

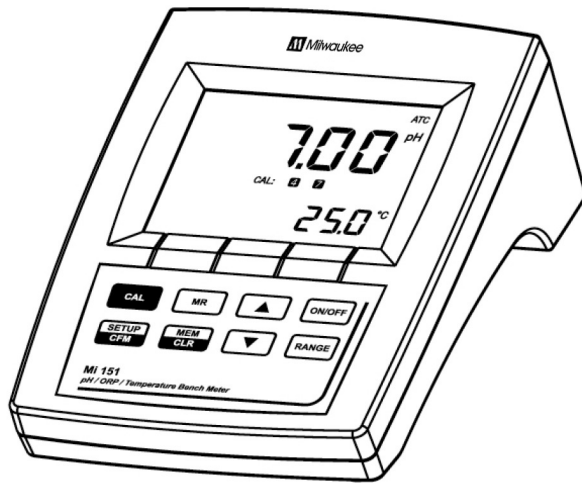
# INSTRUCTION MANUAL

## Bench Meters



■ **Mi 150**  
pH/Temperature

■ **Mi 151**  
pH/ORP/Temperature



 **Milwaukee**

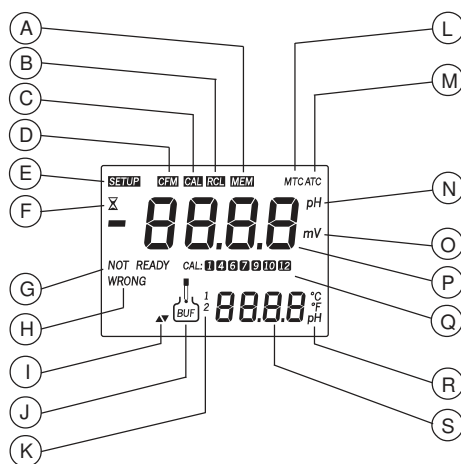
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FUNCTIONAL DESCRIPTION..... 2  
 GENERAL DESCRIPTION..... 4  
 SPECIFICATIONS..... 5  
 OPERATIONAL GUIDE..... 6  
 pH CALIBRATION..... 10  
 pH BUFFER TEMPERATURE DEPENDENCE..... 14  
 SETUP..... 14  
 mV CALIBRATION..... 16  
 TEMPERATURE CALIBRATION..... 16  
 ELECTRODE CONDITIONING & MAINTENANCE..... 16  
 TROUBLESHOOTING..... 18  
 ACCESSORIES..... 19

FUNCTIONAL DESCRIPTION

DISPLAY

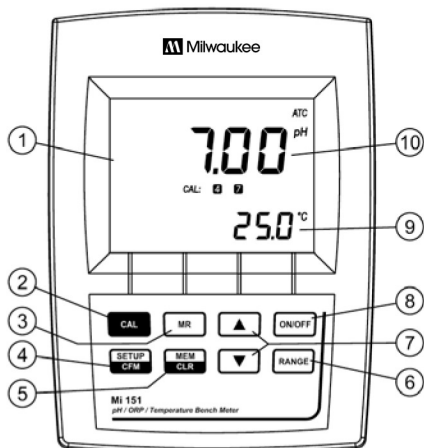
- A. MEMORY INDICATOR
- B. RECALL MEMORY VALUE
- C. CALIBRATION
- D. CONFIRM
- E. SETUP
- F. METER WORKING
- G. WAITING FOR CALIBRATION
- H. WRONG BUFFER
- I. UP/DOWN TEMPERATURE
- J. PRE-MEMORIZED BUFFERS
- K. FIRST & SECOND BUFFER INDICATOR
- L. MANUAL TEMPERATURE COMPENSATION MODE
- M. AUTOMATIC TEMPERATURE COMPENSATION MODE
- N. pH MEASURING UNIT
- O. mV MEASURING UNIT
- P. pH OR mV READING
- Q. SELECTED BUFFERS
- R. UNIT MEASUREMENT
- S. READING TEMPERATURE/ BUFFER CALIBRATION



## FUNCTIONAL DESCRIPTION

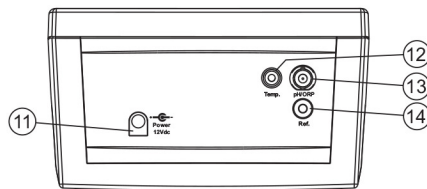
### FRONT PANEL

1. Liquid Crystal Display (LCD).
2. CAL key, to enter/exit calibration mode.
3. MR key, to recall the stored value from memory.
4. SETUP/CFM key, to enter setup mode or to confirm calibration.
5. MEM/CLR key, to store the reading in memory or to clear calibration.
6. RANGE key (Mi 151 only), to select pH or mV.
7. UP and DOWN arrow keys, for manual temperature setting, entering menu parameters and choosing calibration buffers.
8. ON/OFF key, to turn the meter ON and OFF.
9. Secondary LCD.
10. Primary LCD.



