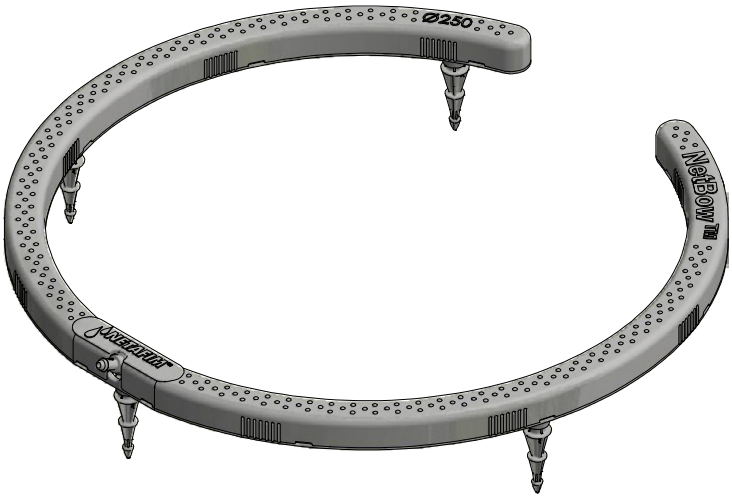
NetBow™

Netafim's latest Innovation that helps growers maximize nutrigation efficiency in containers



Main Benefits

Increase Revenues:

- Healthy plants
- Higher crop quality with greater yields
- Reduced labor costs at installation and during crop rotations

Uniform water & nutrient distribution in container from top to bottom without blind spots

- The 8 outlets of NetBow™ are placed on the substrate surface, to ensure 100% uniform coverage of substrate from top to bottom with no "blind spots".
- With NetBow™, roots develop in every square inch of the container, including the top layer, where root development is critical, ensuring your crops reach their full growth potential.
- In other contemporary solutions (Netafim™ and other manufacturers), water tends to flow on the spike connected to the micro-tube. Water disconnects from the spike only at its tip, thus causing a dry upper layer at the surface.

User-friendly device that simplifies installation and operation

- In other contemporary solutions (Netafim™ and other manufacturers), positioning water outlets correctly is highly dependent on human skills.
- In the case of moving containers around or new installations, other products are more complex to handle and therefore more time-consuming.

Anti-clogging advantages

In the NetBow™ solution, the hub-dripper (PC or PCJ drippers or UniRam™ driplines) delivers the correct flow rate and working pressure to ensure optimal conditions to the NetBow™ internal labyrinths.

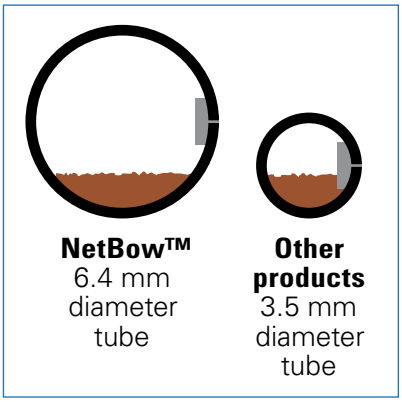
These emitters (PC or PCJ drippers or UniRam™ driplines) provide efficient filtration of water and fertilizers, hence preventing the passage of dirt particles and suspended solids into their labyrinths. Once filtered, the water and fertilizers reach the NetBow™ arc with its labyrinths. These internal labyrinths ensure a uniform and streamlined flow between the dripping points.

NetBow™ features 8 of Netafim's high clog-resistant labyrinths, ensuring uniform water distribution with reduced clogging risk.

The other contemporary solutions (by Netafim™ and other manufacturers) on the market (either 2 or 4 dripping points per pot/plant), which offer only a few outlets per container. If one emitter gets clogged, the plants immediately start suffering stress, so there is very little tolerance for clogging.

