Operating Instructions

BECKMAN

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Safety

SAFETY NOTICE

The international safety symbol displayed above appears on this product and is a reminder to the user that all safety instructions should be read and understood prior to installation, operation, maintenance or repairs are attempted on this meter.

If the meter is used in a manner other than as described, the safety and performance of the meter can be impaired. Refer to the Ordering Information section regarding use of an AC Adapter. No AC Adapters, other than those specifically included, have been approved for use.

WARRANTY

Your Φ™ (pH™) Series Meter is warranted to be free of manufacturing defects for three (3) years from the date of purchase. This does not include any defects that are the result of abuse or misuse of the meter. Beckman Instruments, Inc., will, at Beckman’s option, repair or replace your meter with a comparable unit. This is a limited warranty. You may have additional rights under your state laws. Batteries are not included in this warranty.

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus as set out in the radio interference regulations of the Canadian Department of Communications.

Le present appareil numerique n’emet pas de bruits radioelectriques depassant les limites applicables aux appareils numeriques de classe A, prescrites dans le reglement sur le brouillage radioelectrique edicte par le ministere des communications du Canada.
Cleaning Instructions

The pH Meter may be cleaned with a soft damp cloth. No solvents should be used and no other cleaning methods are recommended.
Chapter 1.0 Overview

The Beckman Coulter Φ Series Meters provide complete, quick and precise pH, mV and Concentration analysis in the lab or in the field. These meters come equipped with selectable resolution, automatic temperature compensation (ATC), Auto-Find™ that automatically recognizes stored buffers, and Auto-Read™ to lock onto stable readings.

1.1 Model Functionality

These operating instructions cover all models of the Φ Series Benchtop meters by describing the features included in the top model (Φ390). If a mode, function or key is not available with the meter you have purchased, please ignore the respective description.

Capabilities, keypads and specification are model dependent. Refer to “Standard Functions and Keys” on page 10, “Setup” on page 13 and “Specifications” on page 46 for more details.

Φ340 Basic meter for pH and temperature measurements.

Φ350 Routine meter for pH, mV and relative mV (ORP), and temperature measurements.

Φ360 High accuracy meter for pH, mV and relative mV (ORP), and temperature measurements. Includes RS-232 interface and data storage and recall for up to 100 samples.

Φ390 High accuracy meter for pH, mV and relative mV (ORP), concentration (ISE) and temperature measurements. Includes RS-232 interface and data storage and recall for up to 100 samples.
1.2 Display

The display is a custom glass liquid crystal display. To verify the proper function of all display elements, simply keep the key pressed for more than 0.5 seconds when turning on the meter. In this case, all elements are displayed. Press any key to return to normal operation.

The various sections of the display are described in this chapter. Example displays and additional information are provided in following chapters.

<table>
<thead>
<tr>
<th>Functionality</th>
<th>340</th>
<th>350</th>
<th>360</th>
<th>390</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setup</td>
<td>n/a</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>pH Mode</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Standard Buffers</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Replacement Buffers</td>
<td>n/a</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Custom Buffers</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>✓</td>
</tr>
<tr>
<td>mV &amp; relative mV Mode</td>
<td>n/a</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Concentration Mode</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>✓</td>
</tr>
<tr>
<td>RS-232 Interface</td>
<td>n/a</td>
<td>n/a</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Data Storage &amp; Recall</td>
<td>n/a</td>
<td>n/a</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Numeric Keypad</td>
<td>n/a</td>
<td>n/a</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Mode Status

The currently selected mode is displayed on the top of the display. The modes are: SETUP, READ, CALIBRATION, STORE, RECALL, and SEND.

Setup Menu

Setup is used to customize the system, set the date and time, and to input values, e.g. for custom buffers and concentration calibration. Refer to “Setup” on page 13 for more details.
**Numeric Display**

The large numeric display shows measurement results (pH, mV, relative mV, concentration) and error messages. It is also used to set and review the date/time as well as the calibration alert time.

The temperature display and the numeric display for % Slope and E₀ (Offset) consist of smaller numeric elements, located below the large numeric display.

**Input and Selection**

This section of the display is used to input values into memory and to review them. It supports the custom buffer, concentration, storage, recall and send modes.
Status and Help Icons

The bottom of the display contains status and help icons that display information about electrode, battery and memory conditions and to assist with the operation of the meter.

Figure 5 Status and Help Icons

Table 2: Icon Descriptions

- **Auto**
  - Auto-Eye or Auto-Read to lock onto stable readings.

- **Δ**
  - Re-Calibration Alert.

- **OK**
  - Functional Electrode (slope within 90 to 110%).

- **??**
  - Electrode Failure (slope outside the range of 90 to 110%).

- **ATC**
  - Automatic Temperature Compensation Probe connected.

- **NO ATC**
  - No Automatic Temperature Compensation Probe.

- **LOW**
  - Battery low.

- **??**
  - Operating on battery power.

- **??**
  - Audio Feature activated.
Table 2: Icon Descriptions

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOC</td>
<td>Select Memory Locations Feature activated.</td>
</tr>
<tr>
<td>Memory Status Bar.</td>
<td></td>
</tr>
<tr>
<td>STO</td>
<td>Reading available for Storage.</td>
</tr>
<tr>
<td>1 2</td>
<td>Numeric Keypad active.</td>
</tr>
<tr>
<td>3 4</td>
<td>Alternate NUM key active.</td>
</tr>
<tr>
<td>CLEAR</td>
<td>Clear key active.</td>
</tr>
<tr>
<td>EXIT</td>
<td>Exit key active.</td>
</tr>
<tr>
<td>ENTER</td>
<td>Enter key active.</td>
</tr>
<tr>
<td>Arrow keys active.</td>
<td></td>
</tr>
</tbody>
</table>
1.3 Connectors

The meter has a BNC connector for a pH/ISE electrode, a pin connector for a reference electrode, a phone plug connector for an ATC probe, an input jack for the AC Adapter, and an RS-232 port (models Φ360 and 390 only).

Figure 6 Device Interface ports

1. BNC Connector for pH/ISE Electrode.
2. Phone Plug Connector for Automatic Temperature Compensation Probe (ATC), P/N 598115 or ATC of 3-in-1 electrodes.
3. Pin connector for reference electrode.
4. Input Jack for AC Adapter. The AC adapter is optional; P/N 599199 (U.S. Plug), P/N 140632 (Euro Plug), P/N 140633 (U.K. Plug).
5. RS-232 Port (DIN) to connect to a printer or a computer. Use cable P/N 511312 for computer (9-pin female) and P/N 511313 for printer (25-pin male).
1.4 Standard Functions and Keys

Each model has a different keypad as illustrated below. The models 360 and 390 have a multi-functional keypad to allow the entry of values.

Figure 7 illustrates the keypad configurations for the different models and describes each key.

**Figure 7 Keypads**

**Φ340 Keypad**

- READ
- CAL
- AUTO
- CLEAR
- SETUP

**Φ350 Keypad**

- READ
- EXIT
- CAL
- AUTO
- CLEAR
- SETUP

**Φ360 Keypad**

- READ
- EXIT
- CAL
- AUTO
- CLEAR
- SETUP

**Φ390 Keypad**

- READ
- EXIT
- CAL
- AUTO
- CLEAR
- SETUP

**On/Off**

Press this key to turn the meter on and off. When the meter is turned off, the standardization data, stored results, and timer values remain intact.
READ/CE

The READ key initiates a reading. When the Auto-Eye is turned off, the reading is continuous and there is no need to press the key. The alternate CE key clears the current input and enables a memory storage location to be input.

