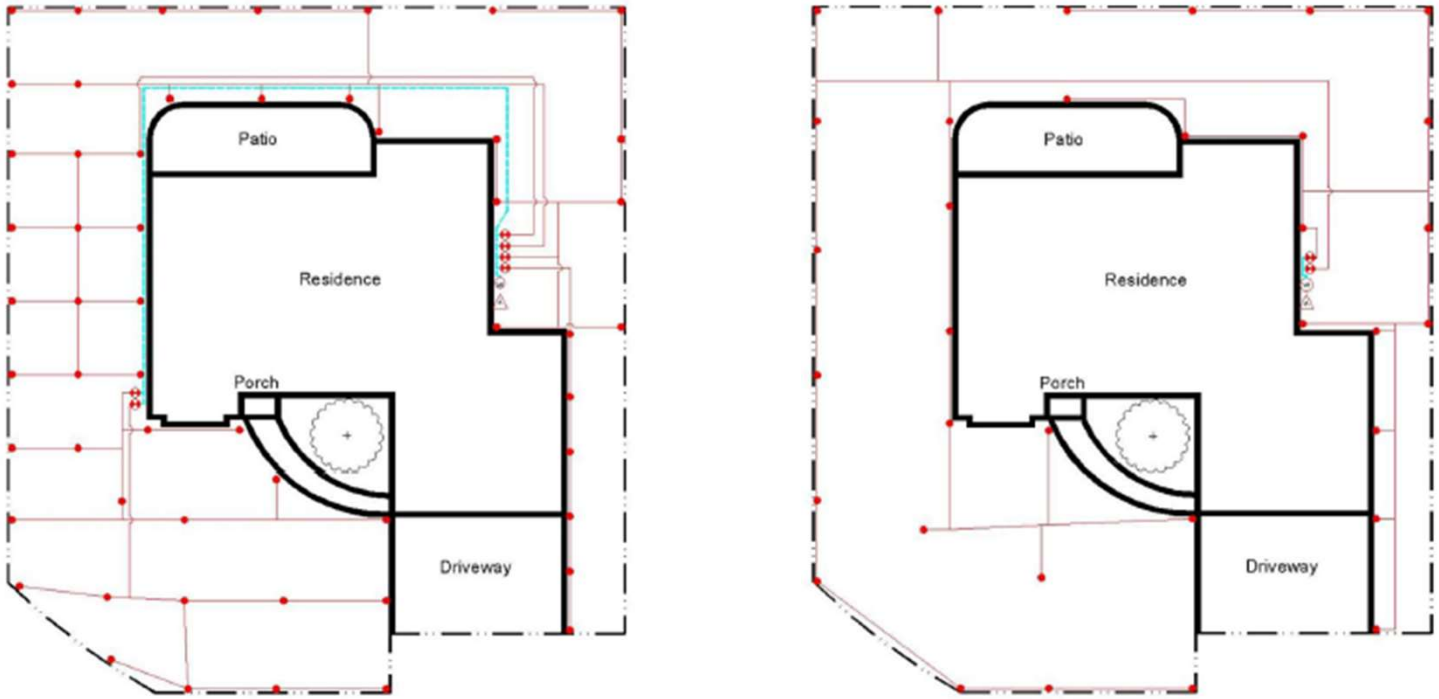
What would be an acceptable variance in application rates to ensure matched precipitation?

If WaterSense requires matched precipitation, how should EPA verify the data?

WaterSense NOI: Water Efficiency and Performance
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.
  - Primarily relates to water efficiency because of its influence on irrigation system design in a new landscape.
  - HES sprinkler nozzles tend to have larger distances of throw.
  - In a new landscape, there is the potential to use fewer sprinklers compared to a system with standard spray nozzles.
  - One study estimated that contractors could save up to 45 percent on their bids for materials alone when designing a landscape for MSMT nozzles as compared to standard sprinkler nozzles.

WaterSense NOI: Water Efficiency and Performance
Distance of Throw



Comparison of irrigation layout with standard sprinkler nozzles (left) and MSMT sprinkler nozzles (right). Figure adapted from a 2011 publication by John Wascher.

