

# FullStop™

## Wetting Front Detectors

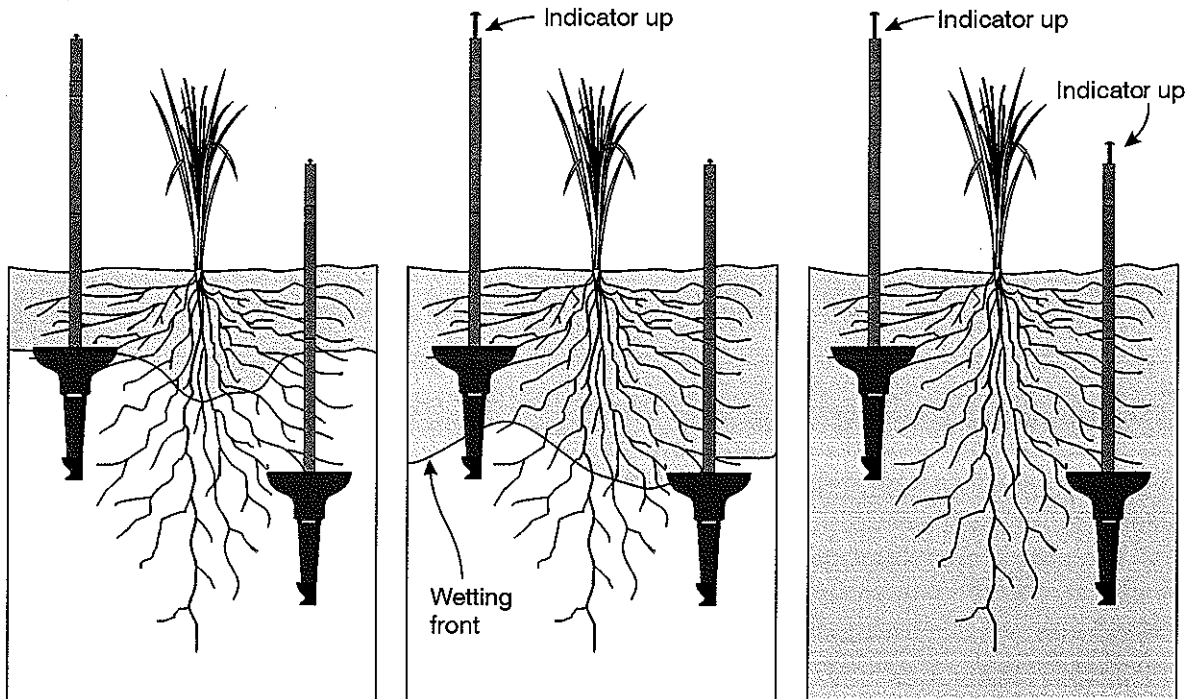
*Important: Please read these instructions before assembly*

The **FullStop™** Wetting Front Detector shows how deep water infiltrates into the soil after irrigation or rain. It takes a soil water sample so that the movement of plant nutrients and salt through the soil can be monitored.

The Wetting Front detector can be used to:

- find out if you are irrigating too little or too much
- assist in the management of fertilizer and salt
- show if the soil is water-logged.

The FullStop Wetting Front Detector helps you to "see" what is happening down in the root zone when you irrigate the soil. Wetting Front Detectors are usually buried at two depths in the root zone and pop up an indicator to show when the infiltrating water goes past. They also capture and store a sample of water from the wetting front.



**Shallow Indicator: DOWN**  
**Deep Indicator: DOWN**

If neither indicator is triggered, then watering is generally too shallow

**Shallow Indicator: UP**  
**Deep Indicator: DOWN**

Water has moved *past* the shallow detector to the lower part of the root zone.

**Shallow Indicator: UP**  
**Deep Indicator: UP**

The deep indicator should be triggered only when it is necessary to fill the whole root zone.

