

**Senninger**<sup>®</sup>



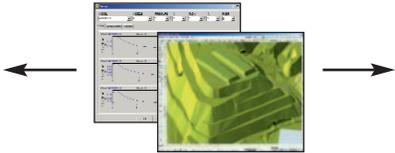
# **Solution Mining**

**IRRIGATION PRODUCTS**

# Product Selection

GOLD/SILVER (Au/Ag) pH Range 3.0 to 9.0	COPPER (Cu) pH Range 0.5 to 3.0	Model	Flow Range	Pressure Range	Page Number
		PRMP Mining Prospector™ Pressure Regulator	0.1 - 7 gpm 0.006 - 0.44 L/s	10 - 40 psi 0.69 - 2.76 bar	5
		PMR-LF ( <i>low-flow</i> ) Pressure-Master® Pressure Regulator	0.1 - 8 gpm 0.006 - 0.504 L/s	6 - 40 psi 0.41 - 2.76 bar	6
		PMR-MF ( <i>medium-flow</i> ) Pressure-Master® Pressure Regulator	2 - 20 gpm 0.126 - 1.26 L/s	6 - 60 psi 0.41 - 4.14 bar	7
	<div style="border: 1px solid black; padding: 5px; text-align: center;">Not Available</div>	PR-HF ( <i>high-flow</i> ) Pressure Regulator	10 - 32 gpm 0.63 - 2.02 L/s	10 - 50 psi 0.69 - 3.45 bar	8
		Xcel-Wobbler® HA ( <i>high-angle</i> )	0.78 - 6.97 gpm 0.05 - 0.47 L/s	10 - 25 psi 0.75 - 1.7 bar	10
		Xcel-Wobbler® MA ( <i>mid-angle</i> )	0.78 - 6.97 gpm 0.05 - 0.47 L/s	10 - 25 psi 0.75 - 1.7 bar	10
		Wobbler® SA ( <i>standard-angle</i> )	0.78 - 6.97 gpm 0.05 - 0.47 L/s	10 - 25 psi 0.75 - 1.7 bar	12
		Wobbler® LA ( <i>low-angle</i> )	0.78 - 6.97 gpm 0.05 - 0.47 L/s	10 - 25 psi 0.75 - 1.7 bar	12
		mini-Wobbler®	0.42 - 4.08 gpm 0.03 - 0.27 L/s	15 - 30 psi 1.0 - 2.0 bar	14

# Product Selection

GOLD/SILVER (Au/Ag) pH Range 4.0 to 9.0	COPPER (Cu) pH Range 0.5 to 4.0	Model	Flow Range	Pressure Range	Page Number
	Consult Factory	*Super Spray®	3.12 - 24.5 gpm 0.21 - 1.55 L/s	20 - 80 psi 1.5 - 5.5 bar	16
		3023 Impact (3/4" NPT M)	1.84 - 5.36 gpm 0.11 - 0.33 L/s	30 - 60 psi* 2.0 - 4.0 bar	18
		4023 Impact (3/4" NPT M)	3.82 - 10.6 gpm 0.24 - 0.66 L/s	30 - 60 psi* 2.0 - 4.0 bar	18
		5023 Impact (3/4" NPT M)	6.50 - 16.8 gpm 0.40 - 1.04 L/s	30 - 60 psi* 2.0 - 4.0 bar	18
		8025HD Impact (1 1/4" & 1 1/2" NPT M)	25.2 - 91.8 gpm 1.66 - 5.69 L/s	40 - 75 psi* 3.0 - 5.0 bar	20
	Consult Factory	3123 Part-Circle Impact (3/4" NPT M)	2.42 - 4.34 gpm 0.15 - 0.27 L/s	30 - 60 psi* 2.0 - 4.0 bar	22
		4123 Part-Circle Impact (3/4" NPT M)	3.82 - 7.81 gpm 0.24 - 0.48 L/s	30 - 60 psi* 2.0 - 4.0 bar	22
					24

\* Sprinklers should be fitted with barrel cylinder vane.

## About Senninger

Since 1963, Senninger Irrigation has earned a reputation based on a commitment to quality and innovation. Senninger continues to meet the special needs of distinctly different industries by manufacturing products specifically suited to their success. We began manufacturing thermoplastic sprinklers for agricultural irrigation in 1963. In 1970, our product line grew to include leaching equipment for solution mining in the Arizona copper industry. Since that time, products such as our **Wobbler®** off-center rotary-action sprinkler, our **8025 impact sprinkler**, and our **Pressure-Master Regulator®** have become industry standards for gold, silver, and copper leaching. The outstanding reliability of these and other products described in this catalog has helped us establish long-standing relationships with mining interests on six continents.

All Senninger mining products are constructed using engineering-grade thermoplastic resins which are specially formulated and selected for resistance to corrosion, abrasion, ultraviolet degradation, and the rugged conditions specific to solution mining. For example, our **Copper-Mine-Special®** line is especially designed for acid leaching copper ores, even at very high sulfuric acid concentrations. We also manufacture products suited to the caustic solutions used for gold and silver mining.

Please use this catalog to select equipment for heap, dump, and in-situ leaching. Other applications include dust suppression, excess solution evaporation, detox rinsing, and application of effluent solutions. If you have any questions or comments, please contact your supplier or the Senninger corporate headquarters.

# What is Mineral Leaching

Removal of materials by dissolving them away from solids is called leaching. This is accomplished in much the same way as water removes chemicals from coffee grounds and produces the well known beverage. When specific minerals such as gold, silver, or copper are targeted with aqueous solutions, the process is known as *hydrometallurgy*. Hydrometallurgy includes a metal recovery process which transforms the dissolved minerals into a solid form that can be refined and worked into a final product suitable for consumers such as copper wire. For copper recovery, the process has been used since the mid 1800's, the first modern gold and silver recovery efforts date to the early 20th century.

The diagram on the right shows a simplified recovery circuit. Ore bearing material is reduced to an optimum size for dissolving the target mineral and then stacked or loaded into a pile on an impermeable layer forming a *heap*. Piles can also be constructed using *run-of-mine*

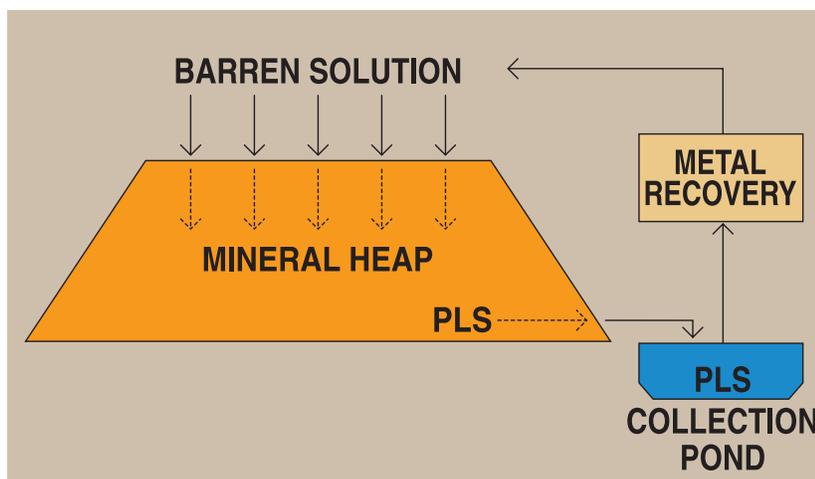
unreduced material, this is called *dump leaching*. When the ore body is too deep or difficult to mine the ore can sometimes be leached in place below ground level, this is referred to as *in-situ leaching*.

All methods employ an aqueous solution called *raffenate* or *barren solution* which is comprised of water and other solutions that have an affinity for dissolving the target mineral. They form a solvent, hence the term *solvent extraction*. In the case of copper leaching, sulfuric acid is added to water. Gold and silver solvent extraction is achieved by mixing cyanide with water.

Raffenate is uniformly distributed to the top of the heap using sprinklers, spray nozzles, or drip emitters and allowed to percolate through the heap until it reaches the impermeable layer. The solution now carries dissolved target minerals and in this form is referred to as *pregnant leach solution* or *PLS*. The PLS is collected and sometimes enriched by passing it back through the heap with more raffenate.

When the PLS becomes sufficiently concentrated, the dissolved target mineral is precipitated out of solution by the addition of another metal which replaces the target mineral. The end result is a precipitate which can be

further refined with filtration and or heat. Another method of recovery called *electro-winning* precipitates the mineral by adding a metal cathode and application of an electrical current. With both methods the solution becomes barren raffenate again and is returned to the heap for further solvent extraction.



Hydrometallurgy has been refined into an efficient technique to recover minerals from ore bodies which in years past were too difficult to process by other means or were considered low-grade waste. It is employed worldwide and presents challenges to equipment manufacturers to produce environmentally friendly, economical, corrosive resistant, and durable products. Senninger Irrigation Inc. has been manufacturing customized sprinklers, spray nozzles, pressure regulators, and fittings of this type since 1970.

# Mining Prospector™ Pressure Regulator

*Ideal for copper or gold/silver mining installations requiring lower flows (0.1 - 7.0 gpm) including side slope leaching and drip. Specifically designed for mining applications even in very low acid-cure processes.*

- Maintains a constant preset outlet pressure while handling varying inlet pressures
- Tamper-proof housing
- Very low hysteresis and friction losses
- Maximum flow path resists plugging
- Patented design
- 100% water-tested for accuracy (no adjustments ever needed)
- Built for strength and durability using high-impact engineering-grade thermoplastics
- One-year warranty on materials, workmanship AND performance

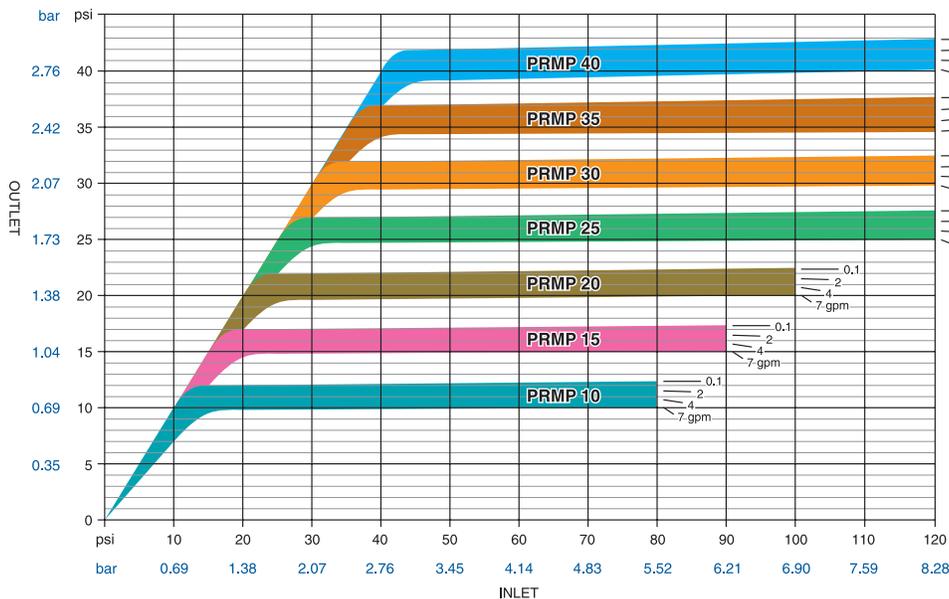


## PRMP – Mining Prospector® Pressure Regulator Performance<sup>1</sup>

Model Number	Preset Operating Pressure		Maximum Inlet Pressure		Flow Range		Inlet Sizes	Outlet Sizes
	(psi)	(bar)	(psi)	(bar)	(gpm)	(L/s)		
PRMP - 10	10	0.69	80	5.52	0.1 - 7	0.006 - 0.44	3/4" F hose, 3/4" M hose, 3/4" F NPT	3/4" M hose, 3/4" M NPT
PRMP - 15	15	1.04	90	6.21	0.1 - 7	0.006 - 0.44	3/4" F hose, 3/4" M hose, 3/4" F NPT	3/4" M hose, 3/4" M NPT
PRMP - 20	20	1.38	100	6.90	0.1 - 7	0.006 - 0.44	3/4" F hose, 3/4" M hose, 3/4" F NPT	3/4" M hose, 3/4" M NPT
PRMP - 25	25	1.73	120	8.28	0.1 - 7	0.006 - 0.44	3/4" F hose, 3/4" M hose, 3/4" F NPT	3/4" M hose, 3/4" M NPT
PRMP - 30	30	2.07	120	8.28	0.1 - 7	0.006 - 0.44	3/4" F hose, 3/4" M hose, 3/4" F NPT	3/4" M hose, 3/4" M NPT
PRMP - 35	35	2.42	120	8.28	0.1 - 7	0.006 - 0.44	3/4" F hose, 3/4" M hose, 3/4" F NPT	3/4" M hose, 3/4" M NPT
PRMP - 40	40	2.76	120	8.28	0.1 - 7	0.006 - 0.44	3/4" F hose, 3/4" M hose, 3/4" F NPT	3/4" M hose, 3/4" M NPT

<sup>1</sup> Regulated pressure is 1/2 psi (0.03 bar) higher with increasing inlet pressure than with decreasing inlet pressure

*Be sure to install regulator in the proper direction. The arrow on the upper housing shows the direction of flow and should always point downstream toward the drip tubing, sprinklers, etc.*



*The Senninger mining Prospector pressure regulator is ideal for side slope leaching and drip.*

**CAUTION:**  
All pressure regulators should always be installed downstream from all shut-off valves.

# Low Flow Pressure-Master Regulator®

*Ideal for installations requiring lower flows (0.1 - 8.0 gpm) to maintain a constant preset outlet pressure while handling varying inlet pressures.*

- Very low hysteresis and friction losses
- Maximum flow path resists plugging
- Patented design
- 100% water-tested for accuracy (no adjustments ever needed)
- Built for strength and durability using high-impact engineering-grade thermoplastics
- One-year warranty on materials, workmanship AND performance



