MALCOLM PIRNIE

# LONG-TERM MONITORING AND MAINTENANCE PLAN

## Former Abalene Pest Control
## Moreau, New York

**NYSDEC Site Number 546035**

**Orkin Exterminating Company, Inc.**
**Atlanta, Georgia**

Prepared by:

**Malcolm Pirnie, Inc.**
15 Cornell Road
Latham, New York 12110

March 1999
1368016

## TABLE OF CONTENTS



## LIST OF FIGURES



## LIST OF APPENDICES

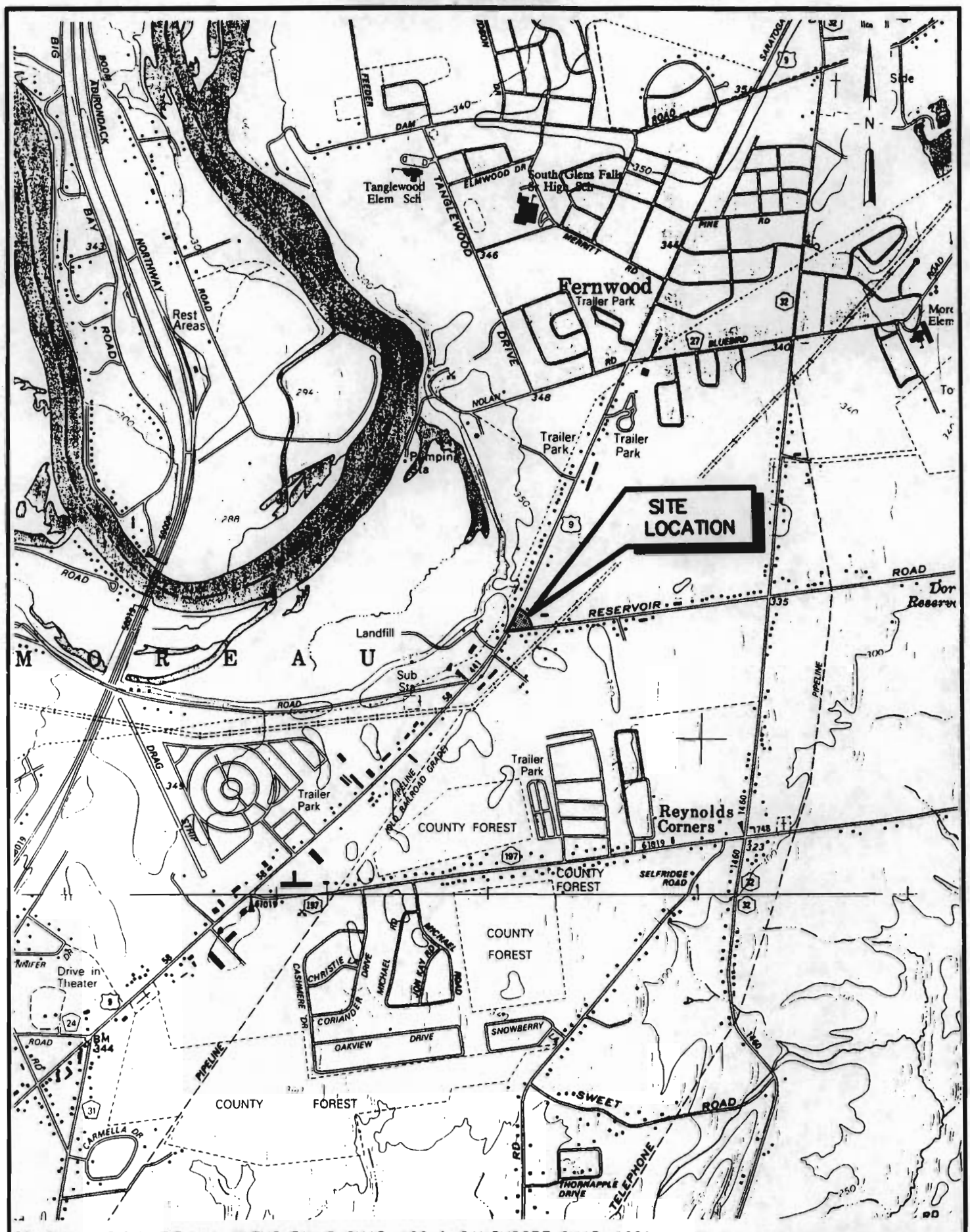
# 1.0 INTRODUCTION

To meet the monitoring and maintenance standards for remedial activities specified in the Record of Decision (ROD) and 6 NYCRR Part 375 for the Former Abalene Pest Control Hazardous Waste site in Moreau, New York, the following Long-Term Monitoring and Maintenance Plan has been prepared. The plan presents, in specific terms, the policies, organizations, objectives, and standards followed in order to monitor the site following completion of the remedial action.

# 2.0 BACKGROUND

## 2.1 SITE INFORMATION

The Abalene Pest Control site is located at the intersection of Reservoir Road and New York State Route 9 in the Town of Moreau, Saratoga County, New York, Figure 2-1. The site is approximately 34,000 square feet in size as shown in Figure 2-2. The surrounding land use is residential and commercial. The site is relatively flat with little or no storm water run-off.




