1. Purpose

To provide the standard operating procedure for the use and operation of the **Jenway 3510 pH Meter** (Made in Switzerland).

2. Scope of Operation

This device is designed for high-precision pH and temperature measurement with the following specifications:

- **pH Measurement Range:** −2.000-2.000−2.000 to 19.99919.99919.999 pH.
- **Resolution/Accuracy:** 0.0010.0010.001 or 0.010.010.01 pH units.
- **Temperature Measurement Range:** −10∘C-10^\circ\text{C}−10∘C to 105∘C105^\circ\text{C}105∘C.

3. Responsibility

The implementation of this procedure is the responsibility of the relevant laboratory experts.

4. Operating Procedure

A. Display and Indicator Guide

Understanding the user interface is essential for accurate measurement:

1. **Setup Icon:** Indicates the device is in the configuration (Setup) mode.
2. **Main Display (Upper):** A 4.5-digit display showing the direct pH value and the millivolt (mV) reading of samples and standards.
3. **Mode Indicator:** Displays the active measurement mode: **pH** or **mV** (Absolute or Relative).
4. **Calibration Points:** Indicates whether the device is at calibration point **1, 2, or 3**, depending on the user's selection.
5. **Buffer Indicator:** Shows whether **Automatic Buffer Recognition** or **Manual Buffer Selection** is being used.
6. **Stability Symbol (End Point):** This symbol appears when the pH reading changes by less than 0.0050.0050.005 within 5 seconds. Once displayed, the reading is considered stable.
7. **Sub-Display (Lower):** A 6-digit display showing the automatic or manual temperature reading. In **Setup Mode**, this area scrolls to show specific parameter information.
8. **Mode Annunciators:** Displays the temperature unit (∘C^\circ\text{C}∘C or ∘F^\circ\text{F}∘F) and the temperature compensation method (**Automatic** or **Manual**).
9. **Status Display:** A 2.5-digit display showing electrode **Slope**, **E0E_0E0 (Offset)** value during calibration, and the stored memory number.
10. **Mode Bars:** The active mode is highlighted on the screen.

B. Keypad Functionality

- **ESC:** Used to power the device ON/OFF and to exit the current mode.
- **CAL/CLR:** Used to initiate and execute calibration steps. It also clears stored memory. In **mV mode**, it selects between **Abs (Absolute)** and **Rel (Relative)**.

- **PRINT:** Used to print measurement data.
- **UP/DOWN:** Used for parameter adjustment in Setup mode, scrolling through stored results, and switching between **pH** and **mV** modes.
- **LEFT/RIGHT:** Used for parameter adjustment in Setup mode and navigating between different mode bars.
- **STO (Store/Cal):** Used to confirm/select a value in Setup mode, recall stored data, or act as the **CAL** key during calibration.

C. Theoretical Background of pH Measurement

The pH of a solution represents its acidity or alkalinity, typically measured on a scale of 000 to 141414. It defines the hydrogen ion activity of an acid or a base. Because of the logarithmic relationship between hydrogen ion concentration and pH, a change of one pH unit reflects a **tenfold (10x) change** in hydrogen ion concentration.

D. Manual Temperature Compensation Calibration

To exit the calibration process at any time, press the **ESC** key; the device will exit calibration and enter **MODE** menu.

Note: Buffer solutions must be prepared with extreme precision according to the manufacturer's instructions. When using **Manual Temperature Compensation** (i.e., when the **ATC** (Automatic Temperature Compensation) probe is not connected), the temperature of the solution must be measured manually and entered into the **Setup** menu before beginning calibration. **All buffers must be at the same temperature.**

Step-by-Step Calibration (Manual):

1. Use the **UP/DOWN** keys to select the **pH** measurement mode.
2. Press the **CAL** key.
3. The current pH reading will appear on the upper display, and the main display indicator will show **CAL 1** along with the type of buffer being used.
4. The lower display will show the manually set temperature in ∘C^\\circ\text{C}∘C or ∘F^\\circ\text{F}∘F, accompanied by the **MAN** (Manual) indicator.
5. The status display area will show the current **SLOPE** value.