**(COPPER MINE SPECIAL®)  
PMR-LF CMS (low flow)**

- Recommended for high sulfuric acid (0.5 to 3.0 pH) copper mining solutions (greater than 10/gpl H<sub>2</sub>SO<sub>4</sub>)

## PMR-LF Pressure-Master Regulator® Low Flow Performance<sup>1</sup>

Model Number	Preset Operating Pressure		Maximum Inlet Pressure		Flow Range		Inlet Sizes <sup>2</sup> (NPT)	Outlet Sizes <sup>3</sup> (NPT)
	(psi)	(bar)	(psi)	(bar)	(gpm)	(L/s)		
PMR - 6 LF	6	0.41	100	6.90	0.5 - 5	0.032 - 0.315	3/4" F	3/4" F
PMR - 10 LF	10	0.69	120	8.28	0.5 - 5	0.032 - 0.315	3/4" F	3/4" F
PMR - 12 LF	12	0.83	135	9.31	0.1 - 8	0.006 - 0.504	3/4" F	3/4" F
PMR - 15 LF	15	1.04	150	10.35	0.1 - 8	0.006 - 0.504	3/4" F	3/4" F
PMR - 20 LF	20	1.38	150	10.35	0.1 - 8	0.006 - 0.504	3/4" F	3/4" F
PMR - 25 LF	25	1.73	150	10.35	0.1 - 8	0.006 - 0.504	3/4" F	3/4" F
PMR - 30 LF	30	2.07	150	10.35	0.1 - 8	0.006 - 0.504	3/4" F	3/4" F
PMR - 35 LF	35	2.42	150	10.35	0.1 - 8	0.006 - 0.504	3/4" F	3/4" F
PMR - 40 LF	40	2.76	150	10.35	0.1 - 8	0.006 - 0.504	3/4" F	3/4" F

<sup>1</sup> Regulated pressure is 1/2 psi (0.03 bar) higher with increasing inlet pressure than with decreasing inlet pressure

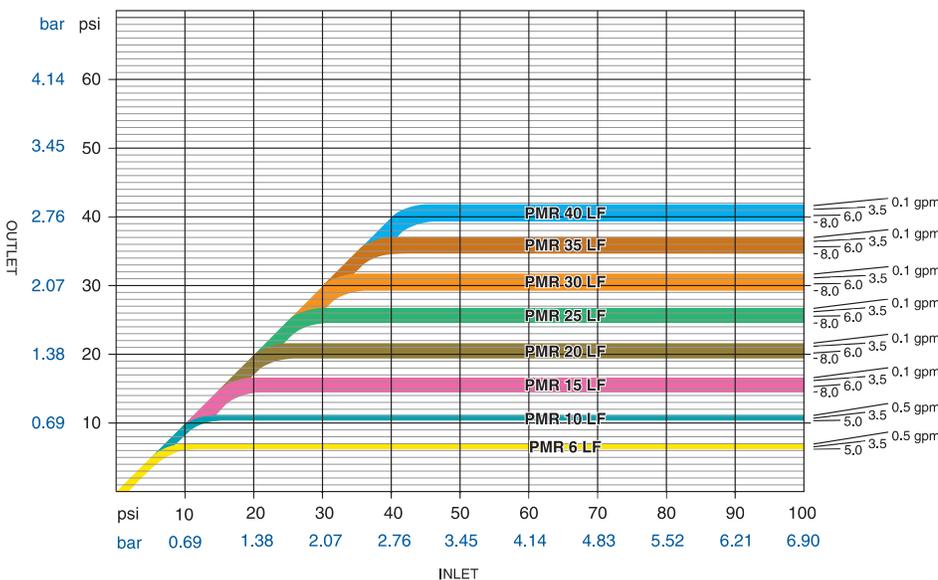
<sup>2</sup> Inlet also available in 3/4" F hose thread

<sup>3</sup> Outlet also available in 3/4" M hose thread



**(GOLD/SILVER MINING)  
PMR-LF (low flow)**

- Recommended for pH range 3.0 to 9.0 gold and silver mining solutions.



Refer to the performance chart above for maximum recommended inlet pressure for each model. Go to [www.senninger.com](http://www.senninger.com) for larger version; click on "Literature;" click on "Pressure Regulators."

**CAUTION:**  
All pressure regulators should always be installed downstream from all shut-off valves.

# Medium Flow Pressure-Master Regulator®

*Ideal for installations requiring mid-range flows (2 - 20 gpm) to maintain a constant preset outlet pressure while handling varying inlet pressures.*

- Very low hysteresis and friction losses
- Maximum flow path resists plugging
- Patented design
- 100% water-tested for accuracy (no adjustments ever needed)
- Built for strength and durability using high-impact engineering-grade thermoplastics
- One-year warranty on materials, workmanship AND performance



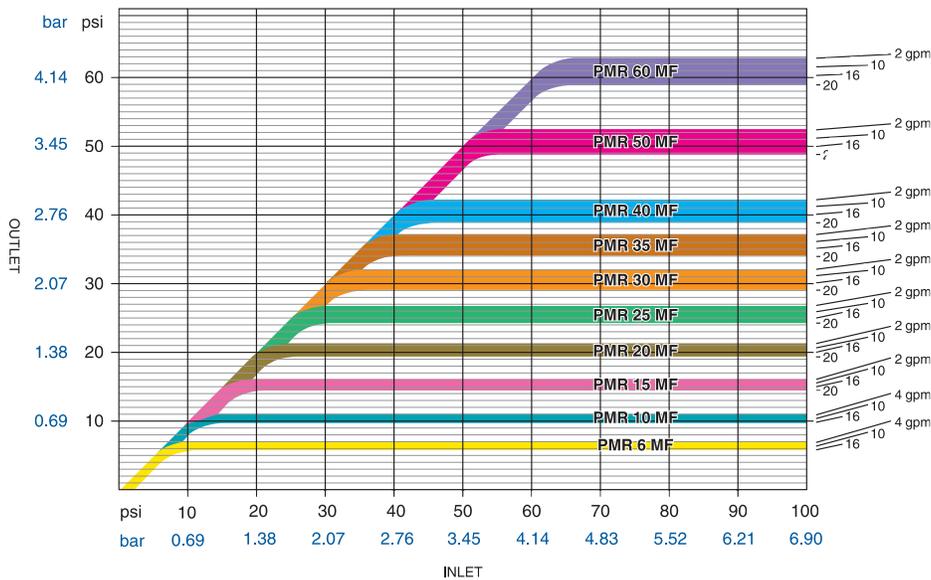
## (COPPER MINE SPECIAL®) PMR-MF CMS (medium flow)

- Recommended for high sulfuric acid (0.5 to 3.0 pH) copper mining solutions (greater than 10/gpl H<sub>2</sub>SO<sub>4</sub>)

## PMR-MF Pressure-Master Regulator® Medium Flow Performance<sup>1</sup>

Model Number	Preset Operating Pressure		Maximum Inlet Pressure		Flow Range		Inlet Sizes (NPT)	Outlet Sizes (NPT)
	(psi)	(bar)	(psi)	(bar)	(gpm)	(L/s)		
PMR - 6 MF	6	0.41	100	6.90	4 - 16	0.252 - 1.01	3/4" F, 1" F, 1" M	3/4" F, 1" F
PMR - 10 MF	10	0.69	120	8.28	4 - 16	0.252 - 1.01	3/4" F, 1" F, 1" M	3/4" F, 1" F
PMR - 12 MF	12	0.83	135	9.31	2 - 20	0.126 - 1.26	3/4" F, 1" F, 1" M	3/4" F, 1" F
PMR - 15 MF	15	1.04	150	10.35	2 - 20	0.126 - 1.26	3/4" F, 1" F, 1" M	3/4" F, 1" F
PMR - 20 MF	20	1.38	150	10.35	2 - 20	0.126 - 1.26	3/4" F, 1" F, 1" M	3/4" F, 1" F
PMR - 25 MF	25	1.73	150	10.35	2 - 20	0.126 - 1.26	3/4" F, 1" F, 1" M	3/4" F, 1" F
PMR - 30 MF	30	2.07	150	10.35	2 - 20	0.126 - 1.26	3/4" F, 1" F, 1" M	3/4" F, 1" F
PMR - 35 MF	35	2.42	150	10.35	2 - 20	0.126 - 1.26	3/4" F, 1" F, 1" M	3/4" F, 1" F
PMR - 40 MF	40	2.76	150	10.35	2 - 20	0.126 - 1.26	3/4" F, 1" F, 1" M	3/4" F, 1" F
PMR - 50 MF	50	3.45	150	10.35	2 - 20	0.126 - 1.26	3/4" F, 1" F, 1" M	3/4" F, 1" F
PMR - 60 MF	60	4.14	150	10.35	2 - 20	0.126 - 1.26	3/4" F, 1" F, 1" M	3/4" F, 1" F

<sup>1</sup> Regulated pressure is 1/2 psi (0.03 bar) higher with increasing inlet pressure than with decreasing inlet pressure



Refer to the performance chart above for maximum recommended inlet pressure for each model. Go to [www.senninger.com](http://www.senninger.com) for larger version; click on "Literature;" click on "Pressure Regulators."



## (GOLD/SILVER MINING) PMR-MF (medium flow)

- Recommended for pH range 3.0 to 9.0 gold and silver mining solutions.

**CAUTION:**  
All pressure regulators should always be installed downstream from all shut-off valves.

# High Flow Pressure Regulator

Specifically designed for installations requiring higher flows (10 - 32 gpm) to maintain a constant preset outlet pressure while handling varying inlet pressures.

- Maintains a constant preset outlet pressures while handling varying inlet pressures
- Very low hysteresis and friction losses
- Maximum flow path resists plugging
- Patented design
- 100% water-tested for accuracy (no adjustments ever needed)
- Built for strength and durability using high-impact engineering-grade thermoplastics
- One-year warranty on materials, workmanship AND performance



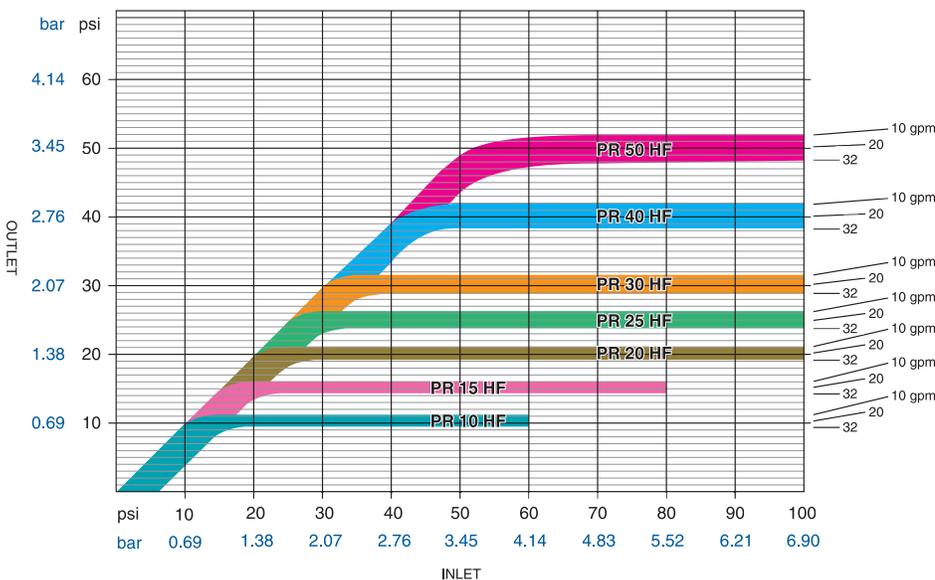
**(COPPER and GOLD/SILVER MINING)**  
**PR-HF (high flow)**

- Specifically designed for mining applications even where pH solutions are less than or equal to 4.0

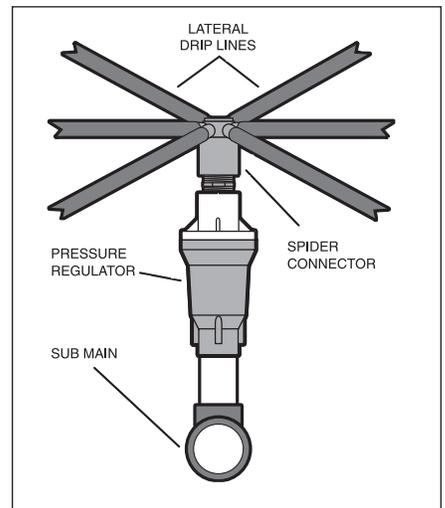
## PR-HF Pressure Regulator - High Flow Performance<sup>1</sup>

Model Number	Preset Operating Pressure		Maximum Inlet Pressure		Flow Range		Inlet Sizes (NPT)	Outlet Sizes (NPT)
	(psi)	(bar)	(psi)	(bar)	(gpm)	(L/s)		
PR - 10 HF	10	0.69	60	4.14	10 - 32	0.63 - 2.02	1 1/4" F	1" F, 1 1/4" F
PR - 15 HF	15	1.04	80	5.52	10 - 32	0.63 - 2.02	1 1/4" F	1" F, 1 1/4" F
PR - 20 HF	20	1.38	100	6.90	10 - 32	0.63 - 2.02	1 1/4" F	1" F, 1 1/4" F
PR - 25 HF	25	1.73	100	6.90	10 - 32	0.63 - 2.02	1 1/4" F	1" F, 1 1/4" F
PR - 30 HF	30	2.07	100	6.90	10 - 32	0.63 - 2.02	1 1/4" F	1" F, 1 1/4" F
PR - 40 HF	40	2.76	100	6.90	10 - 32	0.63 - 2.02	1 1/4" F	1" F, 1 1/4" F
PR - 50 HF	50	3.45	100	6.90	10 - 32	0.63 - 2.02	1 1/4" F	1" F, 1 1/4" F

<sup>1</sup> Regulated pressure is 1/2 psi (0.03 bar) higher with increasing inlet pressure than with decreasing inlet pressure



Refer to the performance chart above for maximum recommended inlet pressure for each model. Go to [www.senninger.com](http://www.senninger.com) for larger version; click on "Literature;" click on "Pressure Regulators."



