A&D Company, Ltd.

AP-21

Pocket pH Meter

Instruction Manual

About This Manual

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1. Introduction

Thank you for purchasing the AP-21 Pocket pH Meter.
This manual describes how the product works and how to get the most out of the product. Read this manual thoroughly before using the product and keep the manual at hand for future reference.

2. Features

- The waterproof performance of this product complies with the protection level 5 of JIS C0920, maintaining waterproof performance that prevents damage from water jets from any direction.
- Sensor sensitivity display function
  You can check the degradation status of the sensor and determine the time for sensor maintenance and replacement.
- Automatic temperature compensation enables accurate pH measurements.
- 1 to 3 pH calibration possible
  Calibration points are automatically recognized from 4.0, 6.9 and 9.2 (at 25°C).
- Interchangeable sensors
- Auto Power Off Function: Power turns off automatically after 20 minutes.

3. Safety Precautions

To prevent accidents due to inappropriate handling, this manual contains the following warning signs and marks.

WARNING DEFINITIONS

The meanings of these warning signs and marks are as follows.

⚠CAUTION	**This symbol indicates a potentially hazardous situation that, if not avoided, could result in personal injury or property damage.**

- **Repair**
  Only qualified professionals should open the case and conduct repairs. Performing such repairs yourself may void the warranty, damage the product, or otherwise cause loss of functionality.

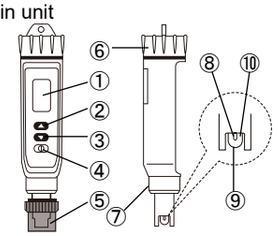
- **Product malfunction**
  If any abnormality is found with the product, stop using it immediately. Attach a notice to the product indicating that the product is "Out of Order" or move the product to a location where it will not be used accidentally. Continued use of the product is extremely dangerous. For repairs, please contact the store where you purchased the product or an A&D office.

4. Handling Precautions

- **Do not subject the product to strong shocks, vibrations, or electrical shocks. Doing so may cause malfunctions.**
- **Do not use the product in places where it will be exposed to direct sunlight for a long time, in a closed car, or near a heater such as a stove. The operating temperature range of this product is 0 to 50°C. Use of the product beyond this temperature range may cause the product to malfunction.**
- **Avoid using in places with sudden temperature changes, high temperatures, high humidity or dust.**
- **To prevent danger, avoid using the product in a location where there is flammable gas.**
- **Do not open or disassemble the case. Doing so may cause malfunctions.**

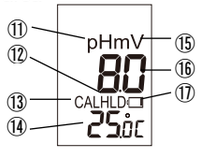
5. Names of Parts

Main unit



① Display area
② [HOLD]/[▲] button
③ [CAL]/[▼] button
④ Power/SET button
⑤ Glass electrode cover
⑥ Battery lid
⑦ Sensor mounting nut
⑧ Temperature sensor
⑨ Glass electrode
⑩ Liquid junction

Display area



⑪ [pH] indicator
⑫ [HLD] indicator
⑬ [CAL] indicator
⑭ Temperature display
⑮ [mV] indicator
⑯ pH display
⑰ Low battery indicator

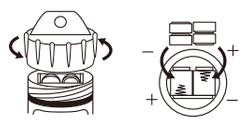
6. Replacing the Batteries

There are no batteries in the main unit at the time of purchase. Follow these steps to insert the batteries correctly. If the low battery indicator is displayed, the display becomes dim or the product is no longer working properly, replace the batteries by following the steps below.

* **Batteries can be purchased at your local convenience store, supermarket, home improvement store, or electronics store.**
* **If the main unit is wet, wipe off the water thoroughly before replacing the batteries. Water entering the main unit can cause a malfunction.**

●Replacing the Batteries

(1) Turn off the power.
(2) Turn the battery lid in the direction indicated by the arrow to remove it.
(3) Take out the old batteries.
(4) Check the polarity indicator on the battery compartment to load the batteries correctly.



(5) Secure the battery lid in the reverse order to the removal procedure.
(6) After battery replacement, recalibration is recommended.

