

445 pH Meter

Instruction Manual

This manual contains complete instructions for setting up and using the 445 pH meter. Applications information is also available.

The information contained in this manual was correct at the time of going to print. However, we continue to improve products and reserve the right to change specifications, equipment and maintenance procedures at any time.

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The power supply unit is classed as IEC Class II equipment (equipment providing an adequate degree of protection against electric shocks, in which additional safety precautions, for example, double or reinforced insulation, are included). The 445 is intended for use by persons knowledgeable in safe laboratory practices. If the 445 is not used in accordance with these instructions for use, the protection provided by the equipment may be impaired.



The 445 is suitable for direct current only.

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

There are no user replaceable parts in the 445 or power supply unit. Do not remove the covers.

Contents

1 Set Up

1.1	<i>Unpacking and Installation</i>	4
1.2	<i>Input and Output Connections</i>	5
1.3	<i>Display and Controls</i>	5

2 Operation

2.1	<i>Calibrating a pH Electrode</i>	9
2.2	<i>Measuring Samples</i>	10
2.3	<i>Automatic Endpoint (Auto Read)</i>	10
2.4	<i>Changing the Calibration Buffer Settings</i>	10
2.5	<i>mV Measurements</i>	11
2.5.1	<i>Absolute mV</i>	12
2.5.2	<i>Relative mV</i>	12
2.6	<i>Temperature Measurements</i>	12
2.6.1	<i>Manual Temperature Compensation</i>	13
2.7	<i>Printer</i>	14
2.8	<i>Changing the Resolution</i>	14
2.9	<i>Memory</i>	15
2.10	<i>Setting Time and Date</i>	15
2.11	<i>Setting the Timer</i>	16
2.12	<i>Setting High/Low Limits</i>	17
2.13	<i>Interfacing via the RS232 Output</i>	17
2.14	<i>Chart Recorder</i>	18
2.15	<i>Karl Fischer Titrations</i>	19
2.16	<i>Replacing the Printer Paper</i>	19

Contents (cont)

3 Support Information

3.1 Basic Theory 21

3.2 Operating Hints 22

3.3 Maintenance 23

 3.3.1 Meter Maintenance 23

 3.3.2 Electrode Maintenance 23

3.4 Problem Solving 24

 3.4.1 Meter Test and Reset 24

 3.4.2 Meter Error Codes 25

 3.4.3 Electrode Problem Solving 26

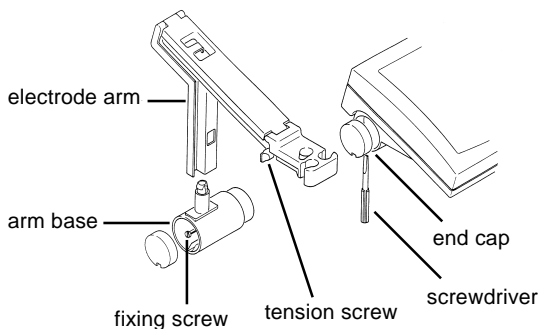
3.5 Specifications 28

Consumables and Accessories inside rear cover

Warranty inside rear cover

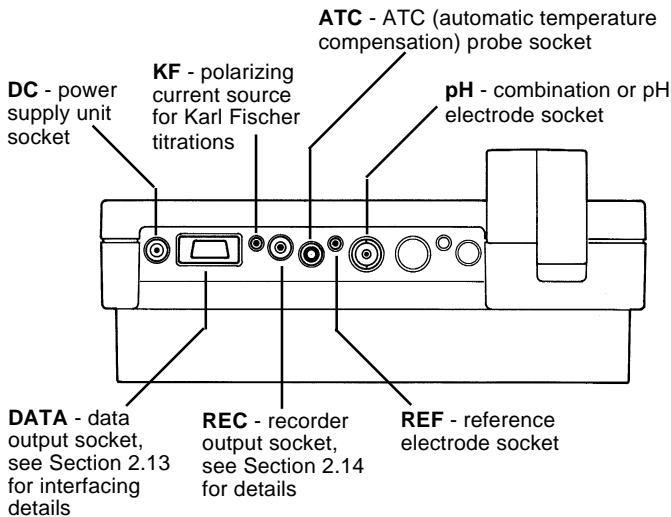
1.1 Unpacking and Installation

1. The main carton will contain the following:
 - Meter with a shorting (test) clip in the pH socket
 - Meter Dust Cover
 - Power Supply
 - Printer Paper (3 rolls)
 - This Instruction Manual
 - Memo Cards, English, French, German, Italian, Spanish
 - Warranty Card
 - Calibration Certificate
2. If you ordered the meter with an electrode, electrode arm and accessories, the top tray of the main carton will contain these items. Refer to the accessories packing sheet for a list of the additional components.
3. To attach the electrode arm to the pH meter:
 - a. The electrode arm can be attached to the left or right-hand side. Using the screwdriver supplied remove the appropriate end cap from the pH meter.
 - b. Slide the arm base into the recess and tighten the fixing screw. Replace the end cap.
 - c. Fit the electrode arm onto the post. Adjust the tension screw as required.



