CORNING

Instruction Manual

320

Instruction Manual

This manual contains complete instructions for setting up and using the 320 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.

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 320 is intended for use by persons knowledgeable in safe laboratory practices. If the 320 is not used in accordance with these instructions for use, the protection provided by the equipment may be impaired.

The 320 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 320 or power supply unit. Do not remove the covers.

Contents

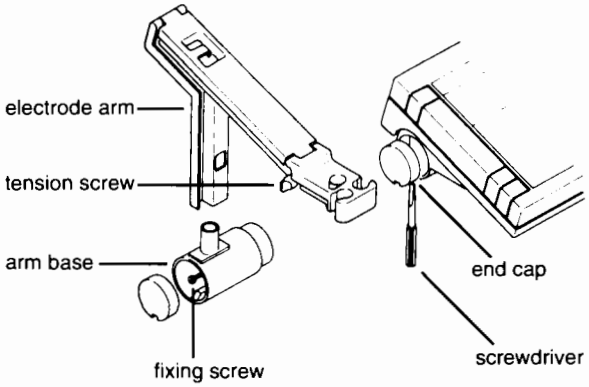
Electrode Arm and Screwdriver	1
Electrode Fill/Storage Solution	1 bottle
Transfer Pipette	1
Electrode Storage Container	1
Guide to pH Measurement	1

3. To attach the electrode arm to the pH meter:

   a. The electrode arm can be attached to the left or right-h side. Using the screwdriver supplied remove the appropriate end cap from the pH meter.

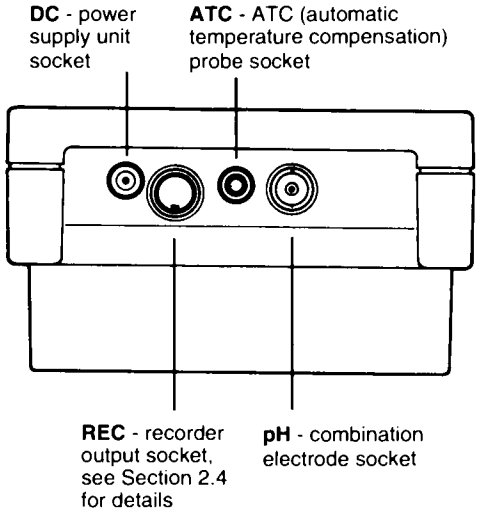
   b. Slide the arm base into the recess and tighten the fixi screw. Replace the end cap.

   c. Fit the electrode arm onto the post. Adjust the tension screw as required.



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

1.2 Input and Output Connections



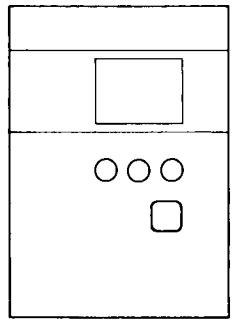
1. Disconnect the shorting clip from the **pH** socket and retain it by clipping it over the socket. Connect the electrode. If you are using an electrode incorporating ATC connect the other lead to the **ATC** socket.

NOTE The 320 will not accept separate reference and pH electrodes.

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.

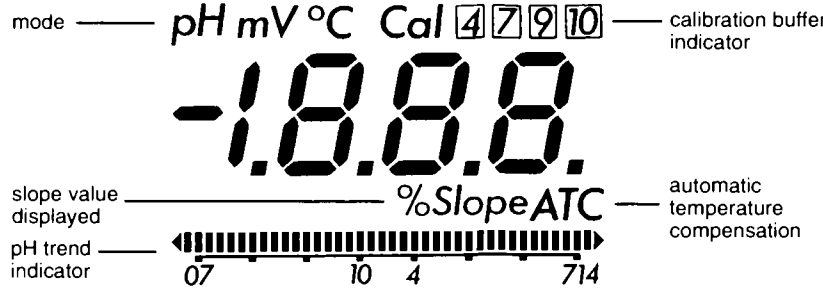
1.3 Display and Controls



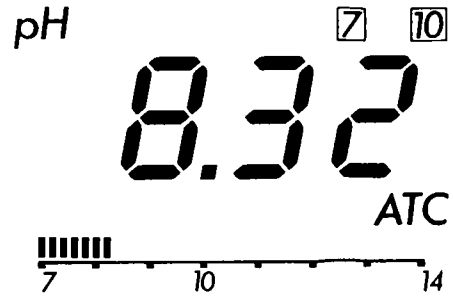
1.3 Display and Controls (cont)

mode	Selects pH, mV or temperature mode.
cal	Starts a calibration sequence in pH mode.
on/off ⏻	Turns the display off, and places the meter in standby mode.
read	Starts sample measurement in all modes. Press again to freeze display at endpoint.

