Advantages of Matching Precipitation Rates and Optimal Pressure Regulation

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The Intelligent Use of Water.™
TOPICS WE WILL COVER

- **Matching Precipitation Rates**
  - Defining precipitation rates
  - How precipitation rates are calculated
  - How precipitation rates impact how much water a system uses
  - How precipitation rates impact scheduling coefficients and distribution uniformity
  - How much water can be saved by MPR

- **Pressure Regulation**
  - Pressure regulation vs. pressure compensation
  - Types of pressure regulation devices
  - When to use them
  - Benefits of their use

- **Water saving resources**
Precipitation Rate* = The speed at which an individual irrigation nozzle or irrigation system applies water. Measured in inches per hour (in/hr) in the United States.

**Square Spacing**

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<th>U.S.</th>
<th>Metric</th>
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<td>PR = 96.3 \times gpm</td>
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96.3 = Constant (inches/square foot/hour)  
1000 = Constant (millimeter/square meter/hour)

gpm = Gallons per minute (applied to area by sprinklers)  
m^3/h = Cubic meters per hour (applied to area by sprinklers)

S = Spacing between sprinklers

**Triangular Spacing**

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* Nozzle precipitation rates are based on spacing at 50% diameter of throw – “Head to Head Coverage”
Considering precipitation rates in an irrigation system helps:
- Eliminate run off
- Apply the only the needed amount of water
- Maximize plant health
- Avoid wet and dry spots
- Minimize water waste
- Reduce system cost
Irrigation precipitation rates are often categorized as:

- **Low** = 0.50 in/hr and less
- **Medium** = 0.51 in/hr to 1.00 in/hr
- **High** = 1.01 in/hr and greater
What factors need to be considered when selecting irrigation with low, medium, and high precipitation rates?

- Low precipitation rate irrigation is not inherently more efficient than medium and high precipitation rates.
- Type of plant material and total landscaped area.
- Infiltration rate of soil. How fast water is absorbed before run off occurs.
- Slope of irrigated area.

Are the terms “Low Precipitation Rate” and “Low Flow” interchangeable?

- NO – Flow measurements consider flow only. Precipitation rates consider both flow and irrigated area. A golf rotor can have a 70GPM flow and a low precipitation rate since it covers such a large area.
Watering to the weak spot – How precipitation rates impact distribution uniformity and scheduling coefficients…

- **Distribution Uniformity (DC)** = A measure of how evenly water is applied to an area. A perfect distribution uniformity (DU) would be 100%.
  - DU is a measure of efficiency. Precipitation rate is only the average rate of application.

- **Scheduling Coefficient (SC)** = Calculated from a denso-gram or catch can test. This measure finds the dry spot and delivers a multiplier for irrigation run time that will provide adequate water to the driest section of the coverage area.
Watering to the weak spot – How precipitation rates impact distribution uniformity and scheduling coefficients…

- Individual component precipitation rates vs. zone or system precipitation rates
  - When an individual component’s precipitation rate is published by a manufacturer it refers to the performance of that specific component.

- A zone or system precipitation rate must be calculated for the average precipitation rate over the entire irrigated area. This can be done by using the Total Area Method.

<table>
<thead>
<tr>
<th>U12 Series</th>
<th>23° Trajectory</th>
<th>Nozzle</th>
<th>Pressure psi</th>
<th>Radius ft.</th>
<th>Flow gpm</th>
<th>Precip ln/h</th>
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Matching Precipitation Rates

- It is important to match as closely as possible precipitation rates of individual components in a zone or system. This helps to maximize the DU and SC of the individual components in a system and minimize water waste.

How is Matched Precipitation Rate (MPR) Achieved?

- When irrigating with spray nozzles, select nozzle families that have matched precipitation rates across both arcs and radii (MPR, U-Series)
- When irrigating with rotors, select nozzles that best maintain similar precipitation rates across both arc and radii or choose specific MPR nozzle sets.
- When irrigating with drip this is less critical since many drip systems use point source irrigation.
Matching Spray and Rotary Nozzle Precipitation Rates in Individual Components to Build an MPR System

- Rain Bird makes this easy by providing three nozzle sets (MPR, U-Series, and Rotary Nozzles) that have matched precipitation across all arcs and radii. We take the work out of choosing the right nozzle, just install for the proper arc and radii.

Matching Rotor Precipitation Rates in Individual Components to Build an MPR System

- This is a little more complicated. Since rotors arcs are adjustable, one nozzle will deliver significantly different precipitation rates depending on the area of coverage.
Matching Rotor Precipitation Rates in Individual Components to Build an MPR System (cont.)

