Essentials for Ion Measurement

Practical Tips and Hints on Use of ISEs

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Table of Contents

Application of ISEs

Click on application icons to know the product details.

Agriculture

Clinical Labs

Food and Beverages

Chemical Labs

Pharmaceutical

Paper and pulp

Mining

Water Testing

Electroplating

Environment

Detergents

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Contact our pH Competence and support Center (CSC) for guidance on common challenges or sensor recommendations.

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Selecting the Right System
For Accurate Ion Measurements

Selecting the Right Meter

Streamlining the Selection Process

Our interactive meter selection tool will help you find the perfect meter to suit your application needs.

- **Benchtop**
  - SevenExcellence Ion Meter → Advanced Requirements
  - Seven Direct Ion Meter → Simple Requirements
- **Portable**
  - Seven2Go Pro Ion Meter → Simple Requirements
  - SevenGo Duo Pro pH/Ion Meter → Simple Requirements

Contact our pH Competence and Support Center for guidance on commom challenges or sensor recommendations for a particular application

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Know the Right Sensor
Eliminating the Guesswork

Choosing the right sensor from plenty of options can be a daunting task, but with our carefully crafted questions, we make it easier than ever to identify the perfect sensor for your specific application

- Ion of interest
- pH range of sample
- Combined Electrode – perfectION ISE
- Half Cell ISE – DX series

Contact our pH Competence and Support Center for guidance on commom challenges or sensor recommendations for a particular application

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Calibration standards and Other Reagents

Essential Components for Accurate Analysis

Selecting the appropriate standards, and reagents ensures accurate and reliable results, every time. Know the right ones and the right volumes for optimal performance.

- Standards
- Ionic Strength Adjusters (ISA) solution
- Total Ionic Strength Adjustment Buffers (TISAB)
- Reference Electrolyte

Contact our pH Competence and Support Center for guidance on commom challenges or sensor recommendations for a particular application

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ISE standard solutions, ISA solutions, and electrolytes are available from METTLER TOLEDO.

Useful Accessories

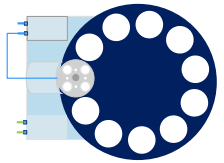
Enhancing the functionality of Meter

Stirrer

Ensure uniform stirring for all samples and standards.

Printer

Eliminate the transcription errors by printing the results on paper.