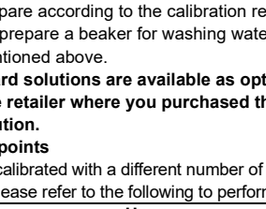
●Precautions for Battery Use

- **The included batteries are for operating verification purposes, so the battery life may be short.**
- **The batteries may leak if left in and the product is not used for a long time. If not in use, remove the batteries before storing the product.**
- **Please be sure to use the specified batteries (4 x LR44).**
- **When replacing batteries, use only new batteries of the same manufacturer and part number.**
- **Be sure to insert the batteries with the (+) and (-) terminals facing the correct directions. Inserting the batteries with (+) and (-) reversed will not only prevent normal operation but may also cause malfunction.**
- **Due to the risk of rupture or leakage, do not charge, short-circuit, disassemble, or put into the fire.**
- **Keep batteries out of the reach of young children. If swallowed, consult a doctor immediately.**
- **For environmental conservation, please dispose of batteries in accordance with municipal ordinances.**

7. Before Measuring

Remove the glass electrode cover when measuring. After the measurement is completed, attach the glass electrode cover and store.

●How to remove the glass electrode cover



Hold the top of the glass electrode cover with one hand, and use your other hand to loosen the lower part of the glass electrode cover by turning it in the direction indicated by the arrow. Pull the glass electrode cover down.

Note: If you are using this device for the first time or after storing it for more than a few days, the response in the pH measurement may be delayed. In such cases, immerse the glass electrode in potassium chloride solution for at least 12 hours. (There is no need to turn on the power of the device.) After immersing, calibrate the device with a pH standard solution before measuring.

Note: The glass electrode cover is filled with potassium chloride solution to prevent the glass electrode from drying out. When installing and removing the glass electrode cover, be careful not to spill the solution inside the cover. Be careful not to let the solution get on your skin or clothing. If it gets on the skin, rinse it off immediately with running water. If it gets into your eyes, rinse them immediately, and consult a doctor.

* **If the solution in the cover is spilled, refill the potassium chloride solution to prevent the glass electrode from drying out.**

8. Calibration

This device can be calibrated to enable more accurate pH measurements. We recommend calibrating about once a day. Before calibrating, prepare the following:

- Automatically identifiable standard solutions

Item	Standard Solution	pH Value (At 25°C)
pH 4.0	AX-APA-01	4.01
pH 6.9	AX-APA-02	6.86
pH 9.2	AX-APA-03	9.18

  Standard solutions such as pH 7.0 and pH 10.0 can also be used, but they cannot be automatically recognized.
- Washing water (distilled, purified or tap water)
- Beaker (Please prepare according to the calibration result.)

It is recommended to prepare a beaker for washing water for each type of standard solution mentioned above.

* **Various pH standard solutions are available as options. Please contact the retailer where you purchased the product or A&D to purchase a solution.**

●About calibration points

The device can be calibrated with a different number of points according to the intended use. Please refer to the following to perform the calibration.

Points	Usage
3 points	If you do not know the pH characteristics of the measured sample
2 points	When the measured sample is known to be acidic or alkaline in advance If acidic: 2 points of pH 4.0 and pH 6.9 If alkaline: 2 points of pH 6.9 and pH 9.2
1 point	If you want to measure pH simply. 1 point with standard solution close to the measured sample

●Calibration method

(1) Press the [POWER]/[SET] button to turn on the power.
Before calibrating, we recommend initializing the unit (see 13-2) to delete all old calibration information.
(2) Remove the glass electrode cover and clean the glass electrode well with distilled, purified or tap water. After cleaning the glass electrode, use clean filter paper, cotton swab, tissue paper, etc. to blot off the water droplets on the glass electrode.

Note: Be careful not to rub the glass electrode. Rubbing glass electrodes can generate static electricity and cause pH instability.

(3) Dip the glass electrode in the standard solution for calibration. Wait for the [pH] indicator to change from flashing to lit without moving the unit.

Note: If the [pH] indicator does not change to a lit state, the pH standard solution or sensor has degraded. If the problem persists even after replacing the pH standard solution, replace the sensor with a new one. For details on replacing the sensor, see "14. Sensor Replacement."

