Pocket Testers versus Portable Meters

So many meters and so many choices

It can be difficult to decide what meter would be best for your use.

Questions to consider when choosing a pH meter include:

What am I going to use the pH meter for? For many water-based applications such as a swimming pool, aquarium, and general-purpose usage then many meters will do well. There are some applications such as measuring at a high temperature (>60 ºC / 140 ºF), low temperature (<5 ºC / 41 ºF), semi-solids including meats and cheese, and slurries such as soils that would benefit by a specialized pH sensor.

How often are you going to use the pH meter? The amount of usage varies and can be from people that use multiple times a day such as in the QC of a product to those that might use once a month or even seasonal.

How accurate do you need to be? Manufacturers provide an accuracy statement with the meters but that is related to the meter and not the system, which also includes the probe and quality of the buffers used for calibration. Most users can attain 0.1 pH accuracy as long as they follow the best practices from the manufacture.

What is your budget? pH meters have a wide range in pricing from very inexpensive at $30 to state of the art meters with many features that are well over $1,000.

Features found in pH testers and portable meters

Features		Testers	Portables
Environment	Waterproof or water resistant	X	X
Calibration	Manual or automatic calibration	X	X
Temperature Compensation	Manual or automatic temperature compensation (ATC)	X	X
pH Electrode	Replaceable or not	X	X
Auto Shutoff	Automatic shut-off to save battery life	X	X
Low battery indicator	Low battery indicator to alert user to replace the battery	X	X
Battery % level at startup	Displays amount of battery life left	X	X
Selectable ^{o}C /^{o}F	Display temperature and in choice of units	X	X
Hold - Freeze reading	Ability to freeze readings so that it can be recorded	X	X
Stability indicator	Alerts the user to when the reading is stable	X	X
Logging	Ability to log data either on demand or at intervals.		X
USB	Ability to transfer logged data to a computer		X
Calibration Time-out	A setting that will display that the meter needs to be re-calibrated at a defined interval.		X
Good Laboratory Practice (GLP)	GLP is a record of the last calibration including date, time, offset, slope and buffers used during the calibration process. Some meters the GLP data is stored along with a logged reading.		X
Probe Condition Indicators	An indicator that displays the overall robe condition based on offset and slope of the pH electrode. Other indicators include when to clean the electrode and when the buffer might be contaminated.		X

Meters have a variety of features to choose from. Some are necessary to get the highest accuracy while others ensure that everything is working, as it should.

To obtain an accuracy of 0.1 pH or better the necessary features are:

- **Automatic temperature compensation**, which corrects for changes to the pH bulb resistance as temperature changes. **Note:** Reading close to pH 7 are less influenced by temperature since pH 7.0 is the isopotential point.

- **Two-point calibration**, allows for the offset (pH 7.0) and slope (pH 4/10) to be determined. Some instruments allow for more than two point calibration and is useful if samples range from being acidic (pH <7.0) or basic (pH >7.0). **Note:** pH 10 buffer is not stable and will degrade over a short period of time.

Features that assist in getting high accuracy readings are:

- **GLP data** in which the offset and slope can be reviewed to see if they are within a user tolerance of +/- 30 mV for an offset and greater than 90% slope.

- **Probe Condition Indicators** are useful to help identify issues with the probe such as to clean or that the offset/slope have degraded (i.e. 0% or one bar flashing) to an extent that the readings will be questionable.

- **Calibration time-out** is helpful is alerting to when to calibrate at a defined interval. The readings are as only as good as the current calibration.

Differences in pH electrodes supplied with the meter

The biggest differences that can be found between a tester and portable meter are in the pH electrode that is supplied.

For example, it is easy to find pocket/handheld testers that have many of the features of what used to be found only in a portable or benchtop meter. In fact, it is possible to find a tester with more features than a portable meter, but does that make it better?

Milwaukee offers a pocket meter, pH 55, which has many of the features listed in the table and at a affordable $65 price point. It is waterproof, has ATC, two-point calibration, stability indicator, and a replaceable probe.

The MW102, on the other hand is a portable meter that has ATC, two-point calibration, and a replaceable electrode. The MW102 is $188 and significantly higher than a tester, but economical for a portable.

Both are quality pH meters but which to choose?

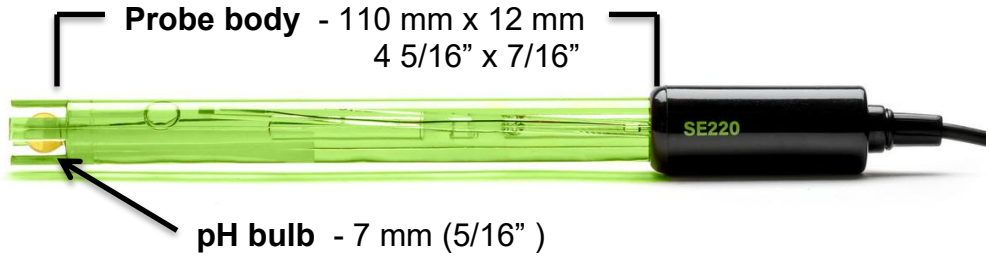
The choice will be the type of user, frequency of use, and the application that the meter is being used for.