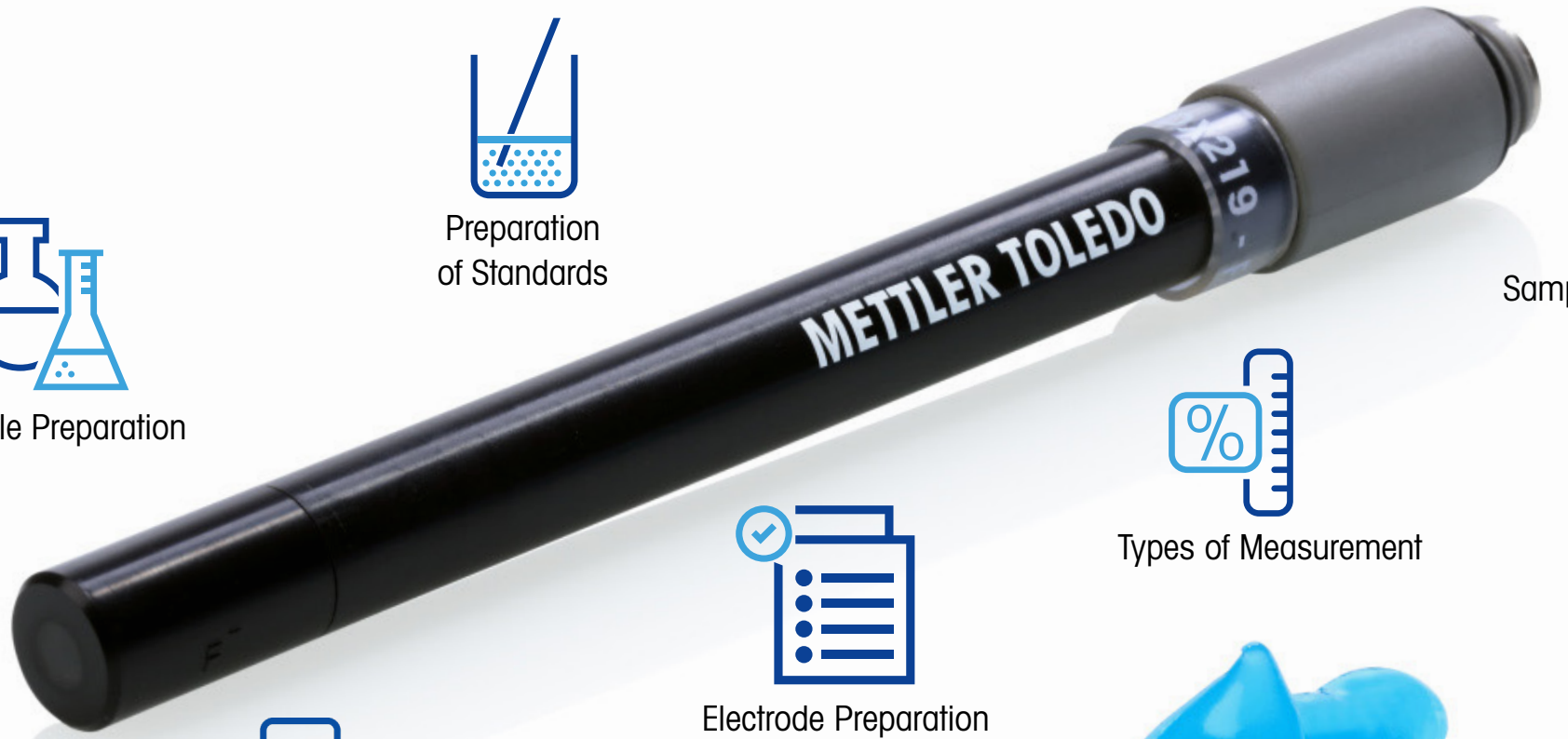
InMotion Autosampler

Free up the operator time for Automated ISE measurement using the InMotion autosampler.

LabX

Automatic data transfer, automatic data storage, connection to laboratory management system, enhanced compliance support

