

HEAP LEACHING GUIDE

Mineral Recovery, Dust Control, Effluent Dispersion, Evaporation, Side of Slope Leaching



FOUNDED IN 1963

Senninger has provided efficient “Low Pressure – High Performance” irrigation by developing products that conserve energy and provide exceptional uniformity. Senninger products became popular in 1970, for agricultural applications and grew to include the mining industry. Custom Mining Sprinklers (CMS) are used globally for mineral recovery, dust control, effluent dispersion, evaporation, side of slope leaching and other industrial applications.

NEW DEMANDS

Modern heap leaching practices include expanding technology which demands higher performance to meet strict industry requirements. Heap leach depths have increased to more than 500 ft of ore depth from only 50 to 65 ft a decade ago.



Layers of coarse and fine textured material during material comprise leach piles. Leaching solutions flow more readily in the conductive layers, potentially leaving areas unleached.



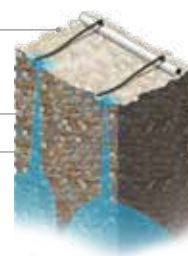
DRIP SYSTEMS

Drip systems depend on source point application of the solution, which promotes channeling. With minimal lateral movement of the solution applied, close spacing of the drippers and laterals is necessary to achieve the desired application rate.

*Drip Lateral Lines
(Emitters are placed
every two feet within
the line)*

Unleached area

Channeling



ORIFICE COMPARISON

The small orifices and flow passages in drip emitters have a greater potential for clogging. Leaching drip emitters often require filtration of 150 mesh or finer. The Senninger mini-Wobbler offers three nozzle sizes minimizing clogging without expensive filtration.

LATERAL LINE EMITTER EFFECTIVE DISCHARGE FLOW AREA

0.052"
(1.32 mm)



MINI-WOBBLER® NOZZLE ORIFICE SIZES



#6 $\frac{3}{32}$ " (2.38 mm)



#7 $\frac{7}{64}$ " (2.78 mm)



#8 $\frac{1}{8}$ " (3.17 mm)



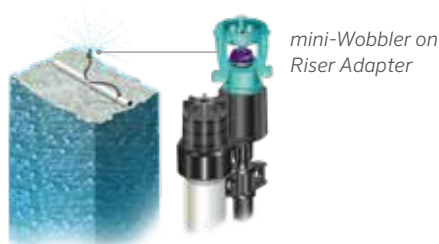
mini-Wobblers can be installed directly into dripper lines to complete the leach cycle or provide a final rinse.

WOBBLER TECHNOLOGY

WOBBLER BENEFITS

- Low pressure operation reduces energy costs.
- Uniformity of distribution (90+ percent) over full 360° area.
- Versatility of being moved and used repeatedly
- Visual confirmation of uniformity not afforded by drip systems.
- Adjustable flow and application rates.
- Adapts to pad rinsing for reclamation.
- Lower cost than drip systems.
- Can install on existing drip systems.

Uniformity of solution distribution is essential to maximizing metals recovery. At 90+ percent of uniformity, Wobbler technology is the most effective method for total solution contact. Wobblers can utilize the same low pressures as drip systems.



Uniform Solution Contact

LOW PRESSURE - HIGH PERFORMANCE

Low pressure, 10-20 psi (1.03-1.38 bar) spray nozzles like the mini-Wobbler® evenly applies solution over large surface areas, much like a gentle rain, maximizing solution/ore contact, while minimizing the potential for channeling or clogging.

MINI-WOBBLERS®



Available in:
½" NPT connection

XCEL-WOBBLERS®



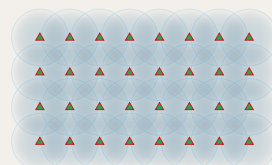
Available in:
High and Mid angle
½" and ¾" NPT connection

WINSIPP CUSTOM MINING SOFTWARE

Developed to help mining leaching installations achieve the required application rate and uniformity. It provides visual comparisons of various combinations of applicators, flows, pressures, and spacing options. Analyzing these combinations in advance helps assure optimal system design and operation.