320 Display



Example: pH Reading, with ATC



2.1 pH Measurements

pH read

We recommend regular calibration before sample measurement (see Sections 2.1.1 and 2.1.2)

To measure the pH of a sample:

Place electrode in sample and press read to start the measurement, the decimal point will flash.

The display simultaneously shows a digital and an analog pH reading. The analog scale shows from 0 to 7, and from 7 to 14. Over or under range readings are indicated by an arrow.

If you are not using an ATC probe (or electrode incorporating ATC), the 320 assumes a temperature of 25°C.

To freeze the display at endpoint press read

To start a new measurement press read

2.1.1 Setting Calibration Points

pH cal read

To get the most accurate pH readings you should calibrate regularly. The 320 allows you to select a set of three calibration buffers. When calibrating you can use any two of the three buffers you have set.

There are three sets of buffers available:

Set 1 (b = 1): pH 4.00, 7.00, 10.01
Set 2 (b = 2): pH 4.01, 7.00, 9.21
Set 3 (b = 3): pH 4.01, 6.86, 9.18

To set the calibration buffers:

Press on/off to turn the display off.

Press and hold mode and press on/off again. Release mode

The display shows b = 1 (or the current buffer set selected).

Press cal to display b = 2, or b = 3.

2.1.1 Setting Calibration Points (cont)

Press read to select the required buffer set when it is displayed.

The 320 will retain this setting, even after a power failure.

2.1.2 Calibrating a pH Electrode

pH cal

If you are using an ATC probe (or an electrode incorporating ATC) the buffer temperature is measured, and compensated for. If you are not using an ATC probe, the 320 assumes a temperature of 25°C.

1 point calibration

Place the electrode in the first calibration buffer and press cal

The 320 automatically endpoints when calibrating. To manually endpoint press read

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

If you are using an ATC probe (or electrode incorporating ATC) the display updates to the temperature corrected value (see Section 3.5).

To return to sample measurement press read

2 point calibration

To continue with a 2 point calibration press cal

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

To return to sample measurement press read

NOTE For maximum accuracy, we recommend using an ATC probe (or electrode incorporating ATC). If you do not have ATC, you should make sure all solutions are at 25°C.

2.2 mV Measurements

mode mV read

To measure the absolute mV of a sample:

Place electrode in sample and press **read** to start the measurement.

The display shows the absolute mV of the sample.

To freeze the display at endpoint press **read**

To start a new measurement press **read**

2.3 Temperature Measurements

mode °C read

To measure the temperature of samples and calibration buffers you must have an ATC probe or an electrode incorporating ATC connected (see Section 1.2).

To measure the temperature of a sample:

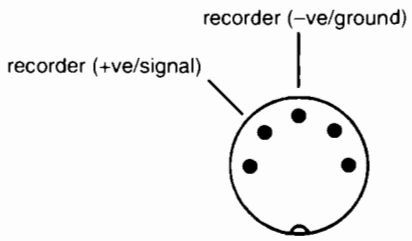
Place ATC probe (or electrode incorporating ATC) in sample and press **read** to start the measurement.

The display shows the temperature of the sample.

To freeze the display at endpoint press **read**

To start a new measurement press **read**

2.4 Chart Recorder



REC Socket

The **REC** socket (5-pin, 180° DIN socket) provides a proportional to the displayed reading in pH and mV polarity of the output is the same as the polarity of t

Approximate Recorder Outputs

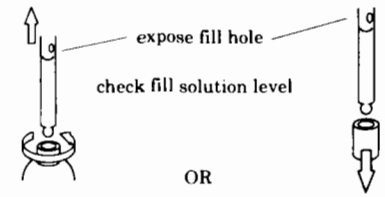
pH - Output follows display and provides approxima output per pH unit. This value will vary with c electrode slope.

mV - Output follows display, i.e. as display varies fr 1999 mV, output varies from –1999 to +1999 m

