

THANK YOU FOR CHOOSING

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instruments

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Bench Meter



■ **Mi 190**
DO/Temperature



www.martini-instruments.com

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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

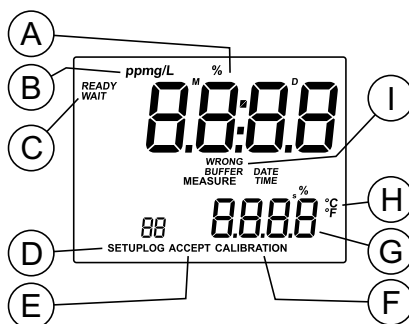
This instrument is warranted against defects in materials and manufacturing for a period of 3 years from the date of purchase. Electrodes are warranted for 6 months. If during this period the repair or replacement of parts is required, where the damage is not due to negligence or erroneous operation by the user, please return the intrument, 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/Martini instruments reserves the right to make improvements in design, construction and appearance of its products without advance notice.

FUNCTIONAL DESCRIPTION

DISPLAY

- A. PRIMARY DISPLAY
- B. MEASURING UNIT FOR PRIMARY DISPLAY
- C. CALIBRATION MESSAGES
- D. SETUP, LOG MODE
- E. REQUIRE USER CONFIRMATION
- F. CALIBRATION MODE
- G. SECONDARY DISPLAY
- H. TEMPERATURE UNIT
- I. CALIBRATION WRONG MESSAGE



TROUBLESHOOTING

SYMPTOMS	PROBLEM	SOLUTION
Reading fluctuates up and down (noise).	DO probe not properly connected.	Insert the probe.
Display shows DO reading blinking.	Reading out of range.	Recalibrate the meter; Check the sample is within measurable range;
Meter fails to calibrate or gives faulty readings.	Broken DO probe.	Replace the probe.
At startup the meter displays all LCD tags permanently	One of the keys is blocked.	Check the keyboard or contact your dealer.
"Err xx" message displayed at start up.	Internal error.	Contact your dealer or any Martini Instruments Service Center.

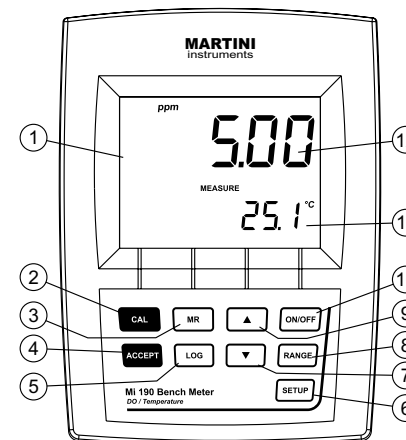
ACCESSORIES

- MA 9070 Zero Oxygen Solution, 230 ml
- MA 9071 Refilling Electrolyte Solution, 30 ml
- MA 9311 115VAC to 12VDC converter
- MA 9310 230VAC to 12VDC converter
- MA 840/2 Spare probe with 2 meters (6.7) cable
- MA 840/10 Spare probe with 10 meters (33) cable
- MA 840/20 Spare probe with 20 meters (67) cable
- MA 841 5 spare membranes
- MA 5200 Windows® compatible software application
- MA 9350 9-pin PC connection cable

FUNCTIONAL DESCRIPTION

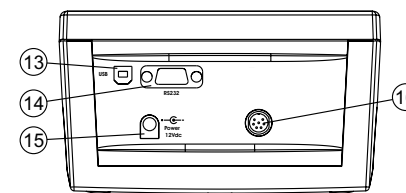
FRONT PANEL

1. Liquid Crystal Display (LCD)
2. CAL key, to enter/exit calibration mode
3. MR key, to enter/exit recall mode
4. ACCEPT key, to confirm value
5. LOG key, to store reading in memory
6. SETUP key, to enter/exit setup mode or to toggle between delete one and all logged data
7. ▼ key, to select SETUP item or to decrease parameter value
8. RANGE key, to select measurement unit/switch focused data
9. ▲ key, to select SETUP item or to increase parameter value
10. ON/OFF key, to turn the meter ON and OFF
11. Secondary LCD
12. Primary LCD



REAR PANEL

13. USB connector
14. RS232 connector
15. Power supply socket
16. DIN connector for probe



GENERAL DESCRIPTION

Thank you for choosing Martini Instruments. This instruction manual will provide you the necessary information for correct use of the meter.

Mi 190 is a logging microprocessor-based DO and Temperature bench meter.