Model	Nozzle
MINI WOBBLER	7
Base Pressure	Flow
20 psi (1.38 bar)	1.51 gpm (343 L/hr)
Layout: Rectangular	
Offset Spacing 0 ft (0 m)	
Head Spacing	Row Spacing
20 ft (6 m)	23 ft (7 m)
Average Precipitation	
0.0033 gpm/ft² (8.2 L/hr/m²)	
0.05 (1.23 m)	0.42 (11.09 m)
Infinite	
Coefficient of Uniformity	92.88%
Distribution Uniformity	88.64%
Scheduling Coefficient 5%	1.24

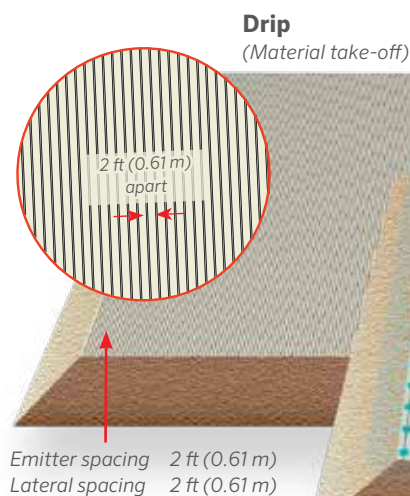
WINSIPP DENSOGRAM*



LEACHING COMPARISON

DRIP

To provide this application rate, drip irrigation systems would require spacing of laterals and emitters to be about 2 ft or (0.61 m) between drip lines and emitters.



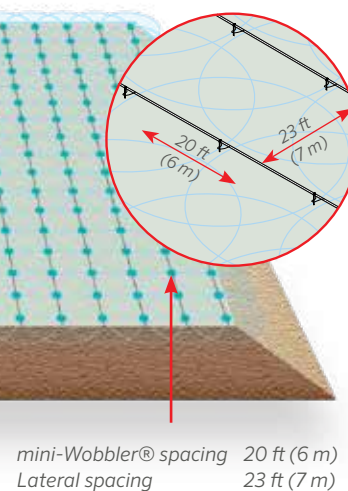
Based on Irri-Maker® design for pad
328 ft x 328 ft (100 m x 100 m)

WOBBLERS®

Mini-wobblers® and Xcel-Wobblers are spaced 20 ft x 23 ft (6 m x 7 m) between sprinklers and lateral lines. Material and labor costs can vary significantly in these two systems.

Sprinkler

(mini-Wobbler®/Xcel-Wobbler®)



LOW PRESSURE SYSTEMS

Save energy and allow greater areas to be leached in less time. Many applicators are not designed to operate at low pressure. Senninger Wobblers® have been engineered and designed to provide optimal performance at low pressures, in many cases as low as that used for drip emitters. At low pressure of 15 to 20 psi (1 to 1.38 bar), Wobblers® provide a consistent droplet size throughout the entire wetted profile. The solution reaches the ore surface with a gentle even distribution.

BILL OF MATERIAL	Sprinkler	Drip
16 mm PE lateral / (20 mm) PE lateral	4,700 linear ft (1,433 linear m)	54,000 linear ft (16,459 linear m)
Fittings	15	328
Emitters	255	27,000
ENERGY REQUIRED	Sprinkler	Drip
Pumps	60	60
Pipes	10	10
Fittings	2	2
Emitter Operating Pressure	15	15
Filtration	4	8
TOTAL	91	95

Based on IrriMaker® design for pad
328 ft x 328 ft (100 m x 100 m)

VERSATILITY	Sprinkler	Drip
PE lateral recyclable?	Yes	No
Emitter recyclable?	Yes	No
Visual performance assessment	Yes	No
Can flow be changed?	Yes	No
Plugging potential?	Low	High
Filtration required?	No	Yes
Can orifice be cleaned?	Yes	No

3123 AND 4123 PART-CIRCLE IMPACT SPRINKLERS

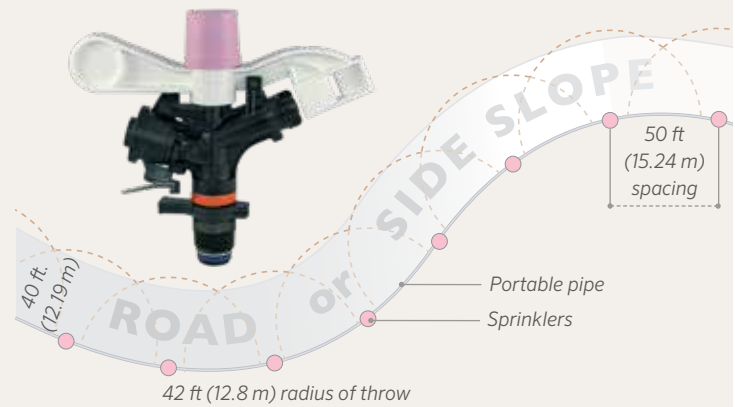
Available for gold and silver mining solutions