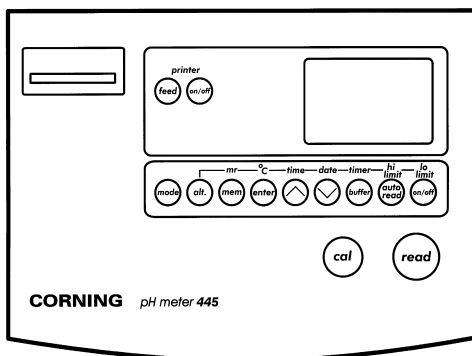
4. Fill in and return the warranty card. For your record make a note of the serial number, date of purchase and supplier on the inside front cover of this manual.

1.2 Input and Output Connections



1. Disconnect the shorting clip from the **pH** socket and retain it by clipping it over the socket. Connect the electrode. If you are using an electrode incorporating **ATC** connect the other lead to the **ATC** socket.
2. If you are using a separate ATC probe connect it to the **ATC** socket.
3. Connect the power supply unit to the **DC** socket.

1.3 Display and Controls



1.3 Display and Controls (cont)

Primary Functions

printer



Turns the printer on or off, and feeds the printer paper.



Selects pH, mV or relative mV mode.



Selects secondary function (i.e function shown above controls).



Enter results into memory. Up to ten results can be stored and recalled from memory.



Enters value displayed, e.g. when required date is displayed.



Increases displayed value; used when setting date, time, hi/lo limits etc. Also changes display resolution.



Decreases displayed value; used when setting date, time, hi/lo limits etc. Also changes display resolution.



Selects calibration buffers.



Selects automatic endpoint detection.



Turns the display off, and places the meter in standby mode. Wakes the meter up.



Starts a calibration sequence in pH and relative mV modes.



Starts sample measurement in all modes. Press again to freeze display in manual endpoint mode.

1.3 Display and Controls (cont)

Secondary Functions

Press **alt.** to select these functions.

mr
 Recalls results from memory.

°C
 Selects manual temperature compensation.

time
 Allows time to be set or changed.

date
 Allows date to be set or changed.

timer
 Allows timer interval to be set or changed.

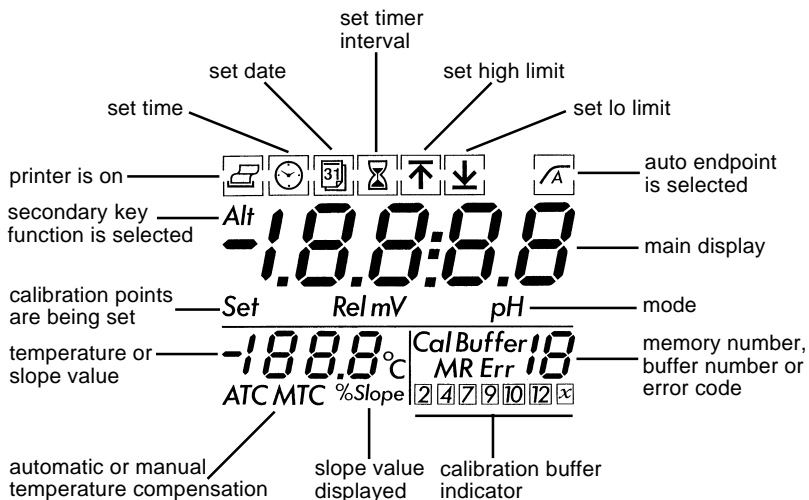
**hi
limit**
 Allows high limit for pH process control to be set or changed.

**lo
limit**
 Allows low limit for pH process control to be set or changed.

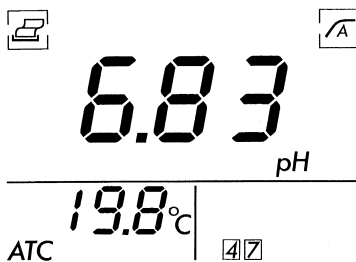
The **alt.** control can also be used with **cal** to recall cal data.

Press **alt.** **cal** Allows time, date and % slope value of last calibration to be recalled to the printer.