Dissolved Oxygen is indicated in ppm (parts per million) or in %.

All measurements are automatically compensated for temperature. Salinity compensation in water allows direct determination of Dissolved Oxygen in saline waters and altitude compensation readjusts for the altitude variance.

The Dissolved Oxygen probe has a membrane covering the polarographic sensors and a built-in thermistor for temperature measurements and compensation.

This permeable Teflon® membrane isolates the sensor elements from the testing solution, but allows Oxygen to pass through. When a voltage is applied across the sensor, oxygen that has passed through the membrane reacts causing a current flow, and hence determining a reading.

This Bench Meter is supplied with:

- MA 840/2 DO probe
- MA 841 membrane cap
- MA 9071 electrolyte solution
- MA 9315 Electrode Holder
- Mi 5200 Application Software
- MA 9350 RS232 Connector cable (2 meters)
- 12 VDC Adapter
- Instruction Manual

PROBE MAINTENANCE

The oxygen probe body is made of reinforced plastic for maximum durability.

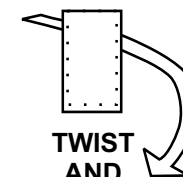
A thermistor temperature sensor provides temperature measurements of the sample.

Use the protective probe cap when not in use.

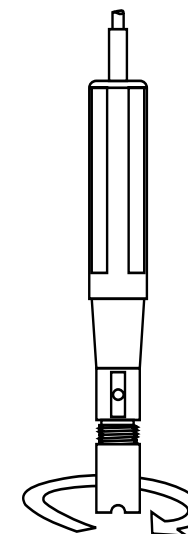
To replace the membrane or refill with electrolyte, proceed as follows:

- Remove the protective cap by gently twisting and pulling it off the body of the probe (see fig. 1).
- Unscrew the membrane cap by turning it counterclockwise (see fig.2).
- Wet the sensor by soaking the bottom 2½ cm (1") of the probe in electrolyte (MA 9071) for 5 minutes.
- Rinse the new membrane cap (MA 841), supplied with the meter with electrolyte solution while shaking it gently. Refill with clean electrolyte solution.
- Gently tap the sides of the membrane cap with your finger tip to ensure that no air bubbles remain trapped. Do not tap directly the bottom with your finger, as this will damage the membrane.
- Make sure that the rubber O-ring sits properly inside the membrane cap.
- With the sensor facing down, slowly screw the membrane cap clockwise. Some electrolyte will overflow.

The Platinum cathode (#8 in the Probe Functional Description page 6) should always be bright and untarnished. If it is tarnished or stained, the cathode should be cleaned. You can use a clean lint-free cardboard or cloth. Rub the cathode very gently side to side 4-5 times. This will be enough to polish and remove any stains without damaging the platinum tip. Afterwards, rinse the probe with deionized or distilled water and install a new membrane cap using fresh electrolyte and follow the steps above. Recalibrate the instrument.



TWIST AND PULL
fig. 1



UNSCREW
fig. 2

<ETX> is 03 ASCII code character (end of text)
 <answer>:
 <ACK> is sent for a recognized command
 <CAN> is sent when the instrument is logging
 <Err6>/<Err8> is sent when the command is incorrect or the instrument is not in measurement mode.

COMMANDS REQUIRING AN ANSWER

The instrument will answer for these commands with:

<STX> <answer> <checksum> <ETX>

where the checksum is the bytes sum of the answer string sent as 2 ASCII characters.

All the answer messages are with ASCII characters.

RDO Causes the instrument to send a complete set of readings in according with the DO range.

MDL Requests the instrument model name and firmware code (16 ASCII chars).

INF Requests the setup parameters.

SAM Requests the number of logged samples (4 chars).

LDDO xxx Requests the xxxth DO record logged data.

LADO Requests all DO Log on demand.

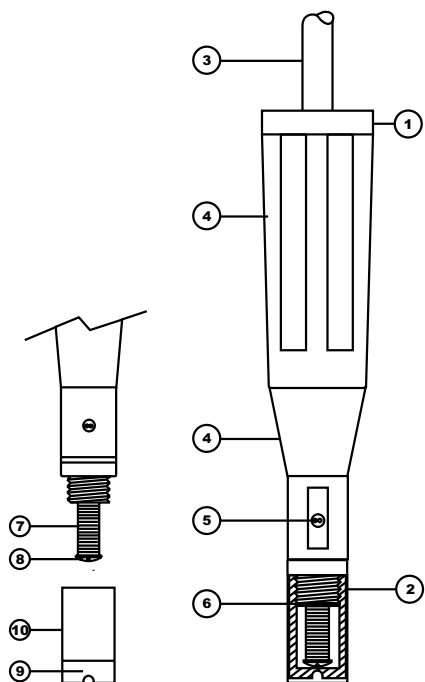
Notes:

- “Err8” is sent if the instrument is not in measurement mode.
- “Err6” is sent if the requested range is not available.
- “Err4” is sent if the requested set parameter is not available.
- “Err3” is sent if the Log on demand is empty.
- Invalid commands will be ignored.