One regulator can handle multiple lines as long as their combined flow does not exceed that of the regulator.

When the flow exceeds the capacity of a single regulator, you may use two or more regulators in parallel to achieve the same result.

Be sure to install the regulator in the proper direction. The arrow on the side of the lower housing shows the direction of flow and should always point downstream toward the drip tubing, sprinklers, etc.

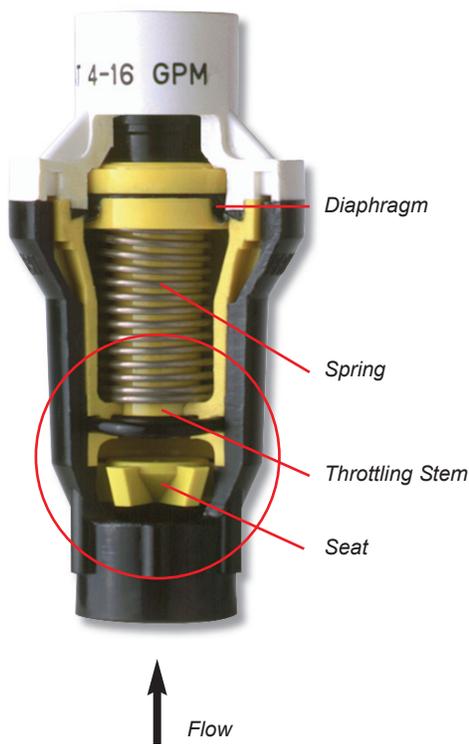
**CAUTION:**  
All pressure regulators should always be installed downstream from all shut-off valves.

# How a Pressure Regulator Functions

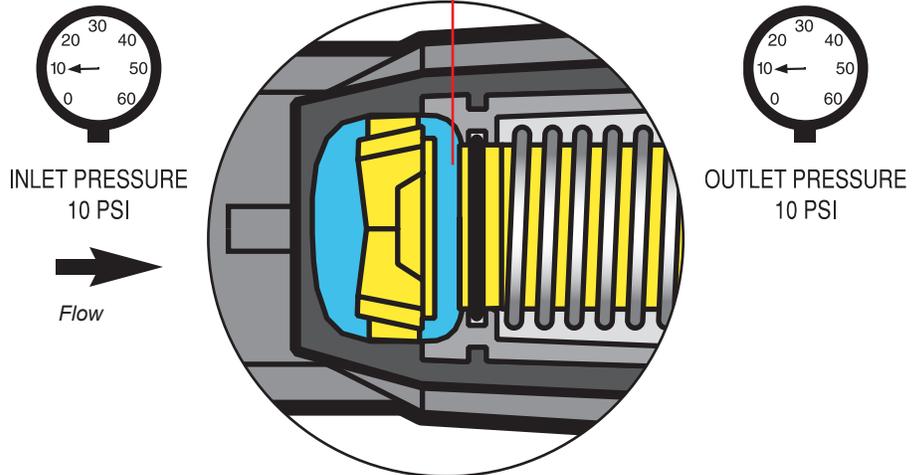
Each Senninger pressure regulator model has an internal compression spring corresponding to the specific preset outlet pressure rating. The example to the right illustrates how a 10 psi model reacts to increasing upstream pressure, maintaining the downstream pressure at 10 psi.

From a normally open position, the throttling stem moves toward the stationary seat as inlet pressure on the diaphragm increases. This adjustment of the flow path provides just enough correction to maintain the downstream pressure at the preset outlet pressure.

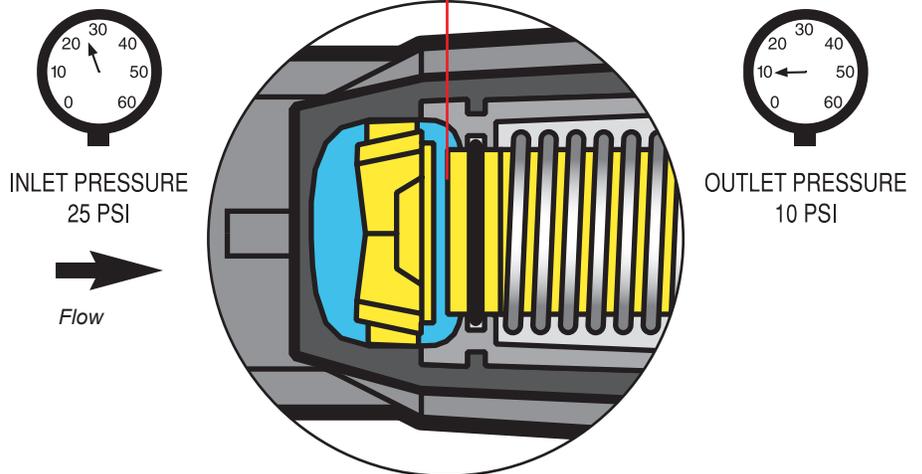
## Cutaway View of a Pressure Regulator



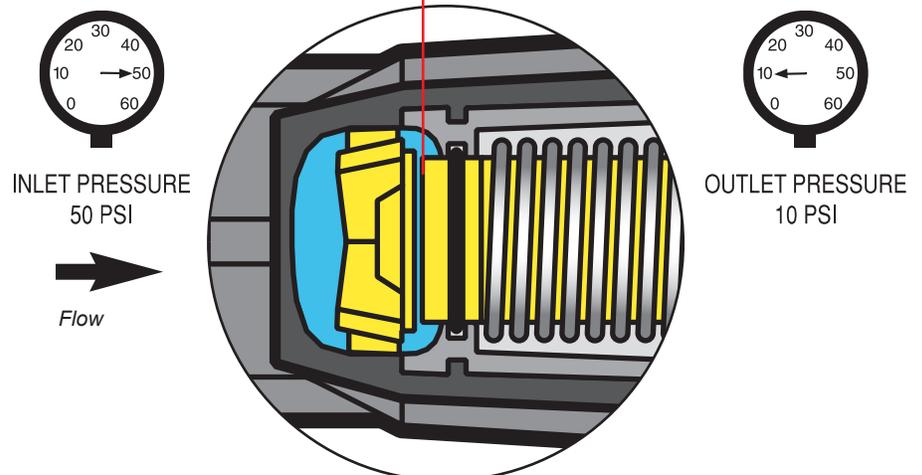
### Non-Pressurized (pressure differential 0 psi)



### Pressurized (pressure differential 15 psi)



### Pressurized (pressure differential 40 psi)



# Xcel-Wobbler®

(high-angle & mid-angle models)



**BALANCED DESIGN FOR  
USE WITH RISERS**

Senninger's Mining Xcel-Wobblers utilize a unique off-center rotary-action to provide extremely uniform coverage at low pressures with very low evaporative losses.

- New balanced design produces smooth, stable performance
- Only one moving part for longer life
- Built for strength and durability using high-impact engineering-grade thermoplastics, no metal parts
- Inlet sizes: 1/2" or 3/4" NPT male
- Flow rates: 0.78 to 5.11 gpm (0.05 to 0.30 L/s)  
(Consult factory for lower or higher flow rates.)
- One-year warranty on materials, workmanship AND performance



The Xcel-Wobbler uniformly provides outstanding uniformity.



**(COPPER MINE SPECIAL®)**  
**Xcel-Wobbler® HA CMS**

- Recommended for high sulfuric acid (0.5 to 3.0 pH) copper mining solutions (greater than 10/gpl H<sub>2</sub>SO<sub>4</sub>)
- Multi-level throw: approximately 24°



**(GOLD/SILVER MINING)**  
**Xcel-Wobbler® HA**

- Recommended for pH range 3.0 to 9.0 gold and silver mining solutions.
- Multi-level throw: approximately 24°



**(COPPER MINE SPECIAL®)**  
**Xcel-Wobbler® MA CMS**

- Recommended for high sulfuric acid (0.5 to 3.0 pH) copper mining solutions (greater than 10/gpl H<sub>2</sub>SO<sub>4</sub>)
- Multi-level throw: approximately 18°
- Smaller droplets than high-angle model for a more gentle application



**(GOLD/SILVER MINING)**  
**Xcel-Wobbler® MA**

- Recommended for pH range 3.0 to 9.0 gold and silver mining solutions.
- Multi-level throw: approximately 18°
- Smaller droplets than high-angle model for a more gentle application

Copper-Mine Special® (CMS) Model Patent Pending

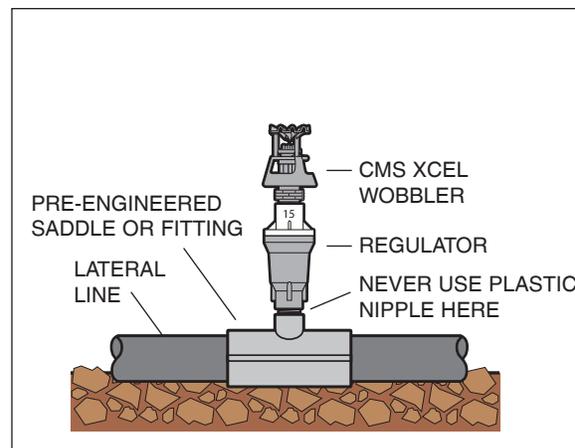
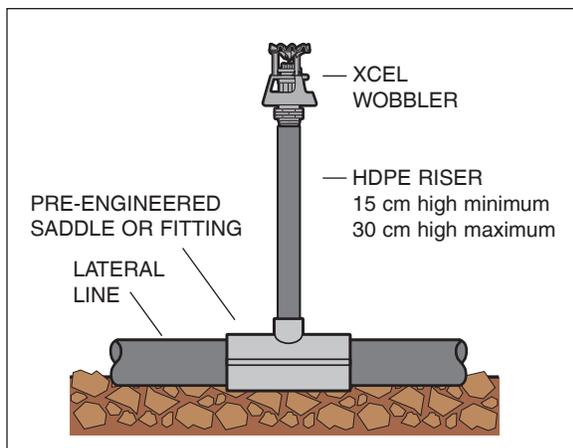


**BALANCED DESIGN FOR  
USE WITH RISERS**

# Xcel-Wobbler® (high-angle & mid-angle models)

SPRINKLER BASE PRESSURE	U.S. - Diameter (feet) at 1.5 ft height				METRIC - Diameter (meters) at 0.5m height				
	(psi)	10	15	20	25	(bar)	0.75	1.0	1.5
<b>#6 Nozzle - Gold (3/32")</b>						(psi)	10.88	14.50	21.75
Flow (gpm)	0.78	0.95	1.10	1.23					
High-Angle	34.0	39.5	42.5	43.5					
Mid-Angle	34.0	39.0	42.0	43.5					
<b>#7 Nozzle - Lime (7/64")</b>									
Flow (gpm)	1.06	1.30	1.50	1.68					
High-Angle	35.0	40.5	43.0	44.5					
Mid-Angle	34.5	39.5	43.0	44.0					
<b>#8 Nozzle - Lavender (1/8")</b>									
Flow (gpm)	1.40	1.71	1.98	2.21					
High-Angle	36.0	41.5	44.0	45.5					
Mid-Angle	35.0	40.0	43.5	44.5					
<b>#9 Nozzle - Grey (9/64")</b>									
Flow (gpm)	1.80	2.20	2.54	2.84					
High-Angle	37.0	42.5	45.0	46.5					
Mid-Angle	35.5	40.5	44.0	45.0					
<b>#10 Nozzle - Turquoise (5/32")</b>									
Flow (gpm)	2.22	2.72	3.14	3.51					
High-Angle	38.0	43.5	46.0	47.5					
Mid-Angle	36.0	41.0	44.5	45.5					
<b>#11 Nozzle - Yellow (11/64")</b>									
Flow (gpm)	2.69	3.30	3.81	4.26					
High-Angle	39.0	44.5	47.0	48.5					
Mid-Angle	36.5	41.5	45.0	46.0					
<b>#12 Nozzle - Red (3/16")</b>									
Flow (gpm)	3.23	3.96	4.57	5.11					
High-Angle	40.0	45.5	48.0	49.5					
Mid-Angle	37.0	42.0	45.5	46.5					

Stream heights range from 2.5 - 5.5 ft (0.8 - 1.7 m) above nozzle based on pressure and nozzle size.

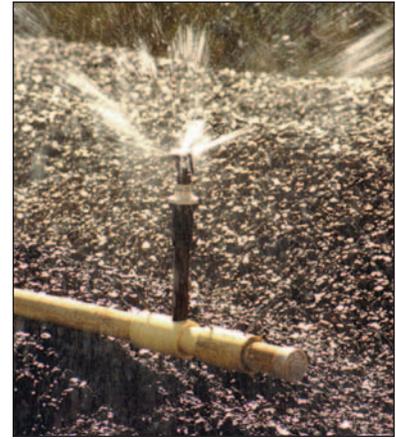


# Wobbler®

(standard-angle & low-angle models)

The Senninger Wobbler® has a unique off-center rotary-action. This design provides extremely uniform coverage over a large diameter at low pressures.

- Only one moving part for longer life
- Built for strength and durability using high-impact engineering-grade thermoplastics, no metal parts
- Low evaporative loss
- Standard inlet: 3/4" NPT male (1/2" NPT male also available)
- Flow range: 0.78 to 6.97 gpm (0.05 to 0.47 L/s) (Consult factory for lower or higher flow rates.)
- One-year warranty on materials, workmanship AND performance



The Wobbler uniformly covers the inside of its entire wetted circle, not just the perimeter.