- NetBow™ supplies 8 outlets per pot/plant.
  Theoretically, Netafim™, like some of its competitors, could offer a 6- or 8-outlet solution, but this would be very expensive and complicated to install. It should be taken into account that for each pot/plant, the farmer/worker would have to install and accommodate 8 different emitters + 8 different micro-tubes, in addition to the physical inconvenience of having to walk between plants with multiple micro-tubes.
- One of the world's strongest trends is organic crops, which can bring higher income. However, the organic fertilizers used are less soluble and may cause clogging. Netafim™ labyrinths used in the NetBow™ solution have proven effective over 20 years of application in the most challenging conditions: harsh water at very low working pressure. Over 100 million labyrinths of this type are used in multiple countries with successful results.
- In NetBow™, the labyrinths are welded onto a relatively large-diameter (6.4 mm) tube (an area 71% larger), instead of a very small-diameter (3.5 mm) micro-tube in other contemporary products, where the accumulated dirt sediments start clogging the labyrinth inlet earlier.
- In NetBow™, the labyrinths are parallel to the main flow, thereby enabling flushing of the labyrinth filtration surface and pushing the accumulated dirt to the end of the tube, where they do not disrupt the labyrinths' proper functioning. In other contemporary products, the filter inlet also functions as a plug, so whenever clogging occurs no flow can remove the dirt out of the system.
- The NetBow™ internal labyrinth filtration area that protects each water passage measures 22 mm^2 vs. 13 mm^2 - 70% larger than other Netafim™ products, and the difference is even greater when compared with competitors' solutions.

Dirt sediment accumulation



NetBow™ 6.4 mm diameter tube

Other products 3.5 mm diameter tube

Improved prevention of root intrusion

- The direction of the labyrinth outlets in the NetBow™ always faces sideways to separate the dripper from the soil/substrate and create an anti-root gap. This dramatically improves the units' root intrusion resistance feature compared with other leading stakes and arrows on the market.

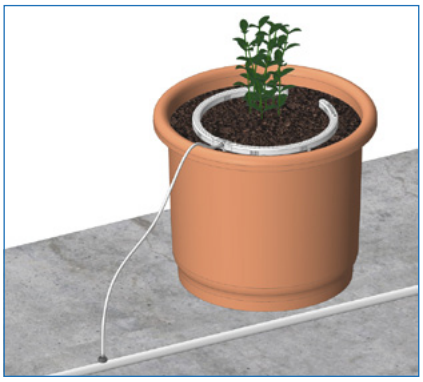
Significant labor-cost reduction

The labor time needed to install/remove NetBow™ is far less than that needed for stake/arrow products (8 outlets). Multiplying this by the number of pot plants per unit area indicates significant time savings. In addition, the accurate positioning of the leading stakes determines the quality of water distribution in the pot plant, which is very difficult to achieve manually.

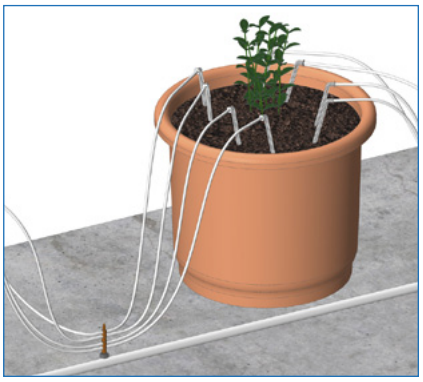
NetBow™ allows installation of 1 product + 1 micro-tube instead of 8 emitters + 8 micro-tubes spaced around the plant, making NetBow™ installation/removal during weeding much simpler.

Using other existing methods requires the installation of 8 micro-tubes per each plant, which is time-consuming and slows the pace of work. Naturally, in that system, moving plants (connected to tubes) from place to place is very difficult..

