

**MODEL 370 pH/mV METER**  
**OPERATING MANUAL**

370 350/REV A/10-03

**MODEL 370  
pH/mV METER  
OPERATING INSTRUCTIONS**

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**INTRODUCTION**

The Model 370 is a general purpose hand held pH/mV meter offering a 1 or 2 point calibration and automatic buffer recognition with manual override. The custom liquid crystal display simultaneously shows temperature compensated pH readings or electrode potential and temperature. The instrument is housed in a robust, ergonomically designed case. Calibration errors are clearly indicated together with the parameter in error. An indication of battery life is also permanently shown on the display. An automatic switch off facility helps to conserve battery life.

**SPECIFICATION**

|                           |   |
|---------------------------|---|
| pH                        | (1 or 2 point cal)                                |
| Range:                    | -2 to 16.00pH                                     |
| Resolution/Accuracy:      | 0.01pH / $\pm 0.02$ pH                            |
| mV                        | (Absolute or Relative)                            |
| Range:                    | -1999 to +1999mV                                  |
| Resolution/Accuracy:      | 1mV / $\pm 1$ mV                                  |
| Temperature Ranges:       | -10 to +105°C / 14 to 221°F                       |
| Resolution/Accuracy:      | 0.1°C / $\pm 0.5$ °C / 1°F / $\pm 1$ °F           |
| ATC Range:                | 0 to 100°C / 32 to 212°F                          |
| Manual Temp. Comp. Range: | 0 to 100°C / 32 to 212°F                          |
| Auto Buffer Recognition:  | 4.00, 7.00, 9.22, 10.00<br>(manual override)      |
| Calibration:              | User selectable 1 or 2 pt                         |
| Power:                    | 2 AA cells  |
| Battery Life:             | 500 hours typical<br>(@ 25°C with alkaline cells) |
| Size:                     | 175(l)x75(w)x35(d)mm                              |
| Weight:                   | 250g  |

## INSTALLATION

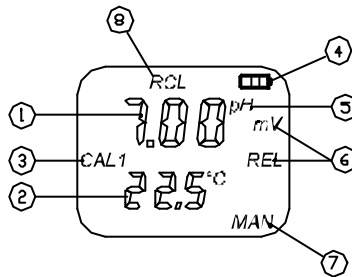
Unpack the instrument and ensure the following items are present:

1. Model 370 pH/mV Meter (370 201)
2. Epoxy bodied combination pH electrode (924 001)
3. Temperature/ATC probe (027 500)
4. pH4, 7 & 10 buffer sachets
5. 2 x AA alkaline batteries (021 007)(fitted)

**Optional accessories which may have been ordered:**

1. Carrying Case (033 268)



## DISPLAYS



1. Main display - 3½ digit display providing direct readout of pH or mV. Underrange (-1) and Overage (1) symbols will be displayed if the instrument is reading outside the ranges of:  
pH -2.00 to 16.00 or mV -1999 to +1999  
In addition, the instrument will display an erroneous result momentarily at the same time as the secondary display indicates the error code.

2. Secondary display - 4 digit display showing temperature (manual temperature compensation value or ATC probe temperature, if connected) in °C or °F. In the event of a calibration error the display will show an error code momentarily (if the reading is outside the range of -10 to 105°C / 14 to 220°F) at the same time as the primary display indicates the erroneous reading. These codes will be shown as Err1, Err2 or Err3.
3. CAL 1 or CAL 2 indicator - shows which point of the calibration routine has been reached.
4. Battery Life Indication - 4 levels will be shown ranging from <25%, 25-50%, 50-75% and 75-100%. Sensor calibration data and user parameters are retained during battery replacement.
5. Mode annunciator - pH or mV is displayed depending on which mode of operation is selected.
6. REL - this is the relative mV mode annunciator. The relative mV mode is selected via the Cal key. If the mV mode is selected and this annunciator is not shown then the instrument is reading in absolute mV.
7. MAN - this is displayed to indicate when manual temperature compensation or manual pH calibration is being performed. This will not appear on the display when the ATC probe is connected.
8. RCL annunciator - this indicates that the displayed reading is the stored value recalled from memory.