## (COPPER MINE SPECIAL®) Wobbler® SA CMS

- Recommended for high sulfuric acid (0.5 to 3.0 pH) copper mining solutions (greater than 10/gpl H<sub>2</sub>SO<sub>4</sub>)
- Multi-level throw: approximately 24°



## (GOLD/SILVER MINING) Wobbler® SA

- Recommended for pH range 3.0 to 9.0 gold and silver mining solutions.
- Multi-level throw: approximately 24°



## (COPPER MINE SPECIAL®) Wobbler® LA CMS

- Recommended for high sulfuric acid (0.5 to 3.0 pH) copper mining solutions (greater than 10/gpl H<sub>2</sub>SO<sub>4</sub>)
- Multi-level throw: approximately 12°
- Smaller droplets than high-angle model for a more gentle application



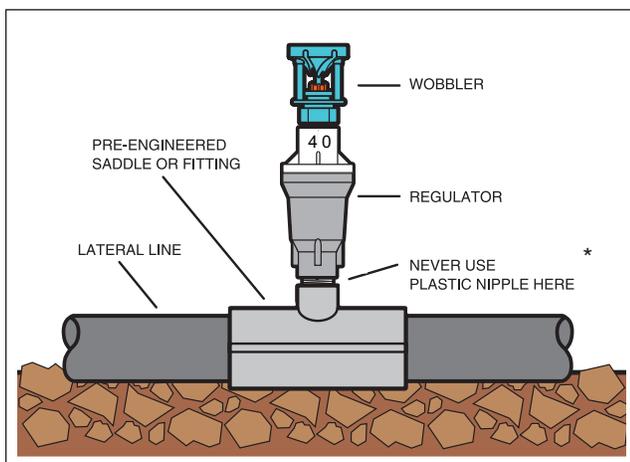
## (GOLD/SILVER MINING) Wobbler® LA

- Recommended for pH range 3.0 to 9.0 gold and silver mining solutions.
- Multi-level throw: approximately 12°
- Smaller droplets than high-angle model for a more gentle application

# Wobbler® (standard-angle & low-angle models)

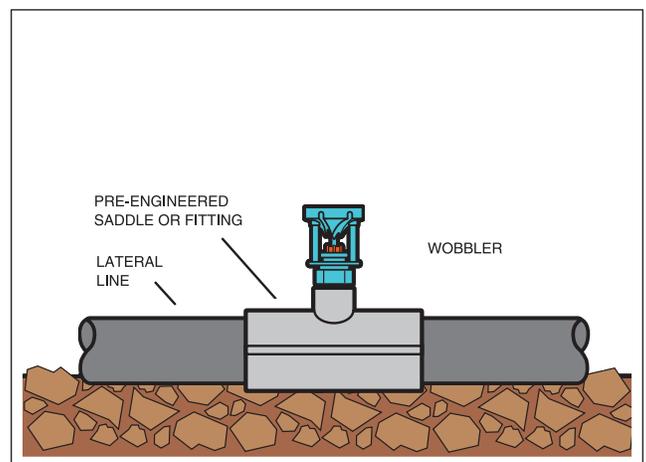
U.S. - Diameter (ft) at 0.5 ft height					METRIC - Diameter (m) at 15 cm height				
SPRINKLER (psi)	10	15	20	25	(bar)	0.75	1.0	1.5	2.0
BASE PRESSURE					(psi)	10.88	14.5	21.75	29.0
<b>#6 Nozzle - Gold (3/32")</b>					<b>#6 Nozzle - Gold (2.38 mm)</b>				
Flow (gpm)	0.78	0.95	1.10	1.23	Flow (L/s)	0.05	0.06	0.07	0.08
Standard Angle (ft)	36.9	41.0	45.0	45.3	Standard Angle (m)	11.5	12.4	13.8	13.9
Low Angle (ft)	28.6	31.5	34.5	35.0	Low Angle (m)	8.9	9.6	10.5	10.8
<b>#7 Nozzle - Lime (7/64")</b>					<b>#7 Nozzle - Lime (2.78 mm)</b>				
Flow (gpm)	1.06	1.30	1.50	1.68	Flow (L/s)	0.05	0.06	0.07	0.08
Standard Angle (ft)	38.9	42.7	46.5	46.7	Standard Angle (m)	12.1	12.9	14.2	14.3
Low Angle (ft)	30.0	32.5	35.3	35.9	Low Angle (m)	9.3	9.9	10.8	11.1
<b>#8 Nozzle - Lavender (1/8")</b>					<b>#8 Nozzle - Lavender (3.18 mm)</b>				
Flow (gpm)	1.40	1.71	1.98	2.21	Flow (L/s)	0.09	0.11	0.13	0.15
Standard Angle (ft)	40.4	45.3	47.5	47.9	Standard Angle (m)	12.6	13.7	14.5	14.7
Low Angle (ft)	31.5	33.5	36.0	36.7	Low Angle (m)	9.8	10.1	11.0	11.4
<b>#9 Nozzle - Grey (9/64")</b>					<b>#9 Nozzle - Grey (3.57 mm)</b>				
Flow (gpm)	1.80	2.20	2.54	2.84	Flow (L/s)	0.12	0.14	0.17	0.19
Standard Angle (ft)	41.4	46.1	48.1	48.7	Standard Angle (m)	12.9	13.9	14.8	14.9
Low Angle (ft)	32.5	34.5	36.7	37.5	Low Angle (m)	10.0	10.4	11.3	11.6
<b>#10 Nozzle - Turquoise (5/32")</b>					<b>#10 Nozzle - Turquoise (3.97 mm)</b>				
Flow (gpm)	2.22	2.72	3.14	3.51	Flow (L/s)	0.15	0.17	0.21	0.24
Standard Angle (ft)	42.2	46.7	48.7	49.3	Standard Angle (m)	13.1	14.1	14.9	15.1
Low Angle (ft)	33.5	35.5	37.4	38.4	Low Angle (m)	10.3	10.7	11.5	11.9
<b>#11 Nozzle - Yellow (11/64")</b>					<b>#11 Nozzle - Yellow (4.37 mm)</b>				
Flow (gpm)	2.69	3.30	3.81	4.26	Flow (L/s)	0.18	0.20	0.25	0.29
Standard Angle (ft)	42.7	47.5	49.3	49.8	Standard Angle (m)	13.3	14.4	15.1	15.3
Low Angle (ft)	33.5	36.2	38.4	39.4	Low Angle (m)	10.3	10.9	11.8	12.2
<b>#12 Nozzle - Red (3/16")</b>					<b>#12 Nozzle - Red (4.76 mm)</b>				
Flow (gpm)	3.23	3.96	4.57	5.11	Flow (L/s)	0.21	0.25	0.30	0.35
Standard Angle (ft)	43.5	48.1	49.6	50.4	Standard Angle (m)	13.5	14.5	15.3	15.5
Low Angle (ft)	33.5	36.9	39.4	40.4	Low Angle (m)	10.4	11.1	12.1	12.6
<b>#13 Nozzle - White (13/64")</b>					<b>#13 Nozzle - White (5.16 mm)</b>				
Flow (gpm)	3.80	4.65	5.38	6.01	Flow (L/s)	0.25	0.29	0.35	0.41
Standard Angle (ft)	44.1	48.5	50.0	50.8	Standard Angle (m)	13.7	14.6	15.4	15.6
Low Angle (ft)	34.5	37.7	40.4	41.4	Low Angle (m)	10.7	11.4	12.4	12.9
<b>#14 Nozzle - Blue (7/32")</b>					<b>#14 Nozzle - Blue (5.56 mm)</b>				
Flow (gpm)	4.40	5.39	6.23	6.97	Flow (L/s)	0.29	0.33	0.41	0.47
Standard Angle (ft)	44.7	48.9	50.4	51.2	Standard Angle (m)	13.9	14.8	15.5	15.7
Low Angle (ft)	35.5	38.4	41.4	42.4	Low Angle (m)	10.9	11.6	12.7	13.2

Larger and half-size nozzles are available; consult factory for specific performance data.  
Stream heights range from 2.5 - 5.0 ft (0.8 - 1.5 m) standard angle model and  
1.0 - 2.5 ft (0.3 - 0.8 m) low angle model above nozzle based on pressure and nozzle size.



The Wobbler can be mounted directly into a pressure regulator. A nipple connects it to the lateral.

\* Use carbon or stainless steel nipples in gold/silver mining.  
Use stainless steel nipples in acid copper leaching.



The Wobbler can be mounted directly into a saddle or pre-engineered plastic female fitting.

For minimizing evaporative loss, operate the Wobbler at 10-20 psi.

# mini-Wobbler®

The patented Senninger mini-Wobbler® employs the same unique off-center rotary-action as the Wobbler. It provides extremely uniform coverage over a large diameter at low pressures. It produces a gentle application of solutions.

- Only one moving part for longer life
- Built for strength and durability using high-impact engineering-grade thermoplastics, no metal parts
- Low evaporative loss
- Standard inlet: 1/2" NPT male
- Flow range: 0.42 to 4.08 gpm (0.027 to 0.27 L/s)
- One-year warranty on materials, workmanship AND performance



The CMS mini-Wobbler is designed specifically for high sulfuric acid solutions used for copper leaching.



## (COPPER MINE SPECIAL®) mini-Wobbler® CMS

- Recommended for high sulfuric acid (0.5 to 3.0 pH) copper mining solutions (greater than 10/gpl H<sub>2</sub>SO<sub>4</sub>)
- Multi-level throw: approximately 10°



## (GOLD/SILVER MINING) mini-Wobbler®

- Recommended for pH range 3.0 to 9.0 gold and silver mining solutions.
- Multi-level throw: approximately 10°

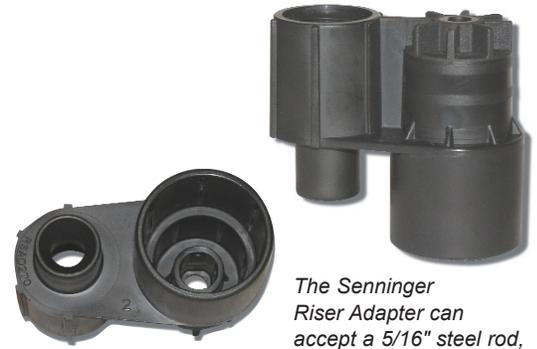
SPRINKLER BASE PRESSURE	U.S. - Diameter (ft) at 1.5 ft. height						METRIC - Diameter (m) at 46 cm height						
	(psi)	15	20	25	30	35	40	(bar)	1.0	1.5	2.0	2.5	3.0
<b>#4 Nozzle - Light Blue (1/16")</b>													
Flow (gpm)	0.42	0.50	0.56	0.62	0.68	0.72			0.027	0.033	0.038	0.042	0.046
Diameter (ft)	26.4	28.0	29.2	30.0	30.4	30.8			8.0	8.7	9.1	9.3	9.4
<b>#5 Nozzle - Beige (5/64")</b>													
Flow (gpm)	0.64	0.75	0.84	0.91	0.99	1.06			0.040	0.049	0.057	0.064	0.070
Diameter (ft)	30.8	33.6	34.8	35.6	36.0	36.4			9.3	10.4	10.8	11.0	11.1
<b>#6 Nozzle - Gold (3/32")</b>													
Flow (gpm)	0.95	1.10	1.25	1.36	1.47	1.58			0.06	0.07	0.08	0.09	0.10
Diameter (ft)	33.2	36.0	36.8	37.2	37.6	38.0			10.0	11.1	11.3	11.5	11.6
<b>#7 Nozzle - Lime (7/64")</b>													
Flow (gpm)	1.30	1.51	1.69	1.86	2.01	2.14			0.08	0.10	0.11	0.13	0.14
Diameter (ft)	34.8	37.6	38.4	38.8	39.2	39.6			10.5	11.5	11.8	12.0	12.1
<b>#8 Nozzle - Lavender (1/8")</b>													
Flow (gpm)	1.67	1.95	2.18	2.39	2.61	2.78			0.10	0.13	0.15	0.16	0.18
Diameter (ft)	35.6	38.4	39.2	39.6	40.0	40.4			10.8	11.8	12.0	12.2	12.3
<b>#9 Nozzle - Grey (9/64")</b>													
Flow (gpm)	2.04	2.36	2.66	2.93	3.17	3.40			0.13	0.16	0.18	0.20	0.22
Diameter (ft)	36.4	39.2	40.0	40.4	40.8	41.2			11.0	12.0	12.3	12.5	12.6
<b>#10 Nozzle - Turquoise (5/32")</b>													
Flow (gpm)	2.47	2.86	3.19	3.52	3.88	4.08			0.15	0.19	0.22	0.24	0.27
Diameter (ft)	37.2	40.0	40.8	41.2	41.6	42.0			11.2	12.3	12.5	12.7	12.8

Stream heights range from 1.5 - 3.0 ft (0.5 - 0.9 m) above nozzle based on pressure and nozzle size.

# Riser Adapter Assembly

The Senninger Riser Adapter allows mini-Wobblers and other sprinklers with 1/2" M (NPT) connections to be mounted securely on to 1/2" or 3/4" PVC or 5/16" steel rod stakes and connected to low-pressure polyethylene laterals.

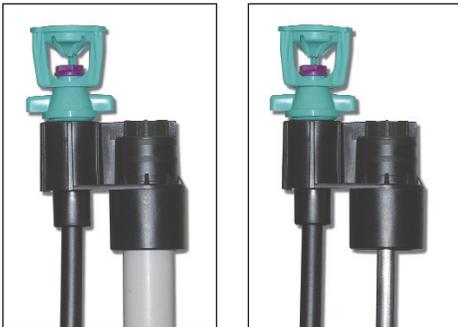
- Allows for easy installation in hard-to-reach places such as side slopes
- No gluing or fusing required
- Rugged engineering-grade thermoplastic construction
- Two models available: for 0.270" ID tubing or 0.345" ID tubing
- Available as individual components or as an assembly. (standard assembly includes Riser Adapter, three feet of tubing, and connection adapter.)
- One-year warranty on materials, workmanship AND performance



The Senninger Riser Adapter can accept a 5/16" steel rod, 1/2" or 3/4" PVC riser.