WaterSense NOI: Water Efficiency and Performance
Distance of Throw

NOI Questions and Data Gaps

WaterSense is interested in feedback from irrigation contractors about whether they are likely to incorporate HES sprinkler nozzles in bids for new irrigation systems, any factors that might influence their decision (i.e., new installation vs. retrofit), and how HES sprinklers affect the cost of materials in practice.

WaterSense NOI: Water Efficiency and Performance
Distance of Throw

- ASABE/ICC 802-2020 includes a test method to calculate distance of throw. Testing is conducted at the minimum, recommended, and maximum operating pressures, as indicated by the manufacturer.
  - Sprinkler nozzles are tested with a specified type of grid depending on their spray pattern (i.e., regular and symmetrical, or circular).
  - ASABE/ICC 802-2020 references ASAE/ASABE S398.1.
- WaterSense is not aware of any distance of throw data generated from the test methods in standards or other research studies.
  - Manufacturers typically advertise distance of throw for different nozzle models. They may be using ASAE/ASABE S398.1 to measure distance of throw.
  - WaterSense intends to engage with certifying bodies and manufacturers to determine whether the advertised distance of throw is based on data generated as part of testing in accordance with ASAE/ASABE S398.1.

WaterSense NOI: Water Efficiency and Performance
Distance of Throw

- WaterSense is considering requiring distance of throw as a water efficiency criterion.
  - Distance of throw is used to calculate application rate in ASABE/ICC 802-2020, so no additional testing would be required.
  - Measuring distance of throw would also help ensure product performance.
- WaterSense is considering requiring that the measured distance of throw be at least equal to—and no more than—a specified percent above, the manufacturer's rated distance of throw.
- These thresholds would ensure that a manufacturer's rated value for distance of throw is accurate (i.e., that the published distance of throw is met without excessive overspray).

WaterSense NOI: Water Efficiency and Performance
Distance of Throw

NOI Questions and Data Gaps

WaterSense seeks stakeholder feedback on whether ASAE/ASABE S398.1 is an appropriate test method for distance of throw.

Do stakeholders believe it is reasonable for WaterSense to require the tested distance of throw to align with the value reported by the manufacturer?

WaterSense is also interested in stakeholder input on the appropriate tolerance (e.g., percentage greater than the rated distance of throw) to prevent water waste due to overspray.

WaterSense NOI: Water Efficiency and Performance
Distribution Uniformity

- **Distribution uniformity (DU)** is a measure of how evenly water is applied to a landscaped area.
  - DU can be considered at the scale of the landscape (i.e., water applied by all sprinkler nozzles) or the sprinkler nozzle (i.e., water applied to the irrigated area of the individual sprinkler).
- DU may be influenced by the type of nozzle; uniformity of individual nozzles; wind conditions; and the design, installation, and maintenance of the irrigation system.
- Despite expectations, field studies have not demonstrated that higher system DU results in increased water savings.

WaterSense NOI: Water Efficiency and Performance
Distribution Uniformity

- ASABE/ICC 802-2020 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.

WaterSense NOI: Water Efficiency and Performance
Distribution Uniformity

- WaterSense is not aware of any compiled dataset related to DU that has been generated in accordance with the ASABE/ICC 802-2020 test method.
- Some manufacturers advertise DU for different nozzle models, but WaterSense is not certain of the test method used to calculate it.
- Early studies on water savings associated with MSMT sprinkler nozzles focused on DU as the likely mechanism for anticipated water savings. Researchers and utilities suggested that MSMT sprinkler nozzles might distribute water more evenly, and that DU might be an appropriate way to measure water efficiency.

WaterSense NOI: Water Efficiency and Performance
Distribution Uniformity

- Currently, WaterSense is only aware of DU data from field studies reported in the literature. However, a potential specification would require licensed certifying bodies to use a laboratory-based test method to measure DU.
- WaterSense would need to review DU data generated in accordance with laboratory testing to develop a threshold for DU in a potential specification.
  - It is possible that WaterSense could obtain this data from manufacturers, who can calculate DU based on data generated from the laboratory-based test method for distance of throw.