## KEYPAD CONTROLS

|   |   |
|---|---|
| STO RCL   | STO stores the current data reading.<br>RCL enters recall mode to view the stored readings.   |
| I:O   | Switches the instrument on and off. This key should be pressed and held for 1-2 seconds to operate. The instrument will automatically switch off after 30 minutes if no key is pressed. |
|   | Back light. Pressing this key will illuminate the back light for 10 seconds. It should be noted that, if used excessively, this will reduce battery life.                               |
|  | Enables manual setting of pH buffer values when performing a calibration, and adjustment of the manual temperature compensation value (no ATC probe connected).                         |
| CAL   | This key is used to select and perform calibration in the pH mode. In the mV mode pressing the Cal key will toggle between Absolute and Relative mV.                                    |
| MODE  | This key changes the measurement parameter to pH or mV mode as required and sets to °C/°F. Press and hold for 3 seconds to select temperature unit.                                     |

## **OPERATION**

Switch the instrument on by holding down the I/O key for 1-2 seconds. All display segments will be illuminated for approximately 2 seconds. The display will either power up in the mV or pH mode depending upon previous usage. An internal self check routine is run during this display and on successful completion normal operating mode is activated.

If no ATC probe is connected to the instrument the MAN annunciator will be shown. Manual temperature compensation should always be entered prior to commencing a calibration.

Remove the electrode from the packaging and ensure it is in good condition. Connect the electrode to the instrument via the BNC socket and remove the wetting cap. Prior to performing pH measurement it is necessary to perform a 1 or 2 point calibration using the buffer sachet(s) provided. Connect the ATC probe (if being used) to the mini-DIN socket and immerse the ATC probe in the pH buffer alongside the pH probe.

## **CALIBRATION**

The 370 features a one or two point calibration. For the best results we recommend that the 370 is calibrated with buffer solutions that are close to the sample value, where possible. For example: when working at pH5.5 we recommend calibrating at pH7 and pH4.

Auto buffer recognition operates over the range of 0 to 100°C, and will recognise 4.00, 7.00, 9.22 and 10.00pH. Alternative manual values may be entered during the calibration sequence by using the ▲ ▼ keys to set the preferred values.

**NOTE** Manual temperature compensation (if being used) should be entered prior to commencing a calibration sequence using the ▲ ▼ keys. (If the displayed reading is altered the auto buffer

recognition feature will be disabled. To retrieve the auto buffer recognition values it is necessary to exit the calibration sequence by pressing the MODE key).

To exit the cal sequence at any point, press the MODE key.

**Rinse electrode(s) in deionised water between measurements.**

Select pH using the MODE key. To commence the calibration immerse the tip of the electrode and the ATC probe into the first buffer solution so that the bulb and reference junction are covered.

**AUTOMATIC CALIBRATION FIRST POINT**

Press the CAL key and the display will show the CAL1 annunciator. The primary display will show a reading close to the buffer value based on the last successful calibration.

For automatic calibration to one of the pre-programmed buffer values wait for the reading to stabilise and then press the CAL key again to update the display to the temperature corrected value for the buffer used (refer to the buffer value tables on buffers used).

If a one point only calibration is required, pressing the MODE key will return the display to the pH measurement mode. The instrument is then ready to perform sample measurements.

**AUTOMATIC CALIBRATION SECOND POINT**

If a two point calibration is required the electrode should be rinsed and then immersed in the second buffer solution.



The primary display will show a reading close to the buffer value based on the last successful calibration. For automatic calibration to one of the pre-programmed buffer values wait for the reading to stabilise and then press the CAL key again to update the display to the temperature corrected value for the buffer used (refer to the buffer value tables on buffers used).

#### **MANUAL CALIBRATION FIRST POINT**

Press the CAL key and the display will show the CAL1 annunciator. The primary display will show a reading close to the buffer value based on the last successful calibration.

For manual calibration press the ▲ ▼ keys to change the reading to the value for the specific buffer being used. When the correct value is achieved press the CAL key again to confirm this value.

#### **MANUAL CALIBRATION SECOND POINT**

If a two point calibration is required the electrode should be rinsed and then immersed in the second buffer solution.