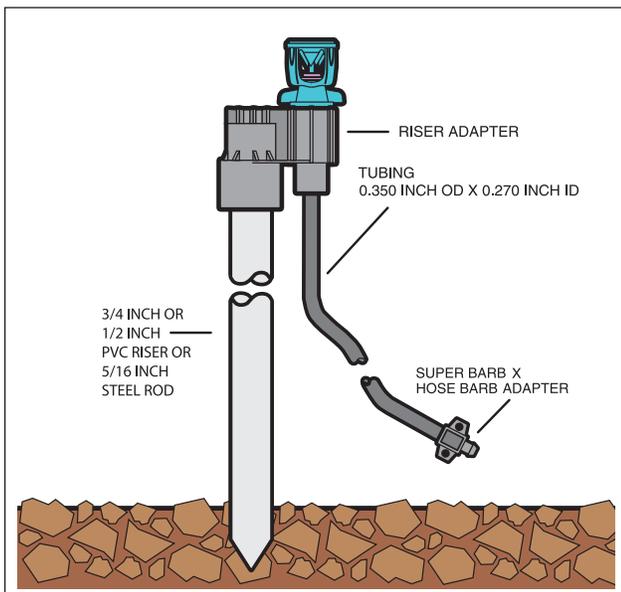
The Senninger Riser Adapter is designed for sprinklers with a 1/2" NPT connection and allows easy installation (shown with CMS mini-Wobbler).



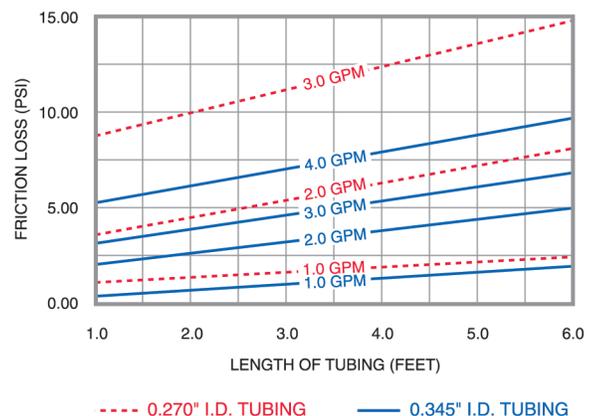
The Senninger mini-Wobbler® can be mounted onto the Riser Adapter using either 1/2" or 3/4" PVC or 5/16" steel rod stake. For maximum efficiency, operate the mini-Wobbler at 15-20 psi.

## Individual Components Available:

- Riser: 1/2" or 3/4" PVC (36" piece) or 5/16" steel rod (36" piece)
- Tubing: 0.270" ID or 0.345" ID PE tubing available in 36" sections or in a 1000 ft roll
- Tubing Punch Tool
- Goof Plugs for 0.270" or 0.345"



FRICITION LOSS THROUGH THE ASSEMBLY INCLUDING INLET BARB & RISER ADAPTER



# Super Spray®

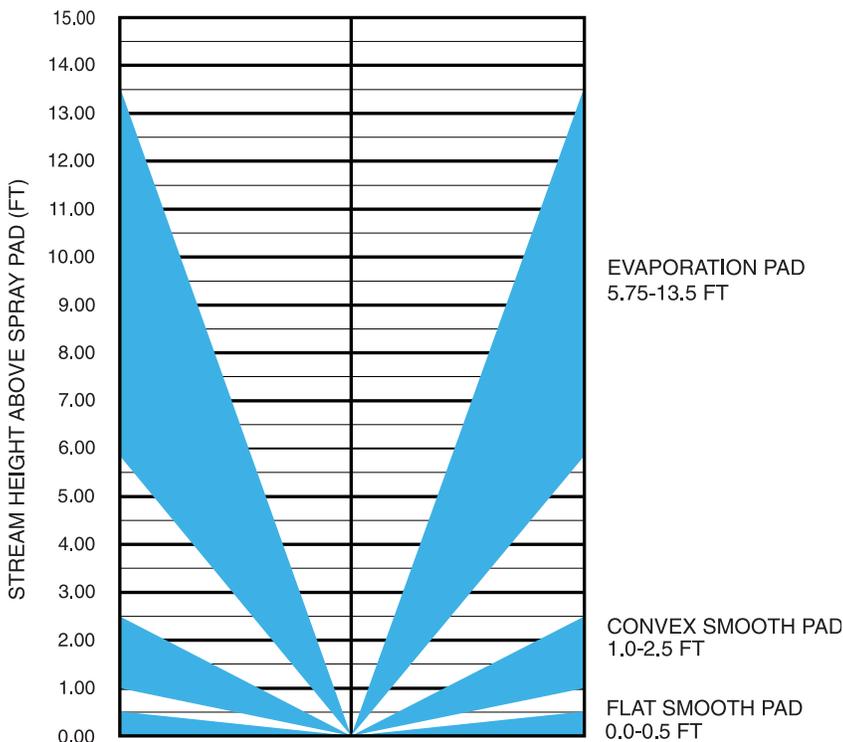
The Senninger Super Spray® provides a full 360° spray pattern.

- No moving parts for longer life
- Built for strength and durability using high-impact engineering-grade thermoplastics, no metal parts
- Interchangeable deflector pads to customize spray angle and droplet size
- Standard inlet: 3/4" NPT male
- Flow range: 3.12 to 24.5 gpm (0.21 to 1.55 L/s) (Consult factory for lower or higher flow rates.)
- One-year warranty on materials, workmanship AND performance



## (GOLD/SILVER MINING) Super Spray®

- Extremely useful for evaporation of excess water
- No moving parts
- Recommended for pH range 3.0 to 9.0 gold and silver mining solutions. Can be used for copper mining with weak sulfuric acid solutions (less than 10/gpl H<sub>2</sub>SO<sub>4</sub>) (Consult factory for other applications.)



Evaporation results will vary depending on wind, temperature, humidity, and other factors. These variables must be considered when calculating evaporative performance.



Super Spray shown with evaporation pad.



Deflector pads (top to bottom):  
 evaporation (black)  
 flat smooth (black)  
 convex smooth (green)  
 Consult factory for other deflector pad options.

SPRINKLER BASE PRESSURE	U.S. - Diameter (ft) at 1.5 ft. height				METRIC - Diameter (m) at 46 cm height				
	(psi)	20	40	60	80	(bar) (psi)	1.5 21.75	2.75 39.88	4.0 58.0
<b>#10 Nozzle - Turquoise (5/32")</b>					<b>#10 Nozzle - Turquoise (3.97 mm)</b>				
Flow (gpm)	3.18	4.50	5.50	6.35	Flow (L/s)	0.21	0.28	0.34	0.40
Evaporation pad - diam. (ft)	22.0	24.0	25.0	25.0	Evaporation pad - diam. (m)	6.8	7.3	7.6	7.6
Convex smooth pad - diam. (ft)	24.5	28.5	31.5	31.5	Convex smooth pad - diam. (m)	7.6	8.7	9.5	9.6
Flat smooth pad - diam. (ft)	22.0	24.0	26.0	27.0	Flat smooth pad - diam. (m)	6.8	7.3	7.9	8.2
<b>#11 Nozzle - Yellow (11/64")</b>					<b>#11 Nozzle - Yellow (4.37 mm)</b>				
Flow (gpm)	3.87	5.47	6.59	7.61	Flow (L/s)	0.25	0.34	0.41	0.48
Evaporation pad - diam. (ft)	23.5	25.5	26.0	25.5	Evaporation pad - diam. (m)	7.2	7.8	7.9	7.8
Convex smooth pad - diam. (ft)	26.5	30.5	33.5	33.5	Convex smooth pad - diam. (m)	8.2	9.3	10.1	10.2
Flat smooth pad - diam. (ft)	22.5	24.5	26.5	27.5	Flat smooth pad - diam. (m)	6.9	7.5	8.0	8.4
<b>#12 Nozzle - Red (3/16")</b>					<b>#12 Nozzle - Red (4.76 mm)</b>				
Flow (gpm)	4.63	6.54	7.95	9.18	Flow (L/s)	0.30	0.40	0.49	0.58
Evaporation pad - diam. (ft)	25.0	27.0	27.0	26.0	Evaporation pad - diam. (m)	7.7	8.2	8.2	7.9
Convex smooth pad - diam. (ft)	28.0	32.0	35.0	35.0	Convex smooth pad - diam. (m)	8.6	9.7	10.6	10.7
Flat smooth pad - diam. (ft)	23.0	25.0	27.0	28.0	Flat smooth pad - diam. (m)	7.1	7.6	8.2	8.5
<b>#13 Nozzle - White (13/64")</b>					<b>#13 Nozzle - White (5.16 mm)</b>				
Flow (gpm)	5.45	7.70	9.40	10.9	Flow (L/s)	0.36	0.48	0.58	0.68
Evaporation pad - diam. (ft)	26.5	28.5	28.0	26.5	Evaporation pad - diam. (m)	8.1	8.7	8.6	8.1
Convex smooth pad - diam. (ft)	29.5	33.5	36.0	36.0	Convex smooth pad - diam. (m)	9.1	10.2	10.9	11.0
Flat smooth pad - diam. (ft)	23.5	25.5	27.5	28.5	Flat smooth pad - diam. (m)	7.2	7.8	8.3	8.7
<b>#14 Nozzle - Blue (7/32")</b>					<b>#14 Nozzle - Blue (5.56 mm)</b>				
Flow (gpm)	6.20	8.77	10.9	12.6	Flow (L/s)	0.41	0.55	0.67	0.79
Evaporation pad - diam. (ft)	28.0	29.5	28.5	27.0	Evaporation pad - diam. (m)	8.6	9.0	8.7	8.2
Convex smooth pad - diam. (ft)	31.0	35.0	37.0	37.0	Convex smooth pad - diam. (m)	9.6	10.7	11.2	11.3
Flat smooth pad - diam. (ft)	23.5	26.0	28.0	29.0	Flat smooth pad - diam. (m)	7.3	7.9	8.5	8.8
<b>#15 Nozzle - Dark Brown (15/64")</b>					<b>#15 Nozzle - Dark Brown (5.95 mm)</b>				
Flow (gpm)	7.09	10.0	12.3	14.2	Flow (L/s)	0.47	0.64	0.76	0.89
Evaporation pad - diam. (ft)	29.0	30.0	29.0	27.5	Evaporation pad - diam. (m)	8.9	9.1	8.9	8.4
Convex smooth pad - diam. (ft)	32.0	36.0	38.0	38.0	Convex smooth pad - diam. (m)	9.9	11.0	11.5	11.6
Flat smooth pad - diam. (ft)	24.0	26.5	28.5	29.5	Flat smooth pad - diam. (m)	7.3	8.1	8.6	9.0
<b>#16 Nozzle - Orange (1/4")</b>					<b>#16 Nozzle - Orange (6.35 mm)</b>				
Flow (gpm)	8.03	11.4	13.6	15.7	Flow (L/s)	0.53	0.72	0.84	0.99
Evaporation pad - diam. (ft)	29.5	30.5	29.5	28.0	Evaporation pad - diam. (m)	9.0	9.3	9.0	8.5
Convex smooth pad - diam. (ft)	33.0	37.0	39.0	39.0	Convex smooth pad - diam. (m)	10.2	11.3	11.8	11.9
Flat smooth pad - diam. (ft)	24.5	27.0	29.0	30.0	Flat smooth pad - diam. (m)	7.4	8.2	8.8	9.1
<b>#17 Nozzle - Dark Green (17/64")</b>					<b>#17 Nozzle - Dark Green (6.75 mm)</b>				
Flow (gpm)	9.03	12.8	15.5	17.9	Flow (L/s)	0.59	0.81	0.96	1.13
Evaporation pad - diam. (ft)	30.0	31.0	30.0	28.5	Evaporation pad - diam. (m)	9.2	9.4	9.2	8.7
Convex smooth pad - diam. (ft)	34.0	37.5	39.5	39.5	Convex smooth pad - diam. (m)	10.5	11.4	12.0	12.0
Flat smooth pad - diam. (ft)	24.5	27.5	29.5	30.5	Flat smooth pad - diam. (m)	7.5	8.4	8.9	9.3
<b>#18 Nozzle - Purple (9/32")</b>					<b>#18 Nozzle - Purple (7.14 mm)</b>				
Flow (gpm)	10.1	14.2	17.3	19.9	Flow (L/s)	0.66	0.90	1.07	1.25
Evaporation pad - diam. (ft)	30.5	31.5	30.5	29.0	Evaporation pad - diam. (m)	9.3	9.6	9.3	8.8
Convex smooth pad - diam. (ft)	35.0	38.0	40.0	40.0	Convex smooth pad - diam. (m)	10.8	11.6	12.1	12.2
Flat smooth pad - diam. (ft)	24.5	28.0	30.0	31.0	Flat smooth pad - diam. (m)	7.6	8.5	9.1	9.4
<b>#19 Nozzle - Black (19/64")</b>					<b>#19 Nozzle - Black (7.54 mm)</b>				
Flow (gpm)	11.1	15.8	19.0	22.0	Flow (L/s)	0.73	0.99	1.18	1.38
Evaporation pad - diam. (ft)	31.0	32.0	30.5	29.0	Evaporation pad - diam. (m)	9.5	9.8	9.3	8.8
Convex smooth pad - diam. (ft)	35.5	38.5	40.5	40.5	Convex smooth pad - diam. (m)	10.9	11.7	12.3	12.3
Flat smooth pad - diam. (ft)	25.0	28.5	30.5	31.5	Flat smooth pad - diam. (m)	7.7	8.7	9.2	9.6
<b>#20 Nozzle - Dark Turquoise (5/16")</b>					<b>#20 Nozzle - Dark Turquoise (7.94 mm)</b>				
Flow (gpm)	12.3	17.4	21.2	24.5	Flow (L/s)	0.81	1.09	1.32	1.55
Evaporation pad - diam. (ft)	31.5	32.5	30.5	29.0	Evaporation pad - diam. (m)	9.6	9.9	9.4	8.8
Convex smooth pad - diam. (ft)	36.0	39.0	41.0	41.0	Convex smooth pad - diam. (m)	11.1	11.9	12.4	12.5
Flat smooth pad - diam. (ft)	25.0	29.0	31.0	32.0	Flat smooth pad - diam. (m)	7.7	8.8	9.4	9.8

Other nozzle sizes and deflector pads are available; consult factory for specific performance data.

# 30-40-50 Series Impact Sprinklers (3/4" NPT male base)

Senninger's full-circle 3/4" impact sprinklers are available in three models based on their flow. These sprinklers can achieve low application rates because of their large diameter of coverage .

