WaterSense Performance Overview: *Weather-Based Irrigation Controllers*

Equal or superior product performance is a pillar of the WaterSense label. Ensuring performance is vital for maintaining program integrity and consumer confidence in WaterSense labeled products. As part of specification development, the U.S. Environmental Protection Agency (EPA) also evaluates whether high-efficiency products will have other environmental or economic impacts. This includes whether there will be unintended or negative impacts to overall system performance, which may affect user satisfaction and health and safety. This Performance Overview details EPA's process for developing performance test methods and criteria for weather-based irrigation controllers (WBICs). In general, as part of the specification development process, EPA involves many WaterSense stakeholders, including manufacturers, certifying bodies and testing laboratories, standard development organizations, trade organizations, water and energy utilities, and other water efficiency experts and advocates. Each of these stakeholders offers a unique perspective and has dedicated technical expertise and other resources that have contributed to the development of performance criteria used to ensure WaterSense labeled products perform as well or better than standard products on the market.

EPA released the *WaterSense Specification for Weather-Based Irrigation Controllers* and associated supporting statement on November 3, 2011. In 2021, WaterSense completed a minor revision to the specification (Version 1.1) to reference the American National Standards Institute (ANSI)/American Society of Agricultural and Biological Engineers (ASABE) Standard S627 *Weather-Based Landscape Irrigation Control Systems*, incorporate clarifications WaterSense made since the release of Version 1.0, and provide consistency with the *WaterSense Specification for Soil Moisture-Based Irrigation Controllers*. The specification applies to stand-alone controllers, add-on devices, and plug-in devices (collectively referred to in the specification as controllers) that use weather data as a basis for scheduling irrigation.

Summary of Performance Requirements

Table 1 summarizes the performance requirements included in the *WaterSense Specification for Weather-Based Irrigation Controllers*. Table 1 also describes the purpose of each requirement, the applicable standard the WaterSense specification references, and any specific requirements or deviations from the referenced standard.

Table 1. Summary of Performance Criteria Included in the *WaterSense Specification for Weather-Based Irrigation Controllers*

Performance Requirement	Purpose	Referenced Standard (if applicable)	Applies to Conventional Models	Applies to WaterSense Labeled Models
Irrigation adequacy	Provides an indication of the controller's ability to meet plant water needs.	Calculated in accordance with Section 4 (Test Method #1) of ANSI/ASABE S627. Irrigation adequacy shall be greater than or equal to 80 percent for each zone.		✓
Irrigation excess	Evaluates the controller's ability to avoid excess watering.	Calculated in accordance with Section 4 (Test Method #1) of ANSI/ASABE S627. Irrigation excess shall be less than or equal to 10 percent for each zone. The average of the irrigation excess scores calculated across the six zones shall be less than or equal to 5 percent.		✓
Supplemental capability requirements	Ensures the presence of additional features (e.g., ability to accommodate watering restrictions) to ensure greater long-term water savings.	No referenced standard; requirements developed through discussions with and feedback from WaterSense stakeholders. The supplemental capabilities are summarized below.		✓

Development of Performance Requirements

EPA began research on WBICs in 2006, the same year the program was launched, and initiated specification development in 2007 with the release of a Notice of Intent (NOI). In the years that followed, EPA worked with several groups of stakeholders, including irrigation industry groups, controller manufacturers, water utilities, and other water efficiency advocates and experts to identify relevant test methods, determine performance criteria, and develop additional product features that would address user satisfaction. Because this was the first irrigation product to be considered by WaterSense, and no national or voluntary product standard existed, it took substantial effort and time to develop the *WaterSense Draft Specification for Weather-Based Irrigation Control Technologies*, which was published in 2009. After significant stakeholder concern regarding the repeatability of the test method, which was heavily based on the eighth draft of the Smart Water Application Technologies® test protocol for climatologically-based controllers (SWAT protocol), as well as concern over its regional applicability, EPA worked with

the University of Florida to conduct two rounds of research to validate the test method[1] and make modifications, resulting in a repeatable test method that generated reproducible results in a variety of regions across the country. Based on these test method modifications, EPA published a revised draft specification for public comment in early 2011 before publishing the final specification in November 2011.

WaterSense labeled WBICs use local weather and landscape conditions to tailor irrigation schedules, allowing for more efficient use of water. The devices must be able to adequately meet the watering needs of a landscape without overwatering, maintaining an aesthetic landscape while also contributing to water efficiency. They also include additional features aimed at increasing water savings and improving user satisfaction, including the ability to comply with watering restrictions, connect to a rainfall device, and send notifications to the user if the weather signal is lost. The combination of producing a water-efficient irrigation schedule and additional performance features provides user satisfaction to a range of end users, including homeowners, facility managers, and irrigation contractors, as well as to water utilities who promote these products with rebates.