WaterSense NOI: Water Efficiency and Performance
Distribution Uniformity

NOI Questions and Data Gaps

WaterSense invites manufacturers to submit laboratory data on DU for spray sprinkler nozzles.

WaterSense also invites manufacturers to indicate whether they collect DU data in accordance with ASABE/ICC 802-2020 or through another method.

WaterSense NOI: Water Efficiency and Performance
Distribution Uniformity

- Based on laboratory data, WaterSense could take two approaches to establishing a threshold for DU.
  1. WaterSense could identify a threshold that indicates a minimum level of performance.
  2. WaterSense could identify a DU value that differentiates between HES and standard spray sprinkler nozzles, with the value of the former expected to be higher than the latter.
- In either case, WaterSense would likely require DU to be calculated based on the ASABE/ICC 802-2020 distance of throw test conducted to measure application rate for WaterSense certification.

WaterSense NOI: Water Efficiency and Performance
Distribution Uniformity

NOI Questions and Data Gaps

WaterSense would like stakeholder input on whether DU should be used in a specification to establish a minimum level of performance or used to differentiate HES and standard spray sprinkler nozzles.

WaterSense invites stakeholders to submit data pertaining to the relationship between DU and water savings and/or performance (e.g., landscape health).

WaterSense NOI: Water Efficiency and Performance
Droplet Size and Spray Pattern

- Standard sprinkler nozzles produce fine droplets that can be blown by the wind and diverted from their intended destination.
- MSMT sprinkler nozzles have a spray pattern that creates larger droplets and reduces misting.
  - The **spray pattern** allows MSMT sprinkler nozzles to distribute water more evenly across the landscape despite their lower flow rate.
  - The larger **droplet size** could also prevent water from being applied to undesirable areas such as hardscapes due to wind, potentially decreasing the total water applied for irrigation.

WaterSense NOI: Water Efficiency and Performance
Droplet Size and Spray Pattern

- ISO Standard 15886-2:2021 *Agriculture irrigation equipment - Sprinklers* includes a drop size test in Annex A to Part 2. The stated purpose of the test is to "characterize the distribution of drop sizes discharged by the water jet of a sprinkler."
  - For this test, measurements are collected in multiple concentric rings within the sprinkler nozzle's radius of throw at different pressures.
  - These measurements are used to calculate the number of drops collected in groupings of diameter sizes.
- WaterSense is not aware of any data on drop size or spray pattern collected in accordance with ISO Standard 15886-2:2021 or published in any research study.

WaterSense NOI: Water Efficiency and Performance
Droplet Size and Spray Pattern

- WaterSense is not aware of any published research measuring droplet size or data demonstrating a correlation between droplet size and water savings.
- One study (Baum-Haley 2014) suggested that larger droplet size could result in greater resistance to wind. It is possible that droplet size could influence irrigation schedules, especially in windy regions.
- It may be possible to connect droplet size or spray pattern to performance, but WaterSense is not aware of any related data.

WaterSense NOI: Water Efficiency and Performance
Droplet Size and Spray Pattern

NOI Questions and Data Gaps

WaterSense invites stakeholders to share data on droplet size and water efficiency, especially collected in accordance with ISO Standard 15886-2:2021.

WaterSense welcomes feedback on whether stakeholders think droplet size should be included as a criterion in a WaterSense specification.

WaterSense NOI: Water Efficiency and Performance
Possible Additional Criteria

- The *WaterSense Specification for Spray Sprinkler Bodies* includes additional criteria from ASABE/ICC 802-2020 that help ensure WaterSense labeled products are of high quality, in addition to being high performing.
- WaterSense could consider including similar requirements in a specification for spray sprinkler nozzles. WaterSense is considering incorporating certain sections in ASABE/ICC 802-2020 by reference (focused on sprinkler design and product marking).

