

Instruction manual
766 Laboratory pH Meter



Knick >

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Warranty

Defects occurring within 3 years from delivery date shall be remedied free of charge at our plant (carriage and insurance paid by sender).
Accessories: 1 year

Subject to change without notice

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Information on this instruction manual

Bold print is used to represent keys, e.g. **meas**.

CAL 1 25.0

The left column often shows display examples

or

keys whose functions are described.



ERR --PH--

A gray representation of the display text indicates a flashing display.



Notes provide important information that should be strictly followed when using the device.



Warning means that the instructions given must always be followed for your own safety. Failure to follow these instructions may result in injuries.

Safety information

Be sure to read and observe the following instructions!

Before connecting the device to the power supply, make sure that the voltage corresponds with the rating given on the rating plate of the device.

Opening the device exposes live parts. Therefore, it shall not be opened. If a repair should be required, return the device to our factory.

If opening the device is inevitable, it shall first be disconnected from all voltage sources. Make sure that the mains supply has been disconnected.

Repair or adjustment of an opened device under voltage shall be carried out only by a skilled person who is aware of the hazards involved.

Remember that the voltage across accessible parts of the open device may be dangerous to life.

Whenever it is likely that the protection has been impaired, the device shall be made inoperative and secured against unintended operation.

The protection is likely to be impaired if, for example:

- the device shows visible damage
- the device fails to perform the intended measurements
- after prolonged storage at temperatures above 70°C
- after severe transport stresses

Before recommissioning the device, a professional routine test in accordance with EN 61010-1 must be performed. This test should be carried out at our factory.

**EG-Konformitätserklärung
EC Declaration of Conformity
Déclaration de Conformité CE**Dokument-Nr. / Document No. /
No. document**EG90817B**Aufbewahrung / Keeping / Garde en dépôt
Jürgen Cammin (KB)

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to which this declaration relates is/are in conformity with all essential requirements of the Council Directives relating to:
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Year in which the CE marking was affixed /
L'année d'apposition du marquage CEHarmonisierte Normen / Harmonised
Standards / Normes harmonisées**EN 61010-1: 2001**EMV-Richtlinie / EMC directive /
Directive CEM**2004/108/EG**

Norm / Standard / Norme

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1 General information



The "General information" chapter provides a summary of the most important points that have to be observed when measuring pH. If you are sufficiently familiar with the practice of pH measurement, you can skip this chapter.

Information on pH measurement

General

For electrometrical pH measurement, you require two electrodes, a glass electrode and a reference electrode. In most cases, they are combined in one glass body to form a so-called combination electrode.

Measuring pH requires simultaneous temperature measurement. When specifying pH correctly, the corresponding temperature value must be stated, e.g. $\text{pH}_{25^{\circ}\text{C}} = 7.15$. By using a temperature probe together with the electrode you can optimally make use of the advantages of microprocessor-controlled pH meters.

Of special advantage are combination electrodes with integrated temperature probe, e.g. SE 100 (see Appendix, Pg. 31).

Calibration and measurement

Measurement characteristics of pH electrodes differ with type, time and temperature. Therefore, you must adjust the measuring instrument to the actual electrode characteristics. This procedure is called calibration.

To do so, you measure the pH of buffer solutions, i.e. solutions with exactly defined pH values. Knick devices calibrate themselves almost automatically. pH and corresponding temperature values of different buffer sets are stored in the software.

Before you calibrate for the first time, you must select the buffer set you are using and adjust it at the meter (see Pg. 15). Then the patented Calimatic[®] calibrates the meter at the press of a key.



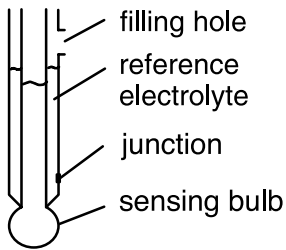
The buffer solutions used for calibration must always correspond with the buffer set currently adjusted at the meter.

Two different buffer solutions are required for calibration. Immerse the electrode and the temperature probe, if required, simultaneously in one of the buffer solutions and press the **cal** key. Then repeat this procedure with the second buffer solution. It does not matter which buffer solution is taken first. The pH meter measures the electrode potentials and temperatures and compares them with the stored pH/temperature tables of the buffer solutions. As a result, zero and slope of the electrode are calculated. This kind of calibration, using two buffer solutions, is called two-point calibration.

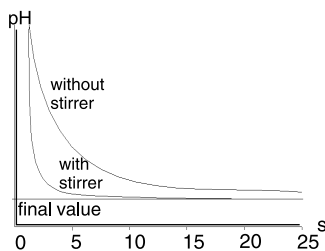
For one-point calibration, you only use one buffer solution and stop the calibration procedure after the first calibration step. In that case, only the zero point is adjusted. The previous slope value is retained. Since with modern microprocessor-controlled devices two point calibration hardly makes any extra effort, it should always be preferred.

How often you calibrate strongly depends on the conditions under which you are measuring. Therefore, we cannot give a general statement.

If you are unsure, you can calibrate more often in the beginning. When the calibration values (electrode zero and slope) deviate only slightly, you can prolong the periods between two calibrations. When measuring under unchanged conditions, one calibration per week might be sufficient. When measuring in media with high temperature or pH differences, however, it might be necessary to calibrate before each measurement.

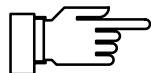


- When using electrodes with liquid electrolyte, open the KCl filling hole for calibration, measurement and cleaning.
- Immerse the electrode in the buffer solution until sensing bulb and junction are completely covered.
- Electrode response time is considerably reduced when the buffer solution is stirred (see figure below on the left). To read the measured value, do not move the electrode.
- Always rinse the electrode with distilled water before immersing it in the buffer solution.
- You should preferably perform two-point calibrations.
- If you calibrate without using a temperature probe, make sure that the manually entered temperature corresponds with the actual temperature of buffer solutions and measured medium.



Example for the response time of a pH electrode when using the ZU 6955 immersion stirrer.

Buffer solutions



You require two buffer solutions for calibration. Their pH values should differ by two pH units at least and comprise the expected value.

To ensure measurement accuracy, buffer solutions must not become dirty.

- Therefore, never pour used buffer solution back into its reservoir. Do not use a buffer solution that has already been used.
- Never immerse the electrode directly in the reservoir.
- Always keep the reservoirs closed. Carbon dioxide from the air can adulterate the buffer solution.

Electrodes

Because of their easier handling combination electrodes are used for most applications.

When using individual electrodes, make sure that they are connected to form a symmetrical system:

- The reference systems of glass and reference electrode must have identical or comparable potentials (e.g. both Ag/AgCl, KCl 3 mol/l, AgCl saturated or both "Calomel", KCl saturated).
- Combine Thalamid glass electrodes with Thalamid reference electrodes only.

Nominal zero of commercial electrodes is at pH 7. Only use electrodes of this kind.

Electrode servicing

Regular cleaning and servicing increases electrode life and measurement accuracy. Therefore you should observe the following:



- Store the electrodes in KCl solution.
- Prior to first use, soak dry electrodes for up to 12 hours in KCl solution.
- When using electrodes with liquid electrolyte, open the KCl filling hole for calibration, measurement and cleaning.
- Make sure that the electrolyte level in the electrode is always at least 2 cm above the measured medium during measurement. If required, top up with KCl solution. Use the appropriate KCl solution according to the manufacturer's specifications. For example, for the SE 100 electrode only KCl solution 3 mol/l (included in the calibration buffer set).