**For more detailed instructions on assembly and use of the Wetting Front Detector for irrigation, fertilizer and salt management see**

**[www.fullstop.com.au](http://www.fullstop.com.au)**

# Assembly

This box contains

- red funnel (x2)
- base piece with steel mesh filter (x2)
- black extension tubes (x5)
- locking ring (x2)
- indicator cap (x2)
- foam floats (x14)
- green flexible tubing (x2)
- syringe (x1)
- bag of filter sand (x1)

See picture opposite and follow 7 steps below.

Before starting step 1, practise joining the base to an extension tube. A cup of very hot water is needed. Dip the last 5 cm of the wide (female) end of the extension tube into hot water to soften the plastic. Insert the base piece into the wide end of the extension tube by lining up the lugs, pushing and twisting hard. The fitting will be in the locked position after a quarter of a turn clockwise. Undo this fitting and follow the steps below.

**Step 1:** Dip one end of green flexible tubing into hot water and connect to the 4 mm barbed outlet on base piece.

**Step 2:** Insert the base into the bottom end of the funnel and push in as far as it will go.

**Step 3:**

Slip the locking ring over the wide end of extension tube that was previously dipped into hot water. Move locking ring one third of way up to the ridge on the extension tube. The spokes on one side of the locking ring are rounded. The rounded side should face upwards.

**Step 4:** Dip the wide end of the extension tube (with locking ring) into hot water again. Pick up the base piece and funnel and join the extension tube to the base through the funnel. This requires a firm pushing and twisting action (quarter turn). When correctly joined there will be a watertight seal with no gap between the base and the funnel.

**Step 5:** Add one or two more extension tubes, depending on depth of installation (no hot water treatment needed).

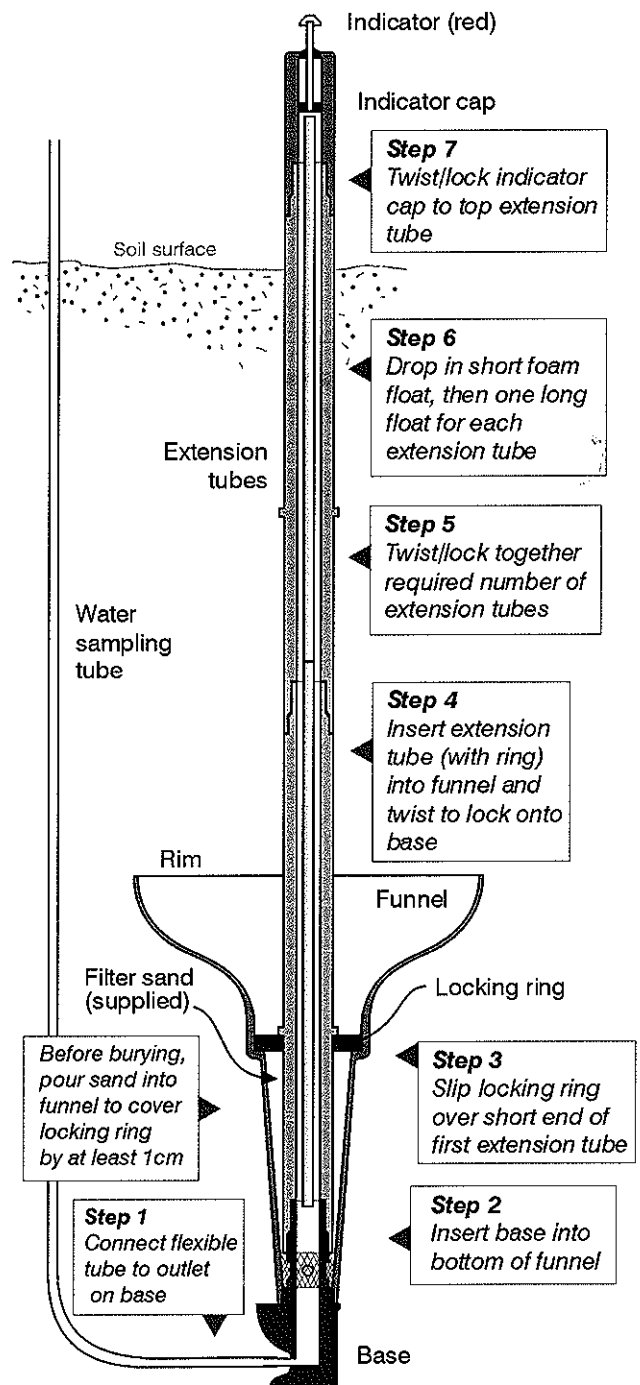
**Step 6:** Drop in the foam floats. 5 floats are required if two extension tubes are used and 7 floats are needed if three extension tubes are used. Use the float marked with blue paint last (it is shorter). The last float must protrude 1 to 2 cm above the opening of the extension tube.