SOURCE: U.S.G.S. 7.5 MIN. GLENS FALLS QUAD. 199 & GANSVOORT QUAD. 1991

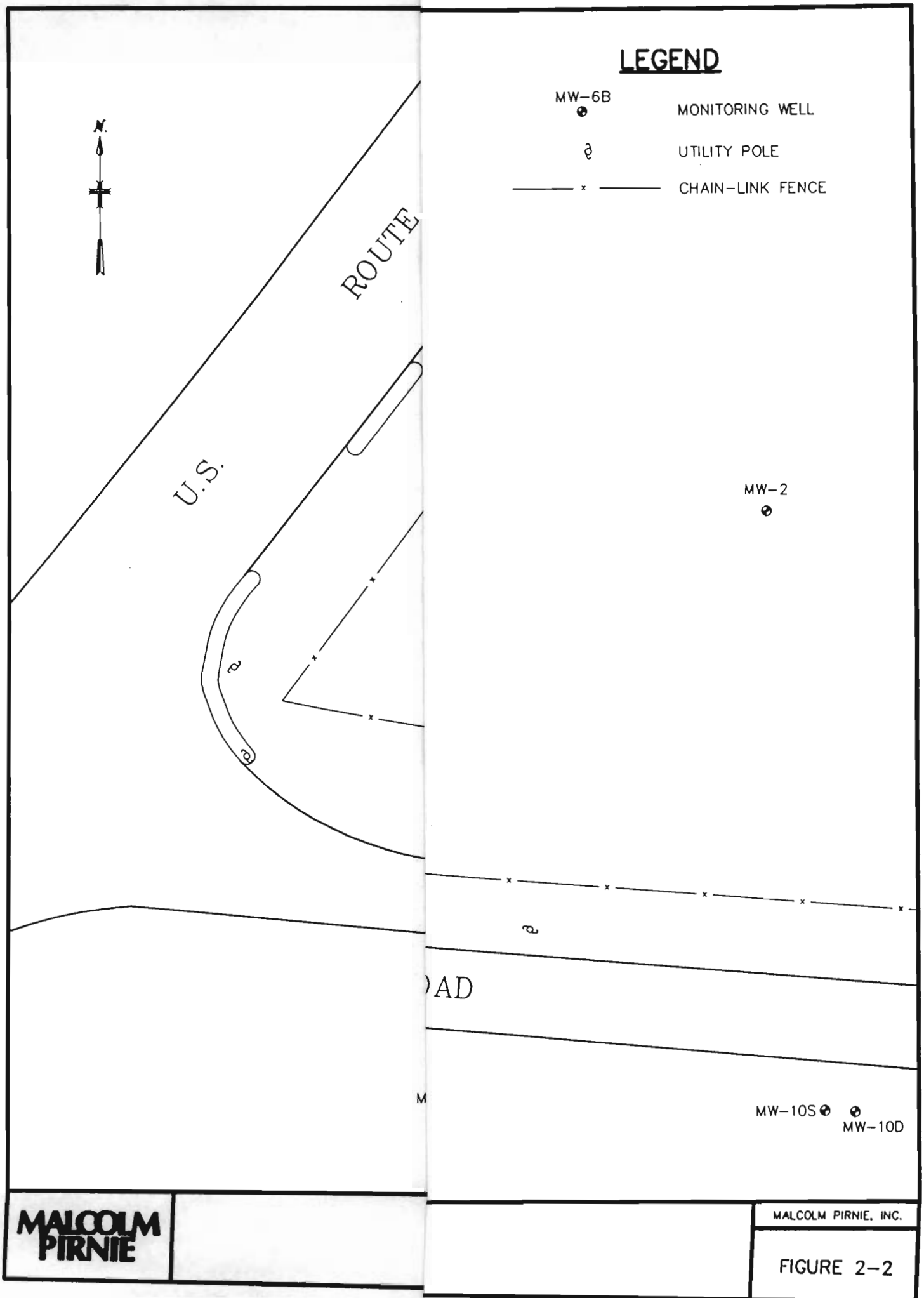
MALCOLM PIRNIE

ABALENE PEST CONTROL
MOREAU, NEW YORK

## SITE LOCATION MAP



FIGURE 2-1




4871 : 1396012900\I:\ACAD\PROJ\1368012900\1368-76 SCALE: 1:30i 05/23, 1996 at 15:45

# 3.0 MONITORING AND MAINTENANCE OBJECTIVES

## 3.1 MONITORING

### 3.1.1 Groundwater

Groundwater samples will be collected from all monitoring wells on a semi-annual basis beginning in Spring 1999. Semi-annual groundwater sampling will be conducted for a period of three years, after which time the sampling frequency and/or the number of wells sampled may be reduced based on the results of the first three years of monitoring. The data from the groundwater sampling will be compared to historic groundwater quality data to document trends in pesticide concentration with time.

Groundwater from the following monitoring wells will be sampled: MW-1, MW-2, MW-3, MW-4, MW-5, MW-6S, MW-6D, MW-6B, MW-7S, MW-7D, MW-7B, MW-8B, MW-9S, MW-9D, MW-9B, MW-10S, and MW-10D. Groundwater samples will be analyzed for Pesticides by USEPA Method 8081A. USEPA-approved low-flow purging techniques will be used to collect representative, low-turbidity samples. During sampling, field parameters will be measured to evaluate the geochemical characteristics of groundwater at the site. These parameters will include temperature, pH, specific conductance, and turbidity. Detailed procedures for groundwater sampling are provided in the Quality Assurance Project Plan (QAPP) developed for the remedial action (Remedial Action Work Plan Appendix C). A multi-parameter Horiba U-10 will be used to measure the field parameter data. The calibration procedures, operation and maintenance of this unit is described in Appendix A. Forms used to read field parameter data and sampling data are included in Appendix B.

Prior to starting groundwater sampling activities, water levels will be measured in each well. This data will be used to construct potentiometric contour maps and monitor groundwater flow patterns at the site.

## 3.2 MAINTENANCE

### 3.2.1 Soil Cover

After completion of the remedial action, the site will be inspected semi-annually. Inspections will be conducted to document the integrity of the soil cap and the general condition of the site. Inspections will be conducted in the spring and fall of each year. Field audit forms will be completed during the site inspection and are included in Appendix C. The inspection will include the following items:

1. The soil cap will be inspected for:
   - erosion
   - animal burrows
   - unvegetated (bare) areas
   - settlement

2. The site drainage system will be inspected for:
   - erosion in swales or drainage ditches
   - obstructions or sediment in swales or drainage ditches
   - evidence of ponding water

3. The monitoring wells will be inspected for:
   - intact locks
   - damage to the protective casing
   - erosion around the casing
   - integrity of the well cement pad
   - integrity of the flush-mount seal

### 3.2.2 Maintenance of Vegetative Cover

Vegetative cover will be mowed at least twice a year to control growth.

### 3.2.3 Response/Contingency Plan

If, during the semi-annual inspections any concerns are identified, they shall be reported to Orkin and the following responses will be initiated:

- Eroded areas will be filled to original grade. Unvegetated areas will reseeded and fertilized as necessary.

- Repairs to monitoring wells.

- A detailed description of the work performed will be prepared after the corrective measure has been completed. This report will be included with the annual report submitted to the NYSDEC.

### 3.2.4 Reporting

The results of the Long-Term Monitoring and Maintenance Plan for each year of monitoring will be summarized in an annual report and submitted to Ms. Denise Wagner, NYSDEC Region 5 Office, P.O. Box 296, Route 86, Ray Brook, New York 12977. The annual report will include:

- Well purge logs.
- Results of groundwater sample analyses in summary tables and appended laboratory data sheets.
- A comparison of analytical results to historic data, NYSDEC Class GA standards, and USEPA MCLs.
- Potentiometric contour maps for the shallow water table and the deep sand unit.
- A discussion of the semi-annual inspections of the site, including a description of repairs performed.