SPECIFICATIONS		
Range	DO	0.00 to 45.00 ppm O ₂ 0.0 to 300.0 % O ₂
	Temp	-5.0 to 55.0 °C (23.0 to 131.0 °F)
Resolution	DO	0.01 ppm 0.1 %
	Temp	0.1 °C (0.1 °F)
Accuracy (@ 20°C / 68°F)	DO	±1.5 % of full scale
	Temp	±0.4 °C (±0.8 °F)
Calibration	DO	single or double point at 0% (MI 9070) and 100% (in air)
	Temp	2-point, at 0 and 50 °C (32.0 and 122.0 °F)
Altitude Compensation		0 to 4 000 m (13 120')
Resolution		100 m (328')
Salinity Compensation		0 to 40 g/l
Resolution		1 g/l
Temperature Compensation		Automatic, from 0.0 to 50.0 °C (32.0 to 122.0 °F)
Probe		MA 840/2
Computer Interface		RS232/USB opto-isolated
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 (32 to 122 °F) ; max RH 95%
Warranty		3 years

This instrument is in compliance with CE Directives.

PROBE FUNCTIONAL DESCRIPTION



- 1. D.O. Probe
- 2. Protective Cap
- 3. Watertight Shielded Cable
- 4. Polypropylene Probe Body
- 5. Temperature Sensor
- 6. O-Ring Seal
- 7. Silver Chloride Anode
- 8. Platinum Cathode (sensor)
- 9. Oxygen Permeable Teflon® Membrane
- 10. Membrane Cap

PC INTERFACE

Data transmission from the instrument to the PC can be done with the **Mi 5200** Windows® compatible software, when using the RS232 or USB serial interface. **Mi 5200** also offers graphing and on-line help feature.

Data can be exported to the most popular spreadsheet programs for further analysis.

To connect the instrument to a PC through the RS232 port, use the Martini **MA 9350** cable connector.

To connect the instrument to a PC through the USB port, use a standard USB cable.

Make sure that your instrument is switched off and plug one connector of the cable to the instrument RS232/USB connector and the other to the serial port of your PC.

Notes:

- Other cables than **MA 9350** may use a different configuration. In this case, communication between instrument and PC may not be possible.
- Keep only one cable connected (RS232 or USB) during PC communication to avoid possible errors.
- If you are not using Martini Instruments **Mi 5200** software, please see the following instructions.

SENDING COMMANDS FROM PC

It is also possible to remotely control the instrument with any terminal program. Use **MA 9350** cable to connect the instrument to a PC, start the terminal program and set the communication options as follows: 8, N, 1, no flow control.

COMMAND TYPES

To send a command to the instrument follow the next scheme:

<*> <command> <CR>

where: <*> is the command prefix.

<command> is the command code.

Note: Either small or capital letters can be used.

UNIT CHANGE COMMAND

CHU xx Change the instrument unit according with the parameter value (xx):

The instrument will answer for this command with:

<STX> <answer> <ETX>

where: <STX> is 02 ASCII code character (start of text)

TEMPERATURE CALIBRATION (for technical personnel only)

The **Mi 190** is factory calibrated for temperature.

Martini’s DO probes are interchangeable and no temperature calibration is needed when they are replaced.

If the temperature measurements are inaccurate, temperature recalibration should be performed. For an accurate recalibration, contact your dealer or the nearest Martini Customer Service Center, or follow the instructions below.