Good Electrochemistry Practices



Preparation of Standards

Sample Preparation

Sample Measurement

Types of Measurement

Electrode Preparation

Calibration Procedure

ISEs Storage

System Check-up

Sample Preparation

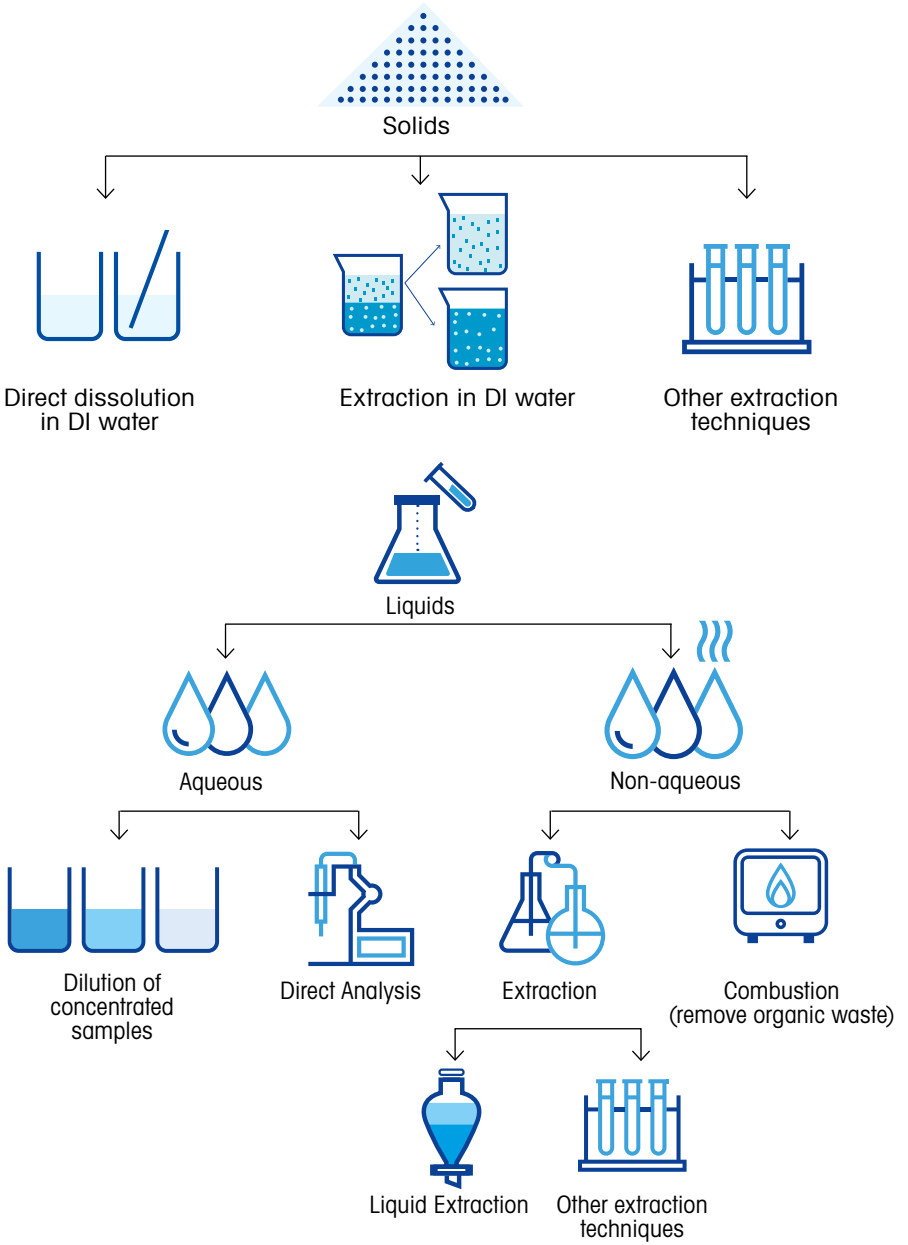
- **Dissolution:**
  - ISE measurements are carried out on liquid samples. Solid samples must, therefore, be converted into a liquid state for analysis using ISEs. Deionized (DI) water is necessary for sample dissolution and extraction to minimize interfering ions.
  - In cases where dissolving the analyte is not feasible, consider alternative techniques like selective extraction of the analyte ion using a suitable solvent.

- **Concentration Adjustment:**
  - The typical working range for ISEs is 0.1 - 1000 ppm.
  - The amount of sample required will depend on the expected concentration of the analyte.
  - Very dilute samples may require concentration techniques, while highly concentrated samples might need dilution with DI water to fall within this range.

- **Interference Removal:**
  - The presence of interfering substances in the sample can affect the ISE's response to the target analyte.
  - If interferences are suspected, explore options like selective extraction of the analyte ion or the use of masking agents to eliminate their effects.