  - 302.1. Rated temperature
  - 302.2. Inlet connections
  - 302.4. Servicing
  - 302.5. Adjustments
  - 302.6. Burst pressure
  - 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 (as applicable)

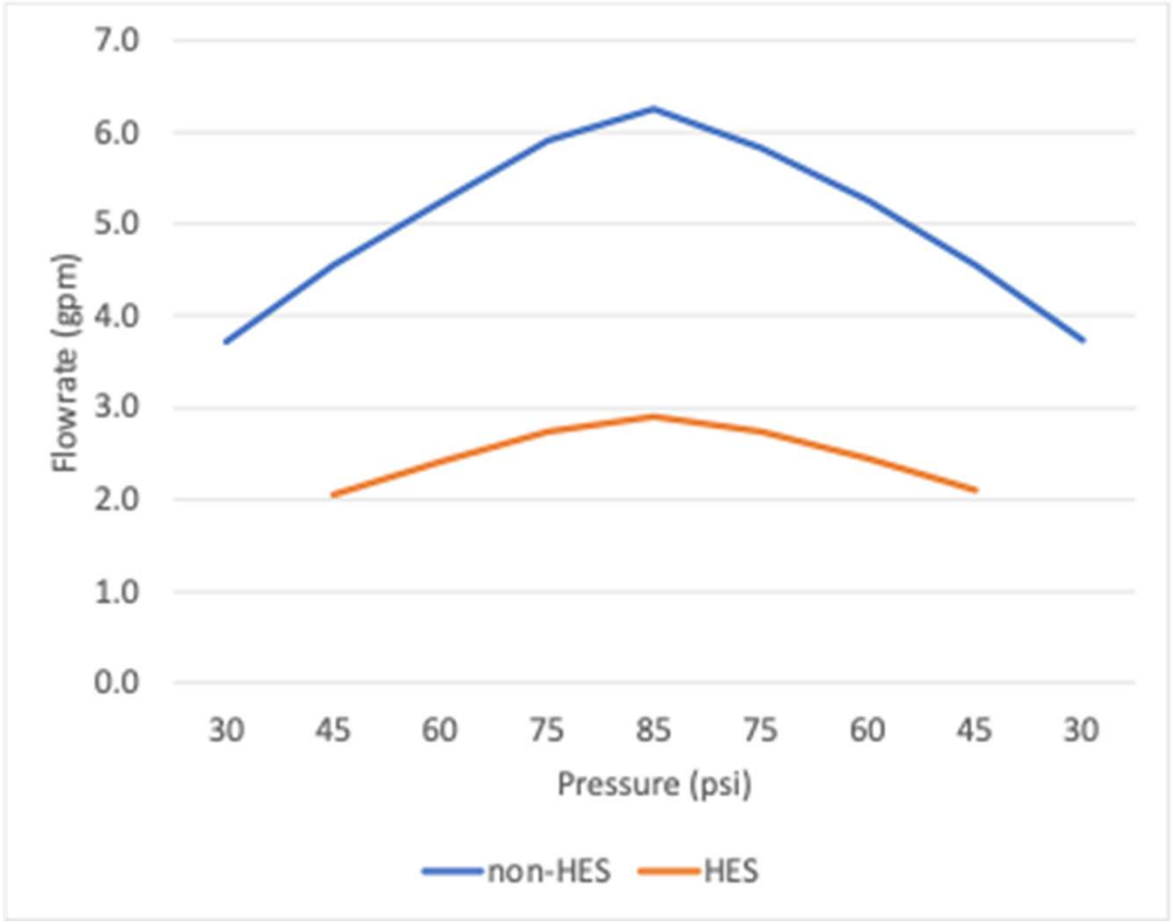
WaterSense NOI: Water Efficiency and Performance
Possible Additional Criteria