The annual report will be submitted within 60 days of receipt of the analytical data from the second semi-annual event for that year (Fall sampling event).

### 3.2.5 Contact List

A contact list for the parties involved on the Monitoring and Maintenance Plan (M&M Plan) for the Orkin site is as follows:

- Party Responsible for M&M Plan: Mr. Bruce R. Nelson
  Malcolm Pirnie, Inc.
  15 Cornell Road
  Latham, New York 12110
  Phone: (518) 786-7349

- Site Owner:

  Mr. Joe Malinowksi
  Orkin Pest Control
  2170 Piedmont Road N.E.
  Atlanta, GA 30324
  Phone: (404) 888-2641

- Department of Health Contact:

  Mr. Bob Montione
  New York State Department of Health
  Bur. of Environmental Exposure Investigation
  2 University Place, Room 205
  Albany, NY 12203-3399
  Phone: (518) 458-6316

- NYSDEC Contact:

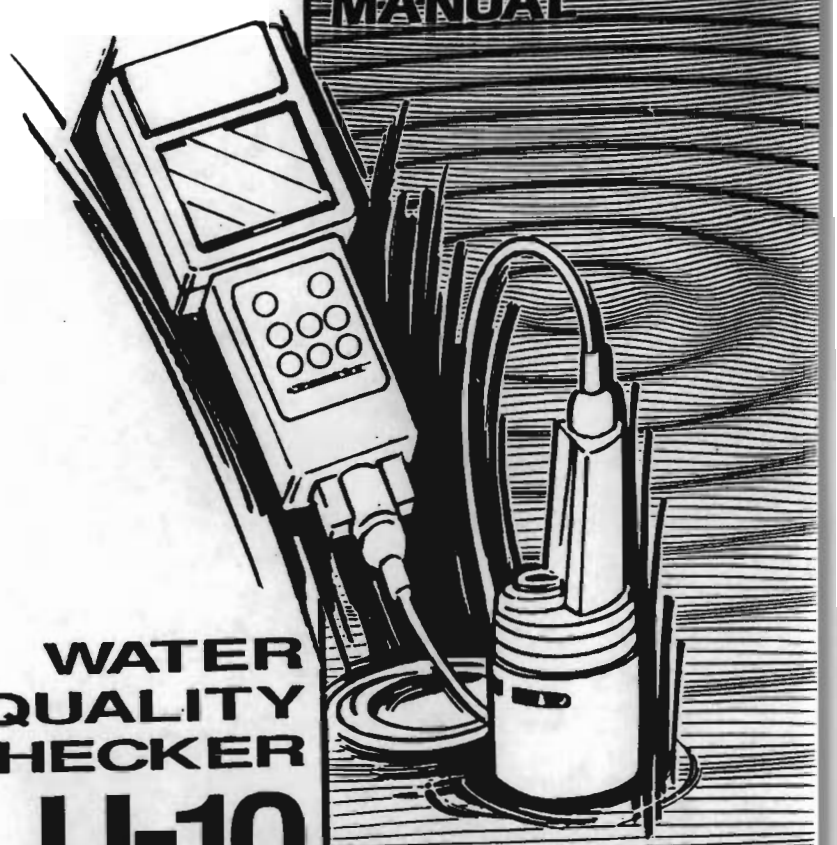
  Ms. Denise Wagner
  New York State Department of
  Environmental Conservation
  Region V, Route 86
  Ray Brook, NY 12977
  Phone: (518) 897-1241

# APPENDIX A

Field Equipment Calibration Instructions

HORIBA

# INSTRUCTION MANUAL



# WATER QUALITY CHECKER U-10

CODE: 040801000HK-5

## WARNING

The DO sensor contains a strong alkaline solution. Should any of this solution come in contact with your clothing or skin, wash it away immediately with plenty of water.

Be especially careful not to allow any of the alkaline liquid in the DO sensor to get in your eyes.

### ⚠CAUTION

Insert the battery with ample care to the polarity. Reverse insertion on the polarity will make damage to the inner PCB.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provede reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

The U-10 Water Quality Checker is a state-of-the-art instrument for simultaneous multiparameter measurement of water quality. The HORIBA U-10 measures six different parameters of water samples: *pH*, *conductivity*, *turbidity*, *dissolved oxygen*, *temperature*, and *salinity*.

The U-10 is compact enough to be held in one hand while taking measurements. It has a large easy-to-read LCD readout. Measurements are taken simply by immersing the probe right into the water sample.

The U-10 is extremely versatile and sophisticated, yet easy to use. You will find it a valuable addition to on-site water control operations, whatever your needs – from testing factory discharges to urban drainage, river water, lake and marsh water, aquatic culture tanks, agricultural water supplies, and sea water.

To get the most out of your U-10 Water Quality Checker, please read this *Instruction Manual* carefully before you begin to take measurements.

Note that Horiba cannot be held responsible for any equipment malfunction or failure should the U-10 Water Quality Checker be operated incorrectly or in a manner other than specified in this *Instruction Manual*.

Horiba's aim is to produce the best possible equipment and documentation for our products. We welcome comments, questions, or suggestions for improvement concerning both our products and the accompanying documentation, such as this *Instruction Manual*.