1.3 Display and Controls (cont)




Example pH Reading




2.1 *Calibrating a pH Electrode*

You can recall the time, date and % slope value (if 2- or 3-point cal) of the last calibration to the printer by pressing  

If you are using an ATC probe (or an electrode incorporating ATC), the buffer temperature is shown. If you are not using an ATC probe, enter the temperature of the buffer manually (see Section 2.6.1).

If you are using auto endpoint the display freezes automatically when a stable endpoint is reached (see Section 2.3). To manually freeze the display press 

1 point calibration


Place the tip of the electrode in a calibration buffer and press 

At the measurement endpoint the appropriate buffer indicator appears on the display.


If you are using a standard buffer the display updates to the temperature corrected value (see Section 2.6).

To return to sample measurement press 


2 point calibration

To continue with a 2 point calibration press 


Place the tip of the electrode in the next calibration buffer and continue as before. When the display freezes the electrode slope value will be displayed in place of the temperature value.

To return to sample measurement press 

3 point calibration


To continue with a 3 point calibration press 


Place the tip of the electrode in the third calibration buffer and continue as before. When the display freezes the electrode slope value will be displayed in place of the temperature value.

Press  to return to sample measurement.

2.2 Measuring Samples


NOTE Good laboratory practice dictates that electrodes should be calibrated at least daily.


Place the tip of the electrode in the sample and press  to start the measurement. The decimal point will be flashing whenever the electrode is reading.


If you are using the '**auto read**' function the display freezes when a stable endpoint is reached (see Section 2.3). To manually freeze the display when the reading is stable, press .


2.3 Automatic Endpoint (Auto Read)

The '**auto read**' function checks the electrode output for stability and automatically freezes the display when the reading appears stable. It can be used during calibration and routine measurements.

Turn auto endpoint on by pressing .

The auto endpoint indicator  will appear at the top right of the meter display. While the meter is reading, both the 'A' and the decimal will flash. When the endpoint is reached, both will stop flashing.

To start another reading press .

To cancel auto endpoint press  again.

2.4 Changing the Calibration Buffer Settings

The default settings in the meter are for 4.00, 7.00 and 10.01 buffers. The Model 445 will allow you to change these settings to any buffer values that you wish to work with.

2.4 Changing the Calibration Buffer Settings (cont)

The buffers cannot be changed while the meter is reading. If the decimal is flashing (meter reading) press the **read** key to freeze the display.

To review or change the buffers currently in memory press **buffer**

The meter will indicate that you are looking at buffer #1 and the value will be flashing indicating that it can be changed.

Change the displayed value using **^** **v** and press **enter**

The second buffer is then displayed. Change as before and repeat for the third buffer.

Press **read** to return to the pH display.

For reasons of automatic recognition, buffers cannot be set closer than 2 pH units from each other. You also cannot move one buffer value past another. For changes on the low end, change buffer #1 first and for changes on the high end change buffer #3 first. During calibration the meter will let you calibrate on all of the three buffers in memory. It does not matter which buffer # you calibrate on first.

The standard buffers that this meter will recognize and temperature compensate are as follows:

buffer	1.68	4.00	4.01	6.86	7.00	9.18	9.21	10.01	non std.
indicator	2	4	4	7	7	9	9	10	X

2.5 mV Measurements

The millivolt capability of pH meters can be used to determine the actual slope of pH electrodes but is most frequently used for doing potentiometric readings or titrations with Platinum Oxidation-Reduction electrodes.

2

2.5 *mV Measurements (cont)*

2.5.1 *Absolute mV*

Press **mode** until mV shows at the top of the display.

Put the tip of the electrode in the sample and press **read**. The meter will display absolute millivolts.

When the reading is stable, press **read** to freeze the display.

2.5.2 *Relative mV*

Press **mode** until Rel mV shows at the top of the display.

Put the tip of the electrode in the reference solution and press **cal**. The meter will be displaying absolute millivolts.

When the reading is stable, press **read** to freeze the display.

The display will update to a relative mV value 0.0 mV.

Put electrode in test sample and press **read**. The meter will show the change in mV from 0.0 mV.

2.6 *Temperature Measurements*

To measure temperature you must be using an ATC probe or the 3-in-1 Combination electrode which includes an ATC probe. If you do not have an ATC probe the temperature will default to 25°C. If an ATC is in use the display will show ATC. If not the display will show MTC and 25°C (or the manually set temperature).

The Model 445 uses the temperature value to correct the electrode slope for temperature (see buffer table).

2.6 Temperature Measurements (cont)


Buffer Temperature Correction Table

If you use standard buffers (listed below) the 445 automatically corrects for temperature using the values shown in the table.