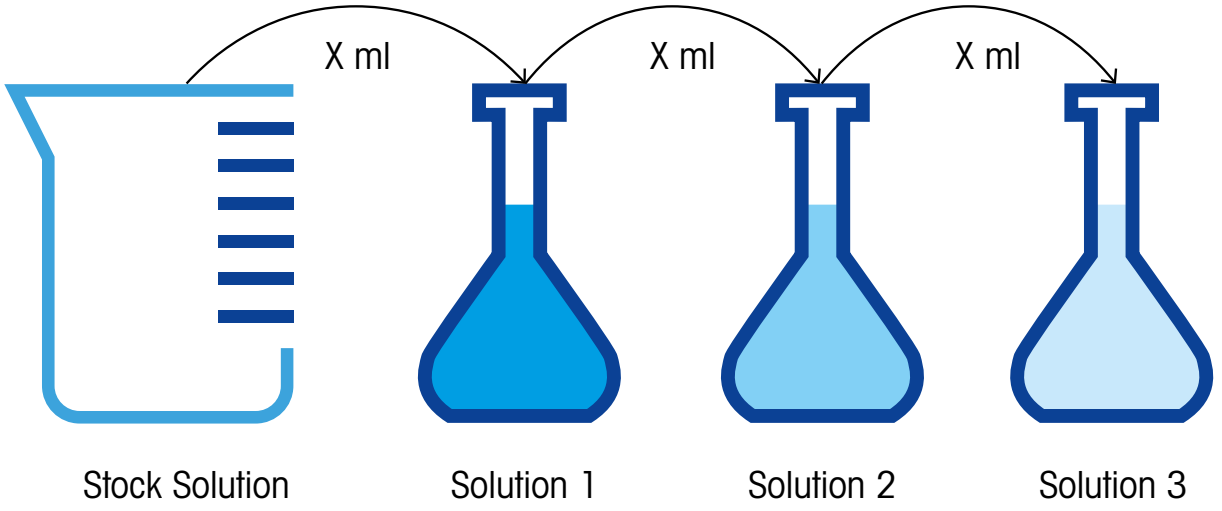
- **Ionic Strength Adjustment (ISA):**
  - ISE measurements rely on a constant ionic background to ensure a consistent response.
  - Add ISA solutions to both samples and calibration standards to achieve this uniform ionic strength.

- **Standardization:**
  - For accurate calibration, maintain uniform conditions of temperature and stirring for both the sample and standard solutions during measurement.



Preparation of Standards

- For ISE measurements, use at least two calibration standards bracketing the expected sample concentration.
- Prepare the required concentrations with a serial dilution.
- **Serial dilution** means that an initial standard is diluted using volumetric glassware to prepare a second standard solution. The second standard is similarly diluted to prepare a third standard, and so on.
- Verify the electrode calibration every two hours by placing the electrode in a fresh aliquot of the least concentrated standard used for calibration.
- Recalibrate the electrode when the following deviation occurs:
  - Solid state membrane ISE: the value has changed by more than 2%.
  - Polymer membrane ISE: the value has changed by more than 4%.



ISE standard solutions, ISA solutions, and electrolytes are available from METTLER TOLEDO.

Navigate back to Calibration standards and Other Reagents

Electrode Preparation

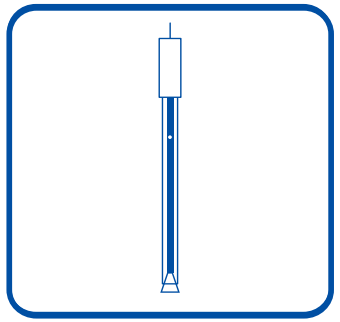
Ion Selective Electrode

- Fill the electrode with the correct electrolyte.
- The filling level must be higher than the sample level.
- Soak for 10–15 minutes in a low-concentration standard solution.
- Condition by soaking overnight if using after a long time – Dry storage. Before the measurements, keep ISE for 15 minutes in deionized water.
- For more details on conditioning, please refer to the operating instructions of the respective ISE.

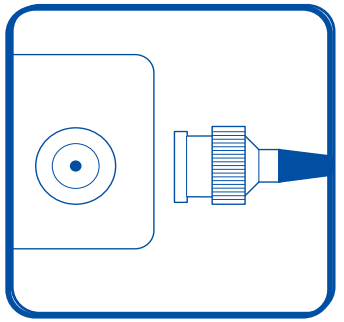
Reference Electrode

- Fill the reference electrode with electrolyte according to the operating instructions.
- The filling level must be higher than the sample level.
- The electrolyte filling hole must be open during measurements.