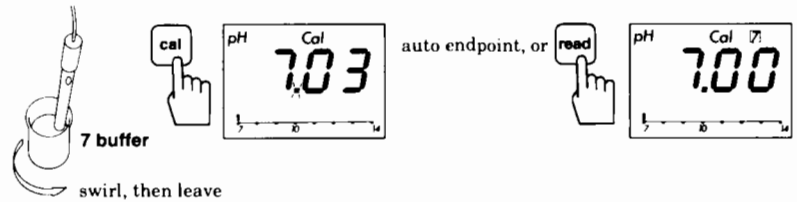
The recorder output is not available in temperature

Step-by-step guide to taking pH measurements

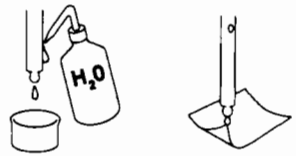
1. Prepare Electrode



2. 1-Point Calibration



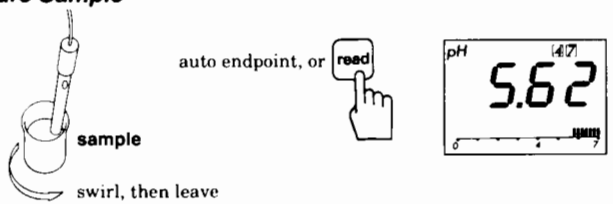
3. Rinse Electrode



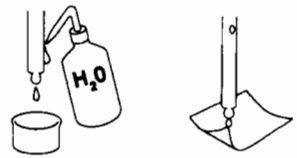
4. 2-Point Calibration

repeat step 2 using 2nd buffer, then rinse

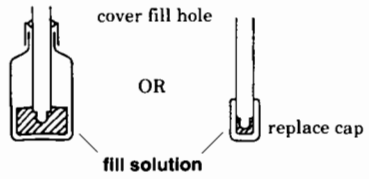
5. Measure Sample



6. Rinse Electrode



7. Store Electrode



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:

$$pH = -\log[H^+]$$

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

To measure a pH value, a sensing electrode and a reference electrode are needed. A combination electrode (sensing and reference electrode in one unit) is commonly used for routine pH measurement.

The sensing (pH) electrode (or sensing element in a combination electrode) has an internal buffer solution with a constant pH value, and develops a potential (difference between inner and outer ionic charge) when placed in solution. This is caused by the activity (concentration) of H^+ in the solution. The reference electrode (or reference element in a combination electrode) has a defined, stable potential irrespective of the H^+ activity in the sample. The 320 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:

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

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

For H^+ (i.e. n = +1) at 25°C (298K) the slope value is 59.16 mV. This is the IDEAL SLOPE FACTOR. For a one unit change in pH an ideal system will sense a mV change of 59.16 mV. The measurement of electrode slope is a good indication of the electrode condition and performance.

Temperature is an important consideration when making pH measurements. It affects the electrode slope (see Nernst equation), the temperature coefficient of the measured solution, the response time of the electrode and the position of the electrode isothermal intersection (isothermals = calibration lines at different temperature - ideally they should intersect at pH7/0mV, but in practice this is rarely the case). The 320 has automatic temperature compensation (using an ATC probe, or an electrode incorporating ATC).

Other factors, including the ionic strength of the solution (the degree to which the molecules in a solution dissociate to form ions) also affect pH measurement.

The following section takes account of these factors and provides hints on electrode care and sample measurement.

Further information is included in the booklet 'Guide to pH Measurement'.

3.2 Operating Hints

This section gives some brief hints on electrode care and sample measurement. The maintenance section gives some advice on keeping the electrode in good condition. For detailed electrode care refer to the electrode instructions.

1. Remove the electrode wetting cap from the end of the electrode, and the rubber cap from the fill hole before using the electrode.
2. New electrodes should be conditioned in 1/2" pH 4 or 7 buffer overnight.
3. Calibrate the electrode using a buffer solution close to that of the test sample. When you use an electrode for the first time, or after electrode maintenance, we recommend you use a buffer close to pH 7 for the first calibration point. After this initial calibration, you can use any of the three calibration buffers you have selected, in any order, for subsequent calibration.