Calibration

Press this key to enter and exit the Calibration mode. The system must be calibrated before one can obtain reliable results. The Calibration mode is described in detail in “pH Mode” on page 17, “mV and Relative mV Mode” on page 28 and “Concentration Mode for Ion-Selective Electrodes (ISE)” on page 30.

Auto-Read

Press this key to turn Auto-Read™ on or off (default is on). Be aware that Auto-Read is automatically turned on when entering the Calibration mode and then reset to its initial setting upon exiting the Calibration mode. The Auto-Eye symbol on the display indicates when the Auto-Read feature is active.

CLEAR

Press this key to delete calibrations and data in memory. Before calibration and stored sample data are actually removed, the “Clr” message appears in the large numeric display and the user must press the CLEAR key again before any data is removed. The function of the key is described in more detail in the following sections.

pH Resolution (.1/.01) and (.1/.01/.001)

Press this key to set the resolution for pH measurements. The large numeric display changes the corresponding digits behind the decimal point. Be aware that a higher resolution requires more time for Auto-Read to lock onto a reading.

Setup

Press this key to enter and exit the Setup Mode. Refer to “Setup” on page 13 for a detailed description of the various setup functions.
**pH/mV and pH/mV/conc**

This key toggles between the pH, mV/relative mV and Concentration measurement modes.

**Exit**

Press this key to exit a mode or function. It always returns the user to the previous level. The functions of the key are described in detail in the following sections.

**Arrows**

Press one of the arrow keys to move the cursor or blinking indicator to the left and right or up and down. The arrow keys are used for the Setup menu, the selection of replacement buffers and the input and review of custom buffers and concentrations, and the review of stored sample data.

**Enter/NUM**

This key is used to toggle between settings, to enter a Setup menu item, and to confirm an entered value. Also, it turns the keypad into a numeric keypad at certain points within the program. The functions of the key are described in detail in “Data Recall” on page 37.

**Store**

Press this key to store a result. Refer to “Storage and Recall” on page 36 for details.

**Recall/Send**

Press this key to recall data from memory and to send it through the RS-232 port to a computer or a printer. The key is also used to review calibration data. Refer to “Storage and Recall” on page 36 and the various measurement modes for details.
Chapter 2.0 Setup

The features available in setup differ from model to model. Refer to Table 6, “Feature Chart (Setup Mode)” for quick reference to the features offered for a particular model.

To enter the Setup mode, press the SETUP key. The setup menu contains those items that are available for your particular model. Press the Arrow key to move the cursor to the appropriate menu item and press ENTER in order to toggle the status or to enter the function.

Table 6: Feature Chart (Setup Mode)

<table>
<thead>
<tr>
<th>Model</th>
<th>°C or °F</th>
<th>Audio</th>
<th>View Standards</th>
<th>Replacement Buffers</th>
<th>Date/Time</th>
<th>Memory Locations</th>
<th>Set Custom Buffers</th>
<th>Set Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Φ340</td>
<td>n/a</td>
<td>√</td>
<td>n/a</td>
<td>√</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>√</td>
</tr>
<tr>
<td>Φ350</td>
<td>n/a</td>
<td>√</td>
<td>n/a</td>
<td>√</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>√</td>
</tr>
<tr>
<td>Φ360</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>√</td>
</tr>
<tr>
<td>Φ390</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>√</td>
</tr>
</tbody>
</table>

Figure 8 Setup Screen

The Setup mode is used to customize the system and to use less-routine functions, such as the setting of Replacement Buffers, Date and Time, Elapsed Time for Re-Calibration Alert, and the setting of Custom Buffers and Concentrations.
°C/°F
This selection is used to toggle between °C and °F temperature displays.

Audio
Turns the audio feature on and off. With the audio feature enabled, the user receives audio feedback when a) pressing a key, b) when the meter locks onto a reading, and c) when the set time for the calibration alert has been exceeded.

View Standards
Turns the continuous display of pH standards on and off. This function is valid in the pH mode when working with standard and/or replacement buffers. It has no effect in other modes or when Custom Buffers is enabled.

Replacement Buffers
This function is used to replace standard buffers with alternate buffers. Refer to “pH Replacement Buffers” on page 17 for details on this function.
Date/Time
This function is used to set the current date and time as well as the time for the calibration alert of the pH and Concentration mode.

Use the Arrow keys to scroll through the Date/Time items (Day, Month, Year, Hours, and Minutes) and the Calibration Alert Time (Elapsed Time) setting.

To edit a Date/Time item or the Calibration Alert Time, select the appropriate item and press the **NUM** key. This turns the keypad into a numeric keypad (the alternate descriptions on the keys apply in this case). The Numeric Keypad icon appears at the bottom of the display and Input is shown together with the current value. Enter the desired value and press the **ENTER** key to complete the entry and to return to the regular keypad mode. Pressing the **EXIT** key instead of the **ENTER** key will ignore the current input. An invalid entry will create an error message. In this case, use the described procedure and enter the correct value.

To return to the Setup menu, press the **EXIT** key. The Date/Time item stops flashing and another item may be selected.

**Note**

The clock utilizes a 24-hour format. The month is entered as a value from 1 to 12 but is later output as three-digit text (JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC). Make sure the year is entered in four digits (e.g., 1999).
The Calibration Alert Time (Elapsed Time) is 24 hours by default. The range is 1 to 99 hours, entered in full hours. There are separate settings for the pH and the concentration mode. The icon pH or Conc to the right of the large numeric display will indicate the current mode. Make sure you are in the appropriate mode before entering the Setup menu. When in mV mode, the Elapsed Time setting for the pH mode will be activated.

**Memory Locations**

Turns the manual selection of memory locations on and off. By default, the function is turned off. If the manual selection of memory locations is turned off, results are stored sequentially. The LOC icon at the bottom of the display indicates if the function has been activated. See also “Data Storage” on page 36.

**Custom Buffers**

Turns the Custom Buffer mode within the pH mode on and off. The item CUSTOM appears in the lower left part of the display, indicating that the Custom Buffer mode has been turned on. See also “pH Custom Buffers” on page 22.

**Set Custom Buffers**

This function is used to enter up to five custom pH buffers. Custom buffers must be defined first before a calibration can be performed. Refer to “pH Custom Buffers” on page 22 for details.

**Set Concentration**

This function is used to enter up to five concentrations. Concentration values must be defined before a calibration can be performed. Refer to “Concentration Mode for Ion-Selective Electrodes (ISE)” on page 30 for details.
Chapter 3.0  pH Mode

This mode is used to obtain precise pH results using a calibration with standard or custom buffers. Make sure you are in the pH Mode, indicated by the pH icon to the right of the large numeric display. To enter the mode, press the pH/mV or the pH/mV/Conc key until the pH icon appears.

The pH mode consists of two sub-modes:

- pH Standard Buffers
- pH Custom Buffers

The default pH mode is the standard buffer mode. The custom buffer mode can be activated in the Setup menu by toggling the Custom Buffers item.

