Version 2.2
17-Mar-2008

TPS uniPROBE Sodium (Na^+) ISE

Introduction

The TPS uniPROBE Sodium ISE belongs to a bold new line of ion sensors that offer superb versatility, performance, and savings. It is based on PVC membrane technology, where the membrane material is sealed to a replaceable silicone rubber tip that fits onto a combination electrode barrel.

- **Silicone rubber seal**

Silicone rubber forms a robust mechanical seal to the PVC membrane insert and the ISE barrel stem that will not deteriorate over extended periods under water.

- **Replaceable tip**

The sodium sensor tip is easily removed from the electrode body. This allows the internal filling solution to be replenished in the event that it dries out, or the entire tip can be replaced at considerable savings if it becomes inoperable. ***NOTE: To obtain maximum life from the sensing tips, store them in a refrigerator. When the sensor is not going to be used for an extended period, remove the tip, rinse with deionised water and also store in a refrigerator.***

- **Replaceable Double Junction Reference Gel**

The double junction reference design allows the reference junction to be easily renewed by replacing the outer reference gel.

- **Interchangeable sensor tips**

In many instances the same electrode barrel can be used with other sensing tips, such as chloride, nitrate, calcium, fluoride, potassium, ammonium, and others. These tips can be ordered separately. In some instances a different reference gel will be required. Consult your TPS representative.

TPS uniPROBE ISE Probe Parts

Electrode Barrel | Plastic Stem | Reference Sleeve | Sensing Tip

TPS Pty Ltd
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4 Jamberoo Street
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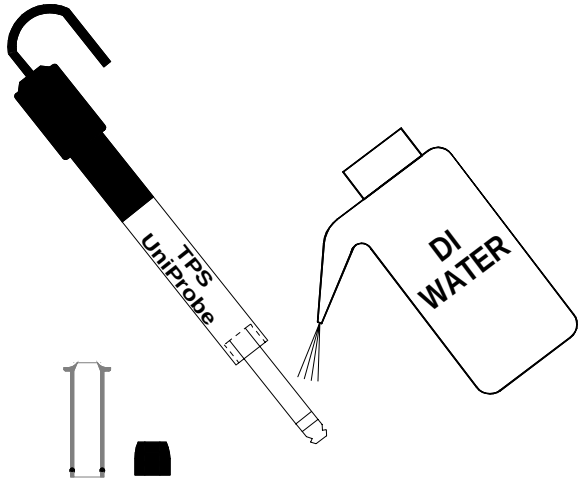
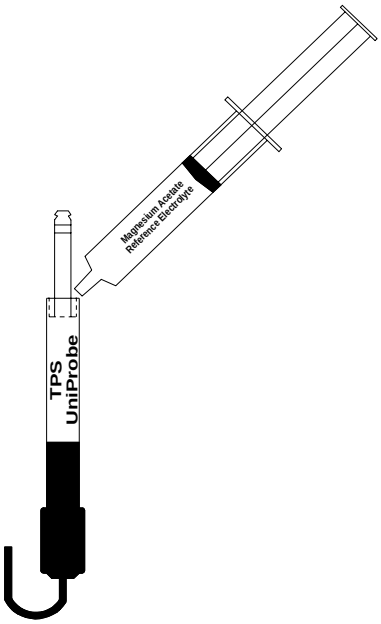
Preparing the Electrode

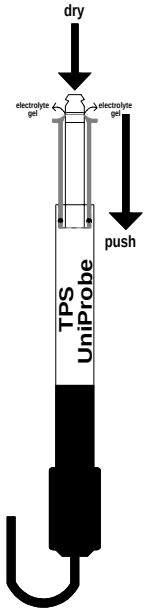
1. Remove the reference sleeve and rinse the plastic stem with deionised water.



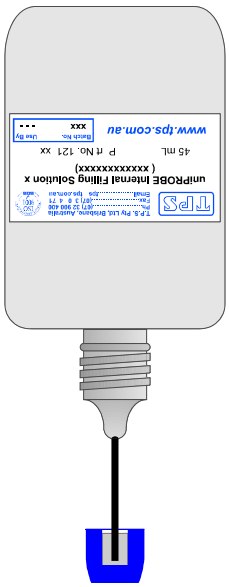
2. Fill the well around the stem with Magnesium Acetate Reference Electrolyte Gel.



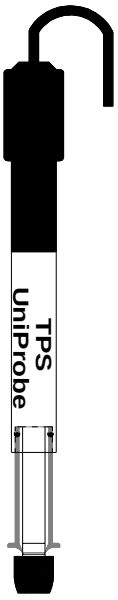
3. Slide the reference sleeve over the plastic stem until the black O ring is 4mm inside the body. Some force may be required. Reference Electrolyte Gel will be expelled from the end of the stem. Rinse with deionised water. Dry the end of the plastic stem with a tissue.