To remove grease or oil, you can use hot water and a household washing-up agent; strong pollutions can carefully be removed using household scoring agent. Protein stains can be removed by applying pepsin-hydrochloric acid solution (electrode cleaner) for one hour.



- Do not dry the electrode by rubbing with a cloth or fleece. This might lead to electrostatic chargings that adulterate later measurements or even make them impossible.

Temperature compensation

Temperature compensation takes account of the temperature dependence of the electrode slope. Reference temperature for zero and slope specifications of the meter is 25°C. The pH value of the measured medium also varies with temperature. This temperature dependence is unknown and depends on the composition of the measured medium. Consequently, it cannot be compensated for. Therefore, always specify the pH value together with its measuring temperature (important when comparing pH values!).



With a high difference between calibration and measuring temperature, an additional temperature dependence of the electrode zero point can cause measurement errors. This electrode error does not follow any general rule (in contrast to the temperature dependence of the slope). To achieve particularly high measurement accuracy, you can eliminate this error by calibrating at measuring temperature (DIN recommendation). The temperature dependence of the calibration buffers' pH values is automatically taken into account.

2 The 766 Laboratory pH Meter

Package contents

After unpacking, please check the shipment for completeness. The package should contain:

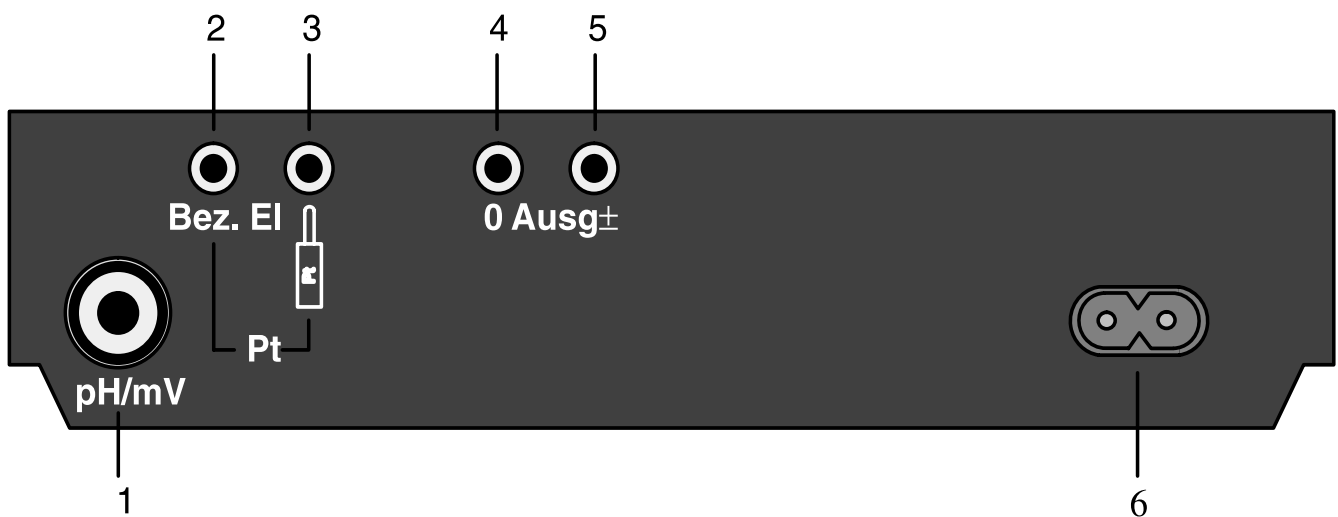
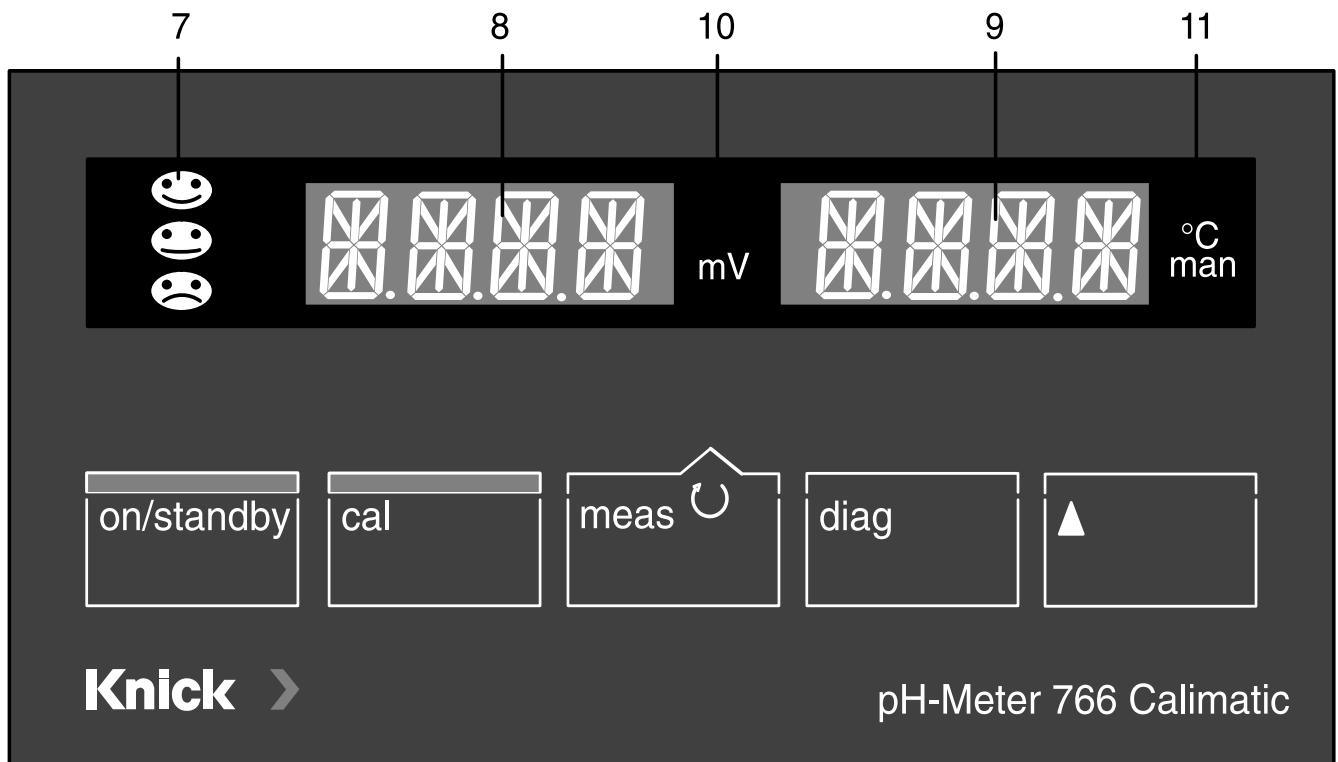
- 766 Laboratory pH Meter
- Power cord
- This instruction manual

Short device description

- The Model 766 is used for pH measurements in the laboratory.
- The meter complies with the European EMC regulations and with the requirements according to German NAMUR NE 21.
- Temperature compensation is automatic using a Pt 1000 temperature probe or manual by entering the temperature.
- Buffer solutions of eleven different, selectable buffer sets are provided for calibration. Buffer recognition is automatic via Calimatic[®].
- Sensoface[®] electrode monitoring checks the connected electrode and provides information on the electrode condition.
- DryCheck[®] monitors the electrode impedance and alerts to dry-up, even in standby mode.
- A short check after power-on and the GainCheck[®] device self-test during diagnostics check the device operability at the press of a key.
- The Trueline[®] recorder output provides a calibrated analog signal without quantizing levels.