NOI Questions and Data Gaps

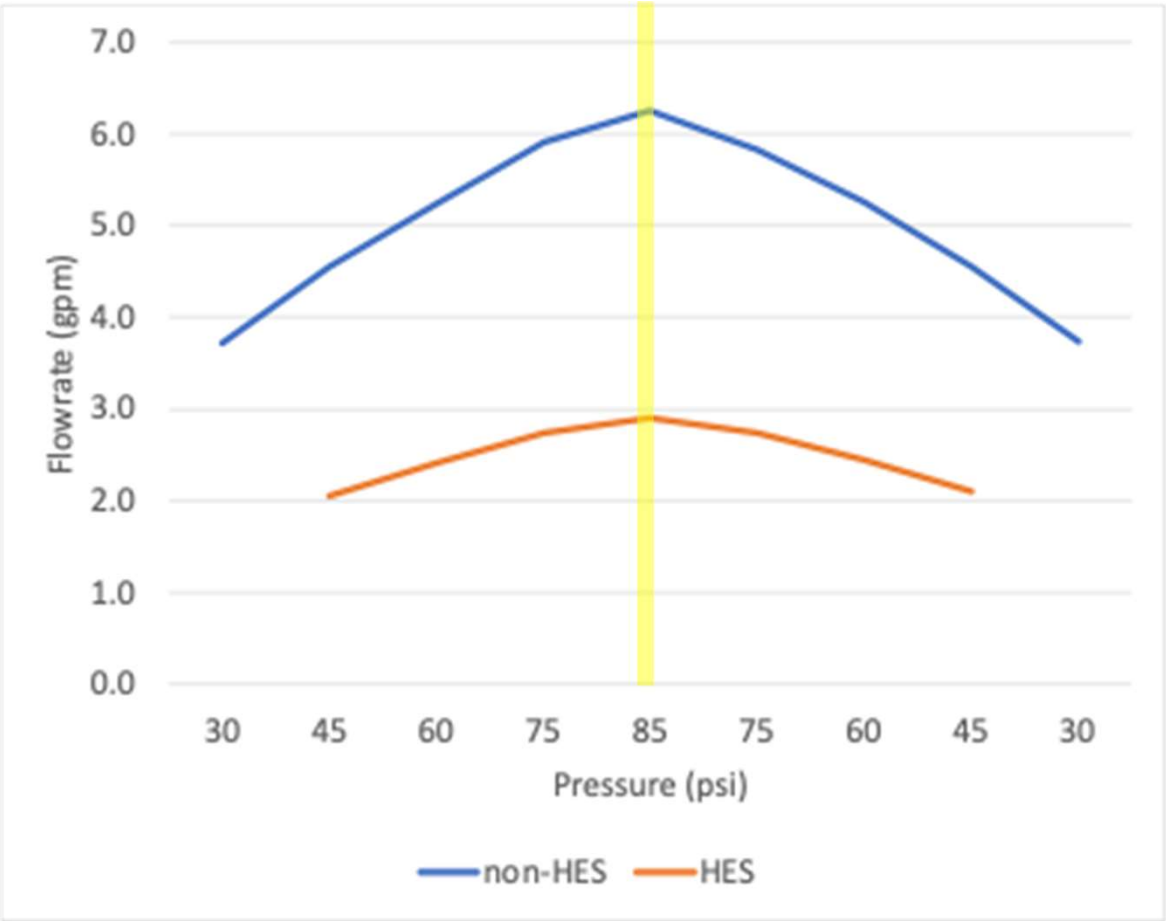
WaterSense welcomes stakeholder feedback on whether to require these additional criteria included in sections of ASABE/ICC 802-2020 in a potential specification.