3.1  pH Standard Buffers

Five standard buffers (pH 1.68, 4.00, 7.00, 10.01, and 12.45) are stored in the system. In addition, four replacement buffers (pH 6.86, 7.41, 9.18, 11.88) are available. Refer to “pH Replacement Buffers” on page 17 for details on how to replace standard buffers with alternate buffers. The system will automatically recognize the above buffers during calibration.

For precise results at temperatures other than room temperature (25°C) or varying temperatures, the use of a Temperature Probe (P/N 598115) or a 3-in-1 electrode with integrated temperature probe is strongly recommended. This allows for automatic temperature compensation (ATC) with both standard and replacement buffers.

The calibration buffers or standards can be displayed continuously for reference. To turn the feature on, press the SETUP key, select the View Stds item and press ENTER.

3.1.1  pH Replacement Buffers

Some standard buffers can be replaced with alternate buffers. This is useful for applications where special buffers are required (e.g., photo industry, etc.) or in countries where a replacement buffer is actually defined as a standard buffer.

<table>
<thead>
<tr>
<th>Standard Buffers</th>
<th>Replacement Buffers</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH 7.00</td>
<td>← pH 6.86 or 7.41</td>
</tr>
<tr>
<td>pH 10.01</td>
<td>← pH 9.18</td>
</tr>
<tr>
<td>pH 12.45</td>
<td>← pH 11.88</td>
</tr>
</tbody>
</table>

Table 7: Replacement Buffers
To replace a buffer, press the SETUP key and move the cursor, using the Arrow keys, to Repl Buffer and press ENTER. The Repl Buffer item starts flashing, indicating standard buffers can be replaced. The defined buffers are displayed with the first buffer underlined. The underlined buffer represents the selected buffer. Use the Arrow keys to select another buffer.

To replace the pH 10.01 buffer with 9.18 or the pH 12.45 buffer with 11.88, press the ENTER key. To replace the pH 7.00 buffer, first press the ENTER key. Then use the Arrow keys to select either pH 6.86 or 7.41 and press ENTER again to complete the action.

To reset a single buffer, select the replacement buffer and press the ENTER key. To reset all buffers, press the CLEAR key.

To return to the Setup menu, press EXIT. The Repl Buffer item stops flashing. Exit the Setup menu and return to the Read mode by pressing the SETUP or EXIT key.

3.1.2 pH Calibration (Standard Buffers)
Press the CAL key to enter the calibration mode. Auto-Read will automatically be turned on. In the lower left part of the display, the standard buffers of an existing calibration are shown. If there is no calibration, only Stds is displayed. If there is an existing calibration, the elapsed time since the calibration has been performed is displayed.
otherwise dashes are displayed in the large numeric display and the [CALIBRATED] icon is not displayed.

In order to re-calibrate, the existing calibration must be removed first. An indicator for an existing calibration is the [CALIBRATED] box. Press the CLEAR key to remove the existing calibration. The message appears in the large numeric display, warning the user that data will be cleared. To confirm the removal of the calibration, press CLEAR again. Otherwise, press the CAL or EXIT key to keep the existing calibration.

The number of available calibration points depends on the model.

<table>
<thead>
<tr>
<th>Model</th>
<th>Maximum Number of Calibration Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Φ340</td>
<td>2</td>
</tr>
<tr>
<td>Φ350</td>
<td>3</td>
</tr>
<tr>
<td>Φ360/390</td>
<td>5</td>
</tr>
</tbody>
</table>

Immerse the electrode into the standard buffer and press the READ key. During the actual measurement of the standard, pH results are displayed continuously and the Auto-Eye flashes. Wait until the Auto-Eye stops flashing, indicating that the meter has locked onto a stable reading. After the meter has locked on, the pH value is displayed in the large numeric display. The buffer value, at 25°C, also appears in the lower left part of the display. $E_o$ is displayed with the first standard and the % Slope is
displayed with the remaining standards. Standard buffers may be re-read by pressing the READ key again.

Continue with the next standard buffer or exit the mode if calibration is complete.

Press the CAL or EXIT to complete the calibration and to exit the calibration mode. When exiting the Calibration mode, all values are stored in memory and the calibration alert timer for this mode starts.

**Note**

When the meter detects an additional standard buffer that would lead to a calibration point exceeding the maximum number of points, an error message will be displayed.

The slope is defined as the change in potential when the pH reading changes by one decade. The % Slope is defined as the ratio of the measured slope and the theoretical Nernst slope (for example, 59.16 mV per decade of pH change at 25°C). If the % Slope value is not between 90 and 110, the electrode failure icon will flash.

### 3.1.3 pH Calibration Review (Standard Buffers)

This function is used to review an existing calibration. The following values can be recalled for each calibration point: mV, Temperature, E₀ (Offset), and % Slope.
While in the Calibration mode, press the **RECALL/SEND** key to activate the calibration review function.

The displayed values relate to the underlined standard calibration point in the lower left corner of the display. The following values are displayed: mV, Temperature, and \( E_0 \) (Offset). To toggle between \( E_0 \) (Offset) and % Slope, press the **ENTER** key. Press the **RECALL/SEND** key to toggle between calibration alert elapsed time and the current calibration point values. Use the Arrow keys to move through the available calibration points.

Press the **EXIT** key to return to the Calibration mode.

### 3.1.4 pH Measurement (Standard Buffers)

To take pH measurements, a calibration should have been performed earlier. An indicator for an existing calibration is the **[CALIBRATED]** box. If there is no calibration, you can still obtain results but the calculation is...
based on a theoretical slope. In this case, the results may be unreliable; especially if they differ significantly from the neutral pH 7.00.

Immerse the probe into the sample and press the READ key. During the measurement, calculated pH values are displayed continuously and the Auto-Eye flashes, if Auto-Read has been turned on. Wait until the result has stabilized or the Auto-Eye stops flashing. This may take 30-60 seconds or longer, depending on the sample.

Notice that the STO icon is shown next to the memory status bar, when Auto-Read is turned on, indicating that the result can be saved by pressing the STORE key (for models with RS-232 interface only).

Continue with the next sample.

### 3.2 pH Custom Buffers

Up to five custom buffers can be entered and used for calibration. Unlike standard buffer calibration, custom buffers are not automatically recognized during calibration. Each custom buffer must be selected before calibrating on it. No temperature compensation is performed during custom buffer calibration.

#### 3.2.1 Setting up pH Custom Buffers

The Setup mode allows the user to enter custom pH buffer values for the calibration. The appropriate buffer values must be entered before performing a calibration.

To enter setup mode, press the SETUP key. Use the Arrow keys to move the cursor (the arrow to the left of the setup items) to Set Cust Buffers and press ENTER. The Set Cust Buffers item starts flashing, indicating
custom buffers can be reviewed and entered. In the lower right corner of
the display, Buffer and the custom buffer indicators are displayed (12345).
The underlined number indicates the currently selected custom buffer.
Below the indicator, the corresponding custom buffer value is displayed.
Use the Arrow keys to review previously entered custom buffers.