- Prepare a vessel containing ice and water and another one containing hot water (at a temperature of around 50 °C). Place insulation material around the vessels to minimize temperature changes.
- Use a calibrated thermometer with a resolution of 0.1 °C as a reference thermometer.
- With the instrument off, press and hold down the LOG & MR keys, then power on the instrument. The “CALIBRATION” tag will appear and the secondary LCD will show 0.0 °C.
- Immerse the temperature probe in the vessel with ice and water as near as possible to the reference thermometer. Allow a few seconds for the probe to stabilize.
- Use the UP and DOWN arrow keys to set the reading on the secondary LCD to that of ice and water, measured by the reference thermometer. When the reading is stable and close to the selected calibration point, the “READY” and “ACCEPT” tags will blink.
- Press the ACCEPT key to accept the calibration point. The secondary LCD will show 50.0 °C.
- Immerse the temperature probe in the second vessel as near as possible to the reference thermometer. Allow a few seconds for the probe to stabilize.
- Use the UP and DOWN arrow keys to set the reading on the secondary LCD to that of the hot water, measured by the reference thermometer.
- When the reading is stable and close to the selected calibration point, the “READY” and “ACCEPT” tags will blink.
- Press the ACCEPT key to accept the calibration point. The instrument returns to measurement mode.

Note: If the reading is not close to the selected calibration point, “WRONG” tag will blink. Change the temperature probe and restart calibration.

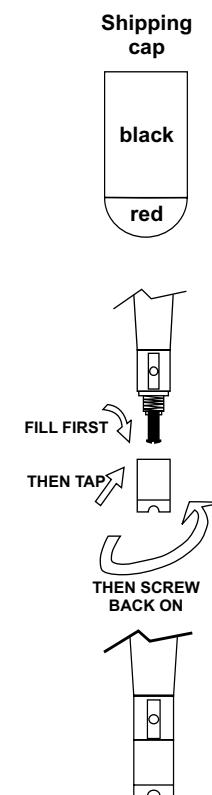
PROBE CONNECTION AND PREPARATION

To take measurements, connect the D.O. probe to the meter securely by aligning the pins with the socket located on the back of the meter, pushing the plug in and tightening the threaded ring.

Probes shipped from Martini Instruments are dry. To hydrate the probe and prepare it for use, connect it to the meter and proceed as follows:

1. Remove the red and black plastic cap. This cap is for shipping purposes and can be thrown away.
2. Wet the sensor by soaking the bottom 2½ cm (1") of the probe in electrolyte (MA 9071) for 5 minutes.
3. Rinse the membrane cap (MA 841 supplied in the kit with the meter) with electrolyte solution while shaking it gently. Refill with clean electrolyte solution.
4. Tap gently the sides of the membrane cap with your finger tip to ensure that no air bubbles are trapped. To avoid damaging the membrane, do not tap it directly on the bottom.
5. Make sure that the rubber O-ring sits properly inside the membrane cap.
6. With the sensor facing down, slowly screw the cap clockwise. Some electrolyte will overflow.

When not in use and during polarization (see page 8), use the protective transparent cap supplied in the kit with the meter.



OPERATIONAL GUIDE

INITIAL PREPARATION

Plug the 12 VDC adapter into the power supply socket.

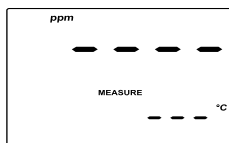
Connect the DO probe to the 7-pin connector. Make sure the probe sleeve is properly inserted and tighten the threaded ring.

Turn the instrument on by pressing ON/OFF. All LCD tags are displayed and a beep is heard while the instrument performs a self test.

- After a few seconds "Cond" message appears on the LCD to inform the user that the probe is in auto-conditioning (automatic polarization) mode.



- When this message disappears, the probe is polarized and the instrument can be calibrated.
- If the probe is disconnected, the meter will display "----".



PROBE POLARIZATION

The probe is under polarization with a fixed voltage of approximately 800 mV.

Probe polarization is essential for stable measurements with the same recurring degree of accuracy. With the probe properly polarized, oxygen is continually consumed when it passes through the sensitive diaphragm and dissolves in the electrolyte solution contained in the probe.

If polarization is interrupted, the electrolyte solution continues to be enriched with oxygen until it reaches an equilibrium with the surrounding solution.

Whenever measurements are taken with a non-polarized probe, the oxygen level revealed is both that of the tested solution, as well as that present in the electrolyte solution. This reading is incorrect.

The calibration of this instrument is very simple.

