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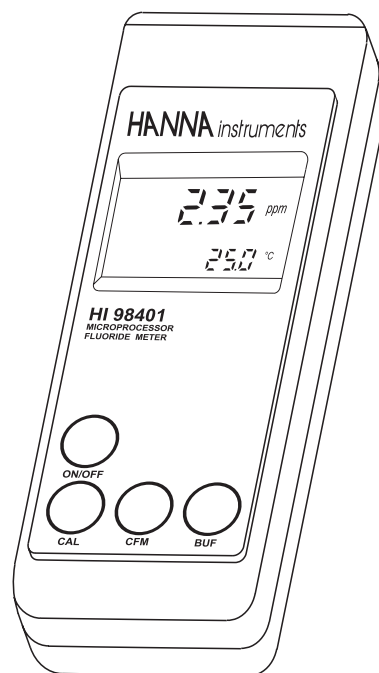
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For e-mail contacts and complete list of Sales and Technical offices, please see www.hannainst.com

Instruction Manual

HI 98401

Waterproof and Accurate Fluoride Meter



MAN98401R2 08/05

HANNA
instruments[®]
www.hannainst.com

Dear Customer,
 Thank you for choosing a Hanna product.
 Please read this instruction manual carefully before using the meter.
 This manual will provide you with the necessary information for a correct use of the instrument, as well as a more precise idea of its versatility.
 If you need additional technical information, do not hesitate to e-mail us at tech@hannainst.com.
 This instrument is in compliance with the **CE** directives.

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Hanna Instruments reserves the right to modify the design, construction and appearance of its products without advance notice.

WARRANTY

All Hanna Instruments **meters are warranted for two years** against defects in workmanship and materials when used for their intended purpose and maintained according to instructions. **Electrodes and probes are warranted for a period of six months.**

This warranty is limited to repair or replacement free of charge. Damages due to accidents, misuse, tampering or lack of prescribed maintenance are not covered. If service is required, contact the dealer from whom you purchased the instrument. If under warranty, report the model number, date of purchase, serial number and the nature of the failure. If the repair is not covered by the warranty, you will be notified of the charges incurred. If the instrument is to be returned to Hanna Instruments, first obtain a Returned Goods Authorization number from the Customer Service department and then send it with shipping costs prepaid. When shipping any instrument, make sure it is properly packaged for complete protection.

CE DECLARATION OF CONFORMITY

	
DECLARATION OF CONFORMITY	
We Hanna Instruments Italia Srl via E. Fermi, 10 35030 Sarmeola di Rubano - PD ITALY herewith certify that the Fluoride meter:	
HI 98401	
has been tested and found to be in compliance with EMC Directive 89/336/EEC and Low Voltage Directive 73/23/EEC according to the following applicable normative:	
EN 50082-1: Electromagnetic Compatibility - Generic Immunity Standard IEC 801-2: Electrostatic Discharge IEC 801-3: RF Radiated	
EN 50081-1: Electromagnetic Compatibility - Generic Emission Standard EN 55022: Radiated, Class B	
EN61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use	
Date of Issue: <u>17-6-1999</u>	 P. Cesa - Technical Director On behalf of Hanna Instruments S.r.l.

Recommendations for Users

Before using this product, make sure that it is entirely suitable for the environment in which it is used. Operation of this instrument in residential areas could cause unacceptable interferences to radio and TV equipment.

Any variation introduced by the user to the supplied equipment may degrade the instrument's EMC performance. To avoid electrical shock, do not use these instruments when voltages at the measurement surface exceed 24 Vac or 60 Vdc.

To avoid damages or burns, do not perform any measurement in microwave ovens.

ACCESSORIES

Calibration Solutions

HI 7023/1L	TISAB fluoride solution, 1 L bottle
HI 7023L	TISAB fluoride solution, 500 mL bottle
HI 70701/1L	1 g/L fluoride solution, 1 L bottle
HI 70701L	1 g/L fluoride solution, 500 mL bottle
HI 70701M	1 g/L fluoride solution, 230 mL bottle
HI 70702/1L	10.0 mg/L fluoride solution, 1 L bottle
HI 70702L	10.0 mg/L fluoride solution, 500 mL bottle
HI 70702M	10.0 mg/L fluoride solution, 230 mL bottle
HI 70703/1L	100 mg/L fluoride solution, 1 L bottle
HI 70703L	100 mg/L fluoride solution, 500 mL bottle
HI 70703M	100 mg/L fluoride solution, 230 mL bottle