### REAR PANEL

11. Power supply socket.
12. Temperature probe socket.
13. BNC electrode connector.
14. Reference electrode socket.



## GENERAL DESCRIPTION

Thank you for choosing Martini Instruments. This instruction manual will provide you the necessary information for correct use of the meters. **Mi 150** and **Mi 151** are advanced pH/ORP/Temp microprocessor-based bench meters.

These meters are provided with a series of new diagnostic features which add an entirely new dimension to the measurement of pH/ORP, by allowing the user to dramatically improve the reliability of the measurement:

- 7 memorized buffers (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45) for calibration;
- Messages on the LCD to make the calibration easy and accurate;
- User-selectable "calibration time out" to remind when a new calibration is necessary;

**Mi 151** can also measure with ORP electrodes, thanks to its capability to measure mV with a resolution up to 0.1 mV.

Moreover, it offers an extended temperature range from  $-20\text{ }^{\circ}\text{C}$  ( $-4\text{ }^{\circ}\text{F}$ ) to  $120\text{ }^{\circ}\text{C}$  ( $248\text{ }^{\circ}\text{F}$ ), using **MA 831R** interchangeable temperature probe.

For accurate measurements, use *the* electrode holder supplied with meter.

Each Bench Meter is supplied with:

- MA 917B/1 pH Electrode
- MA 831R Temperature Probe
- MA 9315 Electrode Holder
- M 10004 pH 4.01 Sachet Buffer Solution
- M 10007 pH 7.01 Sachet Buffer Solution
- M 10010 pH 10.01 Sachet Buffer Solution
- M 10016 Sachet Electrode Cleaning Solution
- Graduate Pipet
- 12 VDC Adapter
- Instruction manual



*These instruments are in compliance with the CE Directives.*

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**SPECIFICATIONS**


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|                            |   |
|----------------------------|---|
| Range                      | -2.00 to 16.00 pH<br>± 699.9 mV / ± 1999 mV ( <b>Mi 151</b> only)<br>-20.0 to 120.0 °C (-4.0 to 248.0 °F) |
| Resolution                 | ± 0.01 pH<br>0.1 mV / 1 mV ( <b>Mi 151</b> only)<br>0.1 °C (0.1 °F)                                       |
| Accuracy (@ 20 °C / 68 °F) | ± 0.01 pH<br>± 0.2 mV / ± 1 mV ( <b>Mi 151</b> only)<br>± 0.4 °C (± 0.8 °F)                               |
| Typical EMC Deviation      | ± 0.02 pH<br>± 0.2 mV / ± 1 mV ( <b>Mi 151</b> only)<br>± 0.4 °C (± 0.8 °F)                               |
| pH Automatic Calibration   | 1 or 2 point-calibration, with 7 memorized buffers  |
| Offset Calibration         | ± 1 pH  |
| Slope Calibration          | From 80 to 108%   |
| Temperature Compensation   | Automatic, from -20.0 to 120.0 °C (-4.0 to 248.0 °F)<br>or manual, without temperature probe              |
| pH Electrode               | MA 917B/1 (included)  |
| Temperature Probe          | MA 831R (included)  |
| Input Impedance            | 10 <sup>12</sup> ohms   |
| Power supply               | 12 VDC power adapter  |
| Dimensions                 | 230 x 160 x 95 mm (9.0 x 6.3 x 3.7")  |
| Weight                     | 0.9 kg (2.0 lb.)  |
| Environment                | 0 to 50 °C ; max RH 95%   |
| Warranty                   | 3 years   |

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## OPERATIONALGUIDE

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### **INITIAL PREPARATION**

Plug the 12 VDC adapter into the power supply socket.