To clear a custom buffer, simply select it and press the CLEAR key.
If no buffer value has been entered, a 0 is displayed. Use the Arrow keys
to move the underline to the standard you want to enter or edit and press
the NUM key to turn the keypad into a numeric keypad (the alternate
descriptions on the keys apply in this case). The numeric keypad icon
appears at the bottom of the display and Input is shown below the
standard indicators. Enter the custom buffer value and press the ENTER
key to store the value in memory or press EXIT to retain the previous
value. In both cases, the meter returns to the regular keypad mode and
you may move the underline to the next standard in order to enter or edit
another custom buffer.

Note

The lowest custom buffer value that can be entered is 0;
the highest value is 16.00 or 19.99, depending on the
model.

To return to the Setup menu, press the EXIT key. The Set Cust Buffer item
stops flashing and another item may be selected. To exit the Setup menu
and return to the Read mode, press the SETUP or EXIT key.
3.2.2 pH Calibration (Custom Buffers)

The appropriate buffer values must have been entered previously in Setup. Make sure you are in the pH mode and that Custom Buffers is selected. In this case, CUSTOM is displayed in the lower left corner of the display.

Press the CAL key to enter the calibration mode. Auto-Read is automatically turned on. If there is an existing calibration, the elapsed time since the calibration has been performed is displayed. The number of calibration points available depends on the number of custom buffers entered previously in Setup.

In order to re-calibrate, the existing calibration must be removed first. An indicator for an existing calibration is the [CALIBRATED] box. Press the CLEAR key to remove the existing calibration. The message appears in the large numeric display, warning the user that data will be cleared. To confirm the removal of the calibration, press CLEAR again. Otherwise, press the CAL or EXIT key to keep the existing calibration.

In the lower right corner of the display, Buffer and the available number of custom buffers are displayed, see Figure 18 below. The flashing number indicates the currently selected standard. Below the indicator,
corresponding buffer value is displayed. Use the Arrow keys to select the appropriate custom buffer.

Immerse the electrode into the appropriate buffer and press the READ key. During the actual measurement of the custom buffer, pH results are displayed continuously and the Auto-Eye flashes. Wait until the Auto-Eye stops flashing, indicating that the meter has locked onto a stable reading. This may take 30-60 seconds or longer, depending on the sample. After the meter has locked on, the custom buffer value is displayed in the large numeric display. An underlined custom buffer indicator means that a calibration reading for this particular buffer has already been taken. You may re-read a selected custom buffer by pressing the READ key again.

Continue with the next custom buffer or exit the mode if calibration is complete.

Press the CAL or EXIT key to complete the calibration and exit the Calibration mode. When exiting the Calibration mode, all values are stored in memory and the calibration alert timer for this mode starts.

Note

The slope is defined as the change in potential when the pH reading changes by one decade. The % Slope is defined as the ratio of the measured slope and the theoretical Nernst slope (for example, 59.16 mV per decade of pH change at 25°C). If the % Slope value is not between 90 and 110, the electrode failure icon will flash.
3.2.3 pH Calibration Review (Custom Buffers)
This function is used to review an existing calibration of custom buffers. The following values can be recalled for each calibration point: mV, Temperature, $E_o$ (Offset), and % Slope.

While in Calibration mode, press the RECALL/SEND key to activate the calibration review function. In the lower right corner of the display, the underlined number indicates the currently selected custom buffer and the value below shows the corresponding pH value. The following values are displayed: mV, Temperature, and $E_o$ (Offset). To toggle between $E_o$ (Offset) and % Slope, press the ENTER key. Use the Arrow keys to select the available calibration points. Press the RECALL/SEND key again to toggle between the set calibration alert elapsed time and the current calibration value.

Press the EXIT key to return to the Calibration mode.

3.2.4 pH Measurement (Custom Buffers)
To take pH measurements, a calibration should have been performed earlier. An indicator for an existing calibration is the [CALIBRATED] box. If there is no calibration, you can still obtain results but the calculation is
based on a theoretical slope. In this case, the results may be unreliable; especially if they differ significantly from the neutral pH 7.00.

Immerse the probe into the sample and press the READ key. During the measurement, calculated pH values are displayed continuously and the Auto-Eye flashes, if Auto-Read has been turned on. Wait until the result has stabilized or the Auto-Eye stops flashing. This may take 30-60 seconds or longer, depending on the sample.

Notice that the STO icon is shown next to the memory status bar, when Auto-Read is turned on, indicating that the result can be stored by pressing the STORE key (for models with RS-232 interface only).

Continue with the next sample.
Chapter 4.0  mV and Relative mV Mode

The mV mode provides mV results while the Relative mV mode requires a mV calibration. The displayed value for Relative mV is the result of subtracting the mV calibration from the actual mV being measured. Temperature readings have no effect on the results.

The mV or Relative mV Mode are indicated by the mV or mV rel icon to the right of the large numeric display. To enter the mode, press the pH/mV or the pH/mV/Conc key until the mV or mV rel icon appears.

4.1  mV and Relative mV Measurement

The result is either raw mV or Relative mV, depending which icon (mV or mV rel) is displayed to the right of the large numeric display.

Immerse the probe into the sample and press the READ key. During the measurement, mV or Relative mV values are displayed continuously and the Auto-Eye flashes, if Auto-Read has been turned on. Wait until the result has stabilized or the Auto-Eye stops flashing. This may take 30-60 seconds or longer, depending on the sample.

Notice that the STO icon is shown next to the memory status bar, when Auto-Read is turned on, indicating that the result can be stored by pressing the STORE key (for models with RS-232 interface only).

Continue with the next sample.

4.2  mV Calibration

Press the CAL key to enter the calibration mode. Auto-Read will automatically be turned on. If the mV icon and the [CALIBRATED] box are
shown, a mV calibration already exists and the mV calibration value is displayed, otherwise dashes are displayed in the large numeric display.

In order to re-calibrate, the existing calibration must be removed first. Press the CLEAR key to remove the existing calibration. The message \( \text{\textemdash} \) appears in the large numeric display, warning the user that data will be cleared. To confirm the removal of the calibration, press CLEAR again. Otherwise, press the CAL or EXIT key to keep the existing calibration.

Immerse the electrode into the sample and press the READ key. During the actual measurement of the sample, mV results are displayed continuously and the Auto-Eye flashes. Wait until the Auto-Eye stops flashing, indicating that the meter has locked onto a stable reading. After the meter has locked on, the mV calibration value is displayed in the large numeric display.

Press the CAL or EXIT key to complete the calibration and to exit the Calibration mode. When exiting the Calibration mode, the mV calibration value is stored in memory and the mV icon changes to mV rel.
Chapter 5.0  Concentration Mode  
for Ion-Selective Electrodes (ISE)

This mode measures concentration using ion-selective electrodes. To enter the Concentration Mode, press the pH/mV/CONC key until the Conc icon appears to the right of the large numeric display.

For precise results, all samples and standards should be at the same temperature. A difference of 1°C will result in about a 2% measurement error. Although the temperature will be measured and recorded when using an Automatic Temperature Compensation (ATC) probe, calibration values and results are not temperature-compensated.

For additional information on concentration calibrations and measurements, please refer to the operating instructions supplied with the Ion-Selective Electrode (ISE).

5.1 Setting up Standard Concentrations
The Setup mode allows the designation of up to five concentration standards for the calibration. The appropriate concentrations must be entered before performing a calibration.