	1.68	4.00	4.01	6.86	7.00	9.18	9.21	10.01
0°C	1.67	4.00	4.01	6.98	7.12	9.46	9.52	10.32
5°C	1.67	4.00	4.01	6.95	7.09	9.40	9.45	10.25
10°C	1.67	4.00	4.00	6.92	7.06	9.33	9.38	10.18
15°C	1.67	4.00	4.00	6.90	7.04	9.28	9.32	10.12
20°C	1.68	4.00	4.00	6.88	7.02	9.23	9.26	10.06
25°C	1.68	4.00	4.01	6.86	7.00	9.18	9.21	10.01
30°C	1.68	4.01	4.01	6.86	6.99	9.14	9.16	9.97
35°C	1.69	4.02	4.02	6.84	6.98	9.10	9.11	9.93
40°C	1.69	4.03	4.03	6.81	6.98	9.07	9.06	9.89
45°C	1.70	4.04	4.04	6.83	6.97	9.04	9.03	9.86
50°C	1.70	4.06	4.06	6.83	6.97	9.01	8.99	9.83




2.6.1 Manual Temperature Compensation

The Model 445 will perform Automatic Temperature Compensation when you have an ATC probe (see Section 2.6) or the user can adjust temperature manually when no ATC probe is in use.

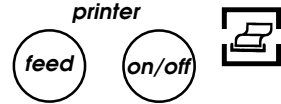
The temperature cannot be adjusted during sample measurement; press  to freeze the display.

When no ATC probe is connected the default temperature setting is 25°C. To change this value:

press   the display flashes showing that the temperature can be changed. If an ATC probe is connected the temperature cannot be manually adjusted - the alarm will sound to remind you.

change the displayed value using   and press 


2.7 Printer





When the printer is on, it will:


- Print your chosen: calibration buffers; date and time; high/low limits; timer interval.
- Print every calibration or sample endpoint value (manual or auto endpoint).
- Print slope values during a 2- or 3-point calibration.
- Print the date, time and % slope value of the last calibration when recalled.
- Print results stored in memory when recalled (see Section 2.9).
- Print at preset intervals if you use the timer function.
- Show high/low limits are exceeded if they have been set.

2.8 Changing the Resolution

The resolution in pH can be changed between one and two decimal places. Start by pressing  to freeze the display.

Use the  to change resolution from 0.0 to 0.00

Use the  to change resolution from 0.00 to 0.0

Press  to resume normal operation.


2.9 Memory





Up to 10 results can be stored in the 445.

Before a result can be stored it must have reached a stable endpoint, using either manual or auto endpoint.

To store a result in memory:

press  the result is stored and the display shows **M 1**.

To recall a result from memory:

press   to recall each stored result in turn. The display shows **MR** and the appropriate result number.

To cancel the memory:


press   until the display shows **M C** then press 

2.10 Setting Time and Date








Time and date are shown on printouts.

The date and time cannot be set during sample measurement;

press  to freeze the display.

To set the time:



press   the display flashes showing that the time can be changed




change the displayed hours using   and press 

Repeat for minutes.

2.10 Setting Time and Date (cont)

To set the date:

press   the display flashes showing that the day can be changed

change the displayed day using   and press 

Repeat for month, and then the year


NOTE For US date format, set month, then day, then year.

2.11 Setting the Timer








Timed interval measurements are used for long or short term monitoring of a sample in pH, mV or relative mV mode. The sample is measured continuously, and at the time interval set the display freezes momentarily, the printer prints out the result and the data is sent to the **DATA** socket. The timer interval can be set from 1 to 59 seconds, or from 1 to 99 minutes. (If the interval is set to less than 16 seconds, or if the printer is off, the information is not printed, but it is sent to the **DATA** socket.)


The timer cannot be set during sample measurement; press

 to freeze the display.

To set the timer:

press   the display flashes showing that the timer can be changed

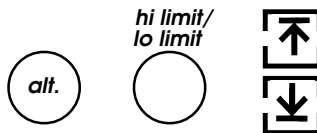
change the displayed value using   and press 

To start the timed interval measurement press 

The printer prints the timer interval selected.


To cancel the timer, press  to freeze the display and reset the interval to 00.00

2.12 Setting High/Low Limits


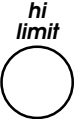





High and low limits can be entered in pH mode for monitoring sample measurements. If a measurement is outside these limits, an alarm sounds, and the relevant indicator flashes. The information is also sent to the printer and to the **DATA** socket. The default values are High 19.99 and Low -2.00.


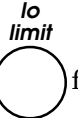
The limits cannot be set during sample measurement; press

 to freeze the display.

To set the high limit:

press   the display flashes showing that the high limit can be changed

change the displayed value using   and press 

Repeat using   for the low limit.