To prepare the instrument for use, connect the pH electrode to the BNC connector and the temperature probe to the appropriate socket on the rear panel of the instrument. The temperature probe is used in conjunction with the pH electrode to utilize the instrument's ATC capability, but it can also be used independently to take temperature measurements. If the probe is disconnected, temperature can be set manually with the UP and DOWN arrow keys (see page 3 for details). Install electrode holder and turn the instrument ON by pressing ON/OFF.

At start up the display will show all the used segments for a few seconds (or while the button is held), and then will enter normal measurement mode.

After measurement switch the meter off, clean the electrode and store it with a few drops of **MA9015** storage solution in the protection cap.

The auto-off feature turns the meter off after 20 minutes of non-use. To disable this feature, see SETUP menu on page 14.

### **pH MEASUREMENTS**

To take a pH measurement remove the electrode protective cap and simply submerge the tip (4cm/ 1 1/2") of the electrode and the temperature probe into the sample to be tested.

If necessary, press the RANGE key (**Mi 151** only) until the display changes to the pH mode.

Allow for the electrode to adjust and reading to stabilize (hourglass symbol turns off).

The LCD will show the measured pH value on the primary LCD and the temperature of the sample on the secondary LCD.

In order to take more accurate pH measurements, make sure that the instrument is calibrated (see page 10 for details).

It is recommended that the electrode is always kept wet and rinsed thoroughly with the sample to be measured before use. The pH reading is directly affected by temperature.



In order for the instrument to measure the pH accurately, temperature must be taken into consideration. If the sample temperature is different from the temperature at which the pH electrode was kept, allow a few minutes to reach thermal equilibrium.

To use the meter's Automatic Temperature Compensation feature, submerge the temperature probe into the sample as close to the electrode as possible and wait for a few seconds.

If manual temperature compensation (MTC) is desired, the temperature probe must be disconnected from the instrument.

The display will show the default temperature of 25 °C or the last temperature set with the "°C" (or "°F") indicator blinking.



The "MTC" tag and up & down arrows symbols light up on the LCD to indicate that the instrument is in MTC mode and the arrow keys can be used to enter the desired temperature value.

**Note:** When in MTC the user can press and hold the arrow keys, and the instrument will start incrementing/decrementing the temperature value. The meter keeps measuring and the display is updated every second.

## **ORP MEASUREMENTS (Mi 151 only)**

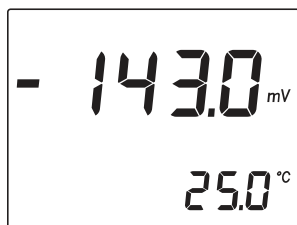
To perform ORP measurements, connect an optional ORP electrode (see "Accessories" section for code) to the instrument and turn it ON.

If necessary, enter the mV mode by pressing the RANGE key until the display changes to mV.

Submerge the ORP electrode tip (4 cm/1 1/2") into the sample to be tested and wait a few minutes for the reading to stabilize.

Measurements within the  $\pm 699.9$  mV range are displayed with 0.1 mV resolution, while outside this range the resolution automatically switches to 1 mV.

The LCD will show the measured mV value on the primary LCD and the temperature of the sample on the secondary LCD.



The "ATC" (or "MTC") tag is turned off because mV readings are not temperature compensated.

For accurate ORP measurements, the surface of the electrode must be clean and smooth. Pretreatment solutions are available to condition the electrode and improve its response time (see "Accessories" section).

## **Notes:**

- When the reading is out of range, the display will flash the closest full-scale value.
- If using pH electrode while in mV mode, the instrument will measure the mV generated by the pH electrode.



### MEM & MR FUNCTIONS

From normal measurement mode, pressing the MEM key will freeze the readings on the display and store into internal memory the current values (pH and temperature, or mV and temperature).

The “MEM” tag blinks and the display remains frozen until the MEM key is pressed again.



**Note:** While in MEM mode, the user can switch between pH and mV by pressing the RANGE key (Mi 151 only).

Last stored value can be recalled by pressing the MR key: the LCD will show the value, together with the “RCL” and “MEM” tags, as long as the MR key is pressed.



**Note:** Pressing MR, only the range that was active at the time MEM was pressed is shown (Mi 151 only).

## pH CALIBRATION

It is recommended to calibrate the instrument frequently, especially if high accuracy is required.