3 Operation

Meter design



- | | | | |
|------|------------------------------|--------|--------------------------------|
| 1 | Electrode connection | 6 | Power input |
| 2 | Reference electrode | 7 | Sensoface [®] display |
| 2, 3 | Temperature probe connection | 8, 9 | LED displays |
| 4, 5 | Recorder output | 10, 11 | Symbols |

General information

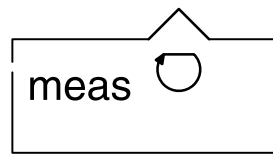
Keypad



Pressing **on/standby** turns the meter on or switches to standby mode. Standby mode is indicated by a lighted Sensoface[®] status indicator. At power-on, the meter automatically performs a short self test and then goes to measuring mode.



Pressing **cal** starts calibration. During calibration the meter is adapted to the electrode. You can conduct either a one or a two-point calibration.



Pressing **meas** exits a function and returns you to measuring mode.

Pressing **meas** in measuring mode selects the desired variable for the left display. The corresponding measurement symbol appears on the right side of the display.

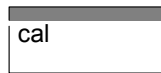


Pressing **diag** starts diagnostics. Here, you can get information on the electrode condition, view the current electrode data, and perform a comprehensive device self test.

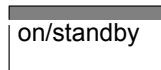
- Hitting **diag** briefly displays only those data that have led to a devaluation of the Sensoface[®] indicator.
- Holding **diag** depressed for longer than 2 seconds displays all Sensoface[®] data, the selected buffer set, as well as the values for zero and slope of the electrode determined during last calibration. Afterwards, a complete device self test (GainCheck[®]) will be performed.
- Pressing **diag** during diagnostics scrolls one line backwards.



Pressing ▲ proceeds to the next step or increases the temperature value during manual temperature adjustment.



+



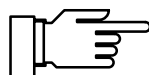
The buffer selection menu is accessed from the standby mode. To do so, hold **cal** depressed and press **on/standby** for more than 2 seconds.



+

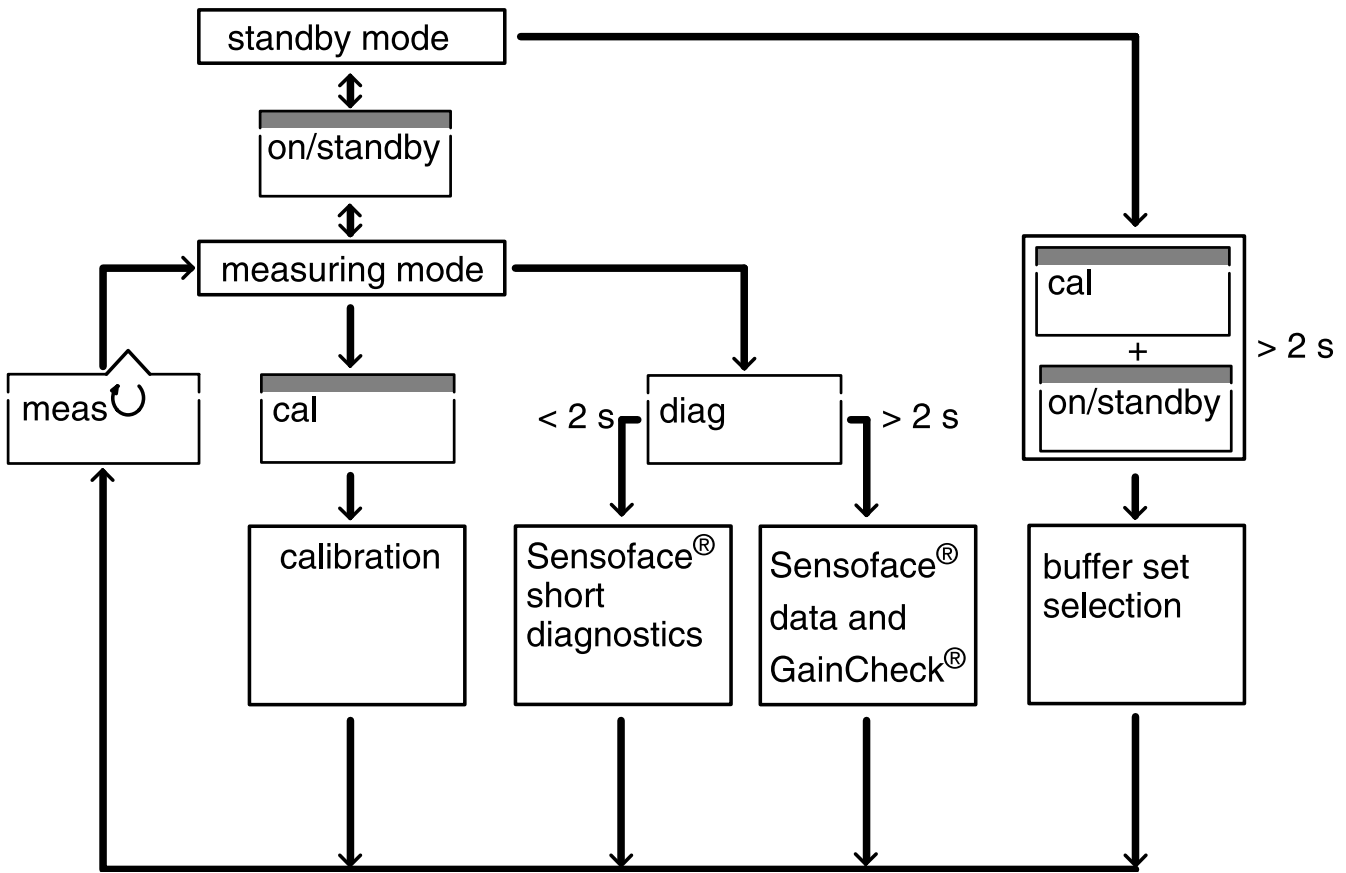


With manual temperature adjustment, ▲ + **diag** reduces the temperature value.



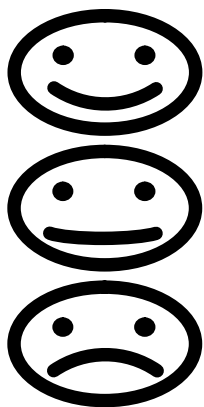
When pressing down two keys simultaneously (see figure), make sure that the upper key of the illustration is pressed first.