To measure whether plant water needs are met without overwatering, the specification relied upon a modified version of the eighth draft of the SWAT test protocol for climatologically based controllers, until the test method was incorporated into ANSI/ASABE S627. Version 1.1 of the WaterSense specification references Section 4 (Test Method #1) of ANSI/ASABE S627. Performance measures include irrigation adequacy, which is a measure of how well the plants' or landscape's consumptive water needs are met, and irrigation excess, which is a measure of the water applied in excess of the plants' or landscape's consumptive needs. To meet performance thresholds, products must score greater than or equal to 80 percent irrigation adequacy for each zone. This threshold is based on well-documented research that indicates that the appearance of warm and cool season turfgrass does not significantly differ when irrigated between 80 and 100 percent of their specific evapotranspiration rates. Products must score less than or equal to 10 percent irrigation excess for each zone. In addition, the average of the irrigation excess scores calculated across the six zones shall be less than or equal to 5 percent. This level allows for a reasonable amount of variation in controller scheduling but prevents excessive overwatering.

Water utility stakeholders indicated during the specification development process that WBICs need to have additional features to maintain their performance and intended long-term water savings. A working group consisting of utility and manufacturer representatives collaborated to produce the list of supplemental capability requirements described in Section 4.0 of the specification. These requirements were refined over time based on comments submitted under the initial and revised draft specifications and continued to receive stakeholder support during the specification review that EPA conducted in 2019. These requirements include the following additional controller capabilities:

[1] For additional information on the University of Florida research on the WBIC test method, as well as the two reports generated based on this research, visit the WaterSense Background Materials web page at www.epa.gov/watersense/product-background-materials.

- The controller must have non-volatile memory to ensure that information regarding the programmed irrigation settings is retained when the power source is lost and no backup battery is available.
- The controller must have zone-by-zone control to successfully manage landscapes that have multiple areas with various watering requirements that need to be managed separately.
- The controller must be able to notify the user if it is not operating in smart mode (e.g., if there is a problem with the signal or local sensor input that is prohibiting it from automatically adjusting irrigation based on weather).
- The controller must be able to connect to a rainfall device or soil moisture sensor. Rainfall devices and soil moisture sensors can be important components of an efficient irrigation system in many climate regions. Multiple states have mandated the inclusion of one of these devices by law.
- The controller must be able to accommodate watering restrictions. With the existence of utility-imposed watering restrictions, it is important that weather-based controllers are capable of watering efficiently while complying with these restrictions.
- The controller must include a percent adjust (water budget) feature. This feature allows end users to increase or decrease water applied to the landscape without changing the detailed settings in the controller's program.
- The controller must be able to rely on a conservative watering schedule if the product loses real-time weather input or a weather signal. This can be either a proxy of historical weather data or a percent adjust (water budget) feature.
- The controller must be capable of automatically returning to smart mode if switched to manual mode. Often, controllers are turned to manual mode for troubleshooting or other reasons and not returned to smart mode. This requirement ensures the controller will automatically return to smart mode within a specified time period as designated by the manufacturer.

Each of these supplemental features offers users flexibility in how they choose to operate their WaterSense labeled irrigation controllers, while also maintaining water efficiency and contributing to local code and regulatory compliance.

In 2014, ASABE initiated the process to develop a standardized test method for WBICs. The standard committee developed and deliberated on several alternative test methods and finalized a standard (ANSI/ASABE S627), which includes a test method (Test Method #1) identical to the method included in Version 1.0 of the WaterSense specification. Harmonization with the *WaterSense Specification for Weather-Based Irrigation Controllers* indicates strong industry support for and confidence that the requirements ensure irrigation controller performance. As mentioned previously, WaterSense subsequently modified its specification to provide reference to the ANSI/ASABE S627 standard.

The ANSI/ASABE S627 committee considered and included an alternative test method (Optional Test Method #2 Modifications) in the standard that differs in its approach from Test Method #1 referenced by the WaterSense specification. As stated in the standard, "Test method #2 is an additional test with a longer test period, different weather requirements, and modified virtual zones. Performance evaluation shall be based on irrigation adequacy, irrigation excess, and frequency of irrigation." EPA sought stakeholder feedback regarding the potential use of

Test Method #2 during its specification review process conducted in 2019 and 2020. Both utilities and manufacturers indicated support for the existing test method (upon which Test Method #1 is based) and its ability to identify high performing products and suggested maintaining it until more of the market consisted of WBICs. Additionally, EPA does not have test data resulting from Test Method #2 to evaluate how products on the market perform according to the test method, and therefore could not validate the efficacy of Test Method #2 in differentiating high performing and water-efficient products. If manufacturers choose to test their controllers to Test Method #2 and generate a set of performance data, WaterSense can review these data in the future.