To enter the Setup mode, press the SETUP key. Use the Arrow keys and move the cursor (the arrow to the left of the setup items) to Set Conc and press ENTER. The Set Conc item starts flashing, indicating that the standard concentration can be reviewed and entered. In the lower right corner of the display, Conc and the concentration indicators are displayed. The underlined number indicates the currently selected concentration. Below the indicator, the corresponding concentration value is displayed. Use the Arrow keys to review previously entered concentrations.

Figure 23 Setting up Standard Concentrations
The currently selected standard is 2, indicated by the underline. The second standard concentration (42) has been keyed in but the ENTER key has not been pressed yet in order to save the value. The system is still in the numeric input mode.
To clear a custom buffer, simply select it and press the **CLEAR** key.

If no concentration value has been entered, a 0 is displayed. Use the Arrow keys to move the underline to the standard you want to enter or edit and press the **NUM** key to turn the keypad into a numeric keypad (the alternate descriptions on the keys apply in this case). The numeric keypad icon appears at the bottom of the display and **Input** is shown below the standard indicators. Enter the concentration value and press the **ENTER** key to store the value in memory or press **EXIT** to retain the previous value. In both cases, the meter returns to the regular keypad mode and you may move the underline to the next concentration indicator in order to enter or edit another concentration.

**Note**

The lowest standard concentration that can be entered is 0.1; the highest value is 99999. It is required to enter the values in sequence, from low to high. A minimum of two standard concentrations or calibration points is required.

To return to the Setup menu, press the **EXIT** key. The Set Conc item stops flashing and another item may be selected. To exit the Setup menu and return to the READ mode, press the **SETUP** or **EXIT** key.

### 5.2 Concentration Calibration

In order to perform a calibration, appropriate concentration values must have been entered, as described in “Setting up Standard Concentrations” on page 30. Press the **CAL** key to enter the calibration mode. Auto-Read is automatically turned on. If there is an existing calibration, the elapsed time since the calibration has been performed is displayed. The number of
calibration points available depends on the number of concentration values entered previously in Setup.

In order to re-calibrate, the existing calibration must be removed first. An indicator for an existing calibration is the [CALIBRATED] box. Press the CLEAR key to remove the existing calibration. The message appears in the large numeric display, warning the user that data will be cleared. To confirm the removal of the calibration, press CLEAR again. Otherwise, press the CAL or EXIT key to keep the existing calibration.

In the lower right corner of the display, Conc and the indicators for the available concentrations are displayed. The flashing number indicates the currently selected concentration. Below the indicator, the corresponding
Immerse the electrode into the appropriate sample and press the **READ** key. During the actual measurement of the sample, concentration values are displayed continuously and the Auto-Eye flashes. Wait until the Auto-Eye stops flashing, indicating that the meter has locked onto a stable reading. This may take 30-60 seconds or longer, depending on the sample. After the meter has locked on, the calibrated concentration is displayed in the large numeric display. An underlined concentration indicator means that a calibration reading for this particular concentration has already been taken. You may re-read the standard concentration by pressing the **READ** key again.

Continue with the next concentration. Remember, at least two calibration points are required.

Press the **CAL** or **EXIT** key to complete the calibration and to exit Calibration mode. When exiting the Calibration mode, all values are stored in memory and the calibration alert timer for this mode starts.

**Note**

The slope is defined as the change in potential when the concentration changes by a factor of 10. The % Slope is defined as the ratio of the measured slope and the theoretical Nernst slope for a monovalent ion (for example, 59.16 mV per decade change at 25°C).
ATTENTION

The % Slope value for monovalent ion calibration should be between 90 to 100. The % Slope value for divalent ion calibration should be between 45 to 50. The % slope value out of this range may indicate electrode contamination. However, many other factors will contribute to a bad slope. Please refer to the operating instructions supplied with the Ion-Selective Electrode (ISE) for guidance.

5.3 Concentration Calibration Review

This function is used to review an existing calibration. The following values can be recalled for each calibration point: mV, Temperature, and % Slope.

While in Calibration mode press the RECALL/SEND key to activate the calibration review function. In the lower right corner of the display, the underlined number indicates the currently selected concentration and the value below shows the corresponding concentration value. The following values are displayed: mV, Temperature, and % Slope. Use the Arrow keys to move through the available calibration points. Press the RECALL/SEND key again to toggle between the set calibration alert elapsed time and the calibrated value.

Press the EXIT key to return to the Calibration mode.
5.4 Concentration Measurement

To take concentration measurements, a calibration must have been performed earlier. An indicator for an existing calibration is the [CALIBRATED] box. If there is no calibration, you cannot obtain a result.

Immerse the probe into the sample and press the READ key. During the measurement, concentrations are displayed continuously and the Auto-Eye flashes, if Auto-Read has been turned on. Wait until the result has stabilized or the Auto-Eye stops flashing. This may take 30-60 seconds or longer, depending on the sample. After the meter has locked on, the concentration result is shown in the large numeric display.

Continue with the next sample.

Note

Concentration results are displayed with two more digits behind the decimal point than the lowest standard concentration. If the result does not fit into the numeric display, a floating point is applied.
Chapter 6.0 Storage and Recall

The models 360 and 390 allow storage and recall of up to 100 samples. Each sample record contains a date and time stamp, the measured temperature, and the actual result. These records can be reviewed on the display or sent through the RS-232 port to a printer or a computer.

6.1 Data Storage

By default, the sample records are stored sequentially. However, the meter can be configured to allow the user to save data to user-specified memory locations. To turn on this feature, press the SETUP key, select Mem Locations, and press ENTER. The LOC icon is displayed next to the memory status bar to indicate that the feature is active.

Each sample record is linked to its own calibration data that is saved in a reserved part of the memory. This allows the system to maintain an organized data output structure even when samples are stored non-sequentially in memory. Up to twelve calibration sets are stored in any combination, invisible to the user. When the maximum number is exceeded, the oldest calibration set gets bumped out of the reserved memory and the samples linked to the bumped calibration data is redesignated as samples without calibration.

Notice that the STO icon is shown next to the memory status bar, when Auto-Read is turned on, indicating that the result can be saved by pressing the STORE key (for models with RS-232 interface only).

If the Mem Locations feature is not selected, press the STORE key to save the sample data sequentially. If the Mem Locations feature is selected, press the STORE key to show the next available memory location.
location in the lower right part of the display. Press the ENTER key to save the sample data in that location, or press the CE key to activate the numeric keypad and to save data in a user-specified memory location. Next, input the memory location desired and press the ENTER key. If the specified location is already being used, the input will be reset to 0. In this case, input another memory location and press ENTER. The STO icon turns off after the data is stored.

The Memory Status Bar informs the user about the current memory status. Each bar represents a 20% usage of the storage memory. When all 100 sample locations are filled, pressing the STORE key will generate an ERROR message.

6.2 Data Recall

Stored sample records may be reviewed when the system is in the Read mode. Press the RECALL/SEND key to enter the Recall mode.

The system searches for the highest memory location that is used and displays the location in the lower right part of the display. The location is called Sample. The data stored in that location is shown on the display. Use the Arrow keys to scroll through the filled memory locations. Empty locations are skipped.