4. For maximum accuracy, we recommend using an ATC probe (or electrode incorporating ATC). If you do not have ATC, you should make sure all solutions are at 25°C.
5. When transferring the electrode from one solution to another rinse it with distilled water or a little of the next solution to be measured. Blot dry with tissue paper - do not wipe the electrode as this may cause polarization and slow response.
6. Handle the electrode carefully, do not use it as a stirrer. Avoid handling the electrode membrane. Damage will cause inaccuracy and slow response.
7. For small sample volumes, make sure the liquid junction is covered.
8. Do not allow the electrode fill solution to dry out as this may cause permanent damage. Keep the electrode topped up with the correct filling solution, and change the filling solution completely on a regular basis.
9. Store the electrode short term in electrode filling solution. The Electrode Storage Container, available as an optional accessory, is ideal.

   For longer term storage, replace the wetting cap, filled with filling solution, and the fill hole cover.
10. Do not use buffer solutions after the expiry date, and do not pour solutions back into bottles.
11. Response time is a function of both the electrode and the solution. Some solutions have very rapid equilibration times, others, particularly those with low ionic strength, may take several minutes.

3.3 Maintenance

3.3.1 320 Maintenance

The 320 needs no maintenance except for an occasional wipe with a damp cloth. The front panel is made of polycarbonate and is impervious to a wide range of solvents. However, polycarbonate 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 Cleaning and filling solutions should be handled with the care accorded to toxic or corrosive substances.

Make sure the electrode is always kept topped up with the appropriate filling solution. For maximum accuracy any filling solution that may have 'crept' and encrusted the outside of the electrode should be removed with distilled water.

Always store the electrode properly and do not allow it to dry out.

If the electrode slope value falls rapidly, or if the response becomes sluggish or inaccurate, the following procedures may help. Try them one by one, in the order given.

- Degrease the membrane with cotton wool soaked in either acetone or soap solution.
- Soak the tip of the electrode in 0.1M HCl overnight.
- If a protein build-up has occurred, remove deposits by soaking electrode in 0.1M HCl + 10% pepsin solution.

3

3.4 Problem Solving

Most problems that arise are caused by electrode faults rather than by the 320. Other factors, such as buffer solutions, sample conditions and so on can also cause problems. Carry out the meter test first to eliminate 320 error.

Meter Test

1. Disconnect the power supply unit from the **DC** socket.
2. Press and hold [read] and reconnect the power supply unit.

   The display shows the test sequence, with all segments showing, and then displays 1. Release [read]
3. Press (mode) the display shows 2.

   Press (cal) the display shows 3.

   Press (on/off) the display shows 4.

   Press [read] the display repeats the test sequence, with all segments showing, then returns to normal operation.
4. Disconnect the electrode from the pH socket, and connect the shorting clip (or shorting plug). Select mV mode. The 320 displays 0 ±1 mV. Disconnect the shorting clip (or shorting plug), and the reading changes.
5. Disconnect the ATC probe and select temperature mode. The display shows 25°C. Reconnect the ATC probe (or electrode incorporating ATC), the display shows the approximate ambient temperature.
6. Reconnect electrode.

NOTE Refer to the electrode manufacturer's instructions for full details on cleaning or conditioning electrodes.

E1 or E2 Displayed (cal/slope out of range)

1. Carry out meter test.
2. Select mV mode and place electrode in pH 7 buffer. The display should read 0 mV ± 35 mV. If it does not, clean the electrode, or replace.
3. Select pH mode, and carry out a 2 point calibration using pH 7 buffer as the first buffer, and pH 4 as the second buffer. (If the display still reads pH 7 when measuring pH 4 buffer the electrode is damaged or broken and should be replaced). Note the % slope value.

Slope Value	Action
>100%	Check calibration buffers.
90 - 100%	Electrode is in good condition. Check calibration buffers.
85 - 90%	Electrode needs cleaning.
<85% (E2)	Electrode needs conditioning, or replacing.

– – – – Displayed (measurement out of range)

1. Carry out meter test.
2. Check electrode is connected.
3. Check electrode is immersed in the sample.
4. Check electrode wetting cap is removed.
5. Replace electrode.

Unstable Reading

1. Check electrode fill hole is uncovered.
2. Check sample covers liquid junction.
3. Check electrode reference fill solution.
4. Clean or replace electrode junction.
5. Replace electrode.