**Step 7:** Add indicator cap - yellow for the shallow and red for the deep wetting front detector. The indicator should be in the fully down position.

# Testing

Test each detector for leaks after it has been assembled by adding a syringe full of water into the funnel, with the flexible tube held upright to ensure water does not escape. The indicator will then rise and be held up by a magnet. No water should be visible at the join between the funnel and the base. Let the water out via the flexible tube and tap the indicator down to release the magnetic 'latch'. The supplied filter sand **must not** be added until you are ready to install the detector.

If you need to disassemble, remove floats first.

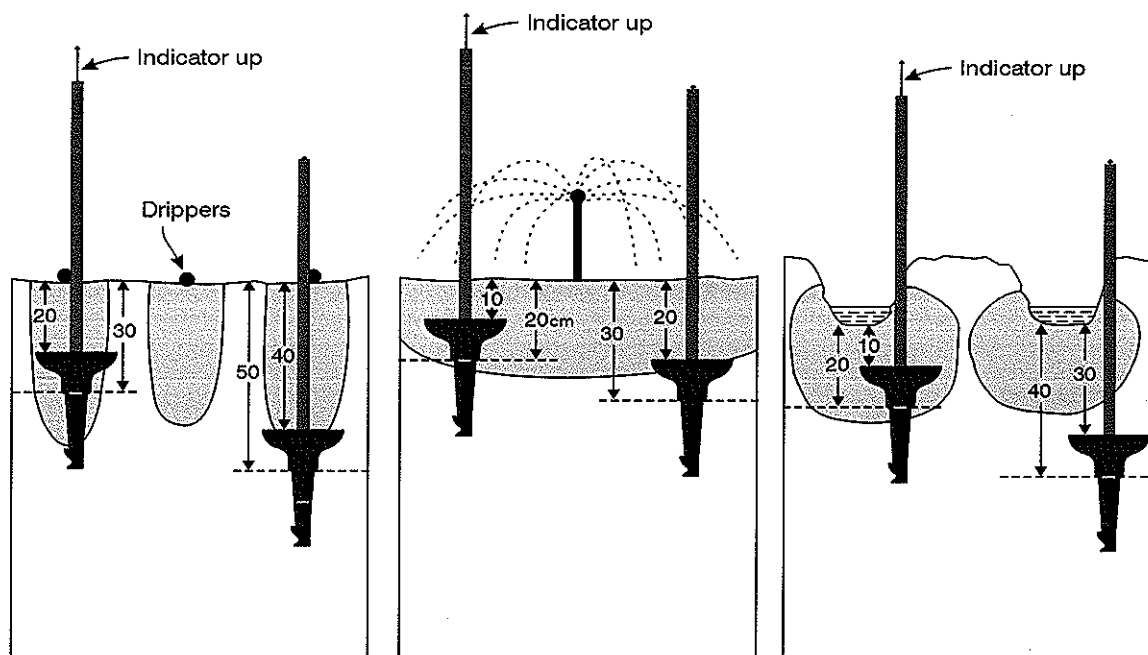


# Depth Placement

The optimum depth of placement depends on the irrigation method and the frequency of irrigation, as well as the type of crop and soil. The table below is given as a guide, based on our experience. Placement depths are measured from the **soil surface to the locking ring**. If measuring to the rim of the funnel, subtract 10 cm from the depths in the table. With experience, these recommendations can be adjusted for local conditions.