Maintenance Solutions

HI 7061M	General purpose cleaning solution, 230 mL bottle
HI 8061M	General cleaning solution, 230 mL FDA bottle
HI 7061L	General cleaning solution, 500 mL bottle
HI 8061L	General cleaning solution, 500 mL FDA bottle
HI 7073M	Protein cleaning solution, 230 mL bottle
HI 8073M	Protein cleaning solution, 230 mL FDA bottle
HI 7073L	Protein cleaning solution, 500 mL bottle
HI 8073L	Protein cleaning solution, 500 mL FDA bottle
HI 7077M	Oil and fat cleaning solution, 230 mL bottle
HI 8077M	Oil & fat cleaning solution, 230 mL FDA bottle
HI 7077L	Oil and fat cleaning solution, 500 mL bottle
HI 8077L	Oil & fat cleaning solution, 500 mL FDA bottle
HI 7082	3.5M KCl electrolyte solution, 4 x 50 mL bottle
HI 8082	3.5M KCl electrolyte solution, 4 x 50 mL FDA bottle

Other Accessories

FC 301B	Fluoride electrode with BNC and 1 m (3.3') cable
HI 5313	Reference electrode with 1 m (3.3') cable
HI 7662	Temperature probe with 1 m (3.3') cable
HI 76405	Electrode holder

PRELIMINARY EXAMINATION

Remove the instrument from the packing material and examine it carefully to make sure that no damage has occurred during shipping. If there is any noticeable damage, immediately notify your dealer.

Each meter is supplied complete with:

- Batteries (4 x 1.5V AA)
- Instruction manual
- Rugged carrying case

Note: Save all packing materials until you are sure that the instrument functions correctly. Any damaged or defective item must be returned in its original packing materials together with the supplied accessories.

GENERAL DESCRIPTION

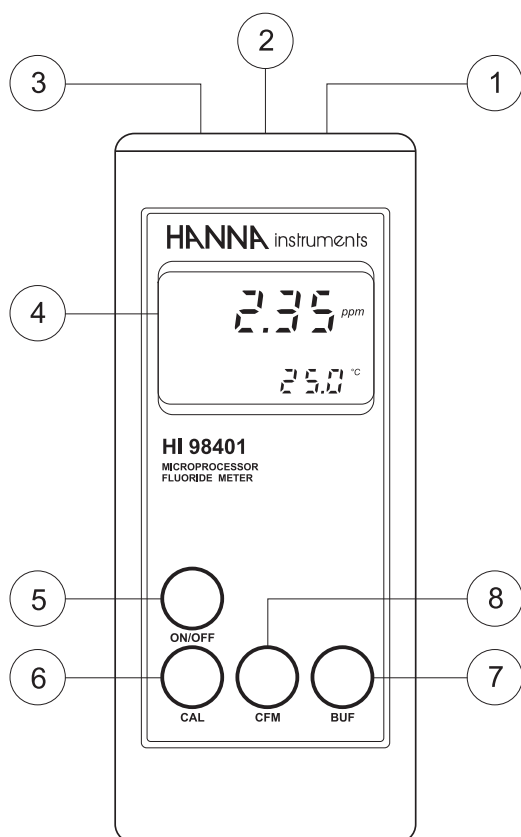
HI 98401 measures fluoride from 0.05 mg/L to 1.9 g/L in 5 distinct scales. With auto-ranging **HI 98401** automatically selects the range that provides the best resolution. All results are displayed directly in fluoride concentration. In order to guarantee maximum repeatability, measurements are performed using the **FC 301B** fluoride specific electrode and the separate **HI 5313** reference electrode.

HI 98401 compensates for temperature automatically from 5 to 35°C using the optional **HI 7662** stainless steel temperature probe. The temperature measured together with fluoride concentrations are displayed on the large LCD simultaneously.

All operations are microprocessor controlled for added precision and simplicity. The calibration is automatic at one or two points. The first calibration point is in the middle of the range at 100 mg/L (ppm). The slope can then be selected for low fluoride measurements at 10 mg/L, or higher contents at 1000 mg/L.

HI 98401 is supplied in a rugged carrying casing complete with 4 batteries, that provide up to 120 hours of continuous operation.

FUNCTIONAL DESCRIPTION



- 1) Temperature probe connector
- 2) Reference electrode connector
- 3) BNC connector for fluoride electrode
- 4) Liquid Crystal Display (LCD)
- 5) ON/OFF button
- 6) CAL button
- 7) BUF button
- 8) CFM button

FLUORIDE ELECTRODE CLEANING

General: Rinse the fluoride electrode with deionized water.