Second edition: November, 1991
First edition: July, 1991

# CONTENTS



**Contents of Tables**

Section 1

# Getting Started

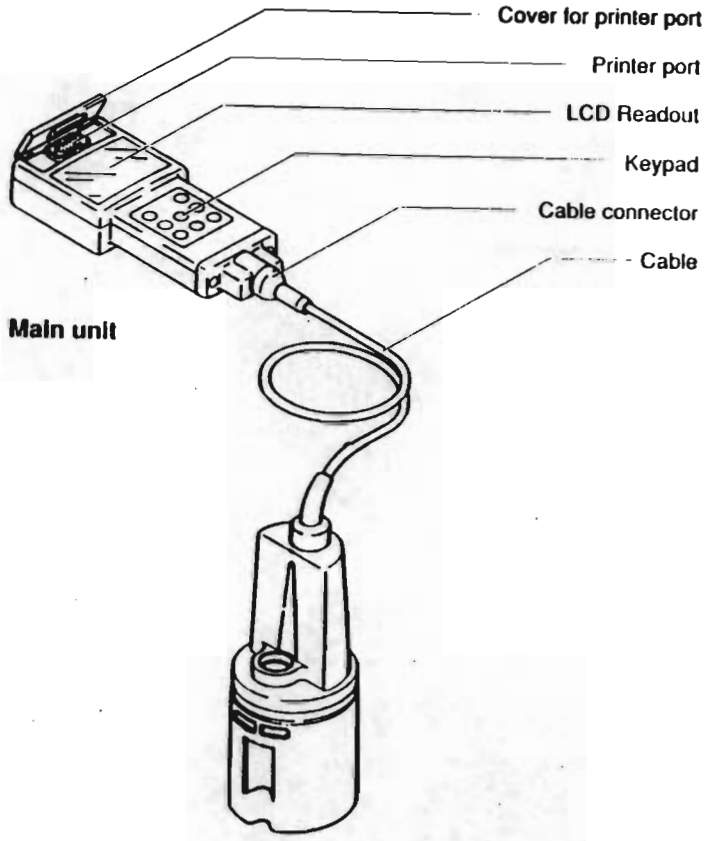
This section first gives an overview of the U-10. It then shows how to set up your U-10 by inserting the DO sensor and the battery.



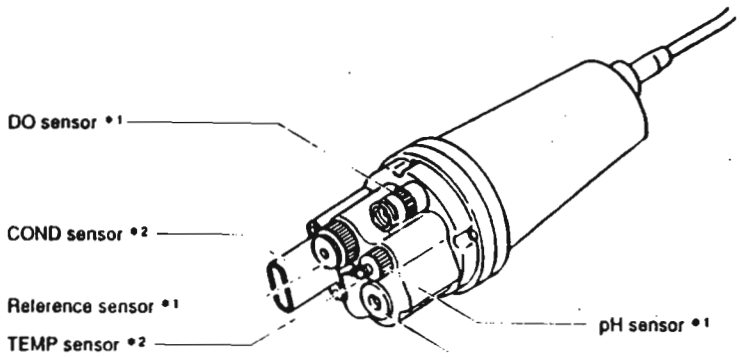


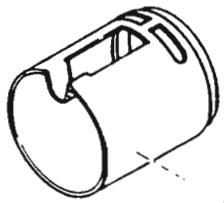
## Configuration of the U-10

### Main unit



## Probe



Probe guard

*1. Removable
DO (Dissolved oxygen)
Reference
pH

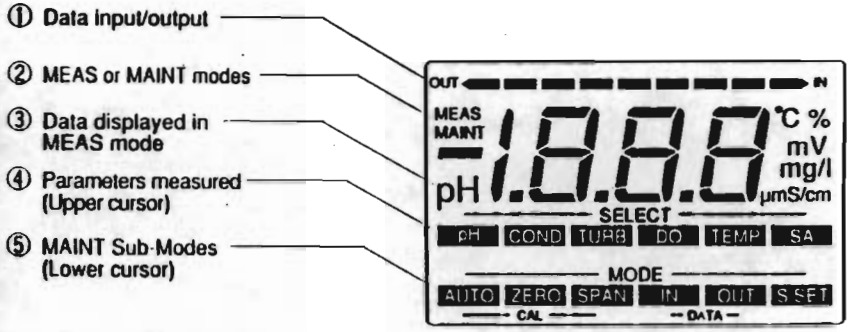
*2. Non-removable
COND (Conductivity)
TEMP (Temperature)
TURB (Turbidity)





## The Readout

The readout has two main functions: (1) it displays the results of measurements, and (2) it serves as a message board to show the operating status of the U-10.




### ① Data input/output

OUT — Data output

— IN Data input

### ② MEAS or MAINT modes

The U-10 may be used in one of two modes: Measurement (MEAS) mode or Maintenance mode.

**MEAS** the U-10 is ready to make 6-parameter measurements

**MAINT** the U-10 is ready for other operations, e.g., calibration, data input/recall, or salinity setting

③ **Data displayed in MEAS mode**

- 6-parameter results:
  pH, conductivity, turbidity, DO, temperature, and salinity
- Designated value for salinity setting
- Error codes

④ **Parameters measured**

Value displayed on readout is highlighted by upper cursor.

| | |
|---|---|
| pH | pH |
| COND | Conductivity |
| TURB | Turbidity |
| DO | Dissolved-Oxygen |
| TEMP | Temperature |
| SAL | Salinity |

⑤ **MAINT Sub-Modes**

One of six Sub-Modes selected is highlighted by lower cursor.

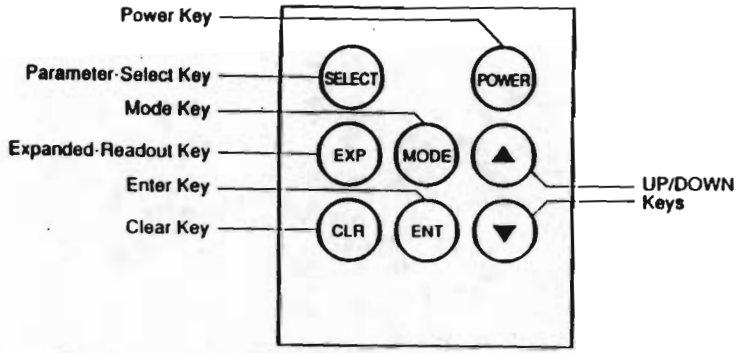
| | |
|---|---|
| AUTO | Automatic 1-point calibration |
| ZERO | Manual zero calibration |
| SPAN | Manual span calibration |
| IN | Data input |
| OUT | Data output (recall) |
| S.SET | Salinity setting correction |





## The Keypad

The U-10 is operated by the keypad on the main unit, which has eight surface-sealed keys, as illustrated.




POWER

**Power Key (POWER)**
Turns the main unit ON/OFF.

When this key is pressed to turn the U-10 ON, the readout comes in the MEAS mode, showing the parameter last displayed in the previous measurement. If the U-10 is left with the power ON for 30 minutes without any of the keys being activated, the power will be turned OFF automatically.

SELECT

**Parameter-Select Key (SELECT)**
Use this key to move the upper cursor to the measured parameter you want to show on the readout. It toggles through the six parameters in order:

pH → COND → TURB → DO → TEMP → SAL

MODE

**Mode Key (MODE)**
Toggles back and forth between MEAS and MAINT modes. When in the MAINT mode, this key toggles the lower cursor through the six maintenance Sub-Modes.