(4) Press the [CAL]/[▼] button for at least 2 seconds. The CAL indicator and pH value will flash and the unit will enter calibration mode.
This instrument displays the value of the automatically recognized standard solution. (See table below)

Temp. (°C)	pH 4.01	pH 6.86	pH 9.18
0	4.0	7.0	9.5
5	4.0	7.0	9.4
10	4.0	6.9	9.3
15	4.0	6.9	9.3
20	4.0	6.9	9.2
25	4.0	6.9	9.2
30	4.0	6.9	9.1
35	4.0	6.8	9.1
40	4.0	6.8	9.1
45	4.0	6.8	9.0
50	4.1	6.8	9.0

Note: If the initial value changes sequentially, the pH standard solution or sensor has degraded. If replacing with new pH standard solution does not improve the situation, replace the sensor with a new one. For sensor replacement, refer to "14. Sensor Replacement."

* **For more accurate measurements, the calibration temperature should be the same as the measured object.**

(5) If you are using a standard solution that cannot be automatically recognized, press the [HOLD]/[▲] button or the [CAL]/[▼] button to match the calibration value to the value of the standard solution. (No operation is required when using an automatically recognized standard solution)
The adjustment range is 3.0 to 5.0, 6.0 to 8.0 or 8.5 to 11.0. Please note that the pH value of the standard solution changes with temperature, so please refer to the temperature table that comes with the standard solution and match with the temperature at the time of calibration.
(6) Once the calibration value is finalized, hold the device until SA is displayed after approximately 30 seconds.
(7) SA is displayed for about 2 seconds and stored in the device's memory. Then it returns to normal pH display.
(8) Clean the glass electrode with distilled, purified or tap water.
(9) If you want to continue calibrating at other points, please calibrate again from step (3).
(10) Turn off to end.

9. pH Measurement

(1) Press the Power/SET button to turn on the power. The display area will be fully lit for about 2 seconds and the device will enter measurement mode.
(2) Remove the glass electrode cover.
(3) Immerse the electrode about 3 cm into the measured object.
(4) Make sure the reading is stable (the [pH] indicator is on) and read the value.

* **About the stable display function**
Once the measurement value stabilizes, the [pH] indicator will stop flashing and remain lit. For details, see "12. Stable Display Function"
* **Depending on the measured sample, the measurement value may not be stable. In that case, use the HOLD function to read the measurement value.**

(5) After the measurement is finished, press the Power/SET button to turn off the power. Clean the glass electrode thoroughly with distilled, purified or tap water before storing it.

⚠CAUTION

- **Measured objects such as organic solvents, oils, adhesives, strong acids (pH 0 to 2), strong alkalis (pH 12 to 14), surfactants, etc., may degrade the glass electrode and shorten its lifetime.**
- **When measuring the pH of pure water, the measured value may not be stable.**
- **When measuring food and drink, collect and measure the measurable amount (about 3 cm of the sensor tip immersed) in a separate container. Do not eat or drink the measured sample.**
- **The sensor part is made of glass. Please handle it with great care to avoid damage. In the unlikely event that the sensor part is damaged, handle it with care to avoid injury.**

10. Auto Power Off Function

The auto power off function works when there is no button operation for about 20 minutes. When performing continuous measurements, please disable the auto power off function.

●**Disable the auto power off function**

While the power is off, press and hold the [POWER]/[SET] button while holding the [HOLD]/[▲] button. When "oF" appears in the display, release the button. The auto power off function is disabled.

* **When the power is turned off, disable auto power off setting is not stored. Set the disable auto power off setting each time you turn on the power.**

11. HOLD Function

If the measured value changes significantly during the measurement, use the HOLD function.

(1) Press the [HOLD]/[▲] button in measurement mode. The [HLD] indicator illuminates and the measured value is held.

(2) To cancel, press the [HOLD]/[▲] button again. The [HLD] indicator disappears and the hold display is released.

12. Stable Display Function

When the measured value meets the following conditions, the [pH] indicator will change from flashing to lit, indicating that the measurement has stabilized.

Stable conditions: Fluctuation in 10 seconds is within ±0.1 pH and ±0.5°C

13. Various Settings

●**Setting mode operations**

While the power is turned off, press the Power/SET button for at least 2 seconds. The software version will be displayed and the unit will automatically enter the setting mode.

(1) Each time you press the [CAL]/[▼] button, the items will change in the following order.