WaterSense NOI: Existing Performance Data

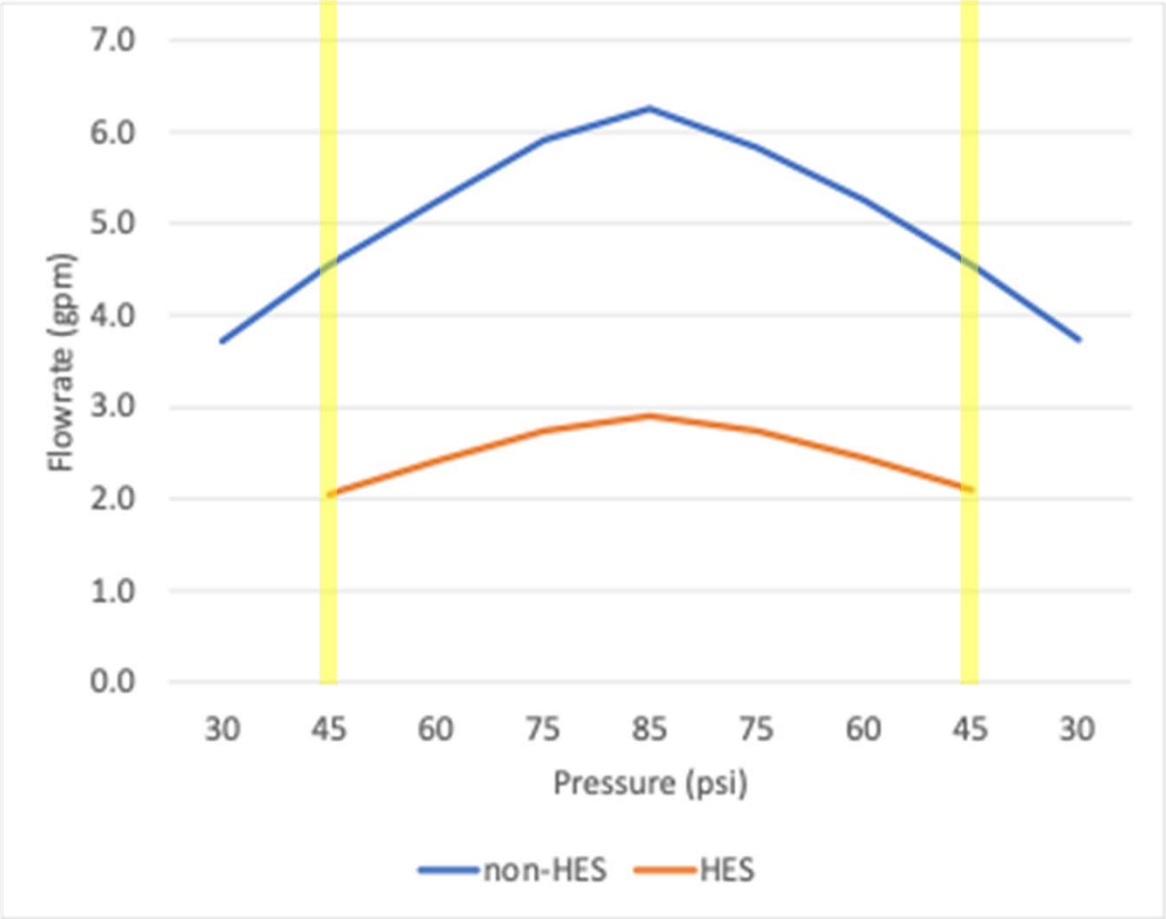
- Dr. Dukes developed a test method based on ASABE/ICC 802-2020 to measure the flow rate of standard and HES sprinkler nozzles through a non-pressure-regulating sprinkler body, as well as variations in flow rate across a range of water pressures.
- Flow rate can be converted to application rate using the methodology in ASABE/ICC 802-2020.
- Dr. Dukes is currently analyzing additional data. WaterSense will incorporate his data if the program proceeds with a draft specification.



Preliminary results from a 15-foot full-circle single test comparison conducted as part of Dr. Dukes' research on HES sprinkler nozzles and standard sprinkler nozzles (abbreviated as "non-HES").



- The maximum tested pressure (85 psi, yellow highlighted area) represents conditions without pressure regulation in the sprinkler body (which could result in high pressure). At 85 psi, the HES sprinkler nozzle had a 54 percent lower flow rate than the standard sprinkler nozzle.



- The recommended operating pressure (45 psi, yellow highlighted areas) mimics conditions with pressure regulation. The HES sprinkler nozzle had a 66 percent lower flow rate at 45 psi compared to the standard sprinkler nozzle at peak tested pressure (85 psi).

WaterSense NOI: Existing Performance Data

- The percent difference in flow rate between maximum and recommended tested pressure was larger for standard spray sprinkler nozzles than HES sprinkler nozzles.
  - For standard sprinkler nozzles, the flow rate was reduced by 40 percent from maximum tested pressure (85 psi) to its recommended operating pressure (30 psi).
  - For HES sprinkler nozzles, the flow rate was reduced by 27 percent between maximum tested pressure (85 psi) and its recommended operating pressure (45 psi).
- Overall, preliminary results show that HES sprinkler nozzles had a lower flow rate over a wide range of pressures compared to standard spray sprinkler nozzles.
- It is important to note that the percentages discussed previously are not necessarily representative of potential water savings.