AUTO → ZERO → SPAN → IN → OUT → S.SET

EXP

**Expanded-Readout Key (EXP)**
Toggles between (1) standard readout value and (2) expanded readout, for greater resolution, with decimal point moved one digit to the left.

ENT

**Enter Key (ENT)**
This acts like the RETURN Key or Enter Key on a computer keyboard. The U-10 Enter Key has four main functions, depending on which mode the unit is in.

1. In the AUTO Sub-Mode: Press this key to start automatic calibration.
2. In either the ZERO or SPAN Sub-Modes: Used in manual calibration to set the value for the standard solution being used.
3. In the IN Sub-Mode: Inputs data being measured to memory.
4. In the OUT Sub-Mode: Recalls values from one of the 20 Data-Set Nos. that is now shown on the readout. Prints data when a printer is connected.

CLR

**Clear Key (CLR)**
This acts like the ESCAPE Key on a computer keyboard It has three main functions, depending on which mode the unit is in.

1. In the AUTO Sub-Mode: Aborts the auto-calibration now in progress.
2. In the IN Sub-Mode: Deletes data in memory from all 20 Data-Sets.
3. When the readout shows an error code: Clears the error code from the readout.

▲
▼

**UP/DOWN keys**
Use these keys to select values when in one of the MAINT Sub-Modes. They have two main functions.

1. In either the ZERO or SPAN Sub-Modes: Use these keys to select value for the standard solution.
2. In the OUT mode: Used to toggle through the 20 Data-Set Nos. to select the one you wish to recall.





# Setting up the U-10

## Preparations of the pH sensor and the reference sensor

1. Remove the protective rubber cap from the pH sensor.
2. Remove the sealing tape from the reference sensor.

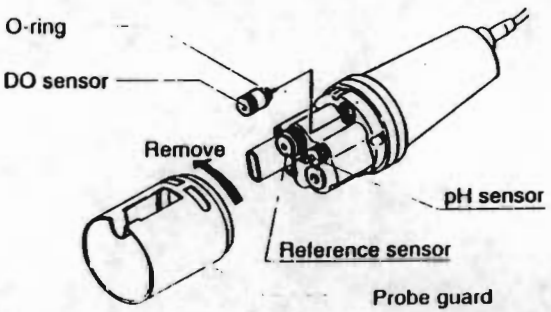
## Inserting the DO sensor

**WARNING**

The DO sensor contains a strong alkaline solution. Should any of this solution come in contact with your clothing or skin, wash it away immediately with plenty of water. Be especially careful not to allow any of the liquid in the DO sensor to get in your eyes.

The Dissolved-Oxygen (DO) sensor has a delicate membrane that can easily be ruptured. For safety's sake, the U-10 is shipped to you with the DO sensor packed separately. You should insert the DO sensor when you unpack your U-10 unit.

1. Make sure that the DO sensor has the correct O-ring, as shown.
2. First, fit the DO sensor lightly into its socket, and then put on the probe guard to align it correctly.
3. Then, tighten the DO sensor securely to the probe body. When doing this, be especially careful not to damage the membrane, which is located in the front of the DO sensor.



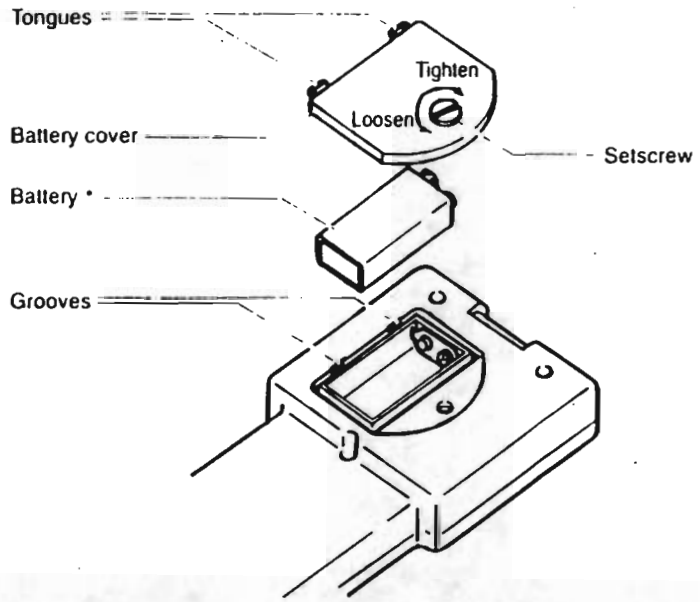
## Inserting the battery

The U-10 is shipped from the factory with the battery packed separately.

The battery may be inserted by loosening the set-screw on the battery cover and pulling up the cover. Make sure that the plus and minus poles of the battery match the terminals correctly.

If the readout shows the message Er 1, it means that the battery is defective or exhausted and should be replaced.

If you are replacing the battery and already have data stored in the U-10 memory that you wish to save, be sure to turn OFF the POWER Key before you remove the old battery. This will assure that data stored in memory will be maintained by the internal backup battery.

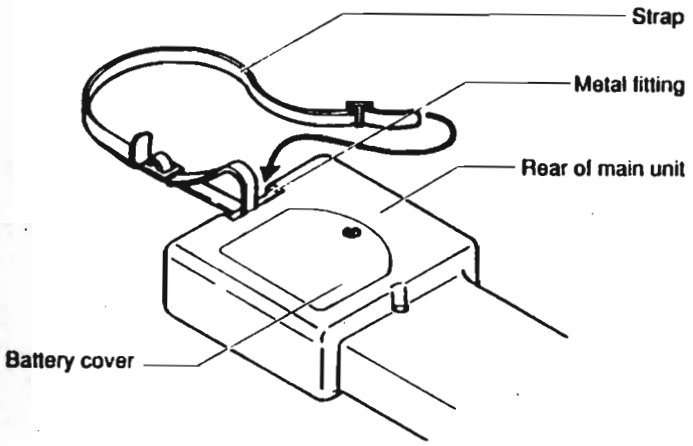



• Use a 9V-battery



## Attaching the carrying strap

Hook both ends of the strap through the metal fitting on back of the main unit, as illustrated.



Section 2

# Making Measurements

Making a measurement with the U-10 Water Checker is extremely simple. Just turn on the power and place the probe in the sample of water you wish to measure.

All six parameters are measured simultaneously. These parameters may be stored in memory, printed out, or viewed one-by-one on the LCD readout. For printing and data storage, see the appropriate sections following this one. To view the parameters one-by-one on the readout, use the SELECT Key to toggle the upper cursor through them.