Functional structure



Sensoface[®] automatic electrode monitoring

Sensoface[®] automatic electrode monitoring provides information on the electrode condition. During calibration it evaluates zero point, slope and response time, during measurement and in standby mode it evaluates impedance and dry-up of the electrode. A summary of the individual results is expressed by three face symbols.



The electrode is in good condition.



The electrode is still usable, but should be calibrated.



The electrode urgently requires calibration.
If the display does not change after calibration, replace the electrode.

More detailed information on the indicated electrode condition and the individual parameter evaluations is given in the "Diagnostics" chapter (see Pg. 19).



Sensoface[®] was specially designed for monitoring pH electrodes. Since ORP electrodes have completely different characteristics, they provoke invalid Sensoface[®] displays. Sensoface[®] display can also be degraded when you use a pH simulator.

Power-on and start-up

Mains supply

The meter is designed for 230 V AC supply (with Option 363 for 115 V AC). Connect the power input of the meter to a mains outlet using the included power cord.



If the meter is disconnected from mains, the settings, calibration and diagnostics data remain permanently stored.

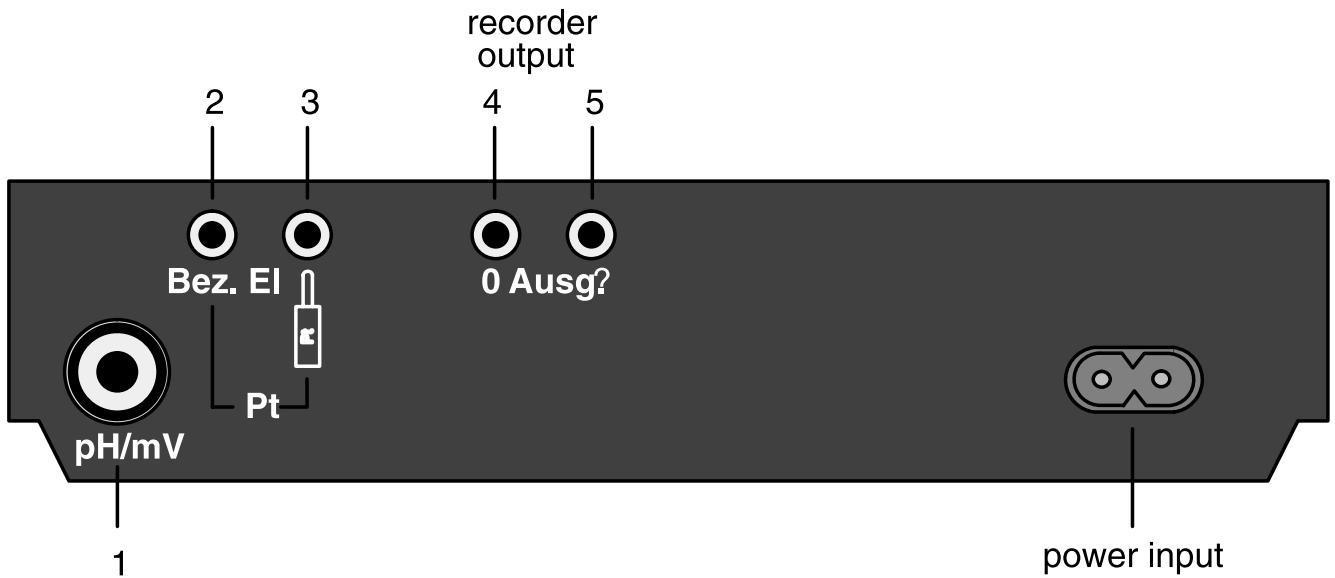
Electrode connection

The Model 766 can be combined with commercial electrodes or electrodes with nominal zero point at pH 7 with the following plugs:

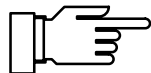
- Standard coaxial plug to DIN 19 262 and/or
- 4 mm banana plug.

Terminal assignments

Connection	Socket
Combination electrode	1
Single sensing electrode	1
Single reference electrode	2
Temperature probe of combination electrodes (electrodes with integrated temperature probe)	3
Separate temperature probe	2, 3



If no temperature probe is connected, the meter uses the manually selected temperature. In this case, the decimal point of the temperature display flashes and man is indicated.



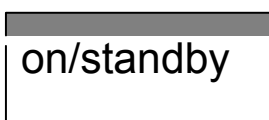
Prior to first measurement, select the buffer set used and calibrate the meter.

Standby mode

If the meter is connected to a mains outlet but not switched on, it is in standby mode. This is indicated by a lighted Senso-face[®] indicator.



DryCheck[®] and impedance monitoring are active in standby mode. Calibration and diagnostics data remain permanently stored.



Pressing **on/standby** switches the meter to measuring mode.

At power-on, the meter performs a short check:

- Simultaneous lighting-up of all display segments, measurement symbols and Sensoface[®] indicators
- Display of model name PH 766
- Display of software version
- Display of nominal buffer values of selected buffer set
- Memory test

To stop the short check, press **meas** .



Do not disconnect the meter from mains if you do not use it. Only when the meter remains in standby mode, can the electrode be monitored.

Measuring mode

In measuring mode the left display shows the selected measured variable, the right display the temperature. The measured variable is selected using **meas** . The corresponding measurement symbol is shown on the right side of the display.

You can choose any of the following variables:

- pH value
- Electrode potential [mV]

Manual temperature specification

A flashing decimal point of the temperature display and the man indicator signal that no temperature probe is connected. The meter now uses the manually selected temperature. Default temperature value is 25 °C.

Buffer set selection

During buffer set selection you select the buffer set with the buffer solutions you are using. The Model 766 has stored eleven different calibration buffer sets. For corresponding buffer tables, refer to pages 35 to 39.

Buffer sets

The following buffer sets are permanently stored in the meter:

BUFF -00-		Knick technical buffers					
pH	2.00	4.01	7.00	9.21			(25°C)
BUFF -01-		Mettler-Toledo technical buffers (correspond to Ingold technical buffers)					
pH	2.00	4.01	7.00	9.21			(25°C)
BUFF -02-		Merck/Riedel					
pH	2.00	4.00	7.00	9.00	12.00		(20°C)
BUFF -03-		DIN19267					
pH	1.09	3.06	4.65	6.79	9.23	12.75	(25°C)
BUFF -04-		DIN19266 and NIST(NBS)					
pH	1.679	4.006	6.865	9.180	12.454		(25°C)
BUFF -05-		Merck/Riedel					
pH	1.00	3.00	6.00	8.00	10.00	13.00	(20°C)
BUFF -06-		Merck					
pH	4.66	6.88	9.22				(20°C)
BUFF -07-		Ciba (94)					
pH	2.06	4.00	7.00	10.00			
BUFF -08-		Customer specific					
pH	2.00	4.62	7.00	8.20	10.00	12.00	(20°C)
BUFF -09-		Customer specific					
pH	2.00	4.01	7.00	9.21	12.00		
BUFF -10-		NIST/Mettler Toledo (USA)					
pH	4.00	7.00	10.01				(25°C)

Select buffer set

To access selection mode, the meter must be in standby mode. If required, press **on/standby** to switch to standby mode.

cal

+

on/standby

Hold **cal** depressed and press **on/standby** for more than 2 seconds.

CAL - BUFF

The display reads CAL-BUFF.