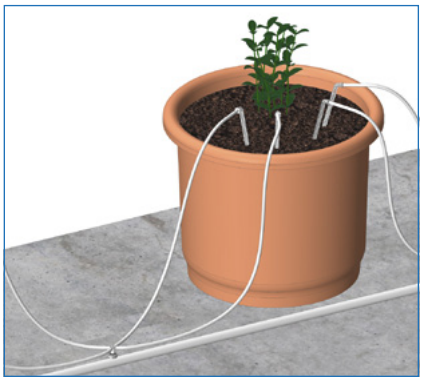
NetBow™



8 stakes/arrows per pot



4 stakes/arrows per pot



For a relevant comparison, consider the NetBow™ installation / removal time versus the installation / removal time of 8 stakes & arrows per pot solutions. NetBow™ is a great solution that saves time with its innovation and provides a simplistic alternative to complex offerings of today which are very time-consuming. For that reason, 8 stakes & arrows per pot solutions are virtually never implemented and farmers opt for the lesser 2-4 stakes & arrows per pot solutions, compromising on water distribution, uniformity, wetting of the entire area and clogging resistance.

The NetBow™ offers single-action installation just place it in the pot and connect the inlet tube).

- The installation accuracy/removal of NetBow™ does not require worker skills or elaborate training.
- The installation accuracy/removal time of stakes & arrows solutions is highly dependent on worker skills and training.

The NetBow™ allows astounding saving of at least 75% on installation/removal time relative to any other solution on the market.

Other options:

Another option that was previously considered (not only by Netafim™) was installing a circle of drippers above each pot plant in a small 8-mm-diameter dripline (resembling the one used with NetBow™). This option was rejected for the following reasons:

- Complexity and time required for placing the circle at equal distance around the plant center.
- The need to connect the tube to several dedicated stakes to ensure proper positioning of the dripline over time.
- Lack of an available connector to allow proper connection between the dripping tube and the hub-dripper or dripline.
- An overly complex and time-consuming product-dismantling operation (for plant container replacement or at the end of a growing cycle) and inaccessibility.

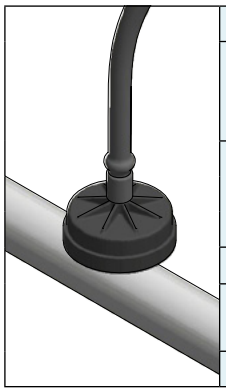
Although some growers have chosen this option (with local improvisations for the missing adaptor), they do so only because no other viable solution has been offered to date by any manufacturer.

The Microdrip dripline used in the NetBow is specially produced with specific spacing of 8 cm to allow 8 dripping points in a circle of 250 mm, there is no standard micro-dripline with this spacing, and in order to reach 8 dripping outlets with the minimum existing spacing you will reach a circle of almost 0.5 m which is not relevant for most pots in the industry.

NetBow™ is great news for those farmers and offers a far more viable and efficient alternative to such applications.

Netafim™ hub-drippers for use with NetBow™

PC hub-dripper



Model	PC	PC LCNL	PC HCNL
Flow rates (l/h)	2.0 4.0 8.5	2.0 4.0 8.5	3.0 6.0 12.0
Labyrinth passage dimensions	2.0 and 3.0 l/h drippers: 1.17 x 1.07 x 61 mm		
	4.0 and 6.0 l/h drippers: 1.32 x 1.44 x 60 mm		
	8.5 and 12.0 l/h drippers: 1.60 x 1.60 x 17 mm		
Filtration area (mm²)	2.0		
Minimum required working pressure (bar)	0.5	1.0	1.4
Shut-off pressure (bar)	N/R	0.15	0.30

Dripper outlet

- **Nipple:** Connection to the outlet is done using a tube with a male-female pressure nipple, allowing connection/disconnection between the hub-dripper and tube at any time, requiring no tools and/or extra work.