While the U-10 is both rugged and precise, the key to accurate measurements is cleanliness and frequent calibration. It is essential to clean the U-10 thoroughly after each measurement, and it is recommended that you re-calibrate your U-10 as frequently as possible. For best results, you should recalibrate it before each measurement session. Cleaning and calibration procedures are described below in this section and in the following one.



## How to make a measurement

POWER **1** Turn the power on.

**2** Gently place the probe into the water sample.

Basically, that's all there is to it: just turn it on and put the probe in the sample. Of course, the U-10 can do many sophisticated things with the sample data, and for best results, you should be careful about calibrating the unit and maintaining it in good condition. This is explained in detail below and in the next section.

---

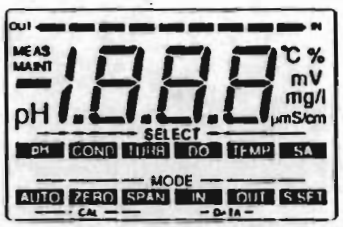
**Be careful!**
Never drop or throw the probe into the water. It is a precision instrument containing five delicate sensors and five pre-amps; you can damage it beyond repair by unnecessary rough handling.

---

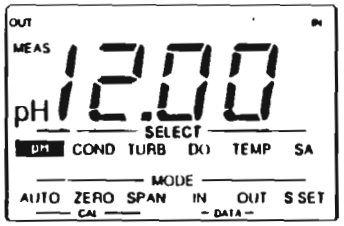
## Initial readout

POWER

When you first turn the power on, the U-10 will be in the MEAS mode, the readout will look like this, with all the LCD segments activated.




After about two seconds, the readout will change to show that a new measurement is being made. The readout will show the last parameter that the upper cursor was on when the previous measurement was made, i.e., pH as illustrated here.




(Expanded readout shown)

The display of the decimal point in the readout mode will also be in the same format as was selected with the EXP Key in the previous measurement, i.e., standard or expanded (as illustrated here).





## Select the parameter you want shown on the readout of the measured data

SELECT

All six parameters are automatically measured at once. Use the SELECT Key to toggle the upper cursor to the parameter you want.

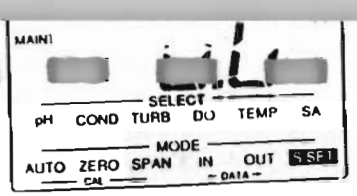
| | |
|---|---|
| pH | : pH |
| COND | : Conductivity |
| TURB | : Turbidity |
| DO | : Dissolved oxygen |
| TEMP | : Temperature |
| SAL | : Salinity |

To get a uniform reading, slowly move the probe up and down to circulate the water through it. (Move it 1 foot (30 cm) per sec.) Then wait for the readout to stabilize while doing this.

| | | | |
|---|---|---|---|
| TURB | 0-[illegible]00 NTU | 10 NTU | 1 NTU |
| DO | 0-19.9 mg/l | 0.1 mg/l | 0.01 mg/l |
| TEMP | 0-50°C | 1°C | 0.1°C |
| SAL | 0-4% | 0.1% | 0.01% |

Note that the salinity parameter is the only value not measured directly with its own sensor. The U-10 obtains salinity by converting the conductivity value. If large amounts of conductive ions other than salt-water components are present in the sample, an error may occur. Be cautious when interpreting the salinity results.






ENT

3. Finally, press the ENT Key to complete the salinity setting while in the S.SET Sub-Mode.

MODE

4. When the salinity setting has been made, switch back to the MEAS mode by pressing the the MODE Key.

Section 3

# Calibrating the U-10

The U-10 Water Checker may be calibrated either manually or automatically. The 4-parameter auto-calibration procedure is quite handy and should be sufficient for most measurement operations.

Manual calibration for each of the four parameters is more accurate but, of course, also more time-consuming. This method should be used for more precise measurement. The manual calibration procedure is explained below in detail, following the description of the auto-calibration procedure.

The auto-calibration procedure is extremely simple. The U-10 Water Checker uses just a single solution to do a simultaneous calibration of four parameters: *pH, COND, TURB,* and *DO*. Your U-10 comes with a bottle of standard phthalate pH solution and a calibration beaker for this purpose.





## Auto-calibration procedure

Fill the calibration beaker to about 2/3 with the standard solution. Note the line on the beaker.

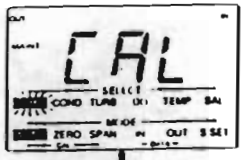
Fit the probe over the beaker, as illustrated. Note that the beaker is specially shaped to prevent the DO sensor from being immersed in the standard solution. This is because the DO auto-calibration is done using atmospheric air.

Calibration beaker

MODE With the power on, press the MODE Key to put the unit into the MAINT mode. The lower cursor should be on the AUTO Sub-Mode; if it is not, use the MODE Key to move the lower cursor to AUTO.

ENT With the lower cursor on AUTO, press the ENT Key. The readout will show CAL. Wait a moment, and the upper cursor will gradually move across the four auto-calibration parameters one-by-one: *pH, COND, TURB,* and *DO*. When the calibration is complete, the readout will briefly show End and then will switch to the MEAS mode.

The upper cursor will blink while the auto-calibration is being made. When the auto-calibration has stabilized, the upper cursor will stop blinking.

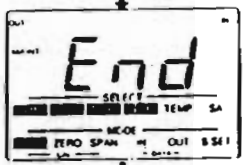



First, pH is being auto-calibrated


Then, COND is being auto-calibrated


Next, TURB is being auto-calibrated


Finally, DO is being auto-calibrated




Auto-calibration now ends


And the readout switches to the MEAS mode

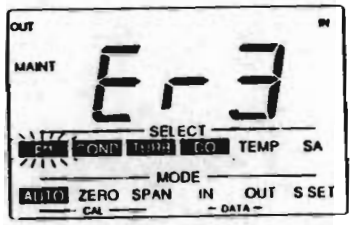
Note: If you wish to abort the auto-calibration for any reason, press the CLR Key. The parameters auto-calibrated so far will be stored in memory.





## Auto-calibration error

After the DO auto-calibration, if the unit does not switch to the MEAS mode as it should, and the readout shows either Er3 or Er4, an auto-calibration error has occurred. Parameters will blink where an error occurred.




pH auto-calibration error

CLR

If this happens, re-do the auto-calibration. First, press the CLR Key to cancel the error code.


ENT

Then press the ENT Key to re-start the auto-calibration. Restart the auto-calibration beginning again with pH.