To send the result records through the RS-232 interface, press the Recall/Send key again. The system goes into the Send mode and transmits the data stream (see 6.3. Data Output for more information). After the stored data have been printed or saved as a file on a computer, the sample records may be deleted to free up memory. To do so, press the CLEAR key. The message r \( \text{ \LARGE \boldsymbol{1} } \) appears in the large numeric display,
warning the user that data will be cleared. To confirm the removal of the sample records, press **CLEAR** or the **EXIT** key to keep the information.

### 6.3 Data Output

When sample records are sent through the RS-232 port, the data stream is preceded with a header containing the corresponding calibration information. This allows the user to re-evaluate any result at a later time, if necessary.

**Table 9: Output Header Information**

<table>
<thead>
<tr>
<th>Mode Description</th>
<th>pH</th>
<th>mV</th>
<th>Relative mV</th>
<th>Conc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date and Time Stamp</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Standard Values</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>mV Value for each Standard</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Temperature for each Standard*</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>E₀ or mV Offset</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Slope for each regression</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

* Based on the selected unit, °C or °F.
To print the data, use the small and lightweight Beckman Coulter 24-column impact printer. The printer is supplied with re-chargeable batteries, an AC adapter, and a roll of paper. The RS-232 cable (P/N 511313) must be ordered separately to connect the printer to the meter. Other commercially available printers that feature a serial port may be used.

<table>
<thead>
<tr>
<th>Standard Buffers</th>
<th>22 Oct 1998 16:30</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: pH 4.00</td>
<td>mV 176.9</td>
</tr>
<tr>
<td>Offset (Eo)</td>
<td>0.0 mV</td>
</tr>
<tr>
<td>Slope 1-2</td>
<td>98.2 %</td>
</tr>
<tr>
<td>2: pH 7.00</td>
<td>mV 0.0</td>
</tr>
<tr>
<td>Offset (Eo)</td>
<td>0.2 mV</td>
</tr>
<tr>
<td>Slope 2-3</td>
<td>97.8 %</td>
</tr>
<tr>
<td>3: pH 10.01</td>
<td>mV -176.9</td>
</tr>
</tbody>
</table>

Sample 1
22 Oct 1998 16:52
pH 7.432 25.4 C

Sample 2
22 Oct 1998 16:54
pH 5.567 25.5 C

Sample 3
22 Oct 1998 16:55
pH 9.701 25.5 C

--- CALIBRATION -------

Figure 30 Data Output

The data stream that is sent through the RS-232 port consists of pure ASCII text. Each line is terminated with a CR/LF (Carriage Return / Line Feed). The data can be easily captured on a computer using commercially available data communication programs. One of these programs is Hyperterminal, which is supplied with Windows 95/98/NT.
6.4 RS-232 Port

The RS-232 port on the meter has a 9-pin female DIN connector. To connect the meter to a serial port printer, use the RS-232 cable with a 25-pin male connector (P/N 511313) at the opposite end. To connect to a computer, use the RS-232 cable with a 9-pin female connector (P/N 511312).

The communication parameters are set as follows and cannot be changed:

- **Baud Rate**: 2400 bps
- **Parity**: None
- **Data Bits**: 8
- **Stop Bits**: 1
- **Handshaking**: Xon, Xoff
Appendix A  AC and Battery Power

The Φ300 Series benchtop pH Meters are powered by either AC or batteries. Use only the AC adapter supplied by Beckman. Before using the adapter, check the voltage specified on the label to verify compatibility with the voltage in your area: 120VAC or 240 VAC. A three-wire grounded outlet is recommended.

Battery Power

All meters are battery-powered and ship with four 1.5V Alkaline batteries (C cells) installed. Fully charged batteries allow for more than 500 hours of continuous operation. The battery icon on the display indicates that the meter is running on battery power. When the low battery icon appears, the meter can still be operated for another 10 hours. However, we strongly recommend replacing the batteries at this time. See Appendix D for the part number.

The system features automatic power shut-off when it is operated on batteries. If Auto-Read is turned on and no key is pressed for 60 to 90 minutes, the auto shut-off feature turns the meter off to preserve its batteries. If Auto-Read is turned off and no key is pressed for 9.5 to 10.5 hours, the auto shut-off feature turns the meter off to preserve its batteries.

Battery Replacement

CAUTION

The following procedure should be performed only by qualified personnel.

Low battery voltage is indicated by the battery status indicator on the display. Replace the batteries whenever low voltage is indicated on the display or if the display is blank when the meter is turned on.

To replace the batteries:

1. Turn the meter off and disconnect all electrodes.
2. Turn the meter upside down.
3. Use a screwdriver to unscrew the screws located at the base of the meter.
4. Carefully remove the battery cover.
5. Remove the old batteries.
6. Check the (+) and (-) markings in the battery compartment and on the new batteries. Insert the new batteries as indicated.
NOTE

Be careful not to touch the contacts on the battery or the battery terminals in the meter.

7. Replace the cover and secure by tightening the screw.

AC Power

Alternatively, the meters can be powered by a 9 Volts, 100mA AC adapter. The AC adapter is supplied with the meter. When the meter is operating on battery power, it will shut itself off when connecting it to the power jack. Press the power key 1 to resume normal operation. When the AC adapter is connected, no battery icons are displayed.
Appendix B  Troubleshooting

If difficulties are encountered while measuring pH or millivolts, the source of the difficulty could be any one of the several components that make up the pH measuring system: the electrode, cable, pH meter, buffers, the solution under test, or operator error. The simplest method for determining which of the components is faulty is to replace them, one at a time, with known-good components until the problem is resolved. If known-good components are not available, it is still possible to determine the source of the problem by carrying out the troubleshooting procedures that follow below.

1. Disconnect electrode cable(s) from meter. Turn the meter on and press READ. If there is no display, replace batteries using the instructions on the previous pages. If the meter still is inoperative, call the Repair Hot Line.

2. Remove the pH electrode. Insert one end of a paper clip into the small hole in the center of the “pH/ISE” input connector. Hold the other end of the clip to the inside barrel of the same connector, as shown.

3. The display should lock at pH 7.00. If meter passes this test, go to step 4. If meter fails, call the Repair Hot Line.

![Diagram of Test for open circuit in instruments pH/ISE BNC connector.](image)
4. Reconnect pH electrode cable to “pH/ISE” input connector. Insert one end of a paper clip into the small hole in the center of the electrode connector. Hold the other end of the clip to the inside barrel of the same connector, as shown.

![Paper Clip](image)

Figure 32 Test for open circuit in detached cable.

5. The display should lock at pH 7.00. Press READ then remove paper clip. The reading should drift. If meter passes this test, go to step 6. If meter fails, call the Electrochemistry Applications Hot Line.

6. Reconnect pH electrode(s). Immerse electrode(s) in pH 4 buffer and perform one-point standardization. Then immerse electrode(s) in pH 10 buffer and take pH reading. At 25°C, the reading should be between 9.7 and 10.1 pH. If the test passes, the pH meter, cable, and electrode(s) are functioning properly. If the test fails, the pH electrode(s) are faulty and must be rejuvenated or replaced. The electrode rejuvenation procedure is provided in the electrode instruction sheet. After rejuvenation, retest using the instructions in step 6.