- Eliminates costly mobile watering
- Conserves water
- Increases coverage efficiency
- Allows dust control automation
- Side slope leaching option
- ¾" NPT male base, nozzle #9 (9/64")

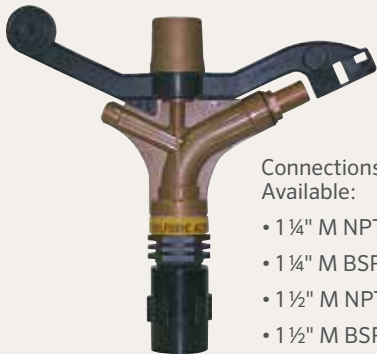
The best and most flexible option to leach side slopes or keep dust under control when coupled with a portable pipe system.

NOTE: Pressure regulator recommended
@ 40 psi (2.76 bar), Flow: 3.65 gpm (829 L/hr)

IDEAL FOR SIDE SLOPE



IMPACT SPRINKLERS



Connections Available:

- 1 ¼" M NPT
- 1 ¼" M BSPT
- 1 ½" M NPT
- 1 ½" M BSPT

SUPER SPRAY

For evaporation
¾" NPT Connection



PRESSURE REGULATORS



PMR-MF-CMS-Medium Flow

- 2 to 20 gpm (454 to 4543 L/hr)
- ¾" and 1" NPT or 1" BSPT connections

PRL-CMS-Low Flow

- 0.5 to 8.0 gpm (114 to 1817 L/hr)
- ¾" NPT or Hose connections

PRMP-Mining Prospector

- 0.5 to 7 gpm (114 to 1590 L/hr)
- ¾" NPT or Hose connections

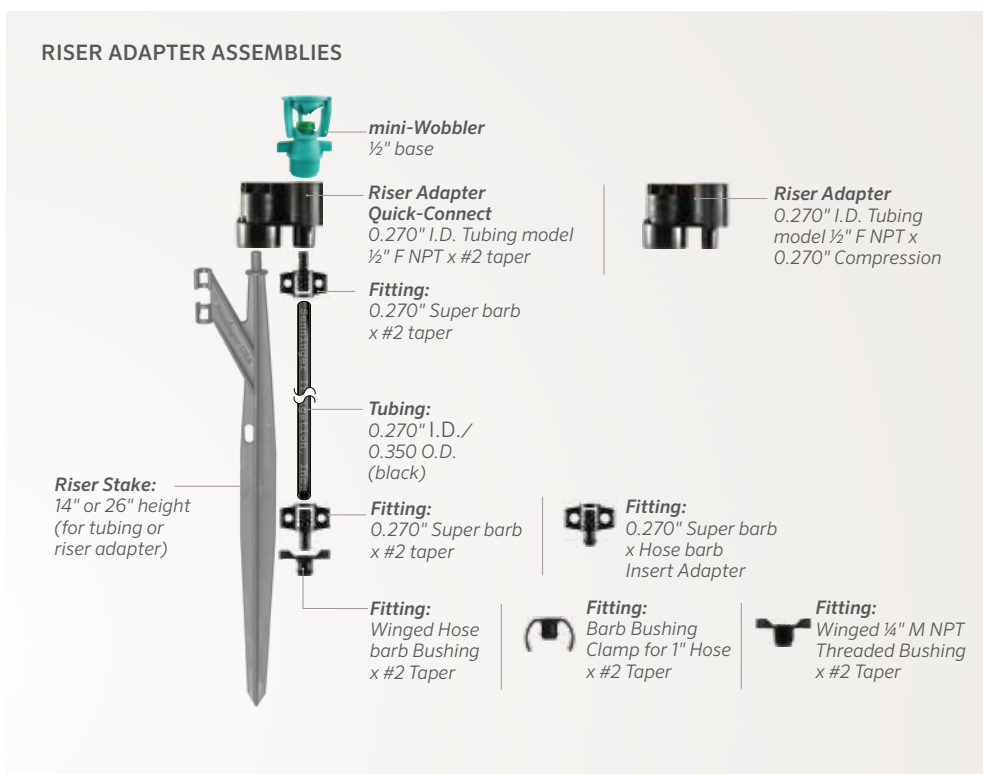
Senninger Riser Adapter Assemblies make irrigating easier in hard to reach places and is ideal for temporary and portable systems. They are connected to the laterals allowing the sprinklers on each to be repositioned as needed.