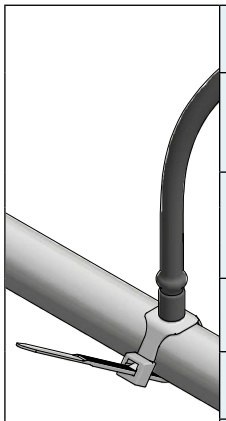
PCJ hub-dripper

Model	PCJ	PCJ LCNL	PCJ HCNL
Flow rates (l/h)	2.0 3.0 4.0 8.0 12.0	2.0 3.0 4.0 8.0 12.0	2.0 3.0 4.0
Labyrinth passage dimensions	2.0 l/h drippers: 0.80 x 0.79 x 35 mm		
	3.0 l/h drippers: 1.03 x 1.07 x 35 mm		
	4.0 l/h drippers: 1.32 x 0.92 x 35 mm		
	8.0 l/h drippers: 1.60 x 1.08 x 35 mm		
	12.0 l/h drippers: 1.60 x 1.08 x 17 mm		
Filtration area (mm²)	2.0		
Minimum required working pressure (bar)	0.5	0.7	1.5
Shut-off pressure (bar)	N/R	0.12	0.18

Dripper outlet

- **Nipple:** Connection to the outlet is done using a tube with a male-female pressure nipple, allowing connection/disconnection between the hub-dripper and tube at any time, requiring no tools and/or extra work.
- **3 mm barb:** Choosing this option eliminates the need for the male-female pressure nipple at the end of the tube. The tube can be connected directly to the barb outlet, thus saving a little on the unit cost, at the cost of losing the benefit of quick and easy connection/disconnection between the hub-dripper and emitter. Should this option be selected, the farmer will need to carefully cut the tube wall above the barb (while avoiding harming its integrity) and before reconnecting the tube to the barb connector, he will need to cut some millimeters off the tube to ensure a new leak-free connection.

UniRam™ hub-dripper



Model	UniRam™ RC	UniRam™ CNL	UniRam™ HCNL
Flow rates (l/h)	2.3 3.5	2.3 3.5	2.0 2.9 4.4
Labyrinth passage dimensions	2.0 l/h drippers: 1.07 x 0.79 x 40 mm		
	2.3 and 2.9 l/h drippers: 1.26 x 0.95 x 40 mm		
	3.5 and 4.4 l/h drippers: 1.59 x 1.10 x 40 mm		
Filtration area (mm^2)	2.0, 2.3 and 2.9 l/h drippers: 130		
	3.5 and 4.4 l/h drippers: 150		
Minimum required working pressure (bar)	0.5	1.0	1.5
Shut-off pressure (bar)	N/R	0.14	0.25

Dripper outlet

- **Hole:** As a dripline, each of the dripper outlets is a hole. To adapt it for the NetBow™ water distribution, a Dr. Zip™ fitting should be mounted on the outlet to serve as an adapter between the hole outlet and the nipple connector.
- **Nipple (assembled Dr. Zip™):** Connection to the outlet is done using a tube with a male-female pressure nipple, allowing connection/disconnection between the hub-dripper and tube at any time, requiring no tools and/or extra work.

Dripper quality comparison

How do we evaluate dripper quality?

Many variants influence dripper quality; each of them individually influences the dripper quality.

- Effective filtration area
- Water passage area
- Water passage length

However, when we come to evaluate dripper quality, we need to relate to the combination of these variants and sum them into one result that enables us to easily rate and evaluate the dripper.

What will be the weight for each?

The only parameter that combines most of the mentioned variants into one formula is the turbulence coefficient.

Why is it important to have higher turbulence in dripper's flow path?

- There is a close connection between high drag and strong turbulence. Both are the result of the pressure differential!
- Higher drag allows lower flow rate in certain flow-path dimensions.
- Higher turbulence creates higher local velocities in various directions. These local velocities prevent sediment conglomeration inside the flow path, and thus prevent clogging!

The only parameter that the turbulence coefficient does not take into consideration is the effective filtration area; Netafim™ built a model that incorporates this variant in the model so that it covers all the variants that impact dripper quality.

To summarize, the two main variants that the "Netafim™ dripper's quality" model takes into account are:

- Turbulence coefficient - **K**
- Effective filtration area - **EFA**

Netafim™ Dripper Quality = DQ = W1 * EFA + W2 * K

- **EFA** - Filtration area
- **K** - Turbulence coefficient
- **W1** - Filtration area weight factor
- **W2** - Turbulence coefficient weight factor

Higher dripper quality = Higher dripper-clogging resistance

(For more related information, please consult the Netafim™ dripper-quality model document)

In line with the above model, and comparing the drippers described above, the comparison between the options will refer to:

Hub-dripper: Uniram™ is ~ 300% more resistant than the PC and PCJ drippers with identical flows.