SL1 → SL2 → oFF → rSt → Measurement mode

Display	Description
SL1	Displays pH sensor sensitivity between pH 4 and pH 7
SL2	Displays pH sensor sensitivity between pH 7 and pH 9
oFF	Displays assymetric potential difference (mV)
rSt	Initialization

13-1. Sensitivity display function SL1 SL2 oFF

Based on the data at calibration period, the instrument displays the sensitivity and asymmetric potential difference of the electrodes. Please use the display as a guide for when to perform electrode maintenance and replacement.

* **Sensitivity: The pH glass electrode generates a potential difference depending on the pH of the measured sample. The sensitivity is obtained by comparing this potential difference with the theoretical value, and the deviation from the theoretical value is expressed as %. When "100.0" is displayed, it indicates that the sensitivity is 100.0%, which is equivalent to the theoretical value. Sensitivity deteriorates due to dirt or degradation of the electrodes, resulting in errors.**

* **Asymmetric potential difference: The internal electrode is sealed with an internal liquid of pH 7. When measuring a liquid with a pH of 7, the potential difference is theoretically 0, but a slight potential difference occurs due to the strain of the sensor or the condition of the glass film. This is called asymmetric potential difference. Dirt, dryness, and degradation of the electrode and internal fluid increase the asymmetric potential difference and cause errors. The asymmetric potential difference is expressed in mV. When "-10.0" is displayed, it means "asymmetric potential difference -10.0 mV".**

(1) In setting mode, switch to SL1 display.
Displays sensitivity (%) between pH 4 and pH 7.

(2) Switch to SL2 display.
Displays sensitivity (%) between pH 7 and pH 9.

(3) Switch to oFF display.
Displays the asymmetric potential difference (mV).

* **This device judges the sensor to be degraded when the sensitivity is 75% or less or 115% or more, or when the asymmetric potential difference is ± 60 mV or more. (Error code "E13")**

13-2. Initialization rSt

The calibration value held on the device is restored to the initial value.

(1) Switch to rSt display in setting mode. "no" will flash at the bottom.

(2) Press the [HOLD]/[▲] button to change the bottom character to YES and then press the [CAL]/[▼] button. After initialization is complete, the unit will return to measurement mode.

14. Sensor Replacement

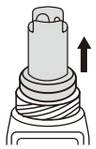
If the sensor degrades, it may become impossible to calibrate, and the displayed reading may even change immediately after calibration.

If an abnormality occurs, refer to "17. Troubleshooting" and take appropriate measures.

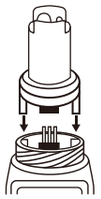
Replace the sensor as follows:

(1) Remove the glass electrode cover and turn the sensor mounting nut in the direction indicated by the arrow to remove it.

(2) Pull the sensor out straight.



(3) Install the new replacement sensor according to the diagram on the right.



(4) Turn the sensor mounting nut in the direction opposite to that of (1) to secure it.

(5) After replacing the sensor, be sure to calibrate it before use.

Note:

- **Tighten the sensor mounting nut securely. Insufficient tightening may inhibit the waterproof function. Also, make sure that there is no debris, etc. adhered to the seal when securing. If the seal is dirty, clean it and then secure it.**
- **Do not remove the sensor mounting nut if there are water droplets on the device or when it is wet. Water can enter the inside of the device and cause a malfunction.**

15. About Glass Electrodes

(1) Storage method

Glass electrodes cannot accurately measure pH when dry. The glass electrode shows normal values when there is moderate moisture. When storing, immerse the electrode in a potassium chloride solution. It is also effective to immerse it in distilled water or tap water and store it.

Note: If you are using a glass electrode for the first time after purchase or if you have not used it for a while, immerse it in potassium chloride solution for at least 12 hours before calibrating and then measure the pH.

(2) Inspection and calibration

To ensure accurate measurement, inspect with a pH standard solution before measurement. If there is an error as a result of the inspection, calibrate the device and then measure the pH.

Note: Use new pH standard solution.

(3) Cleaning

Always clean the glass electrode with distilled, purified, or tap water after pH calibration or pH measurement. If left uncleaned, the measuring liquid will form a film on the surface of the glass electrode, affecting the measurement.

(4) Lifespan

Glass electrodes are consumables. The lifespan depends on the type of solution being measured, pH value, and temperature.