BUFF --00--

You can choose between buffer sets 00 to 10.

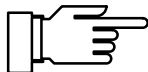
Press **▲** to select the buffer set with the buffer solutions you are using.

Press **cal** to store the selected buffer set.

If you do not want to store, press **meas** to exit buffer selection.

END CBUF

With this display the meter indicates the end of buffer selection and goes to measuring mode.



The Model 766 can only operate properly when the buffer solutions used correspond to the selected, activated buffer set. It is indicated at power-on. Other buffer solutions, even those with the same nominal values, may demonstrate a different temperature behavior. This leads to measurement errors.

Calibration



Calibration adjusts the pH meter to the zero and slope of the electrode used.

You only have to select the used buffer set once. The patented Calimatic® then automatically recognizes the buffer solution, calculates zero point and slope of the electrode and adjusts correspondingly.

Activating calibration

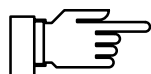


Press **cal** to activate calibration. You can exit the calibration mode at any time by pressing **meas**.

The meter can only operate properly when the buffer solutions used correspond to the selected, activated buffer set. Other buffer solutions, even those with the same nominal values, may demonstrate a different temperature behavior. This leads to measurement errors.

CAL 1

Immerse the electrode and temperature probe in the first buffer solution. This can be any of the selected solutions. Press **▲** or **cal** to start calibration. If you do not want to calibrate, press **meas** to abort calibration.



The response time of the electrode and temperature probe is considerably reduced if the electrode is first moved about in the buffer solution and then held still. The values will stabilize more quickly. DIN 19 268 demands that calibration and buffer solutions are stirred during measurement. To do so, use ZU 6955 immersion stirrer, preferably with ZU 6954 stand (also see example on Pg. 3).

CAL 1 20.0°C

During buffer recognition CAL 1 is flashing. The right display reads the measured temperature. When working with manual temperature compensation, the entered temperature is displayed. This is indicated by a flashing decimal point. In addition, the man indicator beneath the °C symbol is lighted.

BUF 1^{pH} 7.00

The nominal value of the identified buffer solution is displayed for approx. 5 sec. Electrode and temperature probe still remain in the first buffer solution.

0_{mV} 0"

Stability of the electrode is checked. The left-hand display reads the measured mV value. The right-hand display shows a running clock measuring the electrode response time. Stability check can be stopped by pressing **cal**. However, this reduces calibration accuracy.

CAL 2

Calibration with the first buffer is terminated. Take the electrode and temperature probe out of the solution and rinse them thoroughly.

- If you want to perform a one-point calibration, press **meas** to end the calibration now. The meter will display the new, calculated zero point and the old slope and return to measuring mode.
- If you want to perform a two-point calibration, immerse the electrode and temperature probe in the second buffer solution. Press **▲** or **cal** to restart calibration. The calibration process runs again as for the first buffer.

CAL 2 20.0^{°C}

Buffer recognition, CAL 2 is flashing in the left display, temperature is indicated on the right.

BUF 2^{pH} 9.21

Display of nominal buffer value for approx. 5 sec

- 128_{mV} 0"

Display of determined electrode potential. Check of electrode stability and response time

ZERO 7.01^{pH}

Display of zero point determined for the electrode

SLOP 57.6

Display of slope determined for the electrode

END CAL

End of calibration

Diagnostics

diag

During diagnostics the complete pH measurement equipment is checked. This also serves for quality management to ISO 9000.

Activating diagnostics

Press **diag** to start diagnostics. You can choose between short diagnostics and comprehensive diagnostics:

- Short diagnostics: If you only hit the **diag** key, a short diagnostics is started.
- GainCheck[®]: If you hold the key depressed for longer than 2 seconds, GainCheck[®] is started. A complete diagnostics and a comprehensive device self test is running.

To exit diagnostics, press **meas**. It is exited automatically when all diagnostics functions have been performed.

Short diagnostics

Short diagnostics displays the status of those Sensoface[®] criteria that might have led to a devaluation.

Press **diag** to start short diagnostics.

DIAG FACE

After the start the display text DIAG FACE flashes for approx. 3 seconds.

FACE --OK--

This text is displayed if all Sensoface[®] criteria are in good condition. The meter returns to measuring mode.

GLAS IMPD

Sensoface[®] criteria that are not okay are displayed, e.g. glass impedance. The corresponding Sensoface[®] indicator flashes.

For more information on the Sensoface[®] criteria, refer to the following pages.

GainCheck[®]

GainCheck[®] performs a complete diagnostics and a comprehensive device self-test.

In the course of that:

- all Sensoface[®] criteria and all electrode data are displayed
- memories are tested
- the complete measuring circuitry and the measured value processing are checked
- the results of all tests are displayed

The tests run automatically. Only during keypad testing you have to press the requested keys.

--OK--

Successful testing is confirmed by OK on the right display.

How to operate GainCheck[®]:

- To start GainCheck[®], hold **diag** depressed for more than 2 seconds. The DIAG FACE display is flashing.
- The individual tests run automatically but can be influenced with the following keys:
- Pressing **▲** steps forwards.
- Pressing **diag** steps backwards.
- Pressing **meas** returns you to measuring mode at any time.

Sensoface[®] criteria

During Sensoface[®] function you see the criteria that control Sensoface[®] display. Each criterion is displayed separately with the corresponding evaluation. This gives you important information on the condition of your electrode. Sensoface[®] alerts you in time to possible errors or aging of your electrode.

DIAG FACE



The worsening of a Sensoface[®] criterion leads to the devaluation of the Sensoface[®] display. This devaluation is permanent. An improvement can only take place after a calibration.

ZERO SLOP

Here, the Sensoface[®] display provides information on zero and slope of the electrode. The exact values of zero point and slope are displayed in the electrode data function (see Pg. 23).



Zero and slope of the electrode are still okay.



Zero and slope of the electrode are still okay. However, the electrode should be replaced soon.



Zero and slope of the electrode have reached values which no longer ensure proper calibration. It is advisable to replace the electrode.



The values for zero and slope are determined during calibration only. Therefore, correct information depends on a proper calibration. Make sure that you always use correct and pure buffer solutions.

EL -- TIME

This Sensoface[®] display provides information on the electrode's response time. This is the time the electrode requires for delivering a stable measured value. The value determined during calibration.

Wear and aging, but also wrong treatment (such as dry storage) can reduce the gel layer of the glass membrane. This results in a longer response time. The electrode gets sluggish.



The electrode promptly adjusts to the measured value.



The electrode adjusts slowly. You should consider replacing it. It may be possible to achieve an improvement by cleaning, or in the case of an electrode stored dry, by "watering".



The electrode adjusts very slowly to the measured value. Correct measurement is no longer ensured. The electrode should be replaced.

GLAS IMPD

Here, you are provided with information on the electrode impedance. The impedance is permanently monitored, also in standby mode.

The measured impedance is modified by glass breakage, cable interruption or short circuit, a dirty electrode connector or a plugged out electrode. Impedance is also modified when the temperature is too high for the electrode in use.



Electrode impedance is in the normal range.



Impedance is out of range. Check electrode and connections. The display can only be reset after a calibration.