United States and Canada
Repair Hot Line: 1-800-662-6217
Electrochemistry Applications Hot Line: 1-800-854-8067

Outside the United States and Canada, contact your local subsidiary or the dealer from whom you purchased the meter.
Table 10: Error Codes

<table>
<thead>
<tr>
<th>Display</th>
<th>Problem</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERROR01</td>
<td>pH reading is out of range.</td>
<td>Recalibrate with 2-point pH calibration. Make sure that pH is within specification.</td>
</tr>
<tr>
<td>ERROR02</td>
<td>Temperature reading is out of range.</td>
<td>Make sure that temperature of solution is within specification.</td>
</tr>
<tr>
<td>ERROR03</td>
<td>mV reading is out of range.</td>
<td>Make sure that measured mV is within specification.</td>
</tr>
<tr>
<td>ERROR04</td>
<td>Concentration is out of range.</td>
<td>Make sure that concentration is within specification.</td>
</tr>
<tr>
<td>ERROR10</td>
<td>Memory full</td>
<td>Clear memory.</td>
</tr>
<tr>
<td>ERROR11</td>
<td>Invalid date</td>
<td>Enter valid date.</td>
</tr>
<tr>
<td>ERROR12</td>
<td>Points exceed maximum calibration</td>
<td>Press EXIT to leave calibration mode, or re-do calibration.</td>
</tr>
<tr>
<td></td>
<td>Slope is too low or too high (not within 90-110%)</td>
<td>Use fresh buffers. Change electrode</td>
</tr>
</tbody>
</table>
## Appendix C Specifications

<table>
<thead>
<tr>
<th>Models</th>
<th>Hand-Held Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>φ340</td>
</tr>
<tr>
<td>pH and Temperature</td>
<td>✓</td>
</tr>
<tr>
<td>Millivolt and Relative Millivolt</td>
<td>✓</td>
</tr>
<tr>
<td>RS-232 Interface</td>
<td>✓</td>
</tr>
<tr>
<td><strong>ISE (Concentration)</strong></td>
<td>✓</td>
</tr>
<tr>
<td>pH Range</td>
<td>0 to 16 pH</td>
</tr>
<tr>
<td>Resolution</td>
<td>N/A</td>
</tr>
<tr>
<td>Relative Accuracy</td>
<td>N/A</td>
</tr>
<tr>
<td>mV Range</td>
<td>± 0.2 mV</td>
</tr>
<tr>
<td>Resolution</td>
<td>N/A</td>
</tr>
<tr>
<td>Accuracy</td>
<td>N/A</td>
</tr>
<tr>
<td>Temp Range</td>
<td>-5°C to 105°C</td>
</tr>
<tr>
<td>Resolution</td>
<td>N/A</td>
</tr>
<tr>
<td>Accuracy</td>
<td>N/A</td>
</tr>
<tr>
<td>Conc Range</td>
<td>0-1,999 mS</td>
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<tr>
<td>Resolution</td>
<td>N/A</td>
</tr>
<tr>
<td>Accuracy</td>
<td>N/A</td>
</tr>
<tr>
<td>Concentration Mode</td>
<td>N/A</td>
</tr>
<tr>
<td>Automatic Temperature Compensation (ATC)</td>
<td>Over entire range</td>
</tr>
<tr>
<td>Lock onto Stable Readings with Auto-Read™</td>
<td>Yes</td>
</tr>
<tr>
<td>Stored Buffers automatically recognized with Auto-Find™</td>
<td>1.68, 4.00, 7.00, 10.01 and 12.45 pH</td>
</tr>
<tr>
<td>Custom Buffers</td>
<td>N/A</td>
</tr>
<tr>
<td>Calibration Points (pH)</td>
<td>2</td>
</tr>
<tr>
<td>Calibration Points (Concentration)</td>
<td>N/A</td>
</tr>
<tr>
<td>Simultaneous Display of Results and Temperature</td>
<td>Yes</td>
</tr>
<tr>
<td>Setup Mode</td>
<td>N/A</td>
</tr>
<tr>
<td>°C/°F Selection</td>
<td>N/A</td>
</tr>
<tr>
<td>Cont. Display of Standards</td>
<td>N/A</td>
</tr>
<tr>
<td>Audible Support/Alarm</td>
<td>N/A</td>
</tr>
<tr>
<td>Review of mV, E° and Slope</td>
<td>N/A</td>
</tr>
<tr>
<td>Re-Calibration Alert</td>
<td>N/A</td>
</tr>
<tr>
<td>Numeric Keys/Input</td>
<td>N/A</td>
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<tr>
<td>RS-232 Interface</td>
<td>N/A</td>
</tr>
<tr>
<td>Storage Locations</td>
<td>N/A</td>
</tr>
<tr>
<td>Selectable Locations</td>
<td>N/A</td>
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<tr>
<td>Date and Time Stamp</td>
<td>N/A</td>
</tr>
<tr>
<td>Storage/Link of Standards</td>
<td>N/A</td>
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<tr>
<td>Standards Header on Printout</td>
<td>N/A</td>
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<tr>
<td>Display</td>
<td>LCD w/ Status and Help Icons</td>
</tr>
<tr>
<td>Auto Shut-Off with Batteries</td>
<td>Yes</td>
</tr>
<tr>
<td>Battery-Operated</td>
<td>Yes</td>
</tr>
<tr>
<td>AC Line Operation</td>
<td>Standard</td>
</tr>
</tbody>
</table>
Environmental Specifications

For Indoor Use               All models
Temperature, ambient         +5 to 40°C
Humidity                     Maximum relative humidity 80% for
                             temperatures up to 31°C, decreasing
                             linearly to 50% relative humidity at 40°C.
Altitude                     Up to 2000m
Installation Catagories      I or II
Pollution Degree             1 or 2

Width                        15.3 cm (6.00 in.)
Height                       8.9 cm (3.50 in.)
Depth                        23.5 cm (9.25 in.)
Weight (including Batteries) 770 g (27 oz)
# Appendix D  Accessories and Replacement Parts

## Kensington Lock

**P/N 511306**

Protects the meters against theft by securing the system to a fixed object. The Ф-300 Series instruments have been designed with a Kensington lock hole.

## Flexible Arm Electrode Holder

**P/N 511311**

This holder adjusts to any position and rotates around the base. It can hold four electrodes and one temperature probe (ATC).

## Plain-Paper Impact Printer, Battery and AC Line Operated

**P/N 511317 120V (US Plug)**

**P/N 511318 240V (Euro Plug)**

This small, lightweight 40-column impact dot-matrix printer connects to the RS-232 interface of the pH meter. The printer is powered by an AC adapter or internal rechargeable batteries and is therefore suited for both laboratory and field use.

## BNC Adapters Pin to BNC

**P/N 592367**

Adapts BNC connector on Ф Series meters to accommodate electrodes with pin connector.