- Splasharm spring and bearing enclosed for better resistance to corrosion and environmental extremes
- Constructed of engineering-grade thermoplastics and specially selected stainless steel components for excellent corrosion resistance
- Wide range of nozzle/vane combinations for excellent distribution at all pressures
- Standard lower bearing pipe thread: 3/4" NPT male (3/4" NPT female and 1" NPT female also available)
- Flow range: 3023 Model ... 1.84 to 5.36 gpm (0.11 to 0.33 L/s)  
4023 Model ... 3.92 to 10.6 gpm (0.24 to 0.66 L/s)  
5023 Model ... 6.50 to 16.8 gpm (0.40 to 1.04 L/s)
- One-year warranty on materials, workmanship AND performance



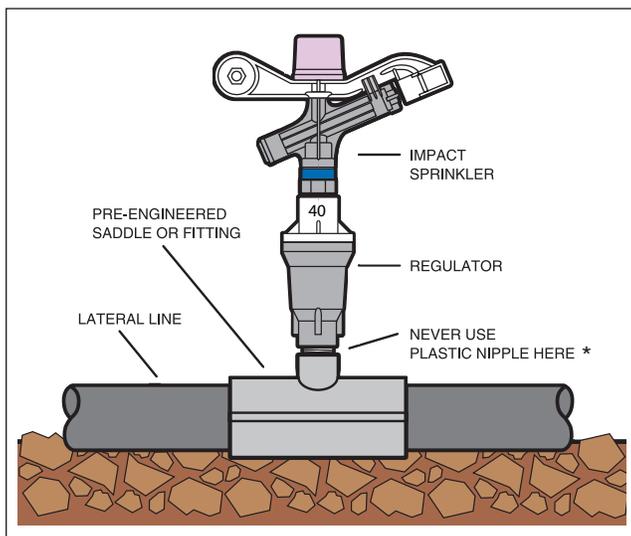
## (COPPER MINE SPECIAL®) 3023-1-3/4" M CMS 4023-1-3/4" M CMS 5023-1-3/4" M CMS

- Recommended for high sulfuric acid (0.5 to 3.0 pH) copper mining solutions
- 23° angle of throw



## (GOLD/SILVER MINING) 3023-1-3/4" M EFF 4023-1-3/4" M EFF 5023-1-3/4" M EFF

- Recommended for pH range 3.0 to 9.0 gold and silver mining solutions.
- 23° angle of throw (12° model also available, consult factory for performance data)



Impact sprinklers can be mounted directly into a pressure regulator that is in turn mounted directly into a saddle or pre-engineered plastic female fitting. They can also be mounted directly into a saddle or pre-engineered plastic female fitting.

\* Use carbon or stainless steel nipples in gold/silver mining.  
Use stainless steel nipples in acid copper leaching.

**3023-1-3/4" M CMS  
3023-1-3/4" M EFF**

SPRINKLER BASE PRESSURE	U.S. - Diameter (ft) at 1.5 ft. height							METRIC - Diameter (m) at 46 cm height						
	(psi)	30	35	40	45	50	55	60	(bar)	2.0	2.5	3.0	3.5	4.0
<b>#7 Nozzle - Lime (7/64")</b>														
Flow (gpm)	1.84	1.99	2.12	2.25	2.37	2.51	2.63		<b>#7 Nozzle - Lime (2.78 mm)</b>					
Diameter (ft)	77	79	81	82	83	84	85		Flow (L/s)	0.11	0.13	0.14	0.15	0.16
									Diameter (m)	23.3	24.2	24.9	25.3	25.8
<b>#8 Nozzle - Lavender (1/8")</b>									<b>#8 Nozzle - Lavender (3.18 mm)</b>					
Flow (gpm)	2.42	2.62	2.79	2.97	3.12	3.28	3.43		Flow (L/s)	0.15	0.17	0.18	0.20	0.21
Diameter (ft)	79	81	83	84	85	86	87		Diameter (m)	24.0	24.8	25.5	26.0	26.4
<b>#9 Nozzle - Grey (9/64")</b>									<b>#9 Nozzle - Grey (3.57 mm)</b>					
Flow (gpm)	3.08	3.33	3.56	3.78	3.98	4.16	4.34		Flow (L/s)	0.19	0.21	0.23	0.25	0.27
Diameter (ft)	80	82	84	85	86	87	88		Diameter (m)	24.3	25.1	25.8	26.3	26.7
<b>#10 Nozzle - Turquoise (5/32")</b>									<b>#10 Nozzle - Turquoise (3.97 mm)</b>					
Flow (gpm)	3.82	4.13	4.41	4.68	4.93	5.13	5.36		Flow (L/s)	0.24	0.26	0.29	0.31	0.33
Diameter (ft)	81	83	85	86	87	88	89		Diameter (m)	24.6	25.4	26.1	26.6	27.0

Stream heights range from 6.0 - 7.5 ft (1.8 - 2.3 m) above nozzle based on pressure and nozzle size.

**4023-1-3/4" M CMS  
4023-1-3/4" M EFF**

SPRINKLER BASE PRESSURE	U.S. - Diameter (ft) at 1.5 ft. height							METRIC - Diameter (m) at 46 cm height						
	(psi)	30	35	40	45	50	55	60	(bar)	2.0	2.5	3.0	3.5	4.0
<b>#10 Nozzle - Turquoise (5/32")</b>														
Flow (gpm)	3.82	4.13	4.41	4.68	4.93	5.17	5.40		<b>#10 Nozzle - Turquoise (3.97 mm)</b>					
Diameter (ft)	80	82	84	86	87	88	89		Flow (L/s)	0.24	0.26	0.29	0.31	0.33
									Diameter (m)	24.3	25.1	26.0	26.6	27.0
<b>#11 Nozzle - Yellow (11/64")</b>									<b>#11 Nozzle - Yellow (4.37 mm)</b>					
Flow (gpm)	4.63	5.00	5.34	5.67	5.98	6.27	6.55		Flow (L/s)	0.29	0.32	0.35	0.38	0.41
Diameter (ft)	82	84	86	88	89	90	91		Diameter (m)	24.9	25.8	26.6	27.2	27.6
<b>#12 Nozzle - Red (3/16")</b>									<b>#12 Nozzle - Red (4.76 mm)</b>					
Flow (gpm)	5.52	5.97	6.37	6.76	7.13	7.48	7.81		Flow (L/s)	0.34	0.38	0.42	0.45	0.48
Diameter (ft)	84	86	88	90	91	92	93		Diameter (m)	25.5	26.4	27.2	27.8	28.2
<b>#13 Nozzle - White (13/64")</b>									<b>#13 Nozzle - White (5.16 mm)</b>					
Flow (gpm)	6.50	7.02	7.49	7.95	8.38	8.80	9.19		Flow (L/s)	0.40	0.45	0.49	0.53	0.57
Diameter (ft)	86	88	90	92	94	96	97		Diameter (m)	26.1	27.0	27.9	28.7	29.4
<b>#14 Nozzle - Blue (7/32")</b>									<b>#14 Nozzle - Blue (5.56 mm)</b>					
Flow (gpm)	7.49	8.09	8.63	9.17	9.66	10.1	10.6		Flow (L/s)	0.46	0.52	0.57	0.61	0.66
Diameter (ft)	89	92	94	96	98	100	101		Diameter (m)	26.9	28.2	29.1	30.0	30.7

Stream heights range from 6.5 - 10.0 ft (2.0 - 3.1 m) above nozzle based on pressure and nozzle size.

**5023-1-3/4" M CMS  
5023-1-3/4" M EFF**

SPRINKLER BASE PRESSURE	U.S. - Diameter (ft) at 1.5 ft. height							METRIC - Diameter (m) at 46 cm height						
	(psi)	30	35	40	45	50	55	60	(bar)	2.0	2.5	3.0	3.5	4.0
<b>#13 Nozzle - White (13/64")</b>														
Flow (gpm)	6.50	7.02	7.49	7.95	8.38	8.80	9.19		<b>#13 Nozzle - White (5.16 mm)</b>					
Diameter (ft)	90	92	94	96	98	100	102		Flow (L/s)	0.40	0.45	0.49	0.53	0.57
									Diameter (m)	27.3	28.2	29.1	30.0	30.8
<b>#14 Nozzle - Blue (7/32")</b>									<b>#14 Nozzle - Blue (5.56 mm)</b>					
Flow (gpm)	7.49	8.09	8.63	9.17	9.66	10.1	10.6		Flow (L/s)	0.46	0.52	0.57	0.61	0.66
Diameter (ft)	91	93	95	97	99	101	103		Diameter (m)	27.6	28.5	29.4	30.3	31.1
<b>#15 Nozzle - Dark Brown (15/64")</b>									<b>#15 Nozzle - Dark Brown (5.95 mm)</b>					
Flow (gpm)	8.51	9.19	9.81	10.4	11.0	11.5	12.0		Flow (L/s)	0.53	0.59	0.64	0.70	0.74
Diameter (ft)	92	94	96	98	100	102	104		Diameter (m)	27.9	28.8	29.7	30.6	31.5
<b>#16 Nozzle - Orange (1/4")</b>									<b>#16 Nozzle - Orange (6.35 mm)</b>					
Flow (gpm)	9.63	10.4	11.1	11.8	12.4	13.0	13.6		Flow (L/s)	0.60	0.67	0.73	0.79	0.84
Diameter (ft)	93	95	97	99	101	103	105		Diameter (m)	28.2	29.1	30.0	30.9	31.8
<b>#17 Nozzle - Dark Green (17/64")</b>									<b>#17 Nozzle - Dark Green (6.75 mm)</b>					
Flow (gpm)	10.7	11.6	12.3	13.1	13.8	14.5	15.1		Flow (L/s)	0.66	0.74	0.81	0.88	0.94
Diameter (ft)	94	96	98	100	102	104	106		Diameter (m)	28.5	29.4	30.3	31.2	32.1
<b>#18 Nozzle - Purple (9/32")</b>									<b>#18 Nozzle - Purple (7.14 mm)</b>					
Flow (gpm)	11.9	12.9	13.7	14.6	15.4	16.1	16.8		Flow (L/s)	0.74	0.82	0.90	0.98	1.04
Diameter (ft)	95	97	99	101	103	105	107		Diameter (m)	28.8	29.7	30.6	31.5	32.4

Stream heights range from 7.0 - 11.5 ft (2.1 - 3.5 m) above nozzle based on pressure and nozzle size.

Diameters shown are for standard straight bore nozzles and barrel cylinder vanes (blue). Other nozzles and/or vane combinations are available; consult factory for specific performance data.

# 80 Series Impact Sprinklers

(1 1/4" & 1 1/2" NPT male base)

*Senninger's largest impact sprinklers distribute water over a large diameter. They are designed for maximum efficiency at high flow rates.*

- Splasharm spring and bearing enclosed for better resistance to corrosion and environmental extremes
- Constructed of engineering-grade thermoplastics and specially selected stainless steel components for excellent corrosion resistance
- 25° angle of throw
- Standard lower bearing pipe thread:  
1 1/4" NPT female and 1" NPT female  
(1 1/4" NPT male and 1 1/2" NPT male also available)
- Flow range: 25.2 to 91.8 gpm (1.66 to 5.69 L/s)  
(Consult factory for lower or higher flow rates.)
- One-year warranty on materials, workmanship AND performance



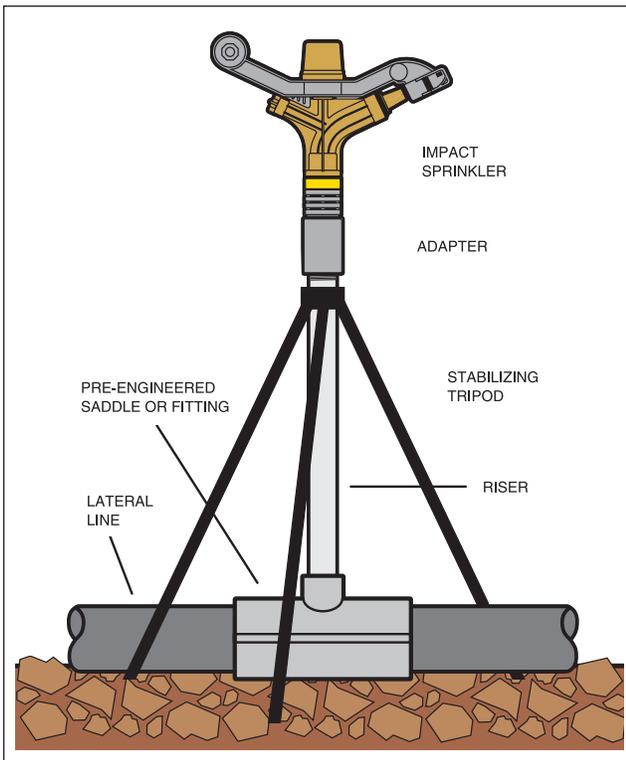
## (COPPER MINE SPECIAL®) 8025HD-1-1 1/4" M CMS

- Recommended for high sulfuric acid (0.5 to 3.0 pH) copper mining solutions
- New heavy-duty design to withstand rugged mining conditions
- 23° angle of throw
- Single-nozzle design provides greater resistance to clogging
- Double-nozzle design also available for greater uniformity

## (GOLD/SILVER MINING) 8025HD-1-1 1/4" EFF

- Recommended for pH range 3.0 to 9.0 gold and silver mining solutions.
- New heavy-duty design to withstand rugged mining conditions
- 23° angle of throw
- Single-nozzle design provides greater resistance to clogging
- Double-nozzle design also available for greater uniformity
- 1" model (7025) also available.  
(Consult factory for specific flow rates.)

# 80 Series Impact Sprinklers (1 1/4" & 1 1/2" NPT male base)



Impact sprinklers that are mounted to a riser should be stabilized to preserve the integrity of the throw. When using risers in gold/silver mining, use carbon steel or stainless steel pipe. When using risers in acid copper leaching, use stainless steel pipe.

