# Double Junction pH Tester - The Next Generation of Long Life Pocket-Sized pH Meters

Since the introduction of the pocket pH meter 15 years ago, five significant design advances have taken place. The latest design advance may be the most significant yet. We will explore this advance in detail after summarizing the other four design advances. Each of these design advances either addressed users' needs or reduced application problems with this category of product. Each of the five advances improved the meter's capabilities and functionality in a wider range of applications.

## First Advance: Microprocessors

The first advance was the introduction of the microprocessor-based pocket pH meter. The microprocessor gave the meter faster, more stable readings and eliminated the annoying reading drift found in non-microprocessor based units as their display slowly settled on the final reading. The microprocessor also allowed all push-button calibration and measurement, a 'Hold' function to freeze readings until they can be written down, and self-diagnostic error messages to assist the user in troubleshooting a calibration or a reading problem. Convenience, reliability, and timesaving were the factors that made these popular.

## Second Advance: Waterproof, dustproof housing

The second design advancement was to enclose pocket-sized pH testers in completely waterproof and dustproof housings to protect them from rugged wet environment and mishandling. This made the pocket pH tester more durable in applications where there was water spray, where the meter might be dropped into liquids, and where meter needs to be cleaned. Since there are many applications for portable pH instruments that meet this description, users readily accepted this design capability a necessity. This also lowered the cost of ownership of pH testers since they were far more durable in these applications than previous designs.

However, the pocket pH tester was still a disposable instrument. In time, users were frustrated by high cost of frequent meter replacements due to inevitable electrode failure. Users could operate the meter until one day the electrode stopped working. Rejuvenation or repair of the electrode was not an economical alternative. So the only option was to throw away the pocket tester, buy another, and repeat.

## Third Advance: Replaceable electrodes

The third design advancement was the introduction of pocket-sized meters with replaceable electrodes. This helped users who were measuring solutions that quickly fouled the electrode, thereby contaminating and ruining the unit. It also made pocket pH testers appealing to users that did not want to replace the entire instrument, even in applications that do not contaminate an electrode. This is because it is more economical to replace the electrode than the whole meter when the electrode inevitably fails due to contamination or normal wear and tear. The user can reuse the meter portion indefinitely.

Many pH meter users (i.e. those in clean water treatment, pool and spa water testing, chemical, laboratory and even some wastewater applications), have their needs met with pocket pH testers that are microprocessor-based, waterproof and have replaceable pH electrodes.

## Fourth Advance: ISFET pH sensors

The fourth design advancement was to incorporate ISFET (Ion Specific Field Effect Transistor) pH sensors into this class of instruments for food and specialty applications. This sensor costs more than standard glass pH sensors, but it lets users measure pH in soft solid materials and semi-solids that could break standard glass pH sensors. This technology still suffers from pH reference electrode contamination and from the high cost of meter replacement since replaceable electrodes are not

offered.

## Fifth Advance: Double junction electrodes

The fifth and latest major advancement in pocket pH testers utilizes double junction pH reference electrodes. This is the next generation and the new standard for this product class.

Data from a 1999 independent proprietary survey of hundreds of industrial and laboratory portable pH meter users shows why this advance is significant. The survey includes users from dozens of chemical process, metal finishing, and assorted other industries, as well as users in research and other laboratory activities. 62% of respondents indicated that the most important improvement they desired for portable pH meters was a longer lasting pH electrode. The next most frequent improvement users wanted was indicated 37% of the time.

This is not surprising as many industrial and laboratory pH measurement applications involve solutions with chemicals (ions) that contaminate, deteriorate and cause rapid failure of pH electrodes. Some of these users' applications where chemical contamination of pH electrodes is a problem include:

- Spot checking pH in tris buffers
- Plant nutrient solutions
- Solutions with sulfides
- Solutions with metal ions
- Food
- Wine
- Chemical processing
- Wastewater

Plus many more

In these and other applications, pocket-sized pH meter electrode failure is due to chemical attack on the single junction pH reference electrode systems that are normally used with this style of meter. In these applications, pocket pH testers will fail too quickly to be economical to use. Even though pocket pH testers are inexpensive, highly portable, and otherwise ideal for these applications, early electrode failure caused users to become frustrated.

## Why single junction electrodes fail in harsh applications

The reason most pocket pH tester electrodes eventually fail is that all pH reference electrodes (whether used with glass sensors or ISFET sensors) deteriorate with use. This deterioration is a combination of two factors:

1. One factor is the reference electrode's electrolyte ions (suspended in liquid, gel or a polymer) are very slowly depleted with use. Electrolyte depletion occurs with all pH electrodes whether they are a heavy-duty industrial electrodes, a sophisticated laboratory electrode, or an electrode on a pocket pH tester. If this is the only factor deteriorating a pH reference electrode, electrode life should be long enough to meet the user's expectations.

2. The second factor is that contaminating ions from the measured solution can rapidly cause chemical reactions with the silver/silver chloride reference electrolyte system commonly used in pH reference electrodes. This causes sluggish, erratic, wrong or even no pH electrode response as the reference electrode wire is spoiled or the reference junction is clogged. This results in fast electrode failure. This type of deterioration proceeds most rapidly when the pH reference electrode is a single junction pH reference electrode and the solution measured has high concentrations of chemicals (ions) that contaminate and then attack critical components of the reference electrode.

## Advantages of double junction electrodes in harsh applications

In high priced, high performance meters, it is common practice to use a double junction pH reference electrode design to slow down pH reference electrode chemical attack. The double junction pH reference electrode isolates the chemically sensitive Ag/AgCl based pH reference electrode system behind a second reference junction and a reference cell filled with KCl electrolyte (suspended in a liquid, gel or polymer).

In double junction electrodes, chemicals (ions) that attack the pH reference electrode signal wire or react with the internal pH reference electrolyte (Ag/AgCl), take much longer to come into contact with the pH reference electrode signal wire and internal pH reference electrolyte. These contaminants must migrate through the first (outer) reference junction, build up a concentration in the cell filled with KCl reference electrolyte, and finally migrate through the second (internal) reference junction before coming in contact with the pH reference electrode signal wire and internal pH reference electrolyte. This longer migration of contamination to internal reference cell delays the pH reference electrode damage that ruins the pH reference electrode. This makes the double junction pH reference electrode and the entire pH electrode system last much longer than single junction pH electrode systems.

## Eutech Instruments Now Offer New Waterproof Double Junction pH Testers!

Double junction pH reference electrode technology was not available on pocket pH meters before. With the recent introduction of the world's first pocket-sized pH meters with double junction reference pH electrode modules, users can enjoy significantly longer pH reference electrode life with their pocket-sized pH meters.

The longer pH electrode life from the new double junction pocket pH tester will be easily observed in the many applications where the measured solution has chemicals (ions) that contaminate and quickly deteriorate single junction pH electrodes on other pocket-sized pH meters.

This next generation of IP67 waterproof double junction pocket pH testers **pHScan WP3/3+** is the first in the world to effectively deliver longer pH electrode life. What's more, the pHScan WP3+ displays measured temperature value at a touch of button.

Their applications include: all categories of water and waste water testing, boilers, laboratory, beverage - beer/wine, plant nutrient solutions, chemical processing, metal plating, soil run-off, ecology, sanitation, biotech (tris buffers), petrochemical, pulp and paper, and many more.