## U.S. Standard to BNC

**P/N 592362**

Adapts BNC connector on Ф Series meters to accommodate electrodes with U.S. Standard connector.
<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P/N 511325</td>
<td>U.S. Standard &amp; Pin to BNC</td>
</tr>
<tr>
<td></td>
<td>Adapts BNC connector on Φ Series meters to accommodate both an indicating (U.S. Standard) and a reference (Pin) electrode.</td>
</tr>
<tr>
<td>P/N 511312</td>
<td>RS-232 Cable (Computer)</td>
</tr>
<tr>
<td>P/N 511313</td>
<td>RS-232 Cable (Printer)</td>
</tr>
<tr>
<td>P/N 93583</td>
<td>Recorder Cable, 1.5 m (5 ft.)</td>
</tr>
<tr>
<td>P/N 14880</td>
<td>Electrode Holder Replacement, 5 inch</td>
</tr>
<tr>
<td>P/N 599199</td>
<td>AC Adapter, 120V (US Plug), Φ 200 and 300 Series</td>
</tr>
<tr>
<td>P/N 140632</td>
<td>AC Adapter, 240V (Euro Plug), Φ 200 and 300 Series</td>
</tr>
<tr>
<td>P/N 140633</td>
<td>AC Adapter, 240V (UK Plug), Φ 200 and 300 Series</td>
</tr>
<tr>
<td>P/N 511330</td>
<td>Batteries, 1.5V Alkaline (C-Cell), Φ 300 Series Benchtop Meters, 4-pack</td>
</tr>
</tbody>
</table>
Appendix E  Electrodes and Supplies

**FUTURA™ Gel-Filled Combination pH Electrodes**
- P/N 511050  Epoxy, AgCl, 12 x 130 mm
- P/N 511052  Epoxy, AgCl, 12 x 130 mm, with ATC
- P/N 511053  Epoxy, AgCl, 12 x 130 mm, with ATC (Waterproof)
- P/N 511054  Epoxy, AgCl, 6.5 x 190 mm
- P/N 511055  Epoxy, AgCl, 9.5 x 225 mm

**FUTURA™ Refillable Combination pH Electrodes**
- P/N 511060  Epoxy, AgCl, 12 x 130 mm
- P/N 511064  Epoxy, AgCl, 12 x 120 mm, Rugged Bulb
- P/N 511062  Epoxy, AgCl, 7 x 245 mm
- P/N 511067  Epoxy, AgCl, 9.5 x 250 mm
- P/N 511066  Epoxy, AgCl, 12 x 120 mm, Flat Bulb
- P/N 511061  Glass, AgCl, 12 x 125 mm
- P/N 511065  Glass, AgCl, 12 x 120 mm, Rugged Bulb
- P/N 511063  Glass, AgCl, 5 x 225 mm
- P/N 511068  Glass, AgCl, 10 x 200 mm

**STAR™ Combination pH Electrodes**
- P/N 511070  Epoxy, AgCl, 12 x 130 mm
- P/N 511071  Glass, AgCl, 12 x 125 mm

**FUTURA™ Refillable Combination pH Electrodes**
- P/N 511080  Epoxy, Calomel, 12 x 130 mm
- P/N 511084  Epoxy, Calomel, 7 x 245 mm
- P/N 511081  Glass, Calomel, 12 x 125 mm
- P/N 511085  Glass, Calomel, 10 x 225 mm
- P/N 511083  Glass, Calomel, 5 x 225 mm
- P/N 511082  Glass, Calomel, 5 x 178 mm

**FUTURA™ Indicating pH Electrodes**
- P/N 511090  Spherical Bulb, 12 x 130
- P/N 511091  Rugged Bulb, 12 x 130 mm

**FUTURA™ Reference pH Electrodes**
- P/N 511100  Calomel, Quartz Fiber, 12 x 130 mm
- P/N 511101  Calomel, Ceramic Frit, 12 x 130 mm
- P/N 511102  Calomel, Inverted Sleeve, 22 x 130 mm
- P/N 511103  AgCl, Quartz Fiber, 12 x 130 mm
- P/N 511104  AgCl, Inverted Sleeve, 22 x 130 mm
- P/N 511105  AgCl, Double Junction, 12 x 150 mm

**pHRESH Refreshable Combination pH Electrodes**
- P/N 511110  Epoxy, AgCl, 12 x 130 mm
- P/N 511112  Epoxy, AgCl, 12 x 130 mm, with ATC
- P/N 511113  Epoxy, AgCl, 12 x 130 mm, with ATC (Waterproof)
- P/N 511111  Glass, AgCl, 12 x 125 mm
Series pH Meters

Electrode Cables

- P/N 511120 Oxygen-Reduction (ORP) Electrode
  Platinum Electrode, 12 x 150 mm
- P/N 511121 Silver Billet Electrode
  Glass, 12 x 128 mm, with Pin Connector

Temperature Probe (ATC)

- P/N 598115 Epoxy, Mini phone jack

Electrode

- P/N 511332 BNC Connector, 1 m (3.3 ft.)
- P/N 511326 BNC Connector, Waterproof, 1 m (3.3 ft.)
- P/N 511333 BNC Connector, 2 m (6.6 ft.)
- P/N 511327 BNC Connector, Waterproof, 2 m (6.6 ft.)
- P/N 511334 BNC Connector, 6 m (19.7 ft.)
- P/N 598976 US Standard and Pin Connectors, Combination, 1 m (3.3 ft.)
- P/N 598979 US Standard Connector, Indicating, 1 m (3.3 ft.)
- P/N 598982 Pin Connector, Reference, 1 m (3.3 ft.)
- P/N 511322 BNC Cable Extension, 2 m (6.6 ft.)
- P/N 511323 BNC Cable Extension, 5 m (16.4 ft.)

Filling Solutions

- P/N 566468 Saturated KCl (Calomel), 4 x 100 mL
- P/N 566467 4M KCl saturated w/ AgCl (AgCl), 4 x 100 mL
- P/N 598943 1M KCl Saturated w/ AgCl (STAR), 4 x 100 mL
- P/N 566576 Storage and Soaking Solution, 4 x 100 mL
### Appendix F  ISE Electrodes and Supplies

#### Ion Selective Electrodes
- **P/N 511130**  Ammonia, Combination, Gas-Sensing
- **P/N 511140**  Chloride, Combination, Solid State
- **P/N 511141**  Fluoride, Combination, Solid State
- **P/N 511142**  Ammonium, Combination, Polymer Membrane
- **P/N 511143**  Nitrate, Combination, Polymer Membrane

#### ISE Filling Solutions
- **P/N 511175**  Fluoride, 4M KCl, 125 mL
- **P/N 511176**  Chloride, 1M KNO₃, 125 mL
- **P/N 511177**  Ammonium, 0.1M NaCl, 125 mL
- **P/N 511178**  Nitrate, 0.1M (NH₄)₂SO₄, 125 mL
- **P/N 511179**  Ammonia, 0.05M NH₄Cl, 125 mL

#### ISE Standard Solutions
- **P/N 511180**  Chloride, 1000 ppm NaCl, 475 mL
- **P/N 511181**  Fluoride, 1000 ppm NaF, 475 mL
- **P/N 511182**  Ammonium, 1000 ppm NH₄Cl, 475 mL
- **P/N 511183**  Nitrate, 1000 ppm NaNO₃, 475 mL
- **P/N 511184**  Ammonia, 1000 ppm NH₄Cl, 475 mL

#### Ion Strength Adjustment Buffers (ISAB)
- **P/N 511190**  Chloride, 5M NaNO₃, 475 mL
- **P/N 511191**  Fluoride, One gallon (Total ISAB)
- **P/N 511192**  Ammonium, 5M NaCl, 475 mL
- **P/N 511193**  Nitrate, 2M (NH₄)₂SO₄, 475 mL
- **P/N 511194**  Ammonia, 10M NaOH, 475 mL
- **P/N 511131**  Membrane Replacement Kit (Ammonia)