The pH calibration is also necessary in the following cases:

- a) Whenever the pH electrode is replaced.
- b) At least once a week.
- c) After testing aggressive chemicals.
- d) When extreme accuracy is required.
- e) When the calibration time out is expired (if feature is enabled).

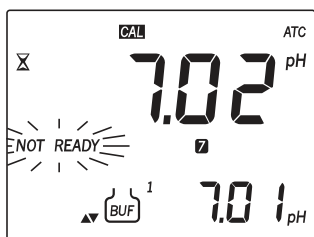
### PROCEDURE

One or two-point calibration can be performed, using 7 pre-memorized buffers (1.68, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45 pH).

- Pour small quantities of selected buffer solutions into clean beakers. For accurate calibration use two beakers for each buffer solution, the first one for rinsing the electrode and the second one for calibration.
- Remove the protective cap and rinse the electrode with some of the buffer solution to be used for the first calibration point.

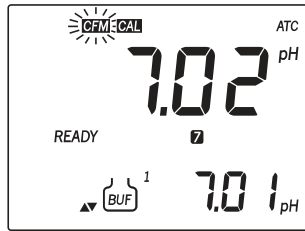
### TWO-POINT CALIBRATION

- Press the CAL key. The "CAL" and "Buf" indicators will be displayed. The secondary LCD will display buffer "7.01". If a different calibration buffer is desired (i.e. "6.86"), use the UP and DOWN arrow keys to change the displayed value.

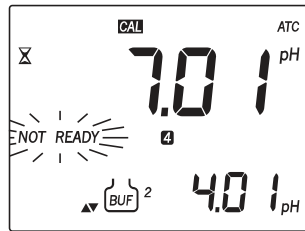


- Submerge the electrode approximately 4 cm (1½") into the solution, place the temperature probe as close to the electrode as possible and stir gently.
- The LCD will flash "NOT READY" for 12 seconds, then:  
if the reading is not close to the selected buffer, "WRONG Buf" and "WRONG T" will blink alternatively;

if it is close to the selected buffer, the instrument will advise the user with an acoustic signal (if enabled) when the reading becomes stable, and the display will change to "READY" and blinking "CFM".

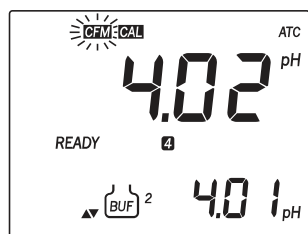


- Press the CFM key to confirm the calibration: the instrument stores the first calibration point; the primary LCD will show the calibrated reading, while the secondary LCD will show the second buffer to be used for calibration (pH 4.01).



If you're going to calibrate with a different buffer, select the desired value by pressing the arrow keys.

- Submerge the electrode approximately 4 cm (1 1/2") into the second buffer solution, place the temperature probe as close as possible to the electrode and stir gently.
- The LCD will flash "NOT READY" for 12 seconds, then:
  - if the reading is not close to the selected buffer, "WRONG (BUF)" and "WRONG ↓" will blink alternatively;
  - if it is close to the selected buffer, the instrument will advise the user with an acoustic signal (if enabled) when the reading becomes stable, and the display will change to "READY" and blinking "CFM".



- Press the CFM key: the value is stored in memory and the instrument returns to normal mode. The tags corresponding to the buffers used for calibration will light up.



## Notes:

- The meter automatically skips the buffer used for the first calibration point to avoid erroneous procedure. A difference of at least 1.5 pH unit is required between the two buffers used for the offset and slope calibration: once calibrated at either pH 7.01 or 6.86, the instrument automatically ignores the other value for the second point (same for pH 10.01 and 9.18).
- During calibration, the secondary LCD shows the selected buffer value; press the RANGE key to display the buffer temperature.
- To clear a previous calibration and return to the default values, press CLR at any time after entering the calibration mode. The LCD will show "CLr CAL" for one second, and then will return to normal measurement mode.



#### **ONE-POINT CALIBRATION**

For optimum accuracy it is always recommended to perform a two-point calibration, but for a faster operation it is also possible to carry out a single-point calibration. Buffers at pH 7.01 or pH 6.86 (NIST) are normally the most appropriate for this purpose, even though the instrument can be calibrated with any of the memorized pH buffers.

After calibrating the first point (see above), press the CAL key to end the calibration procedure.