When you disconnect the electrode from the meter – even if only momentarily for rinsing or replacement – the Sensoface[®] display will be degraded. An improvement can only take place after a calibration.



Sensoface[®] was specially designed for monitoring pH electrodes. ORP electrodes provoke invalid Sensoface[®] displays. Sensoface[®] display can also be degraded when you use a pH simulator.

Electrode data

The electrode data function shows the values for zero and slope determined during last calibration.

DIAG EDAT

BUFF --01--

Display of selected buffer set

ZERO 701

Display of zero point determined for the electrode

SLOP 57.6

Display of slope determined for the electrode

Device self-test

During memory testing RAM, EPROM and EEPROM are checked for operability. Longer testing periods are indicated by a little running clock in the right display.

DIAG MEMO

RAM -----

RAM test

EPROM -----

EPROM test

EEPR -----

EEPROM test

DIAG AMPL

Amplifier linearity test: Using an integrated, high-precision reference, the complete measuring circuitry from input amplifier to recorder output is checked. The displayed mV values lie across the recorder output. The electrode is internally disconnected from the amplifier.

-1500_{mV} 0

Linearity test at -1500 mV

- 500_{mV} 0

Linearity test at -500 mV

0_{mV} 0

Linearity test at 0 mV

500_{mV} 0

Linearity test at +500 mV

1500_{mV} 0

Linearity test at +1500 mV

DIAG DISP

Display test: All Sensoface® indicators, all segments of the two LED displays and all measurement symbols light up.



Check whether really each segment is lighting.

DIAG KEYS

During keypad testing, you are prompted to press the corresponding key.

PUSH ON

Press **on/standby** .

PUSH CAL

Press **cal** .

PUSH MEAS

Press **meas** .

PUSH DIAG

Press **diag** .

PUSH UP

Press **▲** .

KEYS -OK-

If the keypad functions properly, the meter displays the message KEYS -OK- and terminates testing.

KEY ERR

If the keypad is defective, the meter terminates testing and displays the corresponding error message. In that case, you should return the meter to the manufacturer for repair.

Trueline[®] recorder output

The Model 766 is equipped with Trueline[®] recorder output. Trueline[®] provides a pH-calibrated analog output signal, without disturbing voltage steps.

Measured variable:	Output voltage:
• pH value	100 mV/pH
• Voltage	1 mV/mV

The output variable of the recorder output always follows the selected variable to be measured. It switches automatically as the measured variable is changed in the display.

If pH has been selected as output variable, the output voltage zero is at pH 7.



Do not apply an external voltage to the recorder output. The meter might be damaged.

The recorder output is not isolated. To avoid measurement errors, you must use a recorder with floating input when measuring grounded material.

4 Troubleshooting

Error messages

Range exceeded

If a measured value is out of range, an error message is displayed instead of the value measured.

ERR --pH--

The measured pH value is below -2 or above +16.

Possible causes:

- Electrode defective
- Too little electrolyte in electrode
- Electrode not connected
- Break in electrode cable
- Incorrect electrode connected

ERR --mV--

The measured electrode potential is below -1999 mV or above +1999 mV.

Possible causes:

- Electrode defective
- Electrode not connected
- Break in electrode cable

ERR °C

The measured temperature is below -50 °C or above +150 °C

Possible causes:

- Temperature probe defective
- Temperature probe short-circuited

Calibration error messages

When errors occur during calibration or when the determined electrode data are out of range, an error message will be displayed.

FAIL BUFF

The meter cannot identify the buffer solution in use. This message is only momentarily displayed during calibration.

Possible causes:

- Buffer solution used does not belong to selected buffer set
- Electrode defective
- Electrode not connected
- Break in electrode cable
- Wrong buffer temperature set (for manual temperature compensation)

SAME BUFF

The meter identified two identical buffer solutions. This message is only momentarily displayed during calibration.

Possible causes:

- Same or similar buffer solution used for second calibration step
- Buffer solutions contaminated
- Electrode defective
- Electrode not connected
- Open or short circuit in electrode cable

EL INST

Calibration was canceled after approx. 2 minutes, because the electrode drift was too large. This message is only momentarily displayed during calibration.

Possible causes:

- Electrode defective or dirty
- No electrolyte in the electrode
- Electrode cable insufficiently shielded or defective
- Strong electric fields influence the measurement
- Major temperature fluctuation of the buffer solution
- No buffer solution or extremely diluted

ERR ZERO

The electrode zero determined during calibration is out of range. Electrode zero is below pH 6 or above pH 8. This message is displayed in measuring mode after a calibration. It can only be reset by a new calibration.

Possible causes:

- Electrode "worn out"
- Buffer solutions contaminated
- Temperature probe not immersed in buffer (for manual temperature compensation)
- Wrong buffer temperature selected (for manual temperature compensation)
- Electrode has different nominal zero

ERR SLOP

The electrode slope determined during calibration is out of range. Electrode slope is below 47.0 mV/pH or above 61.0 mV/pH. This message is displayed in measuring mode after a calibration. It can only be reset by a new calibration.

Possible causes:

- Electrode "worn out"
- Buffer solutions contaminated
- Temperature probe not immersed in buffer (for manual temperature compensation)
- Wrong buffer temperature selected (for manual temperature compensation)
- Electrode used has different nominal slope

System error message

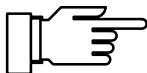
When a system error is found during the self test, an error message is displayed.

ERR SYST

Error in the factory settings or in a memory.

Possible causes:

- EPROM, EEPROM or RAM defective
- Error in factory settings



This error message normally should not occur, as the data are protected from loss by multiple safety functions. Should this error message nevertheless occur, there is no remedy. The meter must be recalibrated at the factory.



Opening the device exposes live parts. Therefore, it shall not be opened. If a repair should be required, return the device to our factory.

Appendix

Product line

		Ref. No.
Device	pH meter with power cord and instruction manual, without electrode	766
	pH meter with power cord, instruction manual and SE 101 electrode	766-SET A
	pH meter with power cord, instruction manual and SE 100 electrode	766-SET B
Accessories	Attachable stand, for ZU 6955 immersion stirrer and three sensors, directly connected to pH meter	ZU 6954
	Immersion stirrer, powered via ZU 6956 power pack	ZU 6955
	Power pack for immersion stirrer	ZU 6956
Sensors and buffer solutions	Combination pH/Pt 1000 electrode Body: glass, 165 mm	SE 100
	Combination pH/Pt 1000 electrode Body: plastic, 110 mm	SE 101
	Combination pH/Pt 1000 electrode Body: glass, 115 mm	SE 102
	Combination pH electrode Body: glass, 165 mm (recommended temp probe: ZU 6959)	SE 103
	pH puncture combination electrode Body: plastic, 99 mm	SE 104

Pt 1000 temperature probe, for fast response temperature measurements (stainless steel, -10 to +100 °C) ZU 6959

Calibration buffer set with Knick technical buffer solutions, (250 ml each of pH 4, pH 7, pH 9 and KCl solution) ZU 0261

Calibration buffer set with standard buffer solutions to DIN 19 266 and NIST (NBS), 250 ml each of pH 4, pH 7 and KCl solution) ZU 6941