4. Fill a blue sodium silicone rubber tip with Internal Filling Solution. Before filling, fit the black tube supplied into the nozzle of the bottle. Carefully insert the tube into the sensing tip and fill it from the bottom up. This procedure prevents air traps.



5. **Gently** push the tip onto the plastic stem until it stops.
DO NOT FORCE IT BEYOND THE STOP POSITION.
DO NOT TOUCH THE SENSING SURFACE.
Rinse with deionised water. Condition the ISE overnight, if possible, or until the reading no longer drifts.



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Analysis

Direct Method

The direct method involves measuring the mV potential of known standards to produce a calibration graph of mV vs. concentration (see graph below). The mV potential of the sample is then measured and correlated to a concentration on the calibration graph. TPS Specific Ion meters are able to take the readings from the electrodes in the different standards and electronically generate the calibration graph to be used to determine the unknown sample concentration. Each meter has included in its manual a step-by-step procedure for calibrating the meter and measuring the sample. Below are specific tips for using the Sodium ISE.

- The general rule of thumb for choosing standards to calibrate the electrode is to use standards that bracket the expected concentration of the sample. For samples with sodium concentrations in the linear portion of the response curve of the electrode ($5x10^{-5}$M to 1M Na^+ or 1.2ppm to 23000ppm NH_4^+-N) standards are generally chosen one decade apart (e.g. 1.2ppm and 12ppm standards). Below 1.2ppm Na^+, standards should be chosen closer together (e.g. 0.1ppm and 0.5ppm or 0.5ppm and 1.0ppm).
- Prepare the TPS Sodium ISE as described above and connect it to the ion meter. If the sodium rubber tip is new, allow the electrode to stabilise overnight if possible, or until the reading no longer drifts, before beginning to take measurements. **Note:** If the ISE barrel had just previously been used with a tip designed for a different ion, then overnight conditioning will be required for maximum stability.
- Measure 50mL of each standard into 100mL beakers with magnetic stir bars. Always stir standards and samples for best results.
- Add 5mL of 1.5M Magnesium Acetate ISAB to each standard. Place the lowest concentration standard on the stir plate, and begin stirring.
- Place the electrode into the solution and dislodge any air bubbles that may have stuck to the surface of the membrane tip.
- When the potential reading is stable (<0.2mV/minute drift) enter the reading into the meter as described by the meter manual.
- Repeat the steps above for the other standard. Rinse the electrode with deionised water and blot dry with a tissue before placing it in the next standard. The calibration is complete.
- Take 50mL of each sample you are to analyze and repeat the procedures above. Rinse the electrode with deionised water between samples. For best results, measure standards and samples at the same temperature.

Storage

For overnight or short-term storage, place the electrode in a beaker of sodium standard. For long term storage, remove the rubber tip and rinse the inside of it with deionised water. Store it dry. Remove the reference sleeve and rinse the electrode stem with deionised water. Place the reference sleeve over the electrode stem. Store it dry.