#### **EXPIRED CALIBRATION**

The instrument is provided with a real time clock (RTC), in order to monitor the time elapsed since the last pH calibration.

The real time clock is reset every time the instrument is calibrated and the “expired calibration” status is triggered when the meter detects a calibration time out. The “CAL” tag will start blinking to warn the user that the instrument should be recalibrated.

The calibration time out can be set (see SETUP menu for details, page 14) from 0 (function disabled) to 14 days.

For example, if a 4 days time out has been selected, the instrument will issue the alarm exactly 4 days after the last calibration.

However, if at any moment the expiration value is changed (i.e. to 7 days), then the alarm will be immediately recalculated and will appear 7 days after the last calibration.

#### **Notes:**

- When the instrument is not calibrated or calibration is cleared (default values loaded) there is no “expired calibration”, and the display always shows a blinking “CAL” tag.
- When an abnormal condition in the RTC is detected, the instrument forces the “expired calibration” status.

**pH BUFFER TEMPERATURE DEPENDENCE**

The temperature has an effect on pH. The calibration buffer solutions are affected by temperature changes to a lesser degree than normal solutions. During calibration the instrument will automatically calibrate to the pH value corresponding to the measured or set temperature. During calibration the instrument will display the pH buffer value at 25 °C.

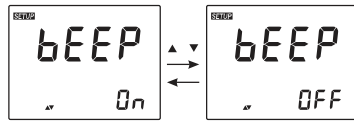
| TEMP |     | pH BUFFERS |      |      |      |      |       |       |
|------|-----|------------|------|------|------|------|-------|-------|
| °C   | °F  | 1.68       | 4.01 | 6.86 | 7.01 | 9.18 | 10.01 | 12.45 |
| 0    | 32  | 1.67       | 4.01 | 6.98 | 7.13 | 9.46 | 10.32 | 13.38 |
| 5    | 41  | 1.67       | 4.00 | 6.95 | 7.10 | 9.39 | 10.24 | 13.18 |
| 10   | 50  | 1.67       | 4.00 | 6.92 | 7.07 | 9.33 | 10.18 | 12.99 |
| 15   | 59  | 1.67       | 4.00 | 6.90 | 7.05 | 9.27 | 10.12 | 12.80 |
| 20   | 68  | 1.68       | 4.00 | 6.88 | 7.03 | 9.22 | 10.06 | 12.62 |
| 25   | 77  | 1.68       | 4.01 | 6.86 | 7.01 | 9.18 | 10.01 | 12.45 |
| 30   | 86  | 1.68       | 4.02 | 6.85 | 7.00 | 9.14 | 9.96  | 12.29 |
| 35   | 95  | 1.69       | 4.03 | 6.84 | 6.99 | 9.11 | 9.92  | 12.13 |
| 40   | 104 | 1.69       | 4.04 | 6.84 | 6.98 | 9.07 | 9.88  | 11.98 |
| 45   | 113 | 1.70       | 4.05 | 6.83 | 6.98 | 9.04 | 9.85  | 11.83 |
| 50   | 122 | 1.71       | 4.06 | 6.83 | 6.98 | 9.01 | 9.82  | 11.70 |
| 55   | 131 | 1.72       | 4.08 | 6.84 | 6.98 | 8.99 | 9.79  | 11.57 |
| 60   | 140 | 1.72       | 4.09 | 6.84 | 6.98 | 8.97 | 9.77  | 11.44 |
| 65   | 149 | 1.73       | 4.11 | 6.84 | 6.99 | 8.95 | 9.76  | 11.32 |
| 70   | 158 | 1.74       | 4.12 | 6.85 | 6.99 | 8.93 | 9.75  | 11.21 |
| 75   | 167 | 1.76       | 4.14 | 6.86 | 7.00 | 8.91 | 9.74  | 11.10 |
| 80   | 176 | 1.77       | 4.16 | 6.87 | 7.01 | 8.89 | 9.74  | 11.00 |
| 85   | 185 | 1.78       | 4.17 | 6.87 | 7.02 | 8.87 | 9.74  | 10.91 |
| 90   | 194 | 1.79       | 4.19 | 6.88 | 7.03 | 8.85 | 9.75  | 10.82 |
| 95   | 203 | 1.81       | 4.20 | 6.89 | 7.04 | 8.83 | 9.76  | 10.73 |

**SETUP**

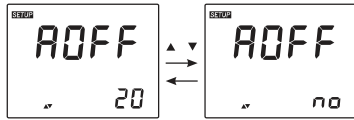
The instrument allows the user to configure several parameters through the SETUP menu. To enter menu mode, press and hold the SETUP key for about 5 seconds while in normal measurement mode. Once the menu is entered, each parameter can be changed by using the arrow keys. Pressing the CFM key will confirm the value and scroll to the next parameter.