Option

Power supply 115 V AC 363


Specifications

Ranges	pH: -2.00 to +16.00 mV: -1999 to +1999 °C: -50.0 to +150.0
Display	Alphanumeric 2 x 4-digit, 14-segment LED, character height 13 mm, measurement symbols pH/mV/°C/man 3 Sensoface [®] status indicators
Measuring cycle	Approx. 1.5/sec
Accuracy *	pH: < 0,01 mV: < 0.1 % ± 0.3 mV °C: < 0.3 K
Input	DIN 19 262
Input resistance	> 1 x 10 ¹² Ω
Input current	< 1 x 10 ⁻¹² A (20 °C) **
Temperature coefficient	< 0.1 count/K
Electrode standardization	Calimatic [®] automatic calibration and buffer recognition (German patent 29 37 227) For buffer tables refer to pages 35 to 39. Permissible calibration ranges: Zero: pH 6 to 8 Slope: 47 to 61 mV/pH (25 °C)
Sensor monitoring	Sensoface [®] : evaluation of zero, slope, response time and impedance of electrode; electrode condition displayed as good / average / poor DryCheck [®] : monitors electrode impedance for dry-out, glass breakage and defective connections, also in standby mode
Device self-test	GainCheck [®] : displays all Sensoface [®] criteria and electrode data, tests measurement electronics incl. memories, measured value processing and recorder output, checks display and keypad during diagnostics At power-on: automatic short check
Temperature compensation	Automatic: Pt 1000 Manual: 0.0 to + 100 °C ***

* ± 1 count

** at 45 °C: factor 10

*** User-defined

Recorder output Trueline®	pH-compensated, no quantizing levels mV: 1 mV/mV pH: 100 mV/pH Automatic matching to measured value setting
Calibration data storage	Automatic storage of calibration data and settings, self-contained
Data retention	>10 years (EEPROM)
Protection against electrical shock	Protective separation of all extra-low-voltage circuits against power supply to DIN VDE 0100 Part 410 as defined in DIN VDE 0106 Part 101 and according to DIN EN 61 010-1
EMC	2004/108/EC Emitted interference: Class B Immunity to interference: Industry To NAMUR recommendation Standards: DIN EN 61326-1(VDE 0843 Part 20-1): 2006-10 DIN EN 61326-2-3(VDE 0843 Part 20-2-3): 2007-05
Low voltage directive	2006/95/EC Standards: EN 61010-1: 2001
Temperature	Operation: 0 ... +45 °C Transport and storage -20 ... +70 °C
Power supply	230 V AC -15 % +10 %, 48 to 62 Hz, < 10 VA, Option 363: 115 V AC
Line fuse	32 mA slow, 5 x 20 mm dia (Option 363: 63 mA slow)
Protection class	II 
Enclosure	Glass reinforced polyamide 12, stainless steel cover, IP 54 protection, ready for connection of ZU 6954 attachable stand
Dimensions	244 x 95 x 255 mm (w x h x d)
Weight	Approx. 2 kg

Buffer tables

Buffer set 01

Mettler-Toledo technical buffers
(correspond to Ingold technical buffers)

°C	pH				
0	2.03	4.01	7.12	9.52	
5	2.02	4.01	7.09	9.45	
10	2.01	4.00	7.06	9.38	
15	2.00	4.00	7.04	9.32	
20	2.00	4.00	7.02	9.26	
25	2.00	4.01	7.00	9.21	
30	1.99	4.01	6.99	9.16	
35	1.99	4.02	6.98	9.11	
40	1.98	4.03	6.97	9.06	
45	1.98	4.04	6.97	9.03	
50	1.98	4.06	6.97	8.99	
55	1.98	4.08	6.98	8.96	
60	1.98	4.10	6.98	8.93	
65	1.99	4.13	6.99	8.90	
70	1.99	4.16	7.00	8.88	
75	2.00	4.19	7.02	8.85	
80	2.00	4.22	7.04	8.83	
85	2.00	4.26	7.06	8.81	
90	2.00	4.30	7.09	8.79	
95	2.00	4.35	7.12	8.77	

Buffer set 02

Merck Titrisol buffers and ready-to-use buffer solutions,
Riedel Fixanal buffers and ready-to-use buffer solutions

°C	pH				
0	2.01	4.05	7.13	9.24	12.58
5	2.01	4.04	7.07	9.16	12.41
10	2.01	4.02	7.05	9.11	12.26
15	2.00	4.01	7.02	9.05	12.10
20	2.00	4.00	7.00	9.00	12.00
25	2.00	4.01	6.98	8.95	11.88
30	2.00	4.01	6.98	8.91	11.72
35	2.00	4.01	6.96	8.88	11.67
40	2.00	4.01	6.95	8.85	11.54
45	2.00	4.01	6.95	8.82	11.44
50	2.00	4.00	6.95	8.79	11.33
55	2.00	4.00	6.95	8.76	11.19
60	2.00	4.00	6.96	8.73	11.04
65	2.00	4.00	6.96	8.72	10.97
70	2.01	4.00	6.96	8.70	10.90
75	2.01	4.00	6.96	8.68	10.80
80	2.01	4.00	6.97	8.66	10.70
85	2.01	4.00	6.98	8.65	10.59
90	2.01	4.00	7.00	8.64	10.48
95	2.01	4.00	7.02	8.64	10.37

Buffer set 03

Technical buffer solutions to DIN 19 267

°C	pH					
0	1.08	3.14*	4.67	6.89	9.48	13.95*
5	1.08	3.12*	4.67	6.87	9.43	13.63*
10	1.09	3.10	4.66	6.84	9.37	13.37
15	1.09	3.08	4.66	6.82	9.32	13.16
20	1.09	3.07	4.65	6.80	9.27	12.96
25	1.09	3.06	4.65	6.79	9.23	12.75
30	1.10	3.05	4.65	6.78	9.18	12.61
35	1.10	3.05	4.65	6.77	9.13	12.45
40	1.10	3.04	4.66	6.76	9.09	12.29
45	1.10	3.04	4.67	6.76	9.04	12.09
50	1.11	3.04	4.68	6.76	9.00	11.98
55	1.11	3.04	4.69	6.76	8.96	11.79
60	1.11	3.04	4.70	6.76	8.92	11.69
65	1.11	3.04	4.71	6.76	8.90	11.56
70	1.11	3.04	4.72	6.76	8.88	11.43
75	1.11	3.04	4.73	6.77	8.86	11.31
80	1.12	3.05	4.75	6.78	8.85	11.19
85	1.12	3.06	4.77	6.79	8.83	11.09
90	1.13	3.07	4.79	6.80	8.82	10.99
95	1.13*	3.08*	4.82*	6.81*	8.81*	10.89*

* Extrapolated

Buffer set 04

Standard buffer solutions to DIN 19 266 and NIST (NBS)