For manual calibration press the ▲ ▼ keys to change the reading to the value for the specific buffer being used. When the correct value is achieved press the CAL key again to confirm this value.

#### **CALIBRATION COMPLETE**

For both automatic and manual calibration procedures the last (3rd) press of the CAL key returns the display to the pH measurement mode and sample measurement can proceed.

### **ERROR CODES**

Refer to Troubleshooting Guide for possible causes of error codes. If a problem is detected during calibration the following error codes will be displayed:

**Err1** This indicates that the calculated electrode offset at pH7 is outside the range of -30 to +30mV. The error code will be displayed for 3 seconds on the secondary display, together with the erroneous electrode offset value in mV on the primary display. The instrument will then reset the calibration data back to the ideal Nernst response of 0mV offset at 7pH and a slope of 59.16mV/pH at 25°C.

**Err2** This indicates that the slope value is out of range. The error code will be displayed for 3 seconds on the secondary display, together with the erroneous value as a % on the primary display. The instrument will then reset the calibration data back to the ideal Nernst response of 0mV offset at 7pH and a slope of 59.16mV/pH at 25°C. The allowable range for slope is 75 to 125% of the ideal Nernst figure.

**Err3** This indicates that the instrument has not recognised the buffer. The displayed reading must be within 1pH of the calibration buffer value for automatic buffer recognition. The error code will be displayed for 3 seconds on the secondary display, together with the erroneous pH buffer value on the primary display. The instrument will then reset the calibration data back to the ideal Nernst response of 0mV offset at 7pH and a slope of 59.16mV/pH at 25°C.

### **mV MODE - Absolute mV**

When this mode is selected the instrument will display the actual voltage developed by the electrode when it is immersed in a solution containing ions to which the electrode is sensitive. Combination type pH, redox and ion selective electrodes can all be used in this mode. Most of these determinations will require the preparation of calibration curves or other analytical methods for the results to be converted to a concentration unit.

This range is also useful for monitoring the performance of standard pH electrodes. Using accurate and fresh buffers at a constant temperature the mV output of the electrode should be noted and compared to the theoretical ideal.

As the electrode ages, becomes contaminated or dirty, these values will drift, indicating that corrective action should be taken. Recording these values as part of a routine quality control programme can give a good indication of the condition of the electrode.

#### **Relative mV**

This mode is also suitable for determinations using redox and ion selective electrodes with the additional benefit of being able to zero any offset developed by the electrode in a blank solution, i.e. a solution that has none of the ions to be measured, but has all the other characteristics of the unknown samples. A blank solution would normally have its ionic strength and pH adjusted as required for the electrode in use.

As the display is zeroed automatically when the relative mV mode is selected, it is necessary to immerse the electrode in the blank solution with the absolute mV mode selected. When the reading has stabilised the relative mV mode should then be selected by pressing the CAL key. The display will be set to zero, thereby removing any offset voltage. Sample measurement is then carried out by using a variety of well tried analytical methods; from simple calibration curves through titrations, to single and multiple addition methods.

#### **MANUAL TEMPERATURE COMPENSATION**

When making measurements without ATC, the displayed temperature reading can be adjusted to the correct value using the ▲ ▼ keys. The instrument will default to this mode if a temperature sensing element is not detected by the electronics. Manual temperature adjustment must be made prior to commencing a calibration sequence or sample measurement.

#### **AUTO SHUT OFF**

This will occur after 30 minutes if no key is pressed

## DATA STORAGE

The 370 can store up to 32 readings. Storage is initiated by manual key press.

### Storing Data

Pressing the STO key stores the current reading in the next available data location. The storage location is indicated by **Sto** and a number (1-32) momentarily displayed for the data. The results are stored sequentially until the memory is full. When all 32 data locations are filled, the next stored reading will overwrite the result previously stored in position 1. The stored data is retained in the event of battery failure and during battery replacement.

### Recalling Data

Pressing the RCL key recalls the last stored reading on to the display. The instrument is now in RCL mode, indicated by the RCL annunciator at the top of the display.

The ▲ ▼ keys are used to select previously stored data. The storage location is indicated by **rCL** and a number (1-32) momentarily displayed prior to the data.