Type of irrigation	Notes	Shallow Detector	Deep Detector
<b>Drip</b>	Amount applied per dripper usually less than 6 litres at one time (e.g. row crops, pulsing)	30 cm	45 cm
<b>Drip</b>	Amount applied per dripper usually more than 6 litres at one time (perennial crops)	30 cm	50 cm
<b>Sprinkler</b>	Irrigation is usually less than 20 mm at one time (e.g. centre pivot, micro-jets)	15 cm	30 cm
<b>Sprinkler</b>	Irrigation is usually more than 20 mm at one time (e.g. sprinklers and draglines)	20 cm	30 cm
<b>Flood</b>	Deeper placements than shown needed for infrequent irrigations or very long furrow	20 cm	40 cm

When the float is in the up position a wetting front has moved **past** the detector. The soil above the detector is as wet as it can be (almost saturated). That is why the above depths may appear to be shallow. A third detector, 10 cm below the deep detector depth shown above, can be installed if necessary.



## DRIP

The detector must always be placed **directly under a dripper**.

It is common for detectors to respond quickly under drip because the water is concentrated around the dripper. If so, apply less water more often.

## SPRINKLER

Wetting patterns tend to be shallower under sprinkler irrigation than drip or furrow irrigation.

Detectors will usually not be activated by applications under 15 mm, unless the soil is quite wet before irrigation

## FLOOD

Detectors should be positioned half under the furrow and half under the bed with the extension tube rising through the shoulder of the bed.

This placement is also suited for sprinkler irrigated crops grown on raised beds.

# Installation

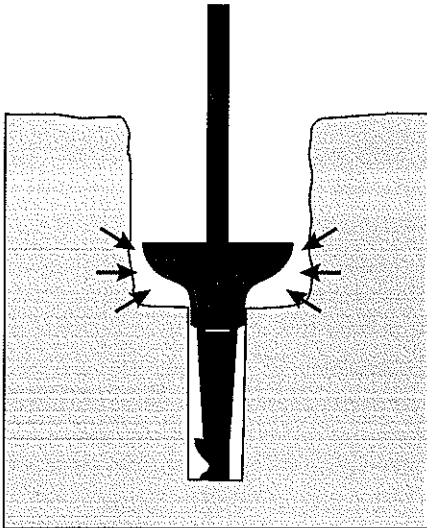
## Step 1 – digging the hole

The detector is easiest to install using two augers: an auger (20 cm or larger in diameter) for the wide end of the detector funnel and another (5–10 cm in diameter) for the narrow end of the funnel. Alternatively, a spade and trowel can be used. Keep different soil layers separate when removing them from the hole if the soil type changes with depth. Installation is easiest when the soil is moist, rather than when it is very wet or dry.

## Step 2 – add filter sand and insert into hole

Pour the supplied filter sand into the funnel until it covers the locking ring by at least 1 cm. Lower the detector into the hole and measure the distance to the locking ring (or rim of the funnel) to check it is at the desired depth.

Holding the extension tube vertically upright in the hole, fill the funnel with soil removed from the layer at the same depth and firm down lightly. Hold the flexible tube alongside the funnel up to the soil surface. Pack soil under and around the sides of the funnel until it is firmly in place as indicated in the diagram below. The deeper narrow hole does not need to be packed with soil.



## Step 3 – bury the FullStop detector

Break the sides of the hole as you return soil above the detector, as smooth sides may restrict the growth of roots and the movement of water. The hole must be filled by returning the removed soil to its original layer. Soil should be firmed down by hand but not compacted. All the soil should be returned to the hole leaving a slight hump over the installation. After settling, check to make sure the soil level over the installation site is the same as the surrounding soil so that

water does not run towards or away from the FullStop detector.

## Step 4 – Activate the float

Water the site over the detector after installation to trigger the float. This may require 20 litres or more for a deeper installation.

## Step 5 – Maintenance

Occasional testing and maintenance should be carried out to ensure the detector is operating as expected.

Ensure there are no leaks before installation. After installation, there are two further checks that should be carried out every few months.