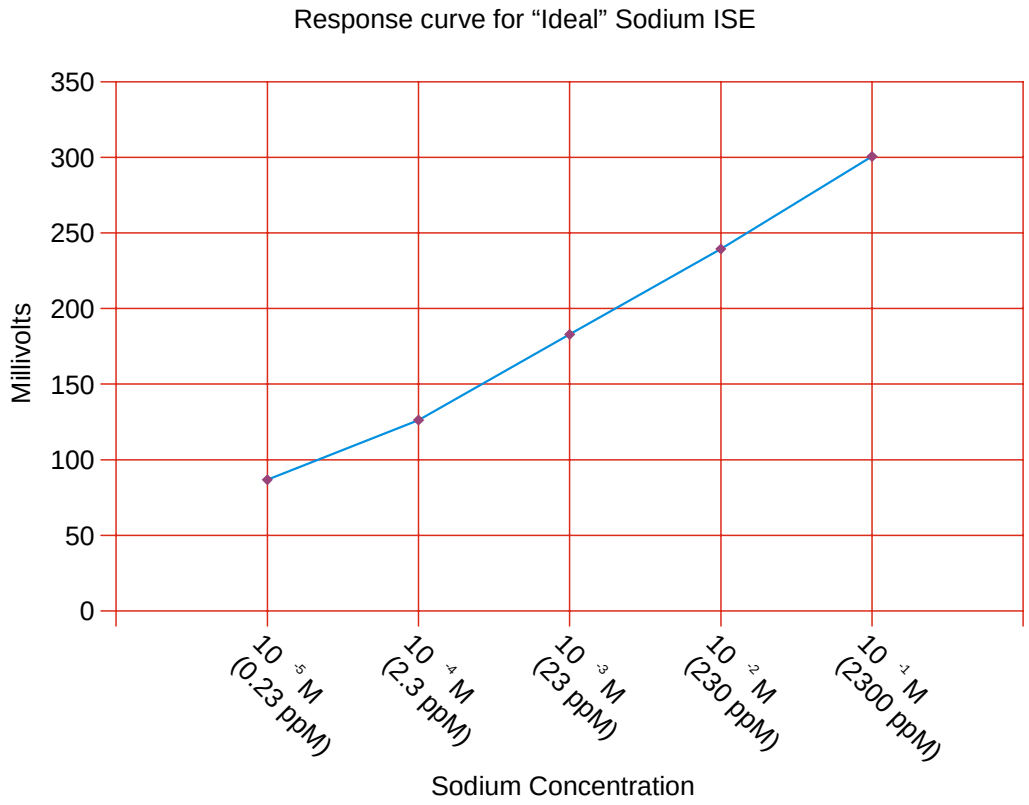
Troubleshooting

Poor response / poor slope / no slope

- First, make sure all electrical connections are tight and the meter is set up correctly on the right channel. **The meter must be set to monovalent cation ($^{+}$) when measuring Sodium.**

- Rubber tip has developed a short or dried out. Remove the rubber tip and rinse the inside with deionised water. This would be a good time to replenish the reference electrolyte as well. Prepare the electrode for use as described above. Check the response.
- Sodium standards are easily contaminated due to the prevalence of sodium ions in the environment. Re-make standards using sodium free make-up water. Check response.
- Sodium membrane has become debonded from the rubber tip. Replace the sodium tip with a new one.

Sodium ISE Response



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The TPS Sodium ISE is a potentiometric sensor, meaning that is develops a potential (or voltage) proportional to the concentration of the ion to which it responds. The mathematical equation that describes this relationship is called the Nernst Equation:

$$E = E^o + S \log_{10} [Ion]$$

where E is the measured voltage, E^o is a constant, S is the slope factor, and [Ion] is the concentration of the ion to which it responds. The relationship between the measured potential and the concentration is logarithmic, which explains why potentiometric sensors are described as having exceptional working ranges, but limited accuracy. The slope factor, S, is dependent on the temperature of the solution, which is why it is best to measure both standards and samples at the same temperature. It has a theoretical value of about 59/n mV at 25°C, where n is the charge of the ion being measured. Ions such as F^- and NO_3^- have a theoretical slope of -59 (n=-1), while ions like Na^+ have a theoretical slope of +59 (n=+1). By plotting the measured potential (E) of several standards versus the $\log_{10}$ of their concentration, it is possible to generate a linear calibration curve. In reality, the slope of the calibration curve has an acceptable range, which for the Sodium ISE is +55 +/-5mV. The calibration curve becomes non-linear below 1.2ppm Na^+ without ISAB, where the electrode starts to reach the limits of its capabilities. At this point the slope begins to fall until it reaches the detection limit of 0.1ppm Na^+.

Reference:

Tamura, H., Kimura, K., Shono, T., Anal. Chem. *54*,1224 (1982).

Sodium ISAB = 1.5M Magnesium Acetate

Specifications:	
Concentration Range	0.1ppm Na^+ to 23000ppm Na^+ ($5x10^{-6}$M to 1M)
Linear Range	1.2ppm Na^+ to 23000ppm Na^+ ($5x10^{-5}$M to 1M)
Slope	+55 mV/decade +/-5mV
Response Time	<30 seconds from 1.2ppm Na^+ to 12ppm Na^+

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Ordering Information

	Part No
Complete TPS Sodium ISE Analysis Kit	121540
Includes 1 x Combination ISE Body	121500
1 x Sodium ISE Membrane / IFS / Electrolyte Kit	121542
1 x 1000ppm Na^+ Standard (200mL)	121544
1 x Sodium ISAB Solution (200mL)	121824
1 x Sodium ISE Instruction Manual	130050

Spare parts and accessories…

Combination Intermediate Junction ISE Barrel	121500
Sodium ISE Membrane Kit	121542
Includes 2 x Blue / White Membrane tips	
1 x Internal Filling Solution (IFS), 45mL	121805
1 x External Reference Electrolyte Gel, 10mL	121813
Internal Filling Solution (IFS), 45mL	121805
External Reference Electrolyte Gel, 10mL	121813
1000ppm Na^+ Standard (200mL)	121544
1000ppm Na^+ Standard (1 Litre)	121546
Sodium ISAB Solution (200mL)	121824
Sodium ISAB Solution (1 Litre)	121826
Sodium ISE Instruction Manual	130050

uniPROBE Membrane Kits are available for the following Ions. All Membrane Kits are supplied with 1 or more colour-coded sensing tips, 45mL internal filling solution and 10mL external electrolyte gel.

Species	Tip Colour Code
• Nitrate	Red / White
• Ammonium	Black / White
• Calcium	White / White
• Sodium	Blue / White
• Potassium	Natural / White
• Fluoride	Green
• Chloride	Yellow
• Iodide	Purple
• Cyanide	Purple
• Bromide	Natural
• Sulphide	Black
• Silver	Black

Ammonia is also available, but is not interchangeable with the other uniPROBE sensor tips.

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