°C	Altitude, Meters above Sea Level														°F	
	0 m	300 m	600 m	900 m	1200 m	1500 m	1800 m	2100 m	2400 m	2700 m	3000 m	3300 m	3600 m	3900 m		4000 m
0	14.6	14.1	13.6	13.1	12.6	12.1	11.7	11.2	10.8	10.4	10.0	9.7	9.3	9.0	8.9	32.0
2	13.8	13.3	12.8	12.4	11.9	11.5	11.0	10.6	10.2	9.9	9.5	9.2	8.8	8.5	8.4	35.6
4	13.1	12.6	12.2	11.7	11.3	10.9	10.5	10.1	9.7	9.3	9.0	8.7	8.4	8.0	7.9	39.2
6	12.4	12.0	11.5	11.1	10.7	10.3	9.9	9.6	9.2	8.9	8.6	8.2	7.9	7.6	7.5	42.8
8	11.8	11.4	11.0	10.6	10.2	9.8	9.5	9.1	8.8	8.4	8.1	7.8	7.5	7.3	7.2	46.4
10	11.3	10.9	10.5	10.1	9.7	9.4	9.0	8.7	8.4	8.1	7.8	7.5	7.2	6.9	6.8	50.0
12	10.8	10.4	10.0	9.6	9.3	8.9	8.6	8.3	8.0	7.7	7.4	7.1	6.9	6.6	6.5	53.6
14	10.3	9.9	9.6	9.2	8.9	8.5	8.2	7.9	7.6	7.4	7.1	6.8	6.6	6.3	6.2	57.2
16	9.9	9.5	9.2	8.8	8.5	8.2	7.9	7.6	7.3	7.0	6.8	6.5	6.3	6.1	6.0	60.8
18	9.5	9.1	8.8	8.5	8.1	7.8	7.6	7.3	7.0	6.8	6.5	6.3	6.0	5.8	5.7	64.4
20	9.1	8.8	8.4	8.1	7.8	7.5	7.3	7.0	6.7	6.5	6.2	6.0	5.8	5.6	5.5	68.0
22	8.7	8.4	8.1	7.8	7.5	7.2	7.0	6.7	6.5	6.2	6.0	5.8	5.6	5.4	5.3	71.6
24	8.4	8.1	7.8	7.5	7.2	7.0	6.7	6.5	6.2	6.0	5.8	5.6	5.4	5.2	5.1	75.2
25	8.3	8.0	7.7	7.4	7.1	6.8	6.6	6.4	6.1	5.9	5.7	5.5	5.3	5.1	5.0	77.0
26	8.1	7.8	7.5	7.2	7.0	6.7	6.5	6.2	6.0	5.8	5.6	5.4	5.2	5.0	4.9	78.8
28	7.8	7.5	7.3	7.0	6.7	6.5	6.2	6.0	5.8	5.6	5.4	5.2	5.0	4.8	4.7	82.4
30	7.6	7.3	7.0	6.8	6.5	6.3	6.0	5.8	5.6	5.4	5.2	5.0	4.8	4.6	4.6	86.0
32	7.3	7.0	6.8	6.5	6.3	6.1	5.8	5.6	5.4	5.2	5.0	4.8	4.7	4.5	4.4	89.6
34	7.1	6.8	6.6	6.3	6.1	5.9	5.6	5.4	5.2	5.0	4.9	4.7	4.5	4.3	4.3	93.2
36	6.8	6.6	6.3	6.1	5.9	5.7	5.5	5.3	5.1	4.9	4.7	4.5	4.4	4.2	4.1	96.8
38	6.6	6.4	6.1	5.9	5.7	5.5	5.3	5.1	4.9	4.7	4.5	4.4	4.2	4.1	4.0	100.4
40	6.4	6.2	5.9	5.7	5.5	5.3	5.1	4.9	4.7	4.6	4.4	4.2	4.1	3.9	3.9	104.4
42	6.2	6.0	5.8	5.6	5.3	5.2	5.0	4.8	4.6	4.4	4.3	4.1	4.0	3.8	3.8	107.6
44	6.0	5.8	5.6	5.4	5.2	5.0	4.8	4.6	4.5	4.3	4.1	4.0	3.8	3.7	3.7	111.2
46	5.8	5.6	5.4	5.2	5.0	4.8	4.7	4.5	4.3	4.2	4.0	3.9	3.7	3.6	3.5	114.8
48	5.7	5.5	5.3	5.1	4.9	4.7	4.5	4.4	4.2	4.0	3.9	3.7	3.6	3.5	3.4	118.4
50	5.5	5.3	5.1	4.9	4.7	4.6	4.4	4.2	4.1	3.9	3.8	3.6	3.5	3.4	3.3	122.0

The salinity affects the D.O. concentration, decreasing its value. The table below shows the maximum oxygen solubility at various temperatures and salinity levels.