# Manual (2-point) calibration procedures

For normal measurements, the 4-parameter auto-calibration described above is sufficiently accurate. However, you may wish to do a parameter-by-parameter, 2-point manual calibration of one or more of the four parameters. This is recommended either for high-accuracy measurements, especially when using the expanded readout mode. It is necessary if a new probe is being used for the *first time*.

Parameters to be calibrated manually.

| | | |
|---|---|---|
| pH | • Zero | (see page 24.) |
| | • Span | (see page 25.) |
| COND | • Zero | (see page 28.) |
| | • Span | (see page 29.) |
| TURB | • Zero | (see page 31.) |
| | • Span | (see page 31.) |
| DO | • Zero | (see page 32.) |
| | • Span | (see page 33.) |

Parameters not to be calibrated.

Sample temperature
Salinity



## pH calibration

pH calibration on the U-10 is done using two commercially-available standard solutions of different pH values, one for the zero calibration, the other for the span calibration. Note that the temperature characteristics of the various standard solutions that are available may differ; therefore, before using these two solutions to make the pH calibration, carefully measure the temperature and determine the temperature characteristics of each.

### Preparation

Wash the probe 2-3 times, using de-ionized or distilled water. Place it in a beaker of each standard solution.

### 1. Zero calibration

Use a pH7 standard solution for the zero calibration.

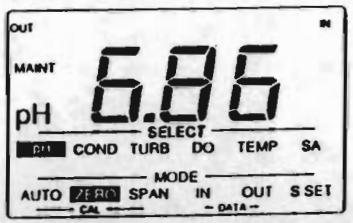
#### Operation

MODE 1. With the power on, press the MODE Key to put the unit into the MAINT mode.

MODE 2. Press the MODE Key again to move the lower cursor to ZERO.

SELECT 3. Use the SELECT Key to move the upper cursor to pH.

▲ ▼ 4. When the readout has stabilized, use the UP/DOWN Keys to select the value of the pH 7 standard solution at the temperature of the sample. Refer to Table 2 for pH values of standard solutions at various temperatures.




ENT 5. Press the ENT Key to complete the zero calibration for pH.

## 2. Span calibration

Use either a pH4 or a pH9(10) standard solution for the span calibration.

**Operation**


1. Use the MODE Key to move the lower cursor to SPAN.

2. As in Step 4. above in zero calibration, when the readout has stabilized, use the UP/DOWN Keys to select the value of the standard solution (i.e., either pH4 or pH9) at the temperature of the sample. Again, refer to Table 2 for pH values of standard solutions at various temperatures.


3. Press the ENT Key to complete the span calibration for pH.

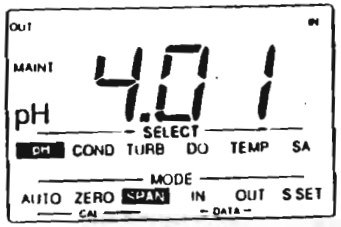



**Table 2** pH values of standard solutions at various temperatures*

| Temperature °C / °F | pH2[a] | pH4[b] | pH7[c] | pH9[d] | pH10[e] | pH12[f] |
|---|---|---|---|---|---|---|
| 0 / 32 | 1.67 | 4.01 | 6.98 | 9.46 | 10.32 | 13.43 |
| 5 / 41 | 1.67 | 4.01 | 6.95 | 9.39 | 10.25 | 13.21 |
| 10 / 50 | 1.67 | 4.00 | 6.92 | 9.33 | 10.18 | 13.00 |
| 15 / 59 | 1.67 | 4.00 | 6.90 | 9.27 | 10.12 | 12.81 |
| 20 / 68 | 1.68 | 4.00 | 6.88 | 9.22 | 10.06 | 12.63 |
| 25 / 77 | 1.68 | 4.01 | 6.86 | 9.18 | 10.01 | 12.45 |
| 30 / 86 | 1.69 | 4.01 | 6.85 | 9.14 | 9.97 | 12.30 |
| 35 / 95 | 1.69 | 4.02 | 6.84 | 9.10 | 9.93 | 12.14 |
| 40 / 104 | 1.70 | 4.03 | 6.84 | 9.07 | 9.89 | 11.99 |
| 45 / 113 | 1.70 | 4.04 | 6.83 | 9.04 | 9.86 | 11.84 |
| | 1.71 | 4.06 | 6.83 | 9.01 | 9.83 | 11.70 |

a : oxalate, b : phthalate, c : neutral phosphate, d : borax,
e : carbonate, f : Sat.calcium hydroxide solution

* These pH valves are for Japanese standard solutions. Should you prefer to use different standard solutions, be sure to make the proper adjustments in calibration.





## COND calibration

The U-10 can measure conductivity in the range of 0-100 mS/cm. Depending on the sample concentration, however, the U-10 automatically selects the proper range out of its three possible ranges of 0-1 mS/cm, 1-10 mS/cm, and 10-100 mS/cm.

Therefore, if you are doing a manual calibration for COND, this must be done for each of the three ranges. However, since the zero point is common for all three ranges, only the three one-point span calibrations need be done separately.

## Preparing the standard solution for COND span calibration

This solution uses a potassium chloride as a reagent. For greater accuracy, the solution should be freshly prepared each time. If it is unavoidable to use a stored solution, be sure to keep it tightly capped in a polyethylene or hard glass bottle. The shelf life of this solution is six months. Date-stamp the bottle for reference. Never use a KCl standard solution that has been stored for more than six months: the calibration accuracy may be adversely affected.

Use potassium chloride powder of the best quality commercially available. Dry the powder for two hours at 105°C, and cool it down, in a desiccator. Weigh out an appropriate amount of dried and cooled potassium chloride powder according to the table below. Make the potassium chloride standard solution as shown.

**Table 3** Making the potassium chloride standard solution

| KCl standard solution | KCl weight g | Conductivity* mS/cm | Range to be calibrated mS/cm |
|---|---|---|---|
| 0.005N | 0.373 | 0.718 | 0-1 |
| 0.05N | 3.73 | 6.67 | 1-10 |
| 0.5N | 37.28 | 58.7 | 10-100 |

* Value at the temperature, 25°C

To prepare the standard solution, use a 1-liter volumetric flask. First, dissolve the KCl in a small amount of de-ionized or distilled water. Then fill the flask with de-ionized or distilled water up to the 1-liter line. Finally, shake the solution to mix it thoroughly.