Slow Response

1. Check electrode fill hole is uncovered.
2. Check if solutions are at different temperatures - allow time for temperature equilibration.
3. Check if sample has low ionic strength (i.e. water) - allow time for equilibration.
4. Avoid wiping the electrode between measurements as this can cause slow response.
5. Clean/condition electrode.
6. Replace electrode.

Inaccurate Readings

1. Check you are using correct calibration buffers.
2. Check that buffers are not past their expiry date, or contaminated.

For further help contact your local distributor, or the technical assistance number on the rear cover.

3.5 Specifications

Operating Ranges

pH	0.00 to 14.00
mV	±1999
Temp.	0 to 100°C

Resolution

pH	0.01
mV	1
Temp.	1

Relative Accuracy

pH	±0.01
mV	±1
Temp.	±1

pH Calibration

2 point, auto buffer recognition

Isopotential Point

7.00 pH

Temperature Compensation

0 to 100°C, automatic with ATC probe, or electrode incorporating ATC.

Display

LCD display

Digital pH, mV and °C.

Analog trend indicator, pH only, 0.2 pH increments.

Outputs

Recorder

Input Conditions

Impedance greater than 10^{12} ohms

Operating Conditions

Operating temperature: 5 to 40°C

Operating humidity: 5 to 80% (non condensing)

Installation category 2

Pollution category degree 2

Size

6 x 8 x 4 inches
(150 x 200 x 100 mm)

Weight

1.8 lb (0.8 kg)

Power Requirements

The 320 is supplied with an appropriate power supply unit, e.g.

UK	240V 50Hz 2.7VA
USA/Japan	100 - 115V 50/60Hz 4.5VA
Europe	220 - 230V 50Hz 4.5VA

320 Power Rating 0.15VA

Output from PSU 9V DC

NOTE The 320 should only be used with the power supply unit provided.

Buffer Temperature Correction Table

The 320 automatically corrects for temperature using the values shown in the table.

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

Regulatory Compliance

The 320 is manufactured in a FDA (Food & Drug Administration) and ISO 9001 approved plant. The following regulatory standards have been applied for: UL1262, CSA151, IEC1010. The 320 complies with the European EMC Directives.

Environmental Compliance

All the components of the 320 are marked with the appropriate recycling identification symbol. The packaging is manufactured with recycled cardboard and water based glue, and printed with water based ink. The packaging is recyclable. The manual is printed on recycled paper.

Consumables and Accessories

Cat.	Description	Quantity
476380	'3 in 1' Combination Electrode	1
476390	High Performance Combination Electrode	1
477968	Automatic Temperature Compensator – Basic	1
477969	Automatic Temperature Compensator – PT1000 (350 only)	1
470124	Starter Kit (320 & 340)	1
470125	Starter Kit (345 & 350)	1
478109	Electrode Arm	1
477000	Electrode Fill/Storage Solution sat. KCl (125 mL)	6 bottles
477006	Electrode Fill/Storage Solution 3M KCl (125 mL)	6 bottles
477965	Electrode Storage Container	3
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 Sachet	30 packs
473650	pH 7.00 Buffer Sachet	30 packs
473652	pH 10.01 Buffer Sachet	30 packs
473653	Rinsing Solution Sachet	30 packs
473676	Multi-Pack Buffer Sachet	32 packs
478353	Electrode Conditioning Solution (30 mL)	3 bottles
470136	Printer Paper (345 only)	5 rolls
471226	Power Supply Unit, 115V/60Hz	1
471228	Power Supply Unit, 230V/50Hz	1
477758	RS232C Cable (340, 345, 350 only)	1
471232	Recorder Cable (320 only)	1
478427	Shorting Plug	1
477989	Guide to pH Measurement	1
477389	Disposable Meter Cover (340, 345, 350 only)	5

Corning warrants this meter to be free from defects in material and workmanship when used under normal laboratory conditions for two (2) years. To validate this warranty, please complete and return the enclosed warranty card.

For your reference, make a note of the serial number, date of purchase and supplier here.

Serial No. ..... Date Purchased .....

Supplier .....

Corning Incorporated
Science Products Division
Corning, New York 14831
USA
Tel: 1-607-974-4667
For Technical Assistance:
in US call 1-800-222-7740
in Canada call 1-607 974 4001

001 91 359L Rev. A. 9/92