°C	pH				
0	1.666	4.010	6.948	9.464	13.423
5	1.668	4.004	6.951	9.395	13.207
10	1.670	4.000	6.923	9.332	13.003
15	1.672	3.999	6.900	9.276	12.810
20	1.675	4.001	6.881	9.225	12.627
25	1.679	4.006	6.865	9.180	12.454
30	1.683	4.012	6.853	9.139	12.289
35	1.688	4.021	6.844	9.102	12.133
40	1.694	4.031	6.838	9.068	11.984
45	1.700	4.043	6.834	9.038	11.841
50	1.707	4.057	6.833	9.011	11.705
55	1.715	4.071	6.834	8.985	11.574
60	1.723	4.087	6.836	8.962	11.449
65	1.733	4.109	6.841	8.942	11.330*
70	1.743	4.126	6.845	8.921	11.210*
75	1.755	4.145	6.852	8.903	11.100*
80	1.766	4.164	6.859	8.885	10.990*
85	1.779	4.185	6.868	8.868	10.890*
90	1.792	4.205	6.877	8.850	10.790*
95	1.806	4.227	6.886	8.833	10.690*

* Extrapolated

Buffer set 05

 Merck Titrisol buffers and ready-to-use buffer solutions,
 Riedel Fixanal buffers and ready-to-use buffer solutions

°C	pH					
0	0.96	3.05	6.04	8.15	10.26	13.80
5	0.99	3.05	6.02	8.10	10.17	13.59
10	0.99	3.03	6.01	8.07	10.11	13.37
15	0.99	3.01	6.00	8.04	10.05	13.18
20	1.00	3.00	6.00	8.00	10.00	13.00
25	1.01	3.00	6.02	7.96	9.94	12.83
30	1.01	3.00	6.03	7.94	9.89	12.67
35	1.01	3.00	6.03	7.92	9.84	12.59
40	1.01	2.98	6.04	7.90	9.82	12.41
45	1.01	2.98	6.05	7.88	9.78	12.28
50	1.01	2.97	6.06	7.85	9.74	12.15
55	1.02	2.97	6.08	7.84	9.71	11.95
60	1.02	2.97	6.10	7.83	9.67	11.75
65	1.02	2.97	6.11	7.82	9.65	11.68
70	1.02	2.97	6.12	7.80	9.62	11.61
75	1.02	2.97	6.14	7.79	9.59	11.50
80	1.02	2.97	6.17	7.78	9.55	11.39
85	1.02	2.97	6.20	7.77	9.52	11.27
90	1.02	2.96	6.24	7.75	9.49	11.15
95	1.02	2.96	6.28	7.74	9.46	11.03

Buffer set 06

Merck ready-to-use buffer solutions

°C	pH		
0	4.68	6.98	9.46
5	4.68	6.95	9.40
10	4.67	6.92	9.33
15	4.67	6.90	9.28
20	4.66	6.88	9.22
25	4.66	6.86	9.18
30	4.66	6.86	9.14
35	4.66	6.85	9.10
40	4.67	6.84	9.07
45	4.68	6.84	9.04
50	4.68	6.84	9.01
55	4.69	6.84	8.99
60	4.70	6.84	8.96
65	4.71*	6.84	8.95
70	4.72*	6.84	8.93
75	4.74*	6.85	8.91
80	4.75*	6.86	8.89
85	4.77*	6.87	8.87
90	4.79*	6.88	8.85
95	4.81*	6.89	8.83

* Values to DIN 19 267
 (not defined by Merck)

Buffer set 07

Ciba (94)

Nominal value: 2.06, 4.00, 7.00, 10.00

°C	pH			
0	2.04	4.00	7.10	10.30
5	2.09	4.02	7.08	10.21
10	2.07	4.00	7.05	10.14
15	2.08	4.00	7.02	10.06
20	2.09	4.01	6.98	9.99
25	2.08	4.02	6.98	9.95
30	2.06	4.00	6.96	9.89
35	2.06	4.01	6.95	9.85
40	2.07	4.02	6.94	9.81
45	2.06	4.03	6.93	9.77
50	2.06	4.04	6.93	9.73
55	2.05	4.05	6.91	9.68
60	2.08	4.10	6.93	9.66
65	2.07 ₅	4.10 ₅	6.92 ₅	9.61 ₅
70	2.07	4.11	6.92	9.57
75	2.04 ₅	4.13 ₅	6.92 ₅	9.54 ₅
80	2.02	4.15	6.93	9.52
85	2.03	4.17 ₅	6.95	9.47 ₅
90	2.04	4.20	6.97	9.43
95	2.05*	4.22 ₅ *	6.99*	9.38 ₅ *

* Extrapolated

₅ Interpolated

Glossary

Buffer set	Contains selected buffer solutions which can be used for automatic calibration with the Knick Calimatic [®] . The buffer set must be selected prior to the first calibration.
Buffer solution	Solution with an exactly defined pH value for calibrating a pH meter.
cal	Key for activating the Calibration.
Calibration	Adjustment of the pH meter to the current electrode characteristics. Zero and slope are adjusted. You can conduct either a one or a two-point calibration.
Calibration buffer set	See buffer set
Calimatic[®]	Automatic buffer recognition. Before the first calibration, the buffer set used must be activated once. The patented Calimatic [®] then automatically recognizes the buffer solution used during calibration.
Combination electrode	Combination of glass and reference electrode in one body.
diag	Key for activating the Diagnostics.
DryCheck[®]	DryCheck [®] monitors the electrode and alerts to dry-out, glass breakage and defective connections.
Electrode slope	Specified in mV/pH. It is different for each electrode and changes with age and wear.
Electrode zero point	Voltage output by a pH electrode at pH 7 (for deviating nominal zero point at correspondingly different pH value). It is different for each electrode and changes with age and wear.

GainCheck[®]

Complete diagnostics and comprehensive self test of device. All Sensoface[®] criteria and electrode data are displayed, memories, complete measuring circuitry, measured value processing, display and keypad are checked and the result of each testing step is displayed.

GLP

Good Laboratory Practice: Guidelines for performance and documentation of measurements in the laboratory.

meas

This key allows return to measuring mode from all other levels.

Measuring mode

When no function is activated, the meter is in measuring mode. The left display shows the selected measured variable, the right display the temperature.

NAMUR

German committee for measurement and control standards in the chemical industry

Nominal electrode slope

Nominal value of electrode slope. For commercial electrodes, the nominal slope is 59.2 mV/pH at 25 °C. Special electrodes, such as Pfaudler or Antimony probes, can have a different slope.

Nominal electrode zero point

Nominal value of electrode zero point. For commercial electrodes, the nominal electrode zero point is at pH 7. Please note that special electrodes can have a different zero point.

One-point calibration

Calibration that only takes account of the electrode zero point. The previous slope value is retained. Only one buffer solution is required for a one-point calibration.

pH electrode

A pH electrode system consists of a glass and a reference electrode. If they are combined in one body, they are referred to as combination electrode.

Response time

Time from the start of a calibration step to the stabilization of the electrode potential.

Sensoface[®]	Automatic electrode monitoring. The Sensoface [®] display provides information on the electrode condition. Zero point, slope, response time, impedance and dry-out of the electrode are evaluated.
Short diagnostics	Short diagnostics only displays the status of those Sensoface [®] criteria that have led to a devaluation.
Slope	See Electrode slope.
Trueline[®]	Trueline [®] recorder output provides a pH-calibrated analog output signal, without disturbing voltage steps.
Two-point calibration	Calibration that takes account of zero point and slope of the electrode. Two buffer solutions are required for two-point calibration.
Zero point	See Electrode zero point.

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