QUICK-CONNECT RISER ADAPTER ASSEMBLIES

1. Place the riser adapter in the desired location
2. Support it with either ½" or ¾" PVC pipe or ⅝" plastic stake (PL/1000093)
3. Cut Polyethylene tubing to desired length
4. Insert Super Barb (with tapered end) into both ends of tubing
5. Press fit one tapered end into riser adapter
6. Using a 7/16" drill and tap to bore a ¼" hole in HDPE lateral where the bushing will fit
7. Insert the threaded bushing into the tapped hole
8. Press fit the tapered end into the threaded bushing

RISER ADAPTER ASSEMBLIES AND RISER STAKES

1. Place the Riser Adapter on a 24" or 14" Riser Stake and install in desired location
2. Cut polyethylene tubing to desired length
3. Push one end of tubing approximately ½" into Riser Adapter
4. Insert Super Barb Fitting (with barbed end) into other end of tubing
5. Using the proper punch tool, cut hole in the lateral where the tubing will attach
6. Insert barb into the hole



Friction loss through the entire assembly:

- including 3 ft (0.9 m) of 0.270" ID PE tubing - is 6.3 psi at 2.0 gpm (0.43 bar at 454 L/hr).
- including 3 ft (0.9 m) of 0.345" ID PE tubing - is 1.7 psi at 2.0 gpm (0.117 bar at 454 L/hr).

Contact technical support for friction loss on flows greater than 2 gpm (454 L/hr) or tubing lengths greater than 3 ft (0.9 m). Punch tools also available, see pg.44

Tubing punch tools sold separately:

GREEN PUNCH	RED PUNCH
TUPTAP4I - for use w/ FTA1B1B	TUPTAP5I - for use w/ FTA15B15B, FTHS2T, FTHS3T, FT1M2T, FT4HSC2T

WARRANTY & DISCLAIMER

This warranty supersedes all other warranties expressed or implied. No person has the authority to incur or assume for Senninger Irrigation, Inc. ("Senninger") any other liability as to the products manufactured by Senninger.

This warranty does not extend to any product or part that has been repaired, altered, or modified in any way outside the Senninger factory, nor shall it apply to any product which has been subject to misuse, negligence or accident, or improper operation contrary to Senninger's published instructions. Under no circumstances will Senninger be held responsible or liable for any consequential, incidental or punitive damages resulting from the use of Senninger products, or resulting from any product defects, failure or malfunction.

This warranty extends only to the original purchaser of the Senninger product. This warranty does not extend to any product or part manufactured by others.

MATERIALS AND WORKMANSHIP

Products manufactured by Senninger for use in mining applications are warranted to be free of defects in materials or workmanship under normal use for a period of one (1) year from the date of manufacture.

PERFORMANCE

Products manufactured by Senninger for use in mining applications are warranted to maintain their original performance for a period of one (1) year from the date of manufacture if installed and operated in accordance with Senninger's published specifications and used as intended for irrigation purposes.

REPAIR OR REPLACEMENT

If a Senninger product is suspected of failure during the applicable warranty period, Senninger will repair or replace, at its option, the product or the defective part. Contact Senninger customer service in Clermont, Florida USA for specific instructions on how to proceed with a warranty claim. If after inspection of the product and documentation the failure is deemed a warranty issue, a replacement or credit will be authorized. Senninger is not obligated to pay for repairs or replacements made by anyone other than itself. No labor allowances will be made for removal or replacement of warranted parts nor for any travel to and from the product to make said repairs or replacement without prior written authorization from Senninger.

SUITABILITY

There are no other warranties, expressed or implied, including warranties of merchantability and warranties of fitness for a particular purpose. It is the sole responsibility of the purchaser to consider and analyze the product and its design to be suitable for specific applications.



Senninger's commitment to world-class products, local support and technical expertise ensure we provide the most efficient and reliable agricultural irrigation solutions available in the world today.

A handwritten signature in white ink, reading "S.D. Abernethy".

Stephen D. Abernethy, President of Senninger Irrigation