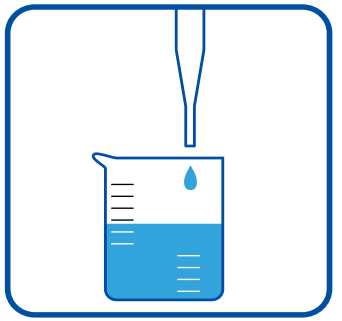
Calibration Procedure



Electrode Preparation

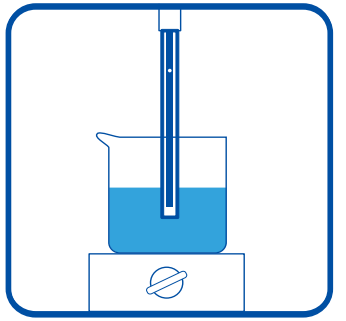


Connection to meter

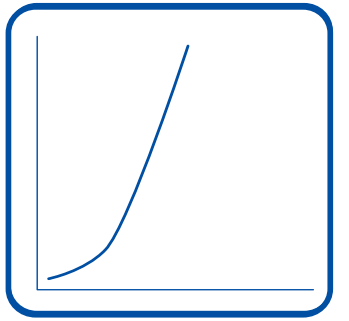


Solution Preparation

Addition of ISA



Uniform Stirring Conditions



Record the Resulting Slope

1. Prepare the electrode as described in the Electrode Preparation section (in the operating instruction manual).
2. Connect the electrode to the meter. Unlike InLab pH sensors, ISE sensors do not have ISM chip and hence require manual input in the meter including the selection of electrode and ion under analysis.
3. Prepare at least two standards that bracket the expected sample range and differ in concentration by a factor of ten. See the Serial Dilution section for instructions on how to prepare standards.
4. Take a defined volume of standards in a clean beaker. All standards should be at the same temperature as the samples.
5. ISA must be added proportionately to standards/ sample (Refer to the respective operating instructions). Apply uniform stirring to standards and samples.
6. Rinse the electrode with deionized water, blot it dry, and immerse it into the beaker (at least 1 cm), first with the least concentrated standard. Start calibration according to the meter's instructions and follow with the more concentrated standards.
7. Repeat the process with more concentrated standard(s).
8. Record the resulting slope value.
9. The difference between per decade of concentration should be 25 - 30 mV for divalent ions and 54 – 60 mV for monovalent ions at 20-25°C.

Types of Measurement Methods

Direct Determination

- After calibrating the sensor with standard solutions, the calibration curve can be plotted, and sample measured.

Standard Addition

- Constant volume of unknown + increased volume of standard(s) in the flask (one or multiple addition).
- Constant volume of standard + increased volume of unknown (one or multiple addition).

- When one – single standard addition.
- When many – multiple standard addition.
- Increment size is selected to achieve an electrode potential of
  - 30 mV for monovalent ions
  - 10 mV for bivalent ions
- Based on the volumes of sample, the volume of standard used, the concentration of standard, and the slope of ISE, the sample concentration is determined.