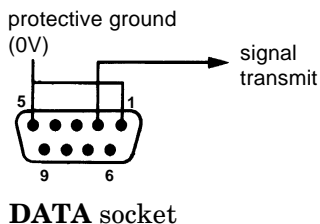
2.13 Interfacing via the RS232 Output

The Model 445 can transmit data in RS232C Serial format to compatible devices such as Serial Printers and computers. There is no handshake capability but data can be received and manipulated by most data acquisition software packages.

The cable required for connection to IBM compatible computers is part number 477758 and can be ordered from your distributor. The pin configuration of that connector and Model 445 output protocols are as follows:

2.13 Interfacing via the RS232 Output (cont)

Pin	Signal
1	device enable (link to pin 5)
2	RS232 Tx (signal transmit)
3	not used
4	not used
5	protective ground (0V)
6 - 9	not used



To enable the RS232 a link is required between pin 1 (device enable) and pin 5 (protective ground).

The data output will be identical to the data printed on the integral printer, except when the timer interval is set to less than 16 seconds. In this case, the information is presented in string format.

e.g. 00: 12:31 19.99pH 100.0'C or
00: 12:31 - 1999.9mV 100.0'C

The information will still be available to the external device even when the integral printer is switched off.

Type of communication - unidirectional
Baud rate - 1200
Data format - 1 start bit
8 data bits
2 stop bits
no parity

2.14 Chart Recorder



REC Socket Polarity

2.14 Chart Recorder (cont)

The **REC** socket (2.5 mm phone jack) provides a voltage proportional to the displayed reading in pH, mV and relative mV modes. The polarity of the output is the same as the polarity of the input signal.

Approximate Recorder Outputs

pH - Output follows display and provides approximately 60 mV output per pH unit. This value will vary with changes in electrode slope.


mV/relative mV - Output follows display, i.e. as display varies from -1999.9 to 1999.9 mV, output varies from -1999.9 to +1999.9 mV.

The recorder output is not available for temperature readings.

2.15 Karl Fischer Titrations

The **KF** socket on the back of the meter provides a constant 1 mA polarizing current. This output may be used to polarize metallic electrode pairs for Karl Fischer moisture determinations or other dead-stop titrations.

2.16 Replacing the Printer Paper

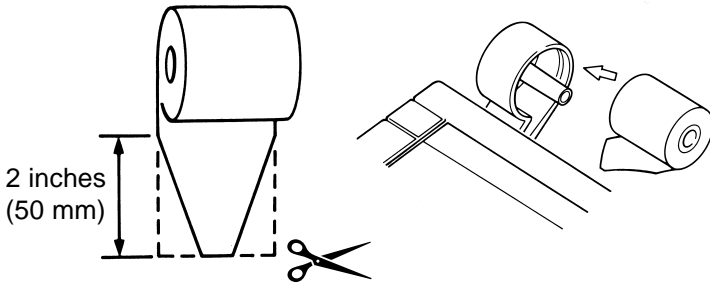
1. Press ^{printer} to remove the last piece of printer paper.
2. Remove the printer paper cover and discard the old paper roll core.

CAUTION Do not run the printer without a paper roll fitted as this may damage the printer head.

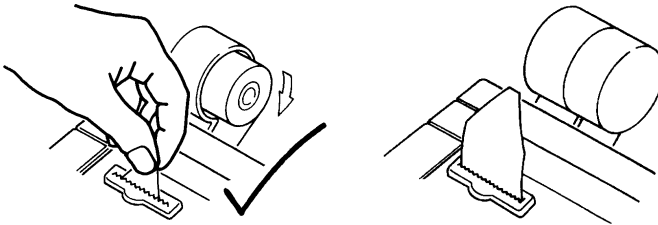
2

2.16 Replacing the Printer Paper (cont)

3. Cut the end of the new paper roll as shown and bend it slightly away from the curve of the paper.



4. Place the roll of paper, with the paper coming from the bottom of the roll, in the paper roll housing.
5. Turn the roll in the housing, checking to see that the end of the paper is entering the paper slot in the back of the 445.



6. Rotate the paper roll until the paper appears through the paper tearer in the front of the 445. Pull the end through - **do not** use the paper feed control - and tear it off.
7. Replace the printer paper cover.

NOTE In the event of a paper jam, disconnect the power supply unit, lift the paper cover out from the front of the 445, and pull the paper out with tweezers. Replace the paper cover with the cutting edge at the bottom. Reconnect the power supply unit.

3.1 Basic Theory

pH is the unit of measurement of the acidity or alkalinity of a solution, and is expressed as the negative logarithm of the hydrogen ion concentration:

$$\text{pH} = -\log[\text{H}^+]$$

pH 0 is very acidic, pH 14 is very alkaline and pH 7 is neutral.

For routine pH measurements a sensing electrode and a reference electrode or a combination electrode (both electrodes in one body) are used along with a meter capable of displaying the measurements.