The sequence of programmable parameters is as follows:

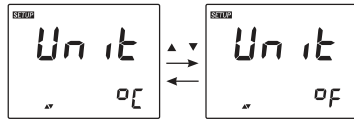
1. Acoustic signal: On (default) or Off



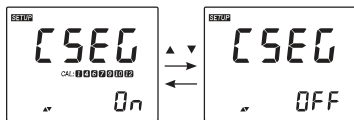
2. Auto-off feature: 20 minutes (default) or disabled



3. Temperature reading unit: °C (default) or °F

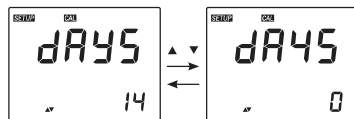


4. Calibration segments: On (default) or Off (this enables or disables the buffer segments)



5. Calibration time out: 1 (default) to 14 days, or disabled (0 days)

After setting the last parameter, pressing the CFM key will confirm the value and return to normal measurement mode.



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mV CALIBRATION (Mi 151)

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**Mi 151** has been accurately precalibrated for mV range at the factory. For optimum accuracy, it is recommended to recalibrate the instrument for mV readings at least once a year. Contact your dealer or Milwaukee Instruments Customer Service Center for more information.

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TEMPERATURE CALIBRATION

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**Mi 150 and Mi 151** have been accurately precalibrated for temperature at the factory. For optimum accuracy, it is recommended to recalibrate the instrument for temperature at least once a year. Contact your dealer or Milwaukee Instruments Customer Service Center for more information.

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ELECTRODE CONDITIONING & MAINTENANCE

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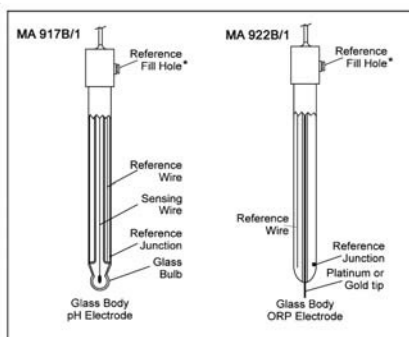
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**PREPARATION PROCEDURE**

Remove the electrode protective cap. **DO NOT BE ALARMED IF ANY SALT DEPOSITS ARE PRESENT.** This is normal with electrodes and they will disappear when rinsed with water.

During transport tiny bubbles of air may have formed inside the glass bulb. The electrode cannot function properly under these conditions. These bubbles can be removed by "shaking down" the electrode as you would do with a glass thermometer.

If the bulb and/or junction are dry, soak the electrode in **M 10016** cleaning solution for at least 1/2 hour. For refillable electrodes, if the refill solution (electrolyte) is more than 2 1/2 cm (1") below the fill hole, add the appropriate electrolyte solution.



\*Not present in gel-filled electrodes



### **MEASUREMENT**

Rinse the electrode tip with distilled water, immerse it (4 cm / 1½") into the sample and stir gently for a few seconds. For a faster response and to avoid cross contamination of the samples, rinse the electrode tip with the solution to be tested before taking any measurements.

### **STORAGE PROCEDURE**

To minimize clogging and ensure a quick response time, the glass bulb and the junction should always be kept moist.

When not in use, store it with a few drops of **MA 9015** storage solution (not included with Bench Meters) in the protective cap.

NEVER STORE THE ELECTRODE IN DISTILLED OR DEIONIZED WATER

### **PERIODIC MAINTENANCE**

Inspect electrode and cable. The cable used for the connection to the instrument must be intact and there must be no points of broken insulation on the cable or cracks on the electrode stem or bulb. If any scratches or cracks are present, replace the electrode.

Rinse off any salt deposits with water.

Connectors must be perfectly clean and dry.

For refillable electrodes:

Refill the electrode with fresh electrolyte (see the electrode's specifications to select the correct refilling solution). Allow the electrode to stand upright for 1 hour. Follow the Storage Procedure above.

