## Commercial dosing systems:

<https://www.dosatronusa.com/nutrient-delivery-system>

* Can dispense any fluid
* Powered by flowing water (Sick!)\
* Proprietary mechanism
* Injection range is 7.5 to 75 mL/gal for the smallest model
* Large - intended to be installed on standard piping

<https://bluelab.com/new_zealand/bluelab-peripod-l3>

* Peristaltic pump array (Pick how many you need)
* 120ml/min per pump
* Separate control box w/sensor inputs
* So expensive
* Opaque tubing to prevent algae growth

<https://www.agrowtek.com/index.php/products/dosing_systems/mini-dosing-systems/gdx-nutrient-ph-dosers>

* Peristaltic pump array
* Separate controller
* Separate sensors

Summary:  
Lots of peristaltic pump arrays, most all look nearly identical. Dosatron was the only system I found not using peristaltic pumps. Use opaque tubing.

## Peristaltic Pumps:

<http://www.iptonline.com/articles/public/IPT_26_p78nonprint.pdf>  
- Describes the use of peristaltic pumps for medical dispensing applications  
- Can be designed to dispense accuracy of .1ml

- Non pulsating pumps can be made by creating a dual roller system with phase offsets.

## PH Sensor:

Super wide cost range of PH Sensors, from $15 to $1500.. What is the difference? How do they work?   
  
A ph meter “works like a [voltmeter](https://www.explainthatstuff.com/movingcoilmeters.html): it measures the voltage (electrical potential) produced by the solution whose acidity we're interested in, compares it with the voltage of a known solution, and uses the difference in voltage (the "potential difference") between them to deduce the difference in pH.”  
  
[Detailed explanation of how PH Meters function](https://www.explainthatstuff.com/how-ph-meters-work.html#:~:text=A%20pH%20meter%20takes%20advantage,between%20them%20to%20deduce%20the)  
  
[The motherload of info on types of PH Sensors and their use cases:](http://web-material3.yokogawa.com/TNA1505_%2BpH%2BInstallation%2Band%2BMaintenance%2BManual.pdf)

* All sensors will become fouled: Glass/junction becomes fouled, solution is depleted
* All sensors will need calibration: The electrode deteriorates over time and thus must be recalibrated for age
* The process conditions will affect calibration interval, solution usage:  
  Process fluid (acidity, TDS, Temp)  
  Process application: (Frequency, pressure, time)

[PH Sensor Selection guide](https://www.coleparmer.com/tech-article/ph-electrode-selection-guide)

**Epoxy vs Glass Body:**  
Epoxy is cheaper but has smaller temp range

Glass bodies can be cleaned/last longer

**Liquid vs Gel Electrode:**

Gel electrodes are consumable, once they dry out they are disposed of.

Liquid electrode can be refilled (Typically these probes last longer overall)

**Single vs. Double Junction:**Double junctions last longer b/c it takes longer for the solution to be fouled. Single junctions are typically adequate for most solutions.

Most everyone says that Ph probes must be stored in a 3M KCL solution so that one you don’t leach fluid/dry out and two to protect from dust ingress. Storing submerged in water will leach the fluid out as well. Storing in a sealed environment (Measuring chamber) could fix this?

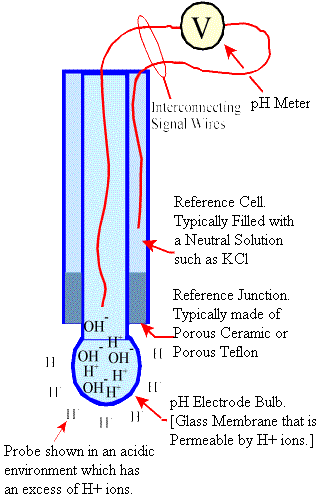
<https://www.reddit.com/r/hydro/comments/5d4h5e/hi_im_matt_from_hanna_instruments_im_here_to/>

<https://bluelab.com/usa/bluelab-ph-probe>

<https://www.hannainst.com/hi3230b-gel-filled-combination-orp-electrode.html>

<https://knowledge.hannainst.com/knowledge/ph>

<https://www.amazon.com/Milwaukee-Instruments-MA911B-Electrode-Electrolyte/dp/B0009YJ22O/ref=sr_1_16?dchild=1&keywords=ph%2Bprobe&qid=1602373400&sr=8-16&th=1>



## EC Sensors:

EC sensors are significantly simpler than PH probes. Far less susceptible to breaking. Calibration is still required, not very frequently though.

3 types:

* **Two electrode Probes** utilize an amperometric approach to make the measurement; a known AC voltage is applied at a specific frequency between a pair of electrodes in solution. The current produced is measured and reported in conductivity units referenced to a calibrated standard.
* **Four ring probe** conductivity (four ring conductivity) utilizes a potentiometric approach to taking a measurement; an alternating current is applied to the outer two “drive”electrodes to induce a current in the solution. The voltage is measured between the inner pair of electrodes in solution. The voltage is proportional to the conductivity.
* An inductive, electrodeless or **toroidal conductivity probe**, uses two or more toroidal transformers which are inductively coupled side by side. These are encased in an inert plastic sheath. By applying a high frequency voltage to the drive toroid, a magnetic field develops that induces a current in the surrounding solution.  
    
  All three types can perform well under our relatively tame conditions. Two pole probes are the most susceptible to error/damage while Toroidal probes are the most robust.

EC probes are intended to be stored in dry conditions.