The pH sensing electrode has an internal solution with a constant pH value, and develops a potential when placed in a solution. This is caused by the activity of the H^+ ions in the solution. The reference electrode has a defined, stable potential irrespective of the H^+ activity in the sample. The Model 445 measures and converts the resulting minute electrode voltages into a pH reading.

The response of a pH electrode (or its slope) is defined by the Nernst equation:

$$\text{Electrode response} = E_0 - \frac{2.3RT}{nF} \cdot \text{pH}$$

where: E_0 = a constant factor T = the temperature (Kelvin)
 R = the gas constant n = the ionic charge
 F = the Faraday constant

The theoretical slope for an electrode is 59.16 mV where the H^+ ionic charge (n) = 1 at 25°C (298K). This means that for a one unit change in pH the system will sense a change of 59.16 mV. The measurement of electrode slope is a good indication of electrode condition.

Temperature is also an important consideration when measuring pH. It affects the electrode slope. ATC probes are recommended so that the slope can be corrected for temperature. There are many other factors that affect pH.

Further information on pH theory and the factors that affect the ability to do accurate pH readings is included in 'Guide to pH Measurement'.

3.2 Operating Hints

This section gives some brief operating hints and good laboratory practices to help assure trouble free pH measurements.

1. New electrodes (or electrodes that have been in storage) should be conditioned in one inch (25 mm) of pH 7.0 or 4.0 buffer for several hours prior to their use. Make sure that the wetting cap has been removed from the tip of the electrode.
2. Always remove the wetting cap and fill hole plug during calibration and measurements. Replace the fill hole plug when done.
3. Calibrate the electrode daily. Though a one point calibration may be suitable for some applications, we recommend that a two point calibration (that brackets the expected pH range) be performed.
4. Be aware that if you are measuring hot or cold samples without the use of an ATC probe, the values displayed are not accurate. You should be calibrating and measuring at room temperature.
5. When transferring from one sample to another, always rinse the electrode with distilled water and blot dry. Handle the electrode carefully and do not use it as a stirring rod.
6. Do not use calibration buffers after the expiration date printed on the package. Keep the bottles tightly capped and stored according to the manufacturer's instructions. Never put used buffer back into the bottle of new buffer.
7. For small sample volumes, make sure that both the pH bulb and the reference junction are in contact with the sample.
8. Response time is a function of both the electrode and the solution. Some solutions have very fast response while others, particularly those with low ionic strength, may take several minutes.
9. Samples must be in solution (water). You cannot measure the pH of a dry sample.

Refer to the electrode manufacturer's instructions for proper electrode care and maintenance. See Section 3.3.2 for general electrode maintenance and Section 3.4.3 for problem solving.

3.3 Maintenance

3.3.1 Meter Maintenance

The Model 445 needs no maintenance except for an occasional wipe with a damp cloth. The front panel is made of polyester and is not affected by most solvents. Polyester is known to be affected by some organic solvents, including toluene, xylene and methyl-ethyl-ketone. It is good laboratory practice to wipe away any spillages as soon as they occur.

3.3.2 Electrode Maintenance

CAUTION Solutions used to clean electrodes must be handled with the care accorded to toxic or corrosive substances.

- Do not allow the reference chamber of the electrode to dry out. Always keep it filled with the proper fill solution.
- Formation of KCl salt at the tip and side of the electrode is normal and should be rinsed off with warm water.
- Leave the tip of the electrode in an inch (25 mm) of pH 7.0 or 4.0 buffer when it is not being used. Do not leave it in distilled water. For long term storage follow the electrode manufacturer's instructions.
- If the electrode slope is off or the electrode response has become sluggish or inaccurate, change the fill solution. If that does not improve the response then the pH sensing glass and the junction have probably become coated with some of the samples being tested.
- Test the junction for flow - rinse the tip of the electrode, blot dry and let the electrode hang in the air for 15 minutes. A proper flowing junction should have KCl salt crystals forming on it. If none appear, review the following suggestions for cleaning.

Protein contamination - soak the tip of the electrode for 1-2 hours in a solution of 10% Pepsin and water with enough Hydrochloric acid added to bring the pH of the solution to 1.0. Rinse the electrode and soak in pH 7.0 buffer until stable.

3.3 Maintenance (cont)

3.3.2 Electrode Maintenance (cont)

Oil contamination - Carefully clean the tip of the electrode using a cotton swab soaked with alcohol or acetone. The tip of Glass body electrodes can be put directly into organic cleaners but do not put plastic or epoxy body electrodes into organic solvents. Rinse the electrode and soak in pH 7.0 buffer until stable.