Protein, oil and fat: clean the electrode tip with a cotton wool soaked in alcohol, then rinse with deionized water.

IMPORTANT: After cleaning, rinse the fluoride electrode thoroughly with deionized water and dry it attentively with a non-abrasive cloth.

TROUBLESHOOTING

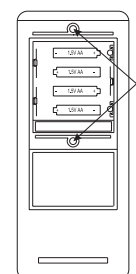
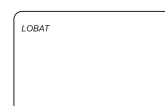
- **Reading fluctuates:** could be due to dirty or blocked reference electrode junction. Follow the cleaning procedure above.
- **Reading drifts:** submerge the tip of the reference electrode in HI 7082 solution at a temperature of 50-60°C for about 1 hour. Afterwards, rinse with deionized water.
- **No slope (meter always reads the same value):** the bulb or stem of the fluoride electrode might be cracked. Repeat the measurement with a new fluoride electrode.
- **Response (of the fluoride electrode) is sluggish:** immerse the fluoride electrode in HI 70702 solution for 3 hours.

BATTERY REPLACEMENT

When the batteries become weak, the "LOBAT" indication is displayed to warn the user. It is recommended to change the batteries as soon as possible.

Battery replacement must only take place in a safe area and using 1.5V AA batteries.

For replacing batteries, remove the two screws on the rear of the instrument and replace all four batteries with new ones, while paying attention to the correct polarity.



ELECTRODE MAINTENANCE

PREPARATION

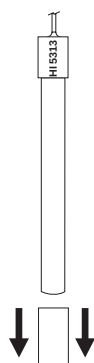
The **FC 301B** fluoride electrode is shipped dry to prolong its life. The **HI 5313** reference electrode instead should be maintained wet with storage solution in the protective cap.

Remove the protective cap from the **HI 5313** reference electrode.

Any salt deposit around the bottom of the electrode is normal and it will dissolve if rinsed with water.

If the junction of the **HI 5313** reference electrode is dry, soak the tip in **HI 7082** solution for at least one hour prior to operation.

If the bulb of the **FC 301B** fluoride electrode is dry, soak the tip in **HI 70702** (10 mg/L fluoride) solution for at least three hours before using it.



STORAGE

The **FC 301B** fluoride electrode must be stored dry to prolong its life. After use, rinse it with deionized water, dry it attentively with a non-abrasive cloth and store it dry.

The **HI 5313** reference electrode should be kept wet for a rapid response. After use, rinse the electrode with deionized water and store it with a few drops of **HI 7082** solution in the protective cap.

PERIODIC MAINTENANCE

Periodically check electrodes and cables. The cables should be intact and show no sign of wear and tear. The electrode bulb and stem should present no cracks (in which case it, must be replaced). The connectors must be clean and dry. Rinse the reference electrode with deionized water to wash away any salt deposits that there might be.

REFERENCE ELECTRODE CLEANING

General: immerse the reference electrode in **HI 7061** general cleaning solution for about one hour.

Protein: immerse the reference electrode in **HI 7073** protein cleaning solution for about 15 minutes.

Oil and fat: rinse the electrode with **HI 7077** cleaning solution.

SPECIFICATIONS

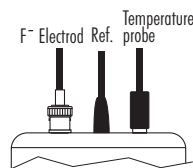
Range	0.050 to 0.500 mg/L (ppm) / 0.50 to 5.00 mg/L 5.0 to 50.0 mg/L / 50 to 500 mg/L / 0.50 to 1.90 g/L Fluoride 0.0 to 50.0°C
Resolution	0.001 mg/L (ppm) / 0.01 mg/L 0.1 mg/L / 1 mg/L / 0.01 g/L Fluoride 0.1°C
Accuracy	±5% of reading or ±0.02 ppm Fluoride (with ±3°C from calibration temperature) ±0.5°C
Typical EMC Deviation	± 2% FS (Fluoride) / ±0.5°C
Calibration	Automatic, 1 or 2 point at 100 mg/L and 10.0 mg/L or 1.00 g/L
Temperature Compensation	Automatic, 5 to 35 °C (with temperature probe)
Electrodes	FC 301B fluoride electrode with BNC and 1 m (3.3') cable HI 5313 reference electrode with 1 m (3.3') cable (not included)
Temperature Probe	HI 7662 with 1 m (3.3') cable
Battery Type / Life	4 x 1.5V AA / approx. 120 hours of use
Environment	0 to 50°C (32 to 122°F); RH max 100%
Dimensions	196 x 80 x 60 mm (7.7 x 3.1 x 2.4")
Weight	500 g (1.1 lb.)