WaterSense NOI: Existing Performance Data

NOI Questions and Data Gaps

WaterSense invites stakeholders to share any additional performance data on HES sprinkler nozzles.

WaterSense NOI: Product Marking, Documentation, and Marketing

- WaterSense is considering requiring labeled spray sprinkler nozzle marking and documentation to conform to the following sections of ASABE/ICC 802-2020:
  - Section 304.1.5, *Sprinkler and Bubbler Product Marking, General*
  - Section 304.1.2, *Marking of Sprays and Rotors*

WaterSense NOI: Product Marking, Documentation, and Marketing

- For instances where flow rate, distance of throw, and/or application rate vary depending on the nozzle selected, Section 304.2 of ASABE/ICC 802-2020 allows manufacturers to provide a range or table.
- WaterSense proposes that certified products and/or their associated packaging or documentation display the recommended and maximum operating pressure.
- WaterSense is considering requiring the product packaging and/or documentation or marketing material of WaterSense labeled spray sprinkler nozzles to indicate whether the nozzle should be installed on a WaterSense labeled spray sprinkler body with integral pressure regulation.

WaterSense NOI: Product Marking, Documentation, and Marketing

NOI Questions and Data Gaps

WaterSense invites stakeholder feedback on these proposed product marking and documentation requirements.

WaterSense NOI: Communicating Savings

- WaterSense has identified application rates as the primary mechanism leading to water savings with HES sprinkler nozzles.
  - Application rate may be a more appropriate attribute than flow rate for the purposes of a potential WaterSense label, since it reflects the irrigated area, as well as the rate at which water is emitted from the sprinkler nozzle.
- Even though HES sprinkler nozzles provide a lower application rate to a landscape, homeowners are likely to maintain a similar irrigation schedule after retrofitting their sprinkler nozzles, leading to water savings.
- The lower application rate also allows water to percolate into the soil, limiting runoff and water waste.

WaterSense NOI: Communicating Savings

- Researchers have speculated that water savings related to HES sprinkler nozzles may be largely influenced by human behavior.
  - Homeowners likely program their irrigation controllers to provide more water than necessary for their landscapes.
  - HES sprinkler nozzles generally have lower flow rates than standard spray sprinkler nozzles. Therefore, industry guidance recommends increasing the runtime of irrigation schedules after a retrofit.
  - However, if a system is retrofitted with HES sprinkler nozzles and the schedule is not changed, HES sprinkler nozzles will apply less water to the landscape.

WaterSense NOI: Communicating Savings

- Customers may not feel comfortable running their sprinklers for more than 30 minutes due to outreach about drought. They may feel guilty about watering their lawns for extended periods of time and want to be seen as doing their part to respond to drought.
- If this is a widespread sentiment, homeowners may see significant water savings from installing HES sprinkler nozzles, because they will not be willing to irrigate for the longer time periods needed to supply the same volume of water to their landscapes that was provided by sprinklers with standard sprinkler nozzles.

WaterSense NOI: Communicating Water Savings

NOI Questions and Data Gaps

WaterSense is interested in stakeholder feedback on suspected reasoning behind potential water savings, including any information on whether stakeholders change irrigation schedules after a retrofit.

WaterSense invites stakeholder opinions on irrigation runtimes, including preferences for duration of irrigation.

WaterSense NOI: Communicating Savings

- The influence of application rate on irrigation volume could also cause challenges with local policies.
- Some regions might have watering windows (i.e., watering restrictions based on time of day). In those locations, there may not be enough time to adequately water larger landscapes with HES sprinkler nozzles.

WaterSense NOI: Communicating Water Savings

NOI Questions and Data Gaps

WaterSense is interested in feedback from water utilities on promoting WaterSense labeled HES sprinkler nozzles.

WaterSense would like to know if water utilities have concerns about whether consumers with HES sprinkler nozzles could meet their irrigation needs with watering windows in place.

Next Steps

Next Steps

- WaterSense is requesting input, supporting information, and data on topics related to HES sprinkler nozzles.
- NOI 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 **February 6, 2023.**
- EPA will review comments and data submissions to determine next steps for developing a draft specification.

Contact Us

EPA WaterSense

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)