°C	Salinity (g/l) at Sea Level					°F
	0 g/l	10 g/l	20 g/l	30 g/l	35 g/l	
0	14.60	13.64	12.74	11.90	11.50	32.0
2	13.81	12.91	12.07	11.29	10.91	36.5
4	13.09	12.25	11.47	10.73	10.38	39.2
6	12.44	11.65	10.91	10.22	9.89	42.8
8	11.83	11.09	10.40	9.75	9.44	46.4
10	11.28	10.58	9.93	9.32	9.03	50.0
12	10.77	10.11	9.50	8.92	8.65	53.6
14	10.29	9.68	9.10	8.55	8.30	57.2
16	9.86	9.28	8.73	8.21	7.97	60.8
18	9.45	8.90	8.39	7.90	7.66	64.4
20	9.08	8.56	8.07	7.60	7.38	68.0
22	8.73	8.23	7.77	7.33	7.12	71.6
24	8.40	7.93	7.49	7.07	6.87	75.2
25	8.24	7.79	7.36	6.95	6.75	77.0
26	8.09	7.65	7.23	6.83	6.64	78.8
28	7.81	7.38	6.98	6.61	6.42	82.4
30	7.54	7.14	6.75	6.39	6.22	86.0
32	7.29	6.90	6.54	6.19	6.03	89.6
34	7.05	6.68	6.33	6.01	5.85	93.2
36	6.82	6.47	6.14	5.83	5.68	96.8
38	6.61	6.28	5.96	5.66	5.51	100.4
40	6.41	6.09	5.79	5.50	5.36	104.0
42	6.22	5.93	5.63	5.35	5.22	107.6
44	6.04	5.77	5.48	5.21	5.09	111.2
46	5.87	5.61	5.33	5.07	4.97	114.8
48	5.70	5.47	5.20	4.95	4.85	118.4
50	5.54	5.33	5.07	4.83	4.75	122.0

Note: The relationship between salinity and chlorinity for sea water is given by the equation below:

$$\text{Salinity (g/l)} = 1.80655 \text{ Chlorinity (g/l)}$$

Before proceeding with the calibration, make sure the probe is ready for measurements (see page 7), i.e. the membrane cap is filled with electrolyte and the probe is connected to the meter and properly polarized.

For an accurate calibration, it is recommended to wait at least 15 minutes to ensure precise conditioning of the probe.

Keep the protective cap on during polarization time and remove it for calibration and measurements. Follow the calibration procedure (see page 10).

SALINITY AND ALTITUDE COMPENSATION

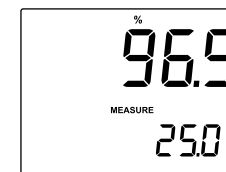
If the sample contains significant concentration of salinity or if you are performing measurements at an altitude different from sea level, the read out values must be corrected, taking into account the lower degree of oxygen solubility in these situations (see pages 20-21).

Remember to set the altitude and/or the salinity before taking any D.O. measurements. The meter will automatically compensate for these factors.

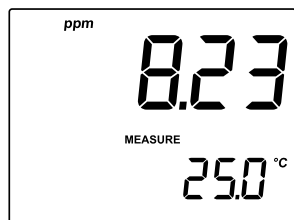
D.O. MEASUREMENTS

Make sure that the instrument has been calibrated and the protective cap has been removed.

- Immerse the tip of the probe in the sample to be tested. Allow approximately one minute for the reading to stabilize.
- The Dissolved Oxygen value (in %) is displayed on the primary LCD and the temperature on the secondary LCD.



- Press RANGE to change the reading from % to ppm and vice-versa.



For accurate Dissolved Oxygen measurements, a water movement of 0.3 m/s is required. This is to ensure that the oxygen-depleted membrane surface is constantly replenished. A moving stream will provide adequate circulation. The use of a magnetic stirrer to ensure a certain fluid velocity is recommended.

TEMPERATURE MEASUREMENTS

The probe has a built-in temperature sensor. The measured temperature is indicated on the secondary LCD as shown above. Allow the probe to reach thermal equilibrium before taking any measurement. This can take several minutes. The greater the difference between the temperature at which the probe was stored and the temperature of the sample, the longer the time will be. Note: If "----" is displayed, the D.O. probe is not properly connected or the temperature is out of range. This also indicates the possibility of a broken probe cable.