OPERATIONAL GUIDE

INITIAL PREPARATION:

The meter is supplied with 4 pieces of 1.5V AA-type alkaline batteries. Remove the battery cover on the back of the meter and insert the batteries while paying attention to their polarity.

Attach the fluoride electrode (#3 on page 4), the reference electrode (#2) and the temperature probe (#1) to their respective connectors on top of the meter.

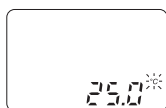


Press the ON/OFF key to turn the meter on.



Note: The temperature probe can also be used on its own to measure the temperature independently.

Note: If the temperature probe is not connected, the lower display will indicate 25.0°C with the "°C" symbol blinking.

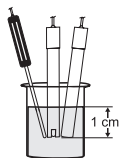


MEASUREMENT OF FLUORIDE ION CONCENTRATION

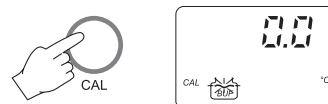
Note: Please ensure the meter is calibrated prior to proceeding any further. In order to obtain accurate results, calibrate the meter at a temperature no more than $\pm 3^\circ\text{C}$ away from the sample to be measured subsequently.

Note: If the fluoride electrode is new, or it has not been used for a few days, it must be soaked in a solution of HI 70702 (10 ppm of F⁻) for at least 3 hours prior to measurement.

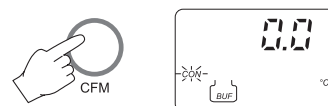
- Pour about 10-20 mL of the sample in a clean beaker and add the same quantity of HI 7023 (TISAB) solution to the beaker. Mix the solution for a few minutes.
- Rinse the electrodes with deionized water and dry them attentively with a non-abrasive cloth.
- Immerse the fluoride and the reference electrode as well as the temperature probe to a depth of at least 1 cm ($\frac{1}{2}$ " in) in the prepared sample. Make sure that the electrodes are not touching the bottom of the beaker. Position the temperature probe close to the tip of the other electrodes.



- The measured temperature is shown on the upper display.
- Immerse the temperature probe in a bath at 0.0°C.
- Press CAL. CAL and BUF will appear on the display with the "°C" symbol blinking. The upper part of the display shows the calibration point (0.0 °C).

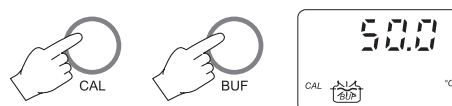


- When CON appears on the display it means that the value has been recognized and the reading is stable. Press CFM to confirm.

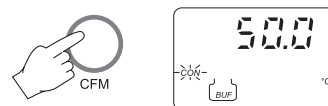


Note: If the reading of the instrument is too far from the expected value (in this case 0.0°C), the "°C" symbol starts blinking to advise of an error. In this case verify if the temperature of the bath is correct (for best results, use a stirrer to agitate a solution of ice and water), and if the probe is functioning properly.

- Press CAL and then press BUF to visualize the second calibration point (50.0 °C).



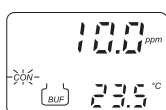
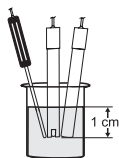
- Immerse the temperature probe in a bath at 50.0°C.
- When CON appears it means that the value has been recognized and the reading is stable. Press CFM to confirm.



- Switch the meter off and back on again to return to normal measurement mode.



- Immerse the fluoride and the reference electrode to a depth of at least 1 cm (1/2") in the second buffer solution. Make sure that the electrodes are not touching the bottom of the beaker. Immerse the temperature probe close to the tip of the other electrodes.
- When the CON symbol appears, it means that the second calibration solution has also been recognized and the reading has stabilized. Press CFM to confirm.



- Calibration is now complete and the meter automatically returns to the normal operational mode.

TEMPERATURE CALIBRATION (for technical personnel only)

All the meters are factory calibrated for temperature.

The temperature probes are interchangeable and no temperature calibration is needed when they are replaced.

If, for any reason, the temperature measurements seem inaccurate, temperature recalibration may be carried out.

For an accurate recalibration however contact your dealer or the nearest Hanna Customer Service Center.

PREPARATION

- 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.
- Connect the temperature probe (#1 on page 4) to the connector on top of the instrument.

Note: If "°C" blinks, it means that the temperature probe is not connected properly.

CALIBRATION PROCEDURE

- With the instrument turned off, press and hold CAL and then the ON/OFF switch.