To clear all readings press and hold the CAL key (>3 seconds) while in RCL mode. When all stored readings are cleared the display will momentarily show **CLr ALL**. The instrument will then return to the main operating mode.

If storage locations are empty and the RCL key is pressed, the display will show **ALL CLr**.

**NOTE: It is not possible to delete individual stored readings.**

## GOOD PRACTICE GUIDELINES

The types of pH electrodes are many and various. The supplied epoxy combination electrode is suitable for the majority of tests carried out on aqueous solutions.

For other applications, such as low ionic strength, high temperatures and strongly acidic solutions a more suitable pH/reference electrode pair may be required. Details or advice supplied on request.

The following general guidelines indicate the care and maintenance required:

1. **After Use** - Rinse thoroughly with distilled water.  
**Short Term Storage** - Immerse in storage solution (025 192)  
**Long Term Storage** - Fit wetting cap filled with storage solution (025 192) and replace in original packaging.
2. Electrodes should be stored:
  - a) away from direct sunlight
  - b) in a vertical position
  - c) within their specified temperature range
3. Always ensure the electrode is used within its specified temperature range. Ageing of electrodes used above their specified temperature is rapid and irreversible.
4. **DO NOT** touch the sensitive glass pH membrane or reference junction. Excess droplets of solution may be removed by gently blotting with filter paper or tissue.  
**DO NOT** rub the electrode as this may induce an electrostatic charge.
5. During use ensure the electrode is rinsed between each measurement to eliminate the contamination of solutions.

## **MAINTENANCE**

### **CLEANING/RE-CONDITIONING OF GLASS ELECTRODES**

For general purpose use, combination electrodes can be cleaned with a mild detergent solution or a commercial glass cleaning solution (provided these are not strongly acidic). The electrode surface should be wiped with a clean cloth soaked in the cleaning agent, and/or allow the membrane to stand in the solution until clean. Rinse and repeat as necessary.

### **TABLE FOR CLEANING OF GLASS ELECTRODES**

**NOTE: The epoxy bodied electrode supplied with the instrument should not be cleaned with aggressive solvents.**

| <b>Deposit</b>        | <b>Cleaning agents</b>  |
|-----------------------|---|
| General deposits      | Mild detergent solution   |
| Inorganic coatings    | Commercial glass cleaning solution (not strongly acidic)                          |
| Metal compounds       | Acid solution, not stronger than 1M   |
| Oil/Grease            | Complexing agent (EDTA) or suitable solvent                                       |
| Resins/Lignins        | Acetone, alcohol or detergent (not strongly alkaline)                             |
| Proteins (blood, etc) | Enzyme solutions e.g. Pepsin in 0.1M HCl  |
| Stubborn deposits     | Weak hydrogen peroxide solution, Sodium Hypochlorite solution or domestic bleach. |

Electrodes which have been allowed to dry out, (often indicated by a hard, dry deposit of KCl crystals on the electrode body), should be rehabilitated by soaking overnight in warm deionised water.

### TROUBLESHOOTING GUIDE

| <b>FAULT</b>               | <b>PROBABLE CAUSE</b>   | <b>ACTION</b>   |
|----------------------------|---|---|
| No power                   | Battery failure<br>Battery polarity incorrect                                     | Replace batteries<br>Refit batteries  |
| Cal error<br>1, 2 or 3     | Incorrect value buffer used<br>Contaminated buffer solution                       | Use correct value<br>Use fresh buffer solutions                                 |
| Cal error<br>1 or 2        | pH electrode defective<br>Same buffer used for 2 point cal                        | Replace pH electrode<br>Recalibrate on 2 buffer solutions                       |
| Unstable display           | pH electrode defective  | Replace pH electrode  |
| Display shows 1 or -1 only | Intermittant or no connection<br>pH electrode defective<br>Contaminated solutions | Check electrode connection to unit<br>Replace pH electrode<br>Replace solutions |
| Temp. value incorrect      | Defective temperature probe   | Replace temperature probe   |
| Intermittant display       | Probes not fitted correctly   | Check connections   |
| I:O switch not working     | I:O key not held down >2 secs<br>No batteries fitted                              | Retry holding key for 2 seconds<br>Fit batteries                                |
| ▲ ▼ keys not working       | Operating in incorrect mode   | Refer to operation section of manual  |