**Float mechanism:** Inject 30 ml of water from syringe into the green 4 mm tubing. The float should pop up.

**Filter:** Irrigate till float pops up – then remove water from 4 mm tube with syringe and reset float. Float should pop up again within 5 minutes.

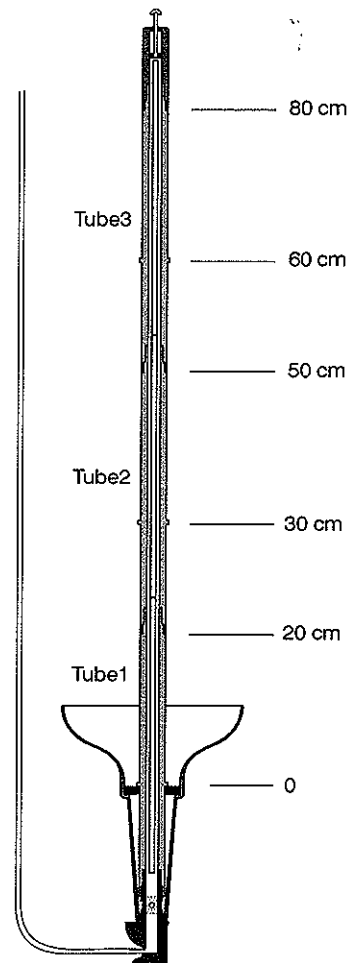
If either test fails, see troubleshooting on back page.

## Depth of placement

The depth of placement depends on the irrigation method and the frequency of irrigation.

The indicator pops up when the wetting front has moved about 10 cm below the rim of the funnel, labeled "0" in the diagram below. The position of the lock up ring is the approximate depth of measurement.

The position of the ridge on the extension tube can be used to show the depth after installation. If the ridge on tube 2 is at the surface, the depth of detection is 30 cm. If the ridge on tube 3 is at the surface, the depth of detection is 60 cm.



# Improving irrigation practice

When starting out, we recommend you continue to irrigate according to your normal practice while you get a 'feel' for how the detectors are responding. Then compare your normal practice to what the *FullStop* shows you as summarized in the table below.

Once you have developed some confidence in the way the detectors are working, you are ready to improve irrigation, nutrient and salt management. Change your water use practice at the rate at which you are comfortable, taking into account the growth and/or yield response of the plants. Note that it is not necessary to get the desired detector response after each irrigation – the general trends are more important.

Shallow Indicator	Deep Indicator	Meaning*	Action
Down	Down	Insufficient water for established crops	Apply more water at one time or shorten the interval between two irrigations
Up	Down	Wetting front has penetrated into the lower part of the root zone	Most of the time this is the desired result. During hot weather or when the crop is at a sensitive growth stage, the deep detector should respond.
Up	Up	The wetting front has moved to the bottom or below the root zone	If this happens regularly then over-watering is likely. Reduce irrigation amounts or increase the time interval between irrigations.
Down	Up	Soil or irrigation are not uniform or the soil surface is uneven	Go through troubleshooting steps Ensure the soil surface is level over the detectors. Check uniformity of irrigation or location of drippers.

\* this assumes that detectors have been placed at depths suited to the irrigation system and management regime

## Four things you need to know

### 1. Resetting the indicator

Water is 'sucked out' of the detector after irrigation by the soil around it. You must reset the detector after the indicator pops up by pushing the indicator gently down to release the magnetic latch. If the indicator immediately pops up again, it means that the soil is still very wet. If the detector will not reset for several days after irrigation, the soil is close to waterlogged.

### 2. Indicator up means a *strong* front has moved *past* the detector

A wetting front will always move deeper than the detector after the indicator pops up. If the soil below the detector is dry, the wetting front will only move a short distance further. If the soil below the detector is wet, the wetting front can move a long way past the detector after the indicator pops up. Therefore it is important not to place detectors too deep, particularly for sprinkler irrigation.

### 3. Effect of soil disturbance

The soil structure is disturbed during installation of the detectors. This is not a problem for installation into ploughed soil. In the case of perennial crops the soil will need to settle and the roots grow back into the disturbed zone before the detector will give reliable information.