- Common rotor installation methods
  - Same Nozzle for all Rotors – “I just use the same nozzle in all rotors because it saves time and keeps the radius the same.” – This method works great if all rotors with similar arc settings are zoned together, but that is not common practice.
  - Select Nozzles to Deliver Best MPR – “If I have a 3 GPM nozzle in the corner (90 degrees), I’ll use a 6 GPM nozzle on the sides (180 degrees).” – This is the most common practice. Rotors are not zoned by arc, but are grouped together by area. To achieve best MPR nozzles are installed per the diagram below:

Remember PR is measured in “inches per hour”

6 GPM is double the flow of 3 GPM. The 6 GPM nozzle covers twice the area of the 3 GPM nozzle. This achieves MPR right? Not exactly. The 6 GPM nozzle will have a longer radius of throw and greater area of coverage giving it a lower PR.
Great time to mention…

- MPR Nozzle sets for the 5000 Series Rotors
  - Recognized by the American Society of Agricultural Engineers (ASAE) for engineering excellence with a prestigious AE50 award.
  - Match both Precipitation Rate **AND** radius
  - As simple as installing spray nozzles!

3 Sets of Nozzles for 25’, 30’ and 35’ provide both MPR of 0.6 in/hr and matched radius.

This is the same precipitation rate as Rotary Nozzles delivering true 0.6 in/hr MPR from 13 to 35’
How much water can matching precipitation rates save? Let’s look at three examples.

All calculations use 9 x 5000 Series rotors on one irrigation zone, operating at 45 psi, spaced 35’ apart in a 3 x 3 grid.

**Installation 1** - All 3 GPM nozzles spaced 35 feet apart

**Installation 2** - 1.5 GPM nozzles in corners, 3 GPM nozzles on sides, and 6 GPM nozzle in center

**Installation 3** - 35’ Series MPR Nozzles in all rotors
Assume all SC and DU is perfect and the same for all nozzles then isolate precipitation rate as the only variable. Consider a weekly watering need of 2.1 inches...

- **Installation 1** - All 3 GPM nozzles spaced 35 feet apart
  - To deliver 2.1 inches of irrigation a week to all areas of turf the zone would consume 204 gallons of water

- **Installation 2** - 1.5 GPM nozzles in corners, 3 GPM nozzles on sides, and 6 GPM nozzle in center
  - To deliver 2.1 inches of irrigation to all areas of turf the zone would consume 156 gallons of water (Savings vs. Installation 1 = 24%)

- **Installation 3** - 35’ Series MPR Nozzles in all rotors
  - To deliver 2.1 inches of irrigation to all areas of turf the zone would consume 135 gallons of water (Savings vs. Installation 1 = 34%, Savings vs. Installation 2 = 13%)
Conclusion

- When isolating precipitation rates as the only variable in an irrigation system it is clear that choosing MPR individual components in a zone or system can have a tremendous impact on reducing water waste and maximizing efficiency.

- Combining the selection of MPR products with a properly designed system, high DU, and low SC products results in a system that performs evenly and efficiently resulting in less water consumption.
PRESSURE REGULATION
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- **Regulation vs. Compensation**
  - **Pressure Regulation** – Maintaining a constant and preset desired outlet pressure regardless of inlet pressure or pressure fluctuations when inlet pressure exceeds threshold of pressure regulating device.
  - **Pressure Compensation** – Predictably reducing outlet pressure relative to inlet pressure where final outlet pressure is subject to variability determined both by compensating device and inlet pressure.
PRESSURE REGULATION

- In irrigation systems, pressure is mainly regulated for the following reasons:
  1. To reduce supply line pressure to be within manufacturers recommended operating pressure for downstream components
  2. To reduce water waste caused by high pressure operation and ensure nozzles operate at maximum efficiency
  3. To make certain that calculated design hydraulics are being achieved in the field and irrigation devices are operating to manufacturer provided radius, flow, and precipitation rates
  4. Accommodate pressure fluctuations of water supply
1. To reduce supply line pressure to be within manufacturers recommended operating pressure for downstream components
   - Supply line regulation typically occurs at one of two locations (sometimes both):
     - At the point of connection (POC) or near backflow device
     - At the valve
   - Pressure regulation at the POC or near backflow device will use in-line regulation devices
   - Pressure regulation at the valve use add on devices like PRS Dial to regulate pressure

_Why not just use PRS?_ – Supply line pressures can easily exceed recommended operating pressure of components downstream of irrigation valves

_What should be considered when choosing where to place pressure regulating devices?_
2. To reduce water waste caused by high pressure operation and ensure nozzles operate at maximum efficiency

- More pressure ≠ Better performance
- Optimal pressure = Optimal performance
  - Spray nozzles = 30 psi
  - ¾” inlet rotors and Rotary Nozzles = 45 psi
  - 1” inlet rotors = 70 psi
- Water savings in a high pressure system can be **+50%** if a 70 psi spray zone is reduced to the optimal 30 psi operating pressure
- Why?
  - Increased pressure leads to – excessive flow, increased velocity, overthrow, misting and fogging, vaporization, wind drift, smaller droplets of water
  - The greater the pressure above optimal, the less water that is beneficially used
  - Every 5 psi reduction in pressure reduces water usage by 6-8%
3. To make certain that calculated design hydraulics are being achieved in the field and irrigation devices are operating to manufacturer provided radius, flow, and precipitation rates