(5) Adhesion of potassium chloride crystals

There may be white potassium chloride crystals on the tip of the glass electrode, but this will not pose a problem with use. You can rinse it off with tap water. If it is difficult to remove with tap water, immerse the glass electrode in warm water to rinse off the crystals.

Note: Do not lick or swallow potassium chloride crystals. If they get on your eyes or skin, rinse immediately with water and consult a doctor immediately.

16. Error Display

If an abnormality occurs with this product, an error code will be shown on the display area.

Category	Code	Contents	Countermeasures
Temperature	E02	The measurement is beyond the display range.	Please use within the measurement range. If the problem is not resolved, please contact the retailer where you purchased the product or A&D.
	E03		
pH	E02	The measurement is beyond the display range.	Please use within the measurement range. Also, the sensor may be degraded or malfunctioning. If cleaning the sensor does not improve performance, replace the sensor.
	E03		
	E04	The automatic temperature compensation function is not working properly.	Please use within the temperature measurement range. If this does not solve the issue, the sensor may be malfunctioning.
	E13	The sensitivity or asymmetric potential difference of the sensor is beyond the calibration range.	(1) Calibration may have failed. Initialize the calibration value and then perform the calibration again. (2) The sensor may be degraded or malfunctioning. If cleaning the sensor does not improve performance, replace the sensor.
	Others	There is an abnormality in the electronic components inside the main unit.	Turn the power off and on again. If this does not solve the issue, please contact the retailer where you purchased the product or A&D.

17. Troubleshooting

Symptoms of the problem	Expected causes	Countermeasures
Readings are not stable	The sample volume to measure is small.	Immerse to about 3 cm from the tip of the sensor.
	Sample with low conductivity, such as pure water was measured.	Due to the characteristics of glass electrode measurement, liquids with low conductivity have symptoms such as unstable measurements.
	The temperature of the sample is changing.	Keep the temperature of the sample stable.
	Sample solution is Heterogeneous.	Mix well until homogeneous.
Measurements do not change	Hold function activated: [HLD] indicator is lit.	Press the [HOLD]/[▲] button to release the hold.
Measurements appear abnormal	The glass electrode is dirty.	Clean the glass electrode. (15. About Glass Electrodes)
	The glass electrode is dry.	
	The glass electrode is broken.	Replace the sensor.
	The device has not been calibrated.	Perform calibration.
	The volume of the measured sample is small.	Immerse about 3 cm from the tip of the sensor.
	The temperature of the measured sample and the temperature at the time of calibration are very different.	Calibrate at a temperature close to the temperature of the measured sample.
	If the above measures do not improve performance, the sensor may be degraded or malfunctioning. Please replace the sensor.	
Unable to calibrate	The sensor has degraded.	Replace the sensor.

18. Care

When cleaning this product, wringe out a soft, damp cloth and wipe it gently. Also, do not use thinners, benzine-like volatile solvents or abrasives.

19. Specifications

Measuring range	pH	0.0 to 12.0 pH
	°C	0.0 to 50.0°C
Display range	pH	0.0 to 14.0 pH
	°C	0.0 to 50.0°C
Resolution	pH	0.1 pH
	°C	0.1°C
Accuracy	pH	±0.2 pH
	°C	±1.0°C
Measurement sampling		Approx. 1 second
Water resistance		IPX5 equivalent
Operating temperature and humidity range		0 to 50°C, 80%RH or less (non-condensing)
Storage temperature and humidity range		0 to 50°C, 80%RH or less (non-condensing)
Batteries used		Button battery (LR44) × 4 pcs
Battery life		Approx. 200 hours (Continuous measurement)
Main unit dimensions		Approx. ϕ38 × 179 (L) mm
Main unit weight		Approx. 88 g (including batteries)
Standard accessories		Instruction manual Button batteries for operation verification (LR44) × 4 pcs Hand strap
Material		Main unit: ABS Electrode: Glass

●**Items sold separately**

AX-APA21-31	pH Electrode: Replacemen Electrode Module
AX-APA-01	pH 4.01 Standard Solution with JCSS Certificate, 500 mL
AX-APA-02	pH 6.86 Standard Solution with JCSS Certificate, 500 mL
AX-APA-03	pH 9.18 Standard Solution with JCSS Certificate, 500 mL
AX-APA-11	Electrode Preservation Solution KCl 3 mol/L, 500 mL (Aqueous Solution)