Press the arrow keys to change the displayed value. Press the ACCEPT key to accept the value or the CAL key to escape. Press the arrow keys to select the next/previous parameter. Press the SETUP key to exit SETUP menu at any time. The following table lists the SETUP parameters, their valid values range and the factory settings (default):

Item	Description	Valid values	Default
SALt	Salinity Factor	0 to 40 g/l	0
ALt	Altitude Factor	0 to 4000 m step 100 m	0
TIME	Time (hh:mm)	00:00 to 23:59	00:00
DATE	Date (MM.DD.YYYY)	01.01.2000-12.31.2099	01.01.2005
bEEP	Beep Status	ON/OFF	OFF
bAud	Baud Rate	600; 1200; 2400; 4800; 9600	2400
In Id	Instrument ID	0000 to 9999	0000
iEMP	Temperature Unit	°C or °F	°C

SETUP

Setup mode allows viewing and modifying the following parameters:

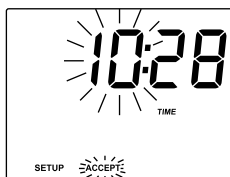
- Salinity Compensation
- Altitude Compensation
- Current Time (hh:mm)
- Current Date (MM.DD.YYYY)
- Beep Status
- Baud Rate (serial communication)
- Instrument ID
- Temperature Unit

To enter SETUP mode, press and hold the SETUP key for about 1 second while in normal measurement mode.

Select the desired setup parameter using the UP and DOWN arrow keys.

Press the CAL key if you want to change the item value. The selected item (e.g. hour, in setting up the correct time) and "ACCEPT" tag will start blinking.

Press the arrow keys to change the displayed value.



If there is another item to be set (e.g. minutes), press the RANGE key. The other item will start blinking.



D.O. CALIBRATION

Calibrate the instrument frequently, especially if high accuracy is required.

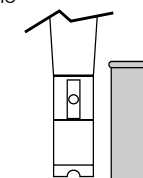
The instrument can be calibrated in maximum 2 points: 0.0% (**zero calibration**) and 100.0% (**slope calibration**).

The zero calibration of the **Mi 190** is very stable, therefore this procedure needs to be performed only whenever the probe or the membrane is replaced.

However, because the slope calibration is more critical, it is recommended to perform this procedure every week.

INITIAL PREPARATION

- Pour small quantities of MA 9070 Zero Oxygen solution into a beaker. If possible, use a plastic beaker to minimize any EMC interferences.
- Make sure the probe is ready for measurements (see probe preparation on page 7), i.e. the membrane is filled with electrolyte and the probe is connected to the meter.
- Switch the meter on by pressing the ON/OFF switch.
- For an accurate calibration, it is recommended to wait for at least 15 minutes to ensure precise conditioning of the probe.
- Remove the protective cap from the D.O. probe.
- Set the appropriate altitude factor (see page 21). Make sure the salinity factor is set to zero (see page 20).

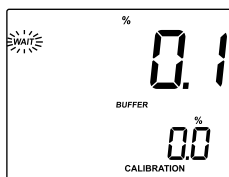


ZERO CALIBRATION

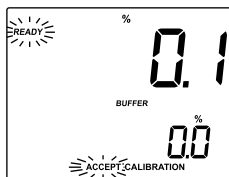
- Submerge the probe into MA 9070 zero oxygen solution and stir gently for 2-3 minutes.



- Press CAL. The "WAIT" tag will blink on the LCD until the reading is stable.

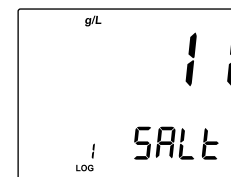


- When the reading is stable, "READY" & "ACCEPT" tags start blinking. Press ACCEPT to confirm the "0.0%" D.O. calibration.

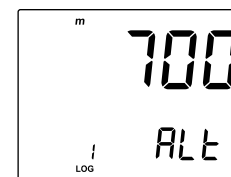


- If the reading is within the limits ($\pm 15\%$ f.s.), the meter stores the value (and adjusts the zero point).
- Press CAL. The instrument will return to measurement mode and will memorize the zero calibration data. For a two-point calibration do not press CAL and follow the procedure below.

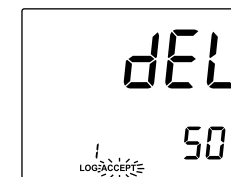
- The salinity factor



- The altitude factor



- The "dEL" message on the primary LCD and the record number on the secondary LCD along with "ACCEPT" tag blinking.