- U12H at 30psi uses 1.30gpm
- U12H at 70psi can use up to 2.3gpm
- Imagine the impact to your system hydraulics if each nozzle used 1gpm more than anticipated!
- Without pressure regulation at the spray a system could experience excessive pressure loss due to increased flow leading to greater water velocity in pipes

### U12 Series

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3. Continued…
   – The same is true for rotors
   – Pressure regulation at the irrigation head…
     ▪ Eliminates head-to-head pressure variation and equalizes performance – upgrading to pressure regulating heads makes a big difference if you notice a decrease in performance the further downstream of the valve you get
     ▪ Eliminates misting and fogging contributing to water waste
     ▪ Results in bigger water droplets
     ▪ Improves distribution uniformity and scheduling coefficient
4. Accommodate pressure fluctuations of water supply
   - Even when great care is taken to calculate system hydraulics, you may still experience unexpected performance of your irrigation system due to fluctuations in your water supply. Always take the following supply and demand factors into consideration:
     - **Short Term Variation**
       - Hours of peak usage – you are not on site to observe performance 24 hours a day
       - Maintenance
       - Season
       - Restrictions
     - **Long Term Variation**
       - Community development – Who here has had trouble passing inspecting at the wrong time of day?
       - Changing regulations
       - Water source
PRESSURE REGULATION

Robertson House

Device: PrTemp1000
Serial Number: M25798
User ID: Dave 1
# PRESSURE REGULATION

## BENEFITS OF PRESSURE REGULATION

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>BENEFIT OF PRS</th>
<th>VALUE</th>
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<tbody>
<tr>
<td>Supply line pressure exceeds operating pressure specifications of irrigation equipment</td>
<td>Regulation on main line or at valve can reduce operating pressure for downstream components</td>
<td>Decreases wear on irrigation system components and achieves desired performance</td>
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<tr>
<td>Misting and fogging leading to water waste</td>
<td>Regulation at the head results in optimal nozzle performance</td>
<td>Reduces water waste and run times. Increases uniformity and efficiency</td>
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<td>High pressure causes excessive flow from nozzles resulting in unexpected pressure loss</td>
<td>Regulation equalizes system performance at manufacturer recommended pressures</td>
<td>Simplifies hydraulic calculations and eliminates poor performance of heads furthest downstream of valve</td>
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<td>Water supply pressure fluctuates</td>
<td>Regulation eliminates the impact of fluctuating supply line pressure</td>
<td>Preserves system performance and ensures intended operation</td>
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PRESSURE REGULATION

- **Rain Bird pressure regulating solutions:**
  - At the valve pressure regulation = PRS Dial
  - The PRS-Dial is an excellent means of regulating outlet pressure from 15 to 100psi at the valve regardless of incoming pressure fluctuations. The visible scale makes installation quick and easy
PRESSURE REGULATION

- **Rain Bird pressure regulating solutions:**
  - At the rotor pressure regulation = Pressure regulating swing joints
  - The Rain Bird Turf Swing Joint with Pressure Regulating System (TSJ-PRS) controls and maintains a preset inlet pressure for rotors with 3/4" (45 psi) and 1" (70 psi) inlets
PRESSURE REGULATION

- **Rain Bird pressure regulating solutions:**
  - In-stem pressure regulation = Pre-installed pressure regulating devices
  - Rain Bird offers these products with pre-installed in-stem pressure regulation
    - 1800 Series Sprays (30 psi for spray nozzles – MPR, VAN, and U-Series)
    - 45 psi 1800 Series Sprays (45 psi for Rotary Nozzles)
    - 5000 PRS Series Rotors – The **ONLY** rotor that provides 45 psi pressure regulation in-stem

**NEW!**

PRS OPTION IN 5000 & 5000 PLUS

© Rain Bird Corporation
QUESTIONS?
RESOURCES

- **The Intelligent Use of Water™**
  - Learn more about Rain Bird and our commitment to the Intelligent Use of Water™

- **Rain Bird water saving calculators**
  - These calculators help estimate water savings, cost savings, and payback of installing PRS devices

- **Rain Bird catalog reference section**
  - This is a link to the reference section of our catalog with pipe sizing reference charts, technical support information, and warranty information

- **Rain Bird para los hispano hablantes**
  - Tenemos un catálogo en español en Internet
  - [http://www.rainbird.com/landscape/literature/catalog.htm](http://www.rainbird.com/landscape/literature/catalog.htm)