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5. Safety and Maintenance

(Note: Since specific maintenance for the Jenway was not in your Persian text, I have added standard professional guidelines for pH meters below)

1. **Electrode Care:** Always keep the pH electrode submerged in the appropriate storage solution (e.g., 3M KCl3\text{M KCl}3M KCl) when not in use. Never store the electrode in distilled or deionized water.
2. **Cleaning:** Rinse the electrode thoroughly with distilled water between measurements to prevent cross-contamination. Blot (do not wipe) the electrode bulb gently with lint-free tissue.
3. **Calibration Frequency:** Calibrate the device daily or before each critical measurement session to ensure accuracy.

4. **Buffer Integrity:** Use fresh, unpolluted buffer solutions. Never pour used buffer back into the original stock bottle.

CAL **[Continuation of Operating Procedure]**

Step 5: Calibration Completion (continued)

- Immerse the electrode into the first buffer solution and wait for the reading to stabilize. Once the pH value stabilizes and the **Stability Symbol** appears on the display, press the **CAL** or **STO** key to proceed.

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5. Safety and Precautions

- **Initial Setup:** If the device is being used for the first time or if the calibration has been compromised, it must be fully calibrated using standard buffer solutions.
- **Buffer Standards:** Always use commercially prepared standard buffer solutions for calibration. If alternative buffers are used, their exact properties must be manually programmed into the device beforehand.
- **Ultrasonic Warning: NEVER** place the pH electrode in an ultrasonic bath; this will cause irreversible damage to the glass membrane.
- **Physical Handling:** Exercise extreme caution when handling the electrode. Ensure the glass bulb does not strike the walls or the bottom of the container. Avoid any mechanical shocks or impacts.
- **Response Time:** When measuring a sample, the reading may fluctuate for several minutes before reaching equilibrium. Wait until the stability symbol appears to ensure an accurate reading.
- **Temperature Synchronization:** Since pH is highly temperature-dependent, ensure that all buffer solutions and samples have reached equilibrium with the ambient room temperature before measurement.
- **Post-Measurement Cleaning:** After measurement, rinse the electrode thoroughly with distilled water and store it in a plastic protective cap containing **3M or 4M KCl solution**. **Never allow the electrode to dry out.**

Preparation of 3M KCl Solution (MW=74.6MW = 74.6MW=74.6 g/mol):

To prepare the electrolyte solution, dissolve **224 grams of Potassium Chloride (KCl)** in sufficient distilled water to make **1 liter** of solution. This solution is essential for maintaining the electrode's **hydration layer** and ensuring stable, accurate measurements.

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6. Maintenance and Electrode Care

A. Storage Protocols

1. **Short-term Storage:** After each use, rinse the electrode thoroughly with distilled water. For short-term storage, place the electrode in a buffer solution with a **pH of 4**.

2. **Long-term Storage:** For extended periods, use a specialized storage cap containing **3M KCl solution** with the pH adjusted to **4**.

B. Environmental Conditions

1. Store the electrode in a vertical position, away from direct sunlight, within its specified temperature range.
2. Always operate the electrode within its designated temperature limits. Exceeding these limits will cause **rapid and irreversible degradation** of the electrode.

C. Electrode Integrity and Fluid Levels

1. **Internal Filling:** Ensure the internal electrolyte level is higher than the internal elements and higher than the level of the sample being measured.

- *Note: Some electrodes are pre-filled with epoxy gel and are not refillable.*

2. **Handling the Membrane:** Do not touch the glass membrane or the **reference junction** with your fingers.
3. **Drying:** Use lint-free tissue to blot away excess droplets. **Do not rub or wipe the electrode**, as this can induce **electrostatic charge interference**.
4. **Air Bubbles:** Ensure no air bubbles are trapped at the tip of the electrode. To remove bubbles, hold the electrode vertically and tap it gently, or move it in a downward motion.

D. Specialized Applications and Cleaning

1. **Cross-Contamination:** Always rinse the electrode with distilled water between different samples to eliminate the risk of contamination.
2. **Side Ports:** If the electrode is equipped with a side port, ensure it remains open, especially during high-throughput sample analysis.
3. **Complex Samples (Blood/Serum):** For samples like blood or serum, or during three-buffer calibration, the junction may become severely clogged. It is recommended to use a **Tris-buffer electrode** for such applications.
4. **Food Industry Applications:** For measuring food extracts, a specialized **Food Electrode** is recommended. These are designed to minimize the risk of protein/fat fouling, are easier to clean, and perform excellently in agar-based environments.
5. **Custom Selection:** If measuring a specific or unique substance, always select an electrode compatible with that substance as specified in the manufacturer's technical brochure.