All others - Soak tip of the electrode in 0.1 M Hydrochloric acid for one hour. Rinse the electrode and soak in pH 7.0 buffer until stable.

3.4 Problem Solving

Most problems are caused by electrode faults rather than by the Model 445 but power fluctuations can corrupt calibration values being held in the meter memory.

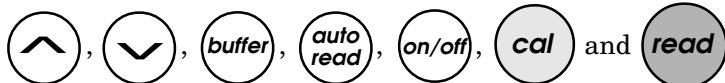
3.4.1 Meter Test and Reset

To assure that the meter memory and calibration points have not been corrupted by power fluctuations, perform the Meter Test and Reset as follows:

1. Disconnect the power plug from the back of the meter.
2. Press and hold **read** and reconnect the power plug. The display first shows the test sequence, with all segments showing, then displays an 01.

3. Release **read** Press **mode** and the display shows 02.

Press **alf.** the displays shows 03. Press **mem**, **enter**,





in turn and check that the display reads 04, 05, 06, 07, 08, 09, 10, 11, 12.

3.4 Problem Solving (cont)

3.4.1 Meter Test (cont)

printer



4. Press  and all segments will display.
5. Press  and the meter will return to normal operation.
6. Disconnect the electrode from the meter and install the shorting clip in the electrode socket. If the meter is operating properly it will display a stable pH value between 6.98 and 7.02 (or 0 ± 1 mV in the millivolt mode).

If the meter passes the above test the problem is electrode related. Refer to Section 3.4.3 for electrode troubleshooting.

If the meter fails the above test call the number on the back of this manual for warranty and service information.

3.4.2 Meter Error Codes

Error codes are designed to give the user information on electrode performance problems.

- E1** Electrode is not reading a value close enough to the first calibration buffer. Electrode needs maintenance.
- E2** pH Electrode is not giving a value within 0.5 pH of the second calibration buffer. Electrode needs maintenance.
-  or  Measurement is out of range of the display. The meter would display dashes if the electrode were not in a solution, the pH of the solution is not between 0.00 and 14.00 or if the fill solution in the electrode is low or wrong. Dashes in the temperature mode indicates that the ATC has failed.

3.4 *Problem Solving (cont)*

3.4.2 *Meter Error Codes (cont)*

Slope is a value that compares the actual slope determined by the calibration to the theoretical slope defined by the Nernst equation. This value is displayed as a percent of theoretical and is called electrode efficiency (see Section 3.1 for Basic Theory). Generally the slope value can be interpreted as follows:

95 - 105%	Everything is probably working fine.
90 - 95%	Electrode needs maintenance. Fresh fill solution and general cleaning.
85 - 90%	Stop and do full electrode maintenance now.
Below 85%	Will not calibrate. Do full electrode maintenance or replace the electrode.

Refer to the electrode manufacturer's instructions for full details on maintenance, cleaning and reconditioning electrodes.

Although slope is useful in generally determining when it is time to do maintenance on an electrode, response time is, by far, the critical factor effecting accuracy of measurements. When moving from the 7.00 to the 4.00 buffer during calibration you should have a stable value in 10-20 seconds. Give a 7.00 to 10.01 calibration 20-30 seconds for a stable value. If it takes longer, the electrode response is getting slow and the calibration may not be accurate. Refer to the manufacturer's instructions for electrode maintenance.

3.4.3 *Electrode Problem Solving*

Slow response or unstable readings in calibration buffers is usually related to the condition of the reference fill solution or its flow through the junction.

1. The fill solution acts as an electrical conductor between the reference inside the electrode and the solution under test. Empty the electrode and refill with fresh fill solution regularly.

3.4 Problem Solving (cont)

3.4.3 Electrode Problem Solving (cont)

2. The junction is designed to allow the fill solution to leak out of the tip of the electrode at a slow controlled rate. To test for proper flow, rinse the tip of the electrode, blot dry and let the electrode hang in the open air for 15 minutes. If it is flowing properly, salt crystals of the fill solution will form on the junction. If they do not, refer to the manufacturer's instructions for junction cleaning or replacement.

Slow response or unstable readings in samples can be caused by a number of things. Those listed below assume that everything was fine in the calibration buffers.

1. Low ionic strength samples will tend to be very drifty. You are trying to take an electrical measurement in a solution that is a very poor conductor. Try adding a drop of KCl fill solution to about 5 mL of the sample. In most cases it will not change the pH but will give the sample enough ionic strength for the electrode to finish the reading.
2. Non aqueous samples (organics) do not follow the normal pH scale and can cause some measuring problems. These solutions are usually low in ionic strength, may dehydrate the pH membrane and often cause the junction to plug due to incompatibility with the electrode fill solution. The most reliable way to pH organics is to dilute them with water until stable readings can be generated.
3. Concentrated samples can cause pH measuring errors. This is caused by problems with the pH sensing glass and its ability to distinguish the Hydrogen ion activity over the mass of other ions in the sample. The creation of new junction potentials due to KCl dissociation problems can also cause instability. The best solution is to dilute the samples into measurable ranges.