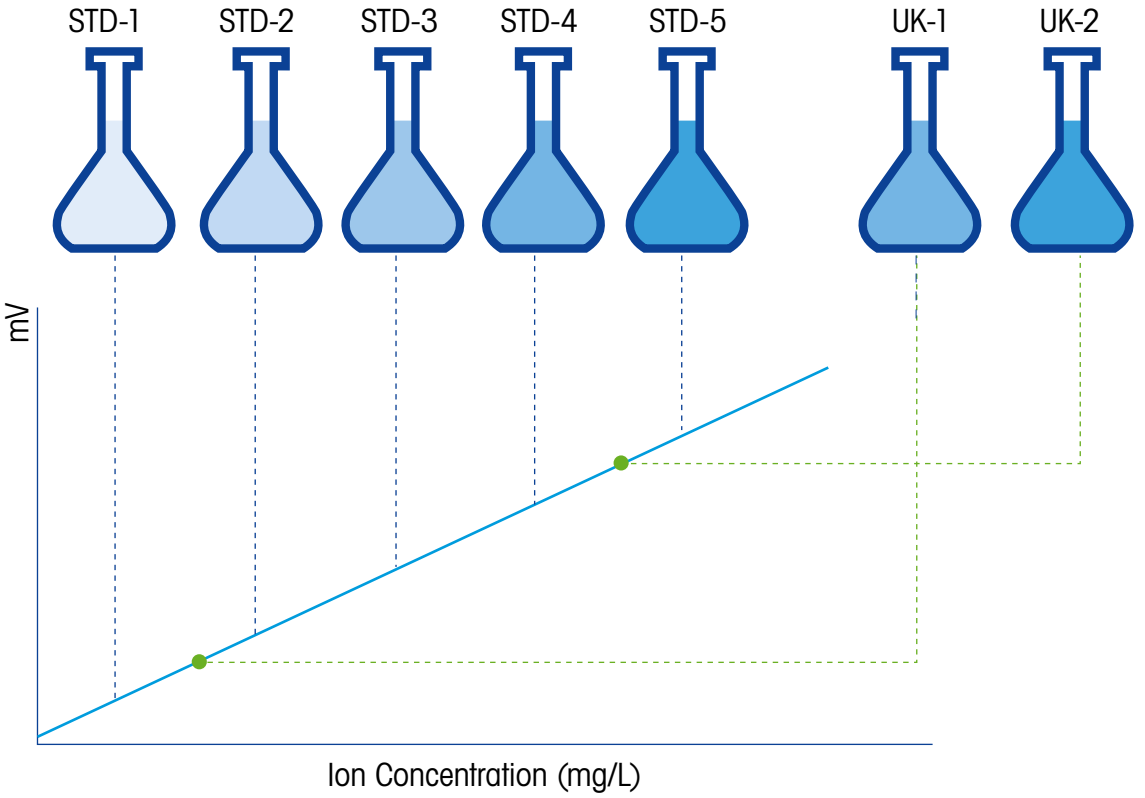


Figure 1: Direct Determination by Calibration Curve Method

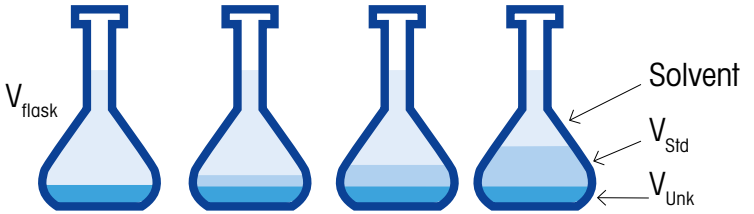
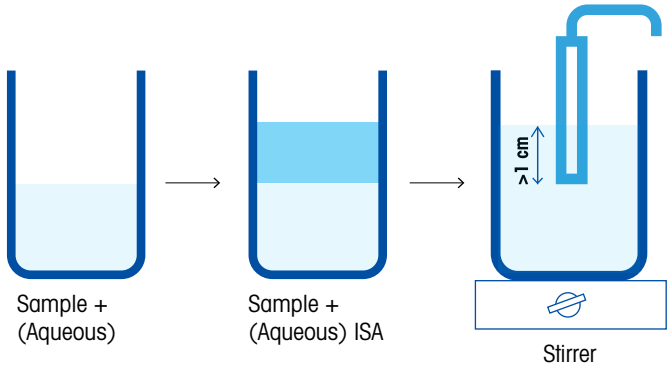


Figure 2: Standard Addition Method

For Details, Refer to the ISE Theory Guide (30414765)

Sample Measurement

- Take a defined volume of samples.
- Add the appropriate amount of ISA / Standard solution to all of them.
- Maintain the same conditions of temperature and stirring for samples as those used for calibration.
- The stirring should be gentle to avoid the formation of air bubbles.
- Immerse the electrode at least 1 cm, to ensure the junction is immersed.
- Rinse with deionized water between the measurements to prevent sample carryover.
- Dab dry with low lint tissue. Do not wipe or rub the electrode sensing element.



ISEs Storage

Reference Electrode

- Store the sensor, replacing the bridge electrolyte with the reference electrolyte.
- Rinse the electrode with distilled water, close SafeLock™ and replace the wetting cap filled with electrolyte or InLab storage solution

Ion Selective Electrodes

- Refer to the respective Operating Instructions
- Short Term Storage
  - Low concentration standard solution
- Long Term Storage
  - Store dry – drain the electrolyte chamber. Clean with DI water.
  - ISEs with glass membrane – never store them dry.

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