SPRINKLER BASE PRESSURE	(psi)	U.S. - Diameter (ft) at 1.5 ft. height								METRIC - Diameter (m) at 46 cm height					
		40	45	50	55	60	65	70	75	(bar)	3.0	3.5	4.0	4.5	5.0
<b>#24 Nozzle - (3/8")</b>															
Flow (gpm)		25.2	26.7	28.2	29.6	30.9	32.1	33.3	34.5	Flow (L/s)	1.66	1.79	1.91	2.03	2.14
Diameter (ft)		134	139	144	149	154	157	159	160	Diameter (m)	41.9	44.1	46.3	47.9	48.6
<b>#26 Nozzle - (13/32")</b>															
Flow (gpm)		29.3	31.0	32.7	34.3	35.9	37.3	38.7	40.1	Flow (L/s)	1.92	2.08	2.22	2.36	2.48
Diameter (ft)		142	147	152	157	161	164	166	168	Diameter (m)	44.4	46.6	48.6	50.0	50.9
<b>#28 Nozzle - (7/16")</b>															
Flow (gpm)		33.9	36.0	38.0	39.8	41.6	43.3	44.9	46.5	Flow (L/s)	2.23	2.41	2.58	2.73	2.88
Diameter (ft)		148	153	157	161	166	169	171	173	Diameter (m)	46.2	48.0	50.0	51.5	52.4
<b>#30 Nozzle - (15/32")</b>															
Flow (gpm)		38.6	40.9	43.1	45.2	47.2	49.2	51.0	52.8	Flow (L/s)	2.53	2.74	2.93	3.10	3.27
Diameter (ft)		153	158	162	166	170	173	175	178	Diameter (m)	47.7	49.6	51.3	52.8	53.8
<b>#32 Nozzle - (1/2")</b>															
Flow (gpm)		43.9	46.5	49.0	51.4	53.7	55.9	58.0	60.1	Flow (L/s)	2.88	3.11	3.33	3.53	3.72
Diameter (ft)		156	161	165	169	173	176	179	183	Diameter (m)	48.6	50.5	52.2	53.7	55.2
<b>#34 Nozzle - (17/32")</b>															
Flow (gpm)		49.5	52.5	55.4	58.1	60.7	63.1	65.5	67.8	Flow (L/s)	3.25	3.51	3.76	3.99	4.20
Diameter (ft)		159	164	168	172	176	180	183	186	Diameter (m)	49.5	51.4	53.2	54.9	56.2
<b>#36 Nozzle - (9/16")</b>															
Flow (gpm)		55.5	58.9	62.1	65.1	68.0	70.8	73.5	76.0	Flow (L/s)	3.65	3.94	4.21	4.47	4.71
Diameter (ft)		161	166	170	174	178	183	187	190	Diameter (m)	50.1	52.0	53.8	55.8	57.5
<b>#38 Nozzle - (19/32")</b>															
Flow (gpm)		59.9	63.5	66.9	70.2	73.3	76.3	79.2	82.0	Flow (L/s)	3.93	4.25	4.54	4.82	5.08
Diameter (ft)		163	168	172	176	180	185	190	192	Diameter (m)	50.8	52.6	54.4	56.5	58.2
<b>#40 Nozzle - (5/8")</b>															
Flow (gpm)		67.1	71.1	75.0	78.7	82.1	85.5	88.7	91.8	Flow (L/s)	4.41	4.76	5.09	5.40	5.69
Diameter (ft)		165	170	174	178	182	187	192	194	Diameter (m)	51.4	53.2	55.0	57.1	58.8

Diameters shown are for standard straight bore nozzles and stream-straightening vanes (black). Other nozzles are available; consult factory for specific performance data. Stream heights range from 12.5 - 28.0 ft (3.8 - 8.5 m) above nozzle based on pressure and nozzle size.

# Part-Circle Impact Sprinklers

(3/4" NPT male base)



The Senninger 3123 & 4123 Series Part-Circle Impact sprinklers are ideal for dust control and are designed specifically for use where a directional impact sprinkler is required. Senninger's part-circle sprinklers are available in two models based on their flow.

- Distributes water in a 60 - 360° pattern at 5° increments
- Enclosed stainless steel springs and fulcrum pin to resist contamination
- Constructed of engineering-grade thermoplastics and specially selected stainless steel components for excellent corrosion resistance
- Standard lower bearing pipe thread: 3/4" NPT male (3/4" NPT female and 1" NPT female also available)
- Flow range:  
3123 Model ... 2.42 to 4.34 gpm (0.15 to 0.27 L/s)  
4123 Model ... 3.82 to 7.81 gpm (0.24 to 0.48 L/s)
- One-year warranty on materials, workmanship AND performance

**(GOLD/SILVER MINING)**  
**3123-1-3/4" M EFF and**  
**4123-1-3/4" M EFF**

- Recommended for pH range 3.0 to 9.0 gold and silver mining solutions.
- 23° angle of throw



**IDEAL FOR  
DUST  
CONTROL**

**3123-1-3/4" M EFF**

SPRINKLER BASE PRESSURE	U.S. - Radius (ft) at 1.5 ft height							METRIC - Radius (m) at 46 cm height						
	(psi)	30	35	40	45	50	55	60	(bar)	2.0	2.5	3.0	3.5	4.0
<b>#8 Nozzle - Lavender (1/8")</b>									(psi)	29.00	36.25	43.50	50.75	58.00
Flow (gpm)	2.42	2.62	2.79	2.97	3.12	3.28	3.43		<b>#8 Nozzle - Lavender (3.18 mm)</b>					
Radius (ft)	40.0	41.5	43.0	43.5	44.0	44.5	44.5		Flow (L/s)	0.15	0.17	0.18	0.20	0.21
									Radius (m)	12.1	12.8	13.2	13.4	13.6
<b>#9 Nozzle - Grey (9/64")</b>									<b>#9 Nozzle - Grey (3.57 mm)</b>					
Flow (gpm)	3.08	3.33	3.56	3.78	3.98	4.16	4.34		Flow (L/s)	0.19	0.21	0.23	0.25	0.27
Radius (ft)	41.0	43.0	44.5	45.5	46.0	46.5	46.5		Radius (m)	2.4	13.2	13.8	14	14.2

Stream heights range from 6.0 - 7.5 ft (1.8 - 2.3 m) above nozzle based on pressure and nozzle size.

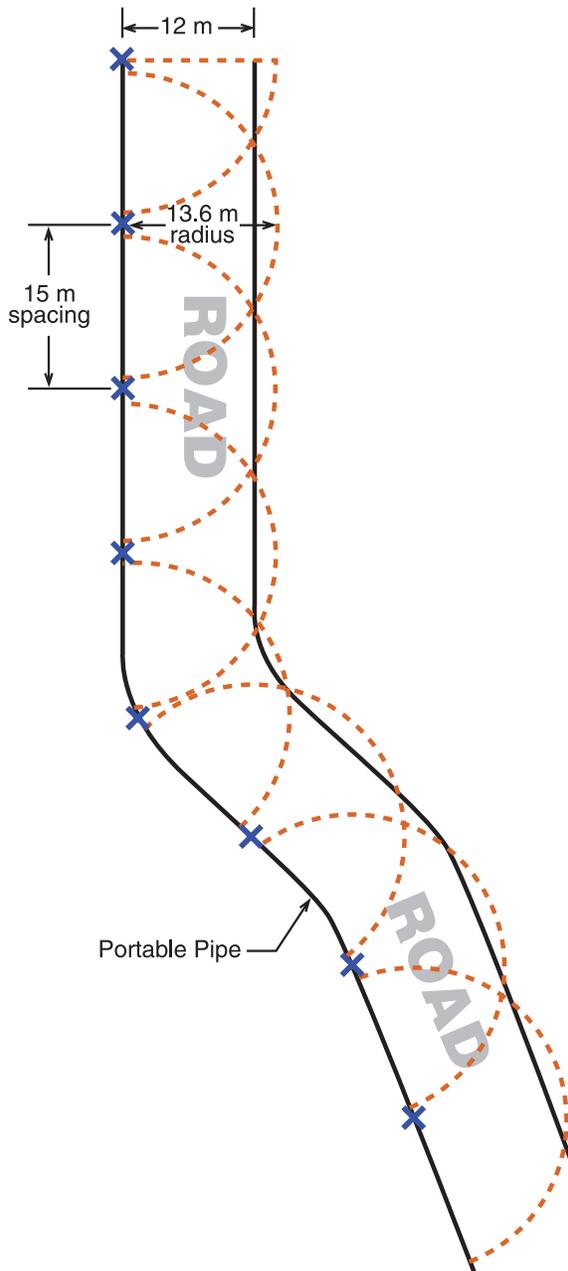
**4123-1-3/4" M EFF**

SPRINKLER BASE PRESSURE	U.S. - Radius (ft) at 1.5 ft height							METRIC - Radius (m) at 46 cm height						
	(psi)	30	35	40	45	50	55	60	(bar)	2.0	2.5	3.0	3.5	4.0
<b>#10 Nozzle - Turquoise (5/32")</b>									(psi)	29.00	36.25	43.50	50.75	58.00
Flow (gpm)	3.82	4.13	4.41	4.68	4.93	5.17	5.40		<b>#10 Nozzle - Turquoise (3.97 mm)</b>					
Radius (ft)	42.0	44.0	46.0	47.0	47.5	48.0	48.0		Flow (L/s)	0.24	0.26	0.29	0.31	0.33
									Radius (m)	12.7	13.6	14.2	14.5	14.6
<b>#11 Nozzle - Yellow (11/64")</b>									<b>#11 Nozzle - Yellow (4.37 mm)</b>					
Flow (gpm)	4.63	5.00	5.34	5.67	5.98	6.27	6.55		Flow (L/s)	0.29	0.32	0.35	0.38	0.41
Radius (ft)	43.0	45.5	47.5	48.5	49.5	50.0	50.0		Radius (m)	13.0	14.0	14.7	15.1	15.2
<b>#12 Nozzle - Red (3/16")</b>									<b>#12 Nozzle - Red (4.76 mm)</b>					
Flow (gpm)	5.52	5.97	6.37	6.76	7.13	7.48	7.81		(L/s)	0.34	0.38	0.42	0.45	0.48
Radius (ft)	44.0	46.5	49.0	50.0	51.5	52.0	52.0		Radius (m)	13.3	14.4	15.1	15.7	15.8

Stream heights range from 6.0 - 10.0 ft (1.8 - 3.1 m) above nozzle based on pressure and nozzle size.



**IDEAL FOR  
DUST  
CONTROL**



## Part-Circle Impact Sprinklers (3/4" NPT male base)

*The Senninger Part-Circle Impact Sprinklers, when coupled to a portable pipe system provide the best and most flexible option to keep dust under control.*

- Eliminates costly mobile watering
- Conserves water
- Increases coverage efficiency
- Allows dust control automation

### EXAMPLE LAYOUT (left)

Sprinkler: (indicated by X)

Model: 3123-1-3/4"M Part-Circle nozzle #9 (9/64")

Note: Pressure regulator recommended @ 40 psi (2.76 bar)

Radius: 45.5 ft (13.6 m)

Flow: 3.65 gpm (0.23 L/s)



*Reduces traffic dust on mining roads.*

# Software: Sprinkler Selection

Use *Mining WinSIPP™* software by Senninger to calculate the precipitation rate of your leach pad:

- Aids in the selection and application of best irrigation products
- Tests the application uniformity of sprinkler layouts before the system is installed
- Compares different spacings, sprinkler models, nozzle sizes, and operating pressures to determine which would be best for your specific application

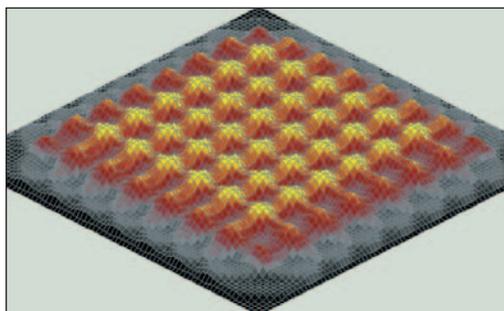
Ask for this program by contacting your local dealer or the Senninger technical support department.

## Distribution Profiles

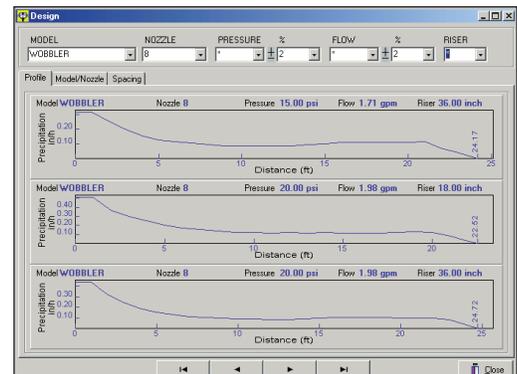
A distribution profile is the illustration of results from “catch can” tests performed in accordance with the American Society of Agricultural Engineers (ASAE) standard S398.1. This data shows how uniformly a device distributes water within its diameter of throw. WinSIPP utilizes the numerous distribution profiles available for Senninger products.

## Densograms

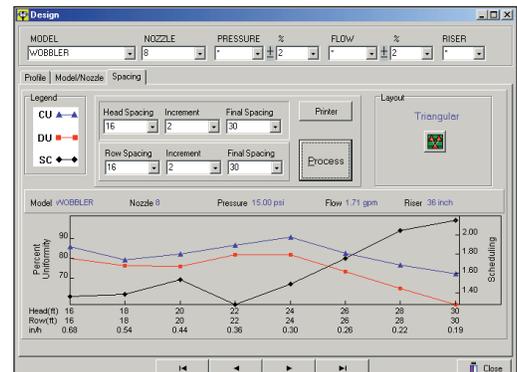
Data from distribution profiles is used to create densograms based on spacing dimensions, layout, and riser height. Densograms are useful in illustrating the uniformity in which water is distributed by multiple overlapping devices.