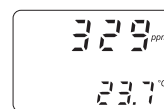


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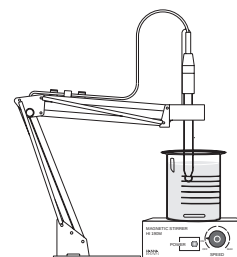


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- Wait until the display stabilizes (about 10-15 minutes). The fluoride ion concentration and the temperature will be displayed on the upper and lower displays, respectively.



Note: It is recommended to mix the sample during the measurement, using a magnetic stirrer set at around 100 rpm.

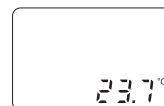
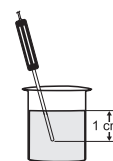


Note: If the temperature probe is not connected, the meter will naturally not compensate for the temperature variance. In this case, accurate fluoride measurements are only possible if the temperature of the sample and the calibration solutions are close (no more than $\pm 3^{\circ}\text{C}$ apart).

TEMPERATURE MEASUREMENT

The temperature can be measured independently from fluoride concentration.

- Immerse the temperature probe to a depth of at least 1 cm (1/2") in the prepared sample.
- Wait for the reading to stabilize. The temperature of the solution will be shown on the lower part of the display.



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CALIBRATION

In order to obtain accurate measurements, frequent calibration is recommended.

For better results, calibrate at a temperature close to that of the solution to be tested (no more than $\pm 3^{\circ}\text{C}$ apart).

The instrument can be calibrated at 1 or 2 points. Two-point calibration is always recommended for better accuracy.

The first point of calibration is fixed at 100 ppm (HI 70703). The second point can be selected between 10.0 (HI 70702) and 1000 ppm (HI 70701). If the sample to be tested has low ionic strength (below 100 ppm), use HI 70702 for the second point. Likewise, with sample concentrations above 100 ppm, use HI 70701 as the second calibration point.

PREPARATION

- Use only clean beakers.

Prepare two calibration solutions by mixing sufficient quantity of 50% HI 70703 (100 ppm) and 50% HI 7023 (TISAB) solution in one beaker and then 50% of HI 70702 (10.0 ppm) or HI 70701 (1000 ppm) solution and 50% HI 7023 (TISAB) in the other.



- Attach the fluoride electrode (#3 on page 4), the reference electrode (#2) and the temperature probe (#1) to their respective connectors on top of the meter.
- Switch the meter on by pressing the ON/OFF button.

Note: For best results, it is recommended to prepare two beakers for each calibration point: one beaker to rinse and the second one to calibrate. This minimizes contamination of the calibration solutions.

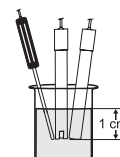
Note: Use plastic beakers to minimize electromagnetic interference.

CALIBRATION PROCEDURE

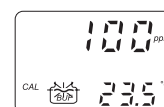
Note: If the fluoride electrode is new, or it has not been used for a few days, it must be soaked in a solution of HI 70702 (10 ppm of F^-) for at least 3 hours prior to calibration.

- Rinse the electrodes with deionized water and dry them attentively with a non-abrasive cloth.

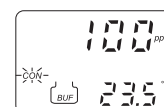
- Immerse the fluoride and the reference electrode as well as the temperature probe to a depth of at least 1 cm ($\frac{1}{2}$ ") in the prepared buffer solution. Make sure that the electrodes are not touching the bottom of the beaker. Immerse the temperature probe close to the tip of the other electrodes.



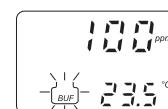
- Press CAL. The display will show "CAL" and "BUF" together with an intermittent "—" symbol. The upper display will show the calibration point (100 ppm) with the temperature of the solution shown on the lower LCD.



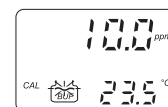
- When the CON symbol appears, it means that the calibration solution has been recognized and the reading has stabilized. Press CFM to confirm the first calibration point.



Note: If the value of the calibration solution measured by the meter is too far from the ideal value, the "BUF" symbol starts blinking to indicate an error in the calibration procedure. Ensure that the calibration solution is fresh and the correct one (in this case 100 ppm), and that the electrodes are in good working condition if necessary follow the electrode maintenance procedure. Repeat the procedure with fresh and/or new solutions and electrodes.



- After pressing CFM, the display will show the second point of calibration (10.0 ppm). Two-point calibration is always recommended, however, by pressing CAL one can exit the calibration procedure at this point, having successfully completed a one-point calibration.



- Press BUF to toggle between 10.0 and 1000 ppm and select the second calibration buffer.