Dripping point: The NetBow™ labyrinth is 14% more resistant than the Arrow dripper.

*In both cases (300% for the hub-dripper and 14% for the dripping point), results were calculated giving an equal rate to the impact of water passage and filtration area on each result. If this rate were different, the results of both would change accordingly.

Technically, the combination of the Uniram™ hub-dripper with a NetBow™ emitter is the recommended solution.

Beyond the technical differences among the available options, here are some other points to consider:
PC and PCJ drippers are insertable barb drippers, available as single drippers that can be inserted on a PE pipe in the field according to the farmers' choice. The great advantage here lies in the farmer's ability to choose exactly where to insert the drippers (the spacing between them). The drawback of this option is the amount of work required to insert/mount the drippers onto the pipe.
Netafim™ supplies these drippers already mounted on the pipe (pre-selected by the farmer) at fixed distances or in grouped drippers mounted in fixed distances, which significantly reduces labor time in the field, but at the same time loses the advantage of flexibility in choosing the desired spacing between the drippers.

The Uniram™-based solution is available as single drippers at fixed distances or in grouped drippers at fixed distances. Extra time will be needed for connecting the Dr. Zip™ fitting above each of the drippers in the field.

Minimum Operating Pressure Requirements for NetBow™ Assemblies

Calculation of the minimal pressure required at the hub-dripper's inlet of the NetBow™ assembly:

1. Determine the desired flow rate at each of the dripping points (based on agronomic parameters).

NOTE

The flow rate intended for each dripping point should **never** be lower than 0.25 l/h.

- Calculate the inlet pressure necessary to deliver the required flow rate of each labyrinth.

A designated table can be built based on the dripper labyrinth technical data:

NetBow™ labyrinth nominal flow rate at 1.0 bar working pressure	Constant K	Exponent X
2.0 l/h	0.647	0.49

To accurately calculate the required pressures, use the formula:

$$Q = K * (P^X)$$

Where:

- **Q** = Flow rate (liters per hour)
- **K** = Constant
- **P** = Pressure (meter)
- **X** = Exponent

2. After entering the data in the formula, the following table will be obtained:

Pressure (bar)	0.015	0.020	0.025	0.030	0.035	0.040	0.060	0.140	0.250	0.275	0.550	1.000
Flow rate (l/h)	0.26	0.29	0.33	0.36	0.39	0.41	0.50	0.76	1.01	1.06	1.49	2.00

*The pressure level displayed in the table above represents the potential flow distribution per each of the hub-drippers presented in this document, divided among 8 dripping points. Calculating the real flow per any desired pressure is done using the formula shown above.

Assuming the desired flow rate at each NetBow™ labyrinth is 0.5 l/h, the table shows that to obtain this flow rate, the required pressure at each labyrinth inlet should be 0.060 bar.

3. Add the working pressure of the selected NetBow™ labyrinth to the minimum working pressure of the hub-dripper. The result will be the minimum pressure required at the inlet of the complete NetBow™ system.

EXAMPLE

Assuming a PCJ CNL system with the hub-dripper connected to NetBow™:

- Flow rate of each NetBow™ dripping point = 0.5 l/h.
- 8 dripping points under the hub-dripper = 0.5 * 8 = 4.0 l/h.
- A 4.0 l/h PCJ-LCNL dripper will be selected as the hub-dripper.
- The minimal pressure required to ensure the 4 l/h PCJ-LCNL dripper standard performance = 0.7 bar.

Add up the required pressures:

- 4 l/h PCJ-LCNL hub-dripper - 0.70 bar.
- NetBow™ labyrinth - 0.06 bar.

Therefore, the minimal pressure required for proper performance of the system is: **0.70 + 0.06 = 0.76 bar**.

Author: Product Management Dept. - May 2020