### TROUBLESHOOTING GUIDE

| <b>FAULT</b>                           | <b>PROBABLE CAUSE</b>                              | <b>ACTION</b>                     |
|--|--|-----------------------------------|
| Back light not on/goes out             | 10 second time elapsed/normal function             | Recheck                           |
| Unable to adjust manual temperature    | Incorrect mode of operation<br>ATC probe connected | Reselect mode<br>Disconnect probe |
| MAN displayed when ATC probe connected | Defective ATC probe                                | Replace ATC probe                 |

If a fault is identified during the start up self check routine an error code will be displayed. This indicates an internal hardware or software software problem. In the event of this, please contact your local distributor or service agent.

### CHECKING pH ELECTRODE FUNCTION

If the pH electrode is considered to be defective the following procedure can be carried out to confirm this:

Select the mV mode and place the electrode in a fresh 7pH buffer solution. Record the mV value as Eo which should be between -30 and +30mV.

Rinse the electrode and place in a fresh 4pH buffer solution.

Record the mV value as 'k' which should be between +133 + Eo and +222+Eo.



The slope of the electrode can be calculated from:

$$\text{Slope \%} = \frac{k + E_0}{177.48} \times 100$$

This value should be in the range of 75% to 125%.

If any of the parameters are outside the limits given the electrode is faulty and should be replaced.

#### **CHECKING pH METER FUNCTION**

Remove the ATC probe and set the temperature display to 25°C to enable manual temperature compensation at this temperature.

Connect the meter to a mV source and apply 0mV. Press the CAL key and the display should read 7 pH.

Apply +180mV and calibrate to 4 pH.

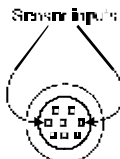
Apply -180mV and the display should show 10 pH.

If the above can be completed successfully the meter can be regarded as operating correctly and the electrode as suspect. This can be confirmed by re-calibration with a replacement or known good electrode.

#### **CHECKING TEMPERATURE INPUT**

Apply a 10.0Kohm resistor across the pins shown:

Check the display reads 25.0°C ±0.5°C



## **BATTERY REPLACEMENT**

If necessary, switch the unit off using the I/O key.  
To fit new batteries; loosen the battery compartment cover (the screws are captive in the cover), remove and carefully discard the used batteries. Fit the new batteries, type R6, AA or AM3, ensuring the correct polarities are observed, as indicated on the moulding. Refit the battery compartment cover, ensuring that the fixings are secured into place, but are not overtightened.

## **OPTIONAL ACCESSORIES**

The following list of items are available for use with the Model 370:

|         |                                |
|---------|--------------------------------|
| 033 268 | Carrying Case                  |
| 025 179 | pH 4 buffer sachets (pack 10)  |
| 025 180 | pH 7 buffer sachets (pack 10)  |
| 025 181 | pH 10 buffer sachets (pack 10) |

Comprehensive ranges of electrodes and consumables are available for use with this product. Details available on [www.jenway.com](http://www.jenway.com)

## **SPARE PARTS**

|                              |         |
|------------------------------|---------|
| Epoxy bodied pH electrode    | 924 001 |
| ATC probe                    | 027 500 |
| Battery (Qty 1) (2 required) | 021 007 |

### **Recommended spares list for 2 years:**

|                                   |         |
|-----------------------------------|---------|
| Batteries (Qty 8)                 | 021 007 |
| Epoxy bodied pH electrode (Qty 2) | 924 001 |
| ATC probe (Qty 1)                 | 027 500 |

### **EC Declaration of Conformity**

JENWAY Model 370 pH/mV Meter complies with the following European Standards:

|                 |  |
|-----------------|--|
| EN 50081-1:1992 | Electromagnetic compatibility - Generic emission standard                                |
| EN 61326:1998   | Electrical equipment for measurement, control and laboratory use - EMC requirements      |
| EN 61010-1:1993 | Safety requirements for electrical equipment for measurement, control and laboratory use |

Following the provision of:

EMC Directive - 89/336/EEC and Low Voltage Directive - 73/23/EEC

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