### 4. How many *FullStop* detectors do you need?

It is best to have three pairs in a field, because irrigation is usually not uniform and soil properties and crop growth vary. Some irrigation systems (e.g. mini-sprinklers) tend to have large variability over small distances. Uniformity of wetting patterns should be measured and detectors placed in 'wetter' and 'drier' spots to give an indication of variability in wetting front depths.

# Troubleshooting

## Before installation:

1. **Check for leaks:** After assembly there must be no leaks between the base piece and the funnel.

**If leaks,** reassemble using hot water for extension tube to base fitting. Spokes on locking ring should be 'rounded' side up.

## After installation:

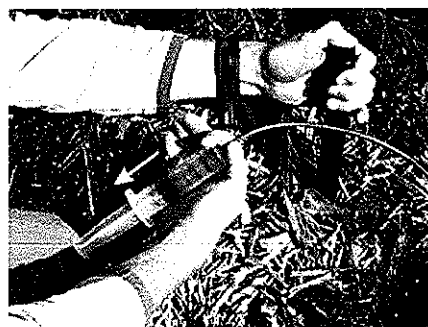
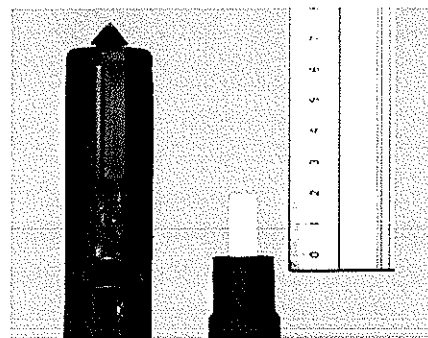
2. **Check the Float Indicator:** Inject 30 ml of water from syringe into the green 4 mm tubing. The float should pop up.

**If float remains down,** remove indicator cap and check that the last float protrudes 1 to 2 cm above extension. Check for stuck floats: Remove indicator cap, pour water down extension tube until all floats pop out. Check float pieces can pass through an extension tube without getting stuck. If indicator will not latch up, check top magnet is secured in ceiling of indicator cap.

3. **Check the filter:** Irrigate till float pops up – then remove all water from 4 mm tube with syringe and reset float. Float should pop up again within 5 minutes.

**If not, Back-flush filter:** To back-flush, remove indicator cap and one float. Press thumb over extension tube to seal opening. Force 60 ml of water from syringe into 4 mm tubing. Repeat. Back-flushing should be carried out after installation and once per year.

4. **Check the depth:** Look for ring on extension tube. From the ring to the depth of measurement is 30 cm (for 2 extension tubes) or 60 cm (3 extension tubes). Use yellow indicator for shallow detector and red indicator for deep detector.



## Service Pack

A service pack containing floats, indicator cap, syringe and extension tube is available

## Monitoring nutrients and salt

Water trapped in the detector can be sucked out with a syringe via the flexible tube and monitored for its electrical conductivity or nutrient concentration. Samples should be taken soon after irrigation. Note that the detector retains a small sample of water after self-emptying. This should be removed prior to irrigations from which samples for nutrient analysis are required.

## Limitations

The **FullStop™** Wetting Front Detector has been designed to respond to 'strong' wetting fronts. In soil physics terms, the strength of the front must be around 2 to 3 kPa suction or wetter for the indicator to rise. In practice this means that 'weak' fronts will not be detected and water can move past a detector without activating the indicator. Wetting fronts get weaker as they move deeply into the soil after the irrigation has been turned off. Weak fronts also occur during light rain, or when small amounts of water are applied at frequent intervals.

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### Disclaimer

Any decisions to change water use should be incremental and must be closely and regularly monitored to ascertain any negative impact on the crop. To the extent permitted by law, CSIRO accepts no liability arising directly or indirectly out of any misuse, negligent or incorrect use of the FullStop, any non-adherence to assembly or installation instructions or any circumstances outside CSIRO's control.