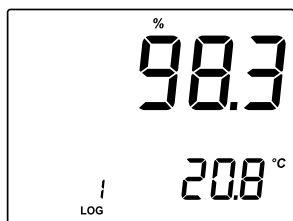


Notes:

- If one of the arrow keys is pressed while "dEL" message is displayed, the next/previous record number will be selected.
- If the SETUP key is pressed, the secondary LCD will toggle between the record number and "ALL" message.
- Press the ACCEPT key to delete the selected or all records.
- If "dEL ALL" option was selected, all records for the selected range are deleted and the instrument returns to measurement mode.
- After deleting a record, the "nuLL" message is displayed on the LCD for the selected record.

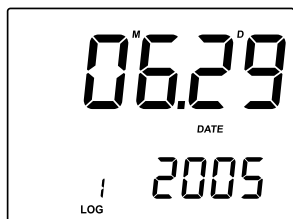
Press the MR key to leave RECALL mode at any time.

Pressing the arrow keys, the instrument will display the same parameter but for a different record:

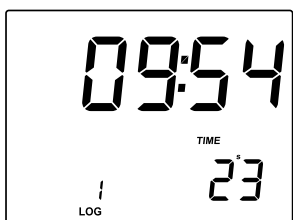


Press the RANGE key and the instrument will display the next logged parameter:

- The date: month and day on the primary LCD and the year on the secondary LCD, along with "DATE" tag.



- The time: hour and minutes on the primary LCD and the seconds on the secondary LCD, along with "TIME" tag.



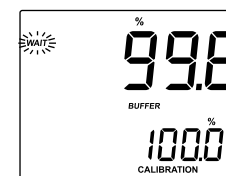
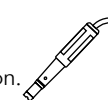
SLOPE CALIBRATION

It is suggested to perform the slope calibration in air.

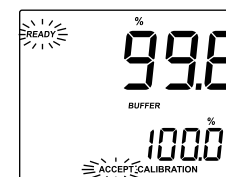
- Rinse the probe in clean water to remove any residual zero oxygen solution.

Note: If you did not perform the zero calibration procedure, press CAL and then the ARROW keys to select the 100% D. O. calibration point.

- Dry the probe tip and allow a few seconds for the LCD reading to stabilize. The "WAIT" tag will blink until the reading is stable.



- When the reading is stable, "READY" & "ACCEPT" tags start blinking. Press ACCEPT to confirm the "100.0%" D.O. calibration.



- If the reading is within the limits ($\pm 15\%$ f.s.), the meter stores the value (and adjusts the slope point).
- The instrument stores the slope calibration data and returns to measurement mode.

- Note:**
- If the reading is not close to the selected value, "WRONG" & "BUFFER" tags will blink.
 - MI 190 has automatic buffer recognition function. If the ARROW keys are pressed to select the desired calibration value, the automatic buffer recognition function is disabled.

LOGGING

Up to 50 LOG samples can be stored into memory

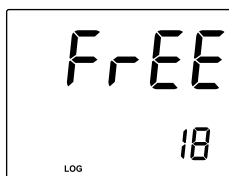
LOGGING THE CURRENT DATA

To store the current reading into memory press the LOG key while in measurement mode.

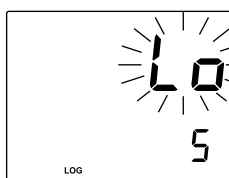
The instrument will display the current date (MM.DD) on the primary LCD and the record number on the secondary LCD, along with "LOG" tag (see example below: record No. 25, dated June 29).



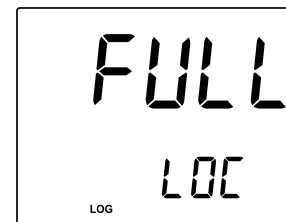
The instrument displays then the amount of free log space for about one second and returns to normal measurement mode (e.g. 18 records free).



If there are less than 6 memory locations remaining, the record number and "Lo" message will blink to alert the user.

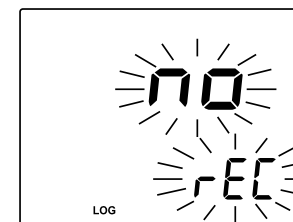


If the log space is full, "FULL LOC" message will be displayed and no more data will be saved. When the LOG key is pressed while in measurement mode, a complete set of information is stored.



VIEW LOGGED DATA

Press the MR key to retrieve the information stored while in measurement mode. If no data were logged, the instrument displays "no rEC" message for the selected range.



Otherwise, the instrument will display the DO value on the primary LCD and the temperature on the secondary LCD, along with last stored record number and "LOG" tag.