For more information refer to the Corning Guide to pH Measurement.

3.5 Specifications

Operating Ranges

pH -1.99 to 19.99
mV ± 1999.9
Rel. mV ± 1999.9
Temp. -5 to 105°C

Resolution

pH 0.01
mV 0.1
Rel. mV 0.1
Temp. 0.1

Relative Accuracy*

pH ± 0.01
mV ± 0.2 (or 0.05%
whichever is greater)
Rel. mV ± 0.2 (or 0.05%
whichever is greater)
Temp. 0 - 50°C $\pm 1\%$
50 - 100°C $\pm 2\%$

* ± 1 least significant digit

Time

0 to 23 hours 59 minutes

Timer

0 to 59 seconds ± 1 second, or
1 to 99 minutes

Memory

10 memories

Isopotential Point

7.00 pH

pH Calibration

3 point, auto buffer recognition

Temperature Compensation

-5 to 105°C, automatic and
manual

Display

LCD display

Outputs

RS232
Recorder
Karl Fischer

Printer

Thermal

Input Conditions

Impedance greater than 10¹²
ohms

Operating Conditions

Operating temperature: 5 to 40°C
Operating humidity: max 80% at
35°C (non condensing)
Installation category 2
Pollution category degree 2

Size / Weight

10 x 9 x 5 inches (255 x 230 x
130 mm) including printer paper
roll / 2.6 lbs (1.2 kg)

Power Requirements

The 445 is supplied with an
appropriate power supply unit,
e.g.

USA/Japan 100 - 120V 50/60Hz,
9VA

Europe 230V 50Hz, 9.7VA

Output from PSU 9V DC

NOTE The 445 should only be
used with the power
supply unit provided.

445 Power Rating 4.5VA

3

3.5 Meter Specifications (cont)

Regulatory Compliance

The 445 is manufactured in a FDA (Food & Drug Administration) and ISO 9001 approved plant for Corning, and complies with the following regulatory standards: UL1262, CSA151, IEC1010. The 445 also complies with the European EMC Directives and therefore carries the CE mark.

Environmental Compliance

The casework components of the 445 are marked with the appropriate recycling identification symbol. The packaging is manufactured using recycled cardboard, and printed with water based ink. The packaging is recyclable. The manual is printed on environmentally friendly paper.

Consumables and Accessories

Catalog #	Description	Quantity
477968	Automatic Temperature Probe - Basic	1
477969	Automatic Temperature Probe - PT1000	1
477389	Disposable Meter Cover	5
478109	Electrode Arm Assembly	1
477006	Electrode Fill Solution 3M KCl (125 mL)	6 bottles
477965	Electrode Storage Container	3
478353	Electrode Conditioning Solution (30 mL)	3 bottles
477989	Guide to pH Measurement	1
476436	pH Combination Electrode, '3 in 1' Refillable	1
476466	pH Combination Electrode, '3 in 1' Gel	1
476146	pH Combination Electrode, Hi-Performance	1
478540	pH 4.00 Buffer (500 mL)	2 bottles
478570	pH 7.00 Buffer (500 mL)	2 bottles
478510	pH 10.01 Buffer (500 mL)	2 bottles
473651	pH 4.00 Buffer Sachets	30 packs
473650	pH 7.00 Buffer Sachets	30 packs
473652	pH 10.01 Buffer Sachets	30 packs
473676	pH Buffer Multi-Pack Sachets	32 packs
473653	pH Electrode Rinse Sachets	30 packs
471226	Power Supply, 100/120V - 50/60Hz	1
471228	Power Supply, 230V - 50Hz	1
470136	Printer Paper	5 rolls
477758	RS232C Cable	1
470109	Shorting Test Clip	3
470493	Dot Matrix Printer with Cables	1

Warranty:

Corning warrants this product to be free from defects in materials and workmanship. The warranty period for the meter is two (2) years from the date of purchase and the probe is six (6) months from the date of purchase.

THIS WARRANTY IS MADE IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. CORNING SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGES ARISING FROM THE USE OF THESE PRODUCTS NOR FOR CONSEQUENTIAL DAMAGES OF ANY KIND.

In the event that a meter or probe fails under normal laboratory conditions within the specified period because of a defect in material or workmanship, Corning will, at its option, repair or replace the product. Contact Corning Customer Service for return authorization and shipping instructions at 1-800-222-7740.

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