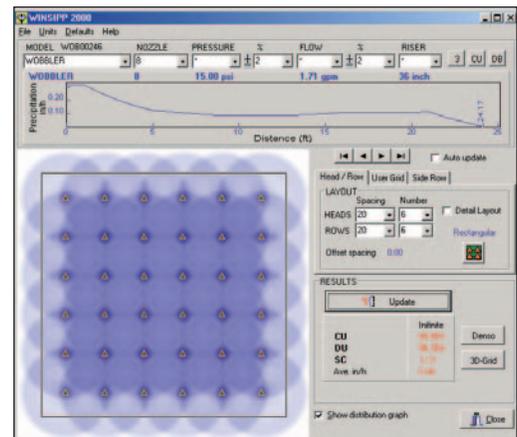
Graphics illustrate the water application pattern in 3-D format.



Sprinkler profile takes specific data and illustrates the amount of water that would be delivered at various intervals as well as the exact radius.

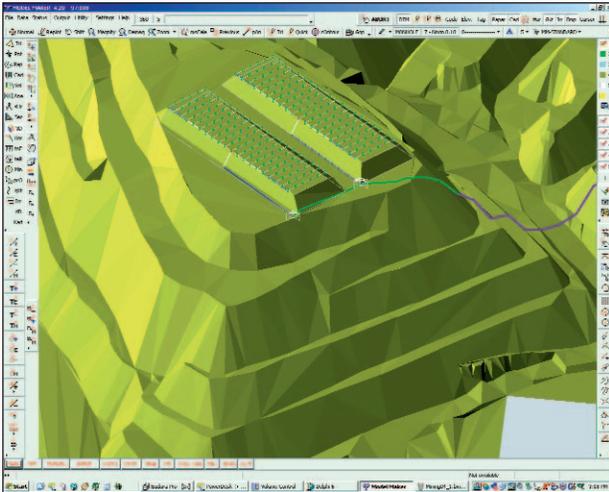


The WinSIPP program provides profiles illustrating the coefficient of uniformity, distribution uniformity, and the scheduling coefficient to determine which spacing would be optimum.

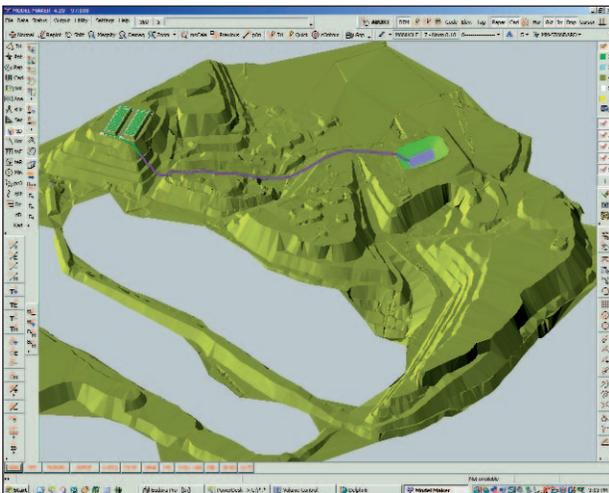


Densograms illustrate the uniformity of a given profile to show water distribution of multiple overlapping devices in graphic form.

# Software: Leaching Solution System Design



Leaching pad, 3-dimensional design.



Terrain modeling of excavation area.

## Irri-Maker™ software by Senninger:

- Optimizes irrigation system design by combining survey, Digital Terrain Modeling (DTM), and Computer Aided Design (CAD) with many hydraulic analysis functions
- Evaluates installation alternatives in advance – surveys any terrain, produces a contour plan, draws the details, and applies the irrigation design
- Allows importation of information from many other programs
- Saves time at repeatable routines

## Survey Data Manipulation

Irri-Maker's flexible structure and user-friendly layout makes converting survey data into a computerized DTM format quick and easy. It is no longer necessary to manually calculate coordinates, reduce survey field books, or do manual plotting of the proposed terrain. Irri-Maker can produce a contour plan from virtually any type of survey data.

## CAD Advantages

The built-in CAD module allows you to add specific details to the contour plan, including text and bitmap images. Details like roads, fences, boundaries, rivers, and trees can also be incorporated. Irri-Maker employs various modules working together with the same set of commands. There is no need to learn different programs or menu layouts to add CAD elements and irrigation designs to your contour plan. Everything can be plotted independently or in combination.

## Flexible Irrigation Designs

Irri-Maker can be used for everything from simple irrigation designs to complex systems. Each element of the design can be controlled, whether it's defining block areas, adding emitters and pipes, sizing the pipes, or calculating the hydraulics. A comprehensive list of materials along with detailed hydraulic reports can be produced as well.

## Other Applications

Irri-Maker operates within the larger Model Maker™ environment. This means any of the other Model Maker modules can be added to your software package. As such, civil earthwork calculation tasks can be performed for various applications including canals, drainage and roads.

Call for your **FREE** sample CD!

# Formulas

## Estimating Precipitation Rate

### U.S.

$$\text{Precipitation Rate} = \frac{Q \times 96.3}{S \times L}$$

(gallons per minute per square feet)

- Q = Flow per sprinkler (*gallons per minute*)  
 S = Spacing of sprinklers along the lateral (*feet*)  
 L = Spacing between laterals (*feet*)

(This applies to square, rectangular, or triangular spacing)

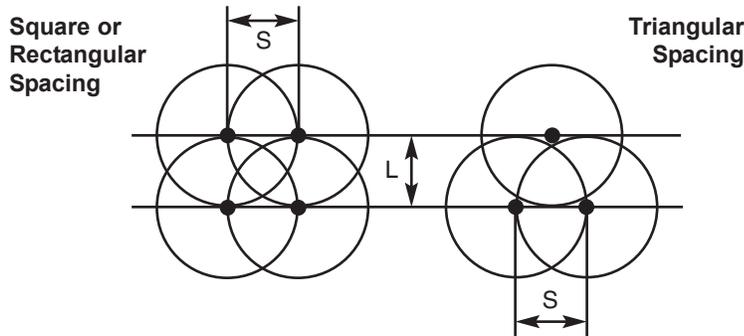
### METRIC

$$\text{Precipitation Rate} = \frac{Q \times 3600}{S \times L}$$

(*millimeters per hour*)  
 (*liters per hour - square meter*)

- Q = Flow per sprinkler (*liters per second*)  
 S = Spacing of sprinklers along the lateral (*meters*)  
 L = Spacing between laterals (*meters*)

(This applies to square, rectangular, or triangular spacing)



## Estimating Sprinkler Flow, Nozzle Size, and Pressure

### U.S.

$$Q = \sqrt{P} \times D^2 \times C \times 29.8$$

$$D = \left[ \frac{Q}{\sqrt{P} \times C \times 29.8} \right]^{1/2}$$

$$P = \left[ \frac{Q}{D^2 \times C \times 29.8} \right]^2$$

- Q = Flow (*gallons per minute*)  
 D = Nozzle diameter (*inches*)  
 P = Nozzle pressure (*psi*)  
 C = Nozzle coefficient of discharge\*

### METRIC

$$Q = \frac{\sqrt{P} \times D^2 \times C}{93.5}$$

$$D = \left[ \frac{Q \times 93.5}{\sqrt{P} \times C} \right]^{1/2}$$

$$P = \left[ \frac{Q \times 93.5}{D^2 \times C} \right]^2$$

- Q = Flow (*liters per second*)  
 D = Nozzle diameter (*millimeters*)  
 P = Nozzle pressure (*bar*)  
 C = Nozzle coefficient of discharge\*

\* Nozzle coefficients of discharge range from 0.90 to 0.98 depending on nozzle design and operating pressure.

## Nozzle Numbers and Colors

Nozzle # and Color	Orifice (inches)	Orifice (mm)	Nozzle # and Color	Orifice (inches)	Orifice (mm)
#4 - Light Blue	1/16 (0.063)	1.59	#12 - Red	3/16 (0.188)	4.76
#5 - Beige	5/64 (0.078)	1.98	#13 - White	13/64 (0.203)	5.16
#6 - Gold	3/32 (0.094)	2.38	#14 - Blue	7/32 (0.219)	5.56
#7 - Lime	7/64 (0.109)	2.78	#15 - Dark Brown	15/64 (0.234)	5.95
#8 - Lavender	1/8 (0.125)	3.18	#16 - Orange	1/4 (0.250)	6.35
#9 - Grey	9/64 (0.141)	3.57	#17 - Dark Green	17/64 (0.266)	6.75
#10 - Turquoise	5/32 (0.156)	3.97	#18 - Purple	9/32 (0.281)	7.14
#11 - Yellow	11/64 (0.172)	4.37	#19 - Black	19/64 (0.297)	7.54
			#20 - Dark Turquoise	5/16 (0.313)	7.94

# Formulas

## Calculating Friction Loss in Pipe (Hazen - Williams)

### U.S.

$$H_f = 1045 \frac{(Q \div C)^{1.852}}{ID^{4.857}}$$

- H<sub>f</sub> = Friction Loss in Feet of Water (*head*) per 100 Feet of Pipe  
 Q = Flow (*gallons per minute*)  
 C = Pipe Friction Coefficient  
 (*PE = 155; PVC = 150; Galv.Steel/Asb.-Cement = 140; Cast Iron = 100*)  
 ID = Pipe Inside Diameter (*inches*)

### METRIC

$$H_f = 1.22 \times 10^{12} \frac{(Q \div C)^{1.852}}{ID^{4.857}}$$

- H<sub>f</sub> = Friction Loss in Meters of Water (*head*) per 100 Meters of Pipe  
 Q = Flow (*liters per second*)  
 C = Pipe Friction Coefficient  
 (*PE = 155; PVC = 150; Galv.Steel/Asb.-Cement = 140; Cast Iron = 100*)  
 ID = Pipe Inside Diameter (*millimeters*)

## Estimating Pumping Brake Power Required

### U.S.

$$BP = \frac{Q \times TDH}{3960 \times EFF}$$

- BP = Brake power required (*horse power*)  
 Q = Flow required (*gallons per minute*)  
 TDH = Total dynamic head (*feet*)  
 EFF = Pump efficiency stated as a decimal

### METRIC

$$BP = \frac{Q \times TDH}{102 \times EFF}$$

- BP = Brake power required (*kilowatts*)  
 Q = Flow required (*liters per second*)  
 TDH = Total dynamic head (*meters*)  
 EFF = Pump efficiency stated as a decimal

## Conversions

To Convert	Into	Multiply by
<b>FLOW</b>		
Acre-Inch / Hr	Gallons / Min (gpm)	452.6
Acre-Inch	Gallons	27,154.0
Cubic Feet	Gallons (US)	7.481
Cubic Feet / Sec	Gallons / Min (gpm)	448.831
Cubic Meters	Gallons (US)	264.2
Cubic Meters / Hr	Gallons / Min (gpm)	4.403
Cubic Meters / Hr	Liters / Sec (L/s)	0.278
Gallons	Liters	3.785
Gallons / Min (gpm)	Cubic Meter / Hr (m <sup>3</sup> /hr)	0.227
Gallons / Min (gpm)	Liters / Sec (L/s)	0.063
Liters	Gallons (US)	0.264
Liters / Sec	Gallons / Min (gpm)	15.852
Liters / Sec	Cubic Meters / Hr (m <sup>3</sup> /hr)	3.6

<b>AREA &amp; LINEAR</b>		
Acres	Hectares	0.405
Acres	Square Feet	43,560.0
Centimeters	Inches	0.394
Feet	Meters	0.305
Hectares	Acres	2.471
Inches	Millimeters	25.40
Meters	Feet	3.281
Miles	Kilometers	1.609
Miles	Feet	5,280.0
Millimeters	Inches	0.0394

To Convert	Into	Multiply by
<b>PRECIPITATION RATE</b>		
Gallons / Min-Ft <sup>2</sup>	Inches / Hr	96.25
Gallons / Min-Ft <sup>2</sup>	Liters / Hr-M <sup>2</sup>	2445
Gallons / Min-Ft <sup>2</sup>	Millimeters / Hr	2445
Inches / Hr	Gallons / Min-Ft <sup>2</sup>	0.0104
Inches / Hr	Liters / Hr-M <sup>2</sup>	25.4
Inches / Hr	Millimeters / Hr	25.4
Liters / Hr-M <sup>2</sup>	Gallons / Min-Ft <sup>2</sup>	0.00041
Liters / Hr-M <sup>2</sup>	Inches / Hr	0.0394
Liters / Hr-M <sup>2</sup>	Millimeters / Hr	1
Millimeters / Hr	Gallons / Min-Ft <sup>2</sup>	0.00041
Millimeters / Hr	Inches / Hr	0.0394
Millimeters / Hr	Liters / Hr-M <sup>2</sup>	1

<b>PRESSURE</b>		
Atmospheres	Kg / Sq Cm	1.033
Atmospheres	Pounds / Sq In (psi)	14.70
Bar	Pounds / Sq In (psi)	14.50
Feet of Water	Pounds / Sq In (psi)	0.434
Gallons of Water	Pounds	8.33
Kilograms / Sq Cm	Pounds / Sq In (psi)	14.22
KiloPascals (kPa)	Pounds / Sq In (psi)	0.145
Pounds / Sq In (psi)	Atmospheres	0.068
Pounds / Sq In (psi)	Bar	0.069
Pounds / Sq In (psi)	Feet of Water	2.307
Pounds / Sq In (psi)	KiloPascals (kPa)	6.895

<b>POWER</b>		
Horsepower	Kilowatts	0.746
Kilowatts	Horsepower	1.341

# **Expressly Limited Product Warranty and Disclaimer**

## **Warning - Disclaimer**

This warranty is the full and complete product warranty and is expressly in lieu of any and all representations or warranties, expressed or implied, including any implied warranties of merchantability or fitness for particular purpose, whether arising from statute, common law, custom, course of dealing, usage of trade, or otherwise. No person has the authority to incur or assume for Senninger any other liability as to products manufactured by Senninger.

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## **Materials & Workmanship**

All solution mining products manufactured by Senninger Irrigation Inc. are warranted for a period of one year from date of original shipment to be free of any defects in materials or workmanship.



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