### **CLEANING PROCEDURE**

- General: Soak in **MA 9016** General Cleaning Solution for approx. ½ hour.  
(not included with Bench Meters)

**IMPORTANT:** After performing any of the cleaning procedures, rinse the electrode thoroughly with distilled water and soak it in **MA 9015** storage solution for at least 1 hour before taking measurements.

TROUBLESHOOTING

| SYMPTOMS  | PROBLEM  | SOLUTION  |
|---|--|---|
| Slow reponse/excessive drift.                             | Dirty pH electrode.  | Soak the electrode tip in MA9016 for 30 minutes and then follow the Cleaning Procedure.               |
| Reading fluctuates up and down (noise).                   | Clogged/dirty Junction.<br>Low electrolyte level (refillable electrodes only).     | Clean the electrode. Refill with fresh electrolyte MA9012 (refillable electrodes only).               |
| Display shows blinking full scale value                   | Reading out of range   | Check the sample is within measurable range;<br>Check electrolyte level and general electrode status. |
| mV scale out of range.                                    | Dry membrane or dry junction.  | Soak electrode in MA9015 storage solution for at least 30 minutes.                                    |
| Display shows blinking "C" or "F".                        | Out of order temperature probe.  | Replace temperature probe.  |
| Meter does not work with temperature probe.               | Broken temperature probe.  | Replace temperature probe.  |
| Meter fails to calibrate or gives faulty readings.        | Broken pH electrode.   | Replace electrode.  |
| "WRONG CAL" is displayed during pH calibration procedure. | Wrong or contaminated buffer.  | Check that buffer solution is correct and fresh.  |
| Meter shuts off.  | Auto-off feature is enabled: in this case, meter shuts off after 20 min on non-use | Press ON/OFF.   |
| "Er0, Er1, Er2" message at start up.                      | EEPROM error.  | Contact your dealer or Milwaukee Instruments Service Center.  |
| "Clr" message at start up.                                | Loaded default pH calibration values.  | Perform pH calibration.   |

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**ACCESSORIES**


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|                  |   |
|------------------|---|
| <b>MA 9001</b>   | pH 1.68 Buffer Solution (230 mL bottle)             |
| <b>MA 9004</b>   | pH 4.01 Buffer Solution (230 mL bottle)             |
| <b>MA 9006</b>   | pH 6.86 Buffer Solution (230 mL bottle)             |
| <b>MA 9007</b>   | pH 7.01 Buffer Solution (230 mL bottle)             |
| <b>MA 9009</b>   | pH 9.18 Buffer Solution (230 mL bottle)             |
| <b>MA 9010</b>   | pH 10.01 Buffer Solution (230 mL bottle)            |
| <b>MA 9012</b>   | Refilling Solution for pH electrode (230 mL bottle) |
| <b>MA 9015</b>   | Storage Solution (230 mL bottle)                    |
| <b>MA 9016</b>   | Electrode Cleaning Solution (230 mL bottle)         |
| <b>MA 9112</b>   | pH 12.45 Buffer Solution (230 mL bottle)            |
| <b>MA 9310</b>   | 12 VDC Adapter, 220 V                               |
| <b>MA 9311</b>   | 12 VDC Adapter, 110 V                               |
| <b>MA 9315</b>   | Electrode Holder                                    |
| <b>MA 917B/1</b> | pH Electrode, glass body, refillable                |
| <b>MA 922B/1</b> | ORP Electrode, glass body, refillable               |
| <b>MA 831R</b>   | Temperature Probe                                   |

For your Safety don't use or store the instrument in hazardous environments. To avoid damages or burns, do not perform any measurement in microwave ovens.

**WARRANTY**

These instruments are warranted against defects in materials and manufacturing for a period of 3 years from the date of purchase. Electrodes and Probes are warranted for 6 months. If during this period the repair or replacement of parts is required, where the damage is not due to negligence or erroneous operation by the user, please return the instruments, electrode and probe to either distributor or our office and the repair will be effected free of charge.

Damage due to accidents, misuse, tampering or lack of prescribed maintenance is not covered by the warranty.

Milwaukee Instruments reserves the right to make improvements design, construction and appearance of its products without advance notice.

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THANK YOU FOR CHOOSING



Sales and Technical Service Contacts:

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6726, Szeged, Hungary  
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