The form factor for a pocket is different from a portable. Pocket meters are relatively small while portables are much larger. The pocket meter will have a smaller display, which can be harder to read as compared to portable meter. The ergonomics of the meter might be one consideration.

Both the pocket meter and portable meters are supplied with general-purpose probe that is also suited for a wide variety of applications.

The pH probe is the most important part of a pH meter

Lets look a little more closely to the pH probe that is supplied with a tester and a portable meter.



SE220 @ $69

Mi56P @ $39.60

Testers are supplied with a general-purpose probe.

- The bulb can be smaller than one that is supplied with a portable. There is less surface area for measuring pH.

- The probe itself is smaller, which means that there is less electrolyte, which leads to a shorter life than one supplied with a portable.
- Most tester probes are proprietary to the meter; meaning that the same probe design will be used for the life of the meter.

Portable meters are supplied with a general-purpose probe that is similar to a laboratory pH probe used with a benchtop meter.

- The sensing bulb tends to be larger
- The probe is longer in length allowing for more electrolyte for a longer life
- Many portables use a BNC connector, which is universal. Meaning that any probe with a BNC connector can be used. The meter is not limited to one style.

pH Probe Design and Construction

pH glass-sensing bulb

- Low Temperature (LT) glass, which is a formulation, used for refrigerated product.
- General Purpose (GP) glass, as the name implies, made for measuring products at room temperature.
- High Temperature (HT) glass, is a formulation for measuring products at a high temperature (i.e. > 140 ^{o}F) and suitable for high pH measurements (> pH 12) due to less sodium error.

Shape of the glass-sensing bulb

- Spherical shape that is commonly found. Used in general purpose applications such as with liquids.
- Conic shaped which is used for penetration. Common applications include soils, slurries and semi-solids.
- Bullet shaped which used to conserve space in some designs
- Flat tip that allows for surface measurements

Body of the electrode

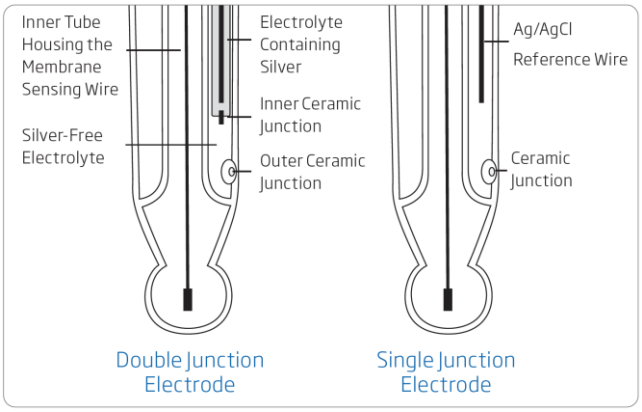
- Plastics such as PEI that offers excellent chemical resistance.
- Plastics such as polypropylene that offer the durability of a PEI version but without the same type of chemical resistance.

Types of junction material – All combination pH probes have a junction in which completes the electrical circuit from the indicating wire in the bulb to the reference wire in the reference cell of the probe. Types of junction materials include:

- Ceramic frit – most common. Has a flow rate of 15-20 μL/hour.
- PTFE – A hydrophobic chemically resistance material used in many heavy-duty applications.
- Cloth – A wick style junction that is extractable to allow clearing of any clogging that might be present.
- Sleeve or ground glass junction that allows for a high flow rate and is clogging resistant. The ground glass surface allows for micro-channels for the electrolyte to flow through.
- Open is as the name implies. There is no junction just a hard gelled surface. Has very high flow rate and is clogging resistant since the surface can be cleaned exposing the hard gel reference.

Types of junctions used – Single Junction vs. Double Junction

- Single junction probes are a design win which there is one barrier from the inside reference wire to the sample. The reference electrolyte will be 3.5M KCl saturated with AgCl. The silver can be precipitated by heavy metals and Tris buffer. The precipitate will clog the junction leading to erratic readings and probe failure.
- Double junction probe is a design in which there are two barriers between the internal reference wire and the sample. The inner reference still has the 3.5M KCl saturated with AgCl (part of the measurement) but the outer barrier has just 3.5M KCl. It is silver-free, which prevents any silver precipitate from being formed that can clog the junction.



Types of Fill Solution

- Refillable probes allow the reference electrolyte to be drained and refilled as needed. Provides for a long life since the electrolyte can be replaced. They have a port that can be opened to allow for better flow through the reference due to positive head pressure.

- Non-Refillable or Gel Filled are considered maintenance free. Generally, the electrolyte cannot be replaced. The gel can be made from different materials including a polymer.

Which design is right for you? Give a call and provide the details about the sample being measured, we can then provide the best recommendation for your particular application.

Overall, a tester and portable meter provide for an accurate and reliable measurement. The biggest advantages for a portable meter are the meters that use a BNC connector. The BNC connector is brand agnostic and allows for any manufacturers probes to be used and allows for the many different probe designs that are available.

The other advantage of a portable pH probe compared to a tester is the volume of reference electrolyte used. The portable pH probes uses more electrolyte, which in most cases, will provide for a longer life.