## 1. Zero calibration

This calibration is carried out in atmospheric air; no solution is needed.

### Preparation

Wash the probe 2-3 times, using de-ionized or distilled water. Shake the probe to remove any water droplets from the COND sensor. Then allow it to dry by exposing it to fresh air.

### Operation


1. Use the MODE Key to move the lower cursor to ZERO.


2. Use the SELECT Key to move the upper cursor to COND.

3. Use the UP/DOWN Keys to set the readout to zero.



4. Press the ENT Key. This completes the zero calibration for COND.

## 2. Span calibration

This procedure uses a standard solution of potassium chloride. For best results, a fresh batch of the solution should be prepared each time. See page 27 for details.

### Preparation

Wash the probe 2-3 times using de-ionized or distilled water. Following this, wash it 2-3 times in the KCl standard solution you have prepared. Then place the probe in a beaker of the KCl solution maintained at a temperature of 25±5°C.

### Operation


1. Use the MODE Key to move the lower cursor to SPAN.

2. After the readout stabilizes, as you did for the pH calibration, use the UP/DOWN Keys to select set the value of the KCl standard solution, referring to the KCl table.


3. Press the ENT Key to complete the span calibration for this COND range.

4. Repeat this procedure for the three ranges, using each of three values of KCl standard solutions.





## TURB calibration

Use good-quality de-ionized water, which may be considered as having a turbidity of zero. If that is not readily available, distilled water may be used instead. When doing the turbidity zero calibration, it is particularly crucial that you clean the probe thoroughly. Never use a dirty probe; otherwise the calibration will be unreliable.

### Preparing the standard solution for TURB span calibration

1. Weigh out 5.0 g of hydrazine sulfate.
2. Dissolve this in 400 m*l* of de-ionized or distilled water.
3. Then weigh out 50 g of hexamethylenetetramine, and dissolve it in 400 m*l* of de-ionized or distilled water.
4. Mix these two solutions, add enough de-ionized or distilled water to make 1,000 m*l*, and stir the mixed solution thoroughly.
5. Allow this solution to stand for 24 hours at a temperature of 25 ±3°C.

   The turbidity of this solution is equivalent to 4000 NTUs. The shelf-life of this solution is six months; i.e., this 4,000-NTU value will remain accurate for a maximum of six months.

   Each time you carry out this calibration, it is necessary to dilute the 4,000-NTU standard solution to prepare an 800-NTU standard solution for calibration. To do this, measure out 50 m*l* of the 4,000-NTU solution into a 250-m*l* measuring flask.

   It is recommended that you use a rubber pipette aspirator for this. Then add de-ionized or distilled water up to the 250-m*l* line.

   The standard solution used here for the turbidity calibration will precipitate easily. Therefore, be sure to stir the solution thoroughly before use.

## 1. Zero calibration

**Preparation**

Wash the probe thoroughly 2-3 times using de-ionized or distilled water. Shake off excess water droplets, and then place it in a beaker of de-ionized or distilled water.

**Operation**

MODE 1. Use the MODE Key to move the lower cursor to ZERO.

SELECT 2. Use the SELECT Key to move the upper cursor to TURB.

▲ ▼ 3. After the readout has stabilized, set it to 0.0, using the UP/DOWN Keys.

ENT 4. Press the ENT Key to complete the zero calibration for TURB.

## 2. Span calibration

**Preparation**

Wash the probe thoroughly, using de-ionized or distilled water. Shake off excess water droplets. Then place it in a beaker of the 800-NTU solution you have prepared for this purpose.

**Operation**

1. Stir this 800-NTU span standard solution thoroughly.

MODE 2. Use the MODE Key to move the lower cursor to SPAN.

3. After readout has stabilized, i.e., about 60 to 90 seconds, set the readout to "800" NTU, which is the value for this standard solution.

ENT 4. Press the ENT Key to complete the span calibration for TURB.





# DO calibration

Unlike the other calibration procedures, the solution for the DO calibration cannot be stored for use; because the amount of dissolved oxygen in the solution is crucial, a fresh batch must be prepared each time, just before it is used in the DO calibration.

## 1. Zero calibration

Use a solution of sodium sulfite dissolved in either de-ionized water or tap water.

**Preparation**

1. Add about 50g of sodium sulfite to 1,000 ml of water (either de-ionized water or tap water will do). Stir this mixtuer to dissolve.

2. Wash the probe 2-3 times in tap water, and place it in the zero standard solution.

**Operation**

MODE 1. Use the MODE Key to move the lower cursor to ZERO.

SELECT 2. Use the SELECT Key to move the upper cursor to DO.

▼ 3. After the readout has stabilized, set it to 0.0, using the UP/DOWN Keys.

ENT 4. Press the ENT Key. This completes the zero calibration for DO.

## 2. Span calibration

Use either de-ionized water or tap water that has been saturated with oxygen in air.

**Preparation**

1. Put 1 or 2 liters of water in a container (either de-ionized water or tap water will do). Use an air pump to bubble air through the solution until it is oxygen-saturated.

2. Wash the probe 2-3 times in tap water, and put it in the span calibration solution.

**Operation**

1. First, be sure the U-10 is set for fresh water readings. To do this, set the S.SET Sub-Mode to 0.0%.


2. Then, use the MODE Key to move the lower cursor to SPAN.

3. After the readout has stabilized, while slowly moving the probe up and down in the solution, set the readout value to the appropriate DO value for the temperature of this solution. For DO values at various temperatures, refer to Table 4.


4. Press the ENT Key to complete the span calibration for DO.



**Table 4** Amounts of saturated dissolved oxygen in water at various temperatures, salinity = 0.0%

| Temperature | DO | Temperature | DO |
|---|---|---|---|
| 0 °C | 14.16 mg/l | 21 °C | 8.68 mg/l |
| 1 | 13.77 | 22 | 8.53 |
| 2 | 13.40 | 23 | 8.39 |
| 3 | 13.04 | 24 | 8.25 |
| 4 | 12.70 | 25 | 8.11 |
| 5 | 12.37 | 26 | 7.99 |
| 6 | 12.06 | 27 | 7.87 |
| 7 | 11.75 | 28 | 7.75 |
| 8 | 11.47 | 29 | 7.64 |
| 9 | 11.19 | 30 | 7.53 |
| 10 | 10.92 | 31 | 7.42 |
| 11 | 10.67 | 32 | 7.32 |
| 12 | 10.43 | 33 | 7.22 |
| 13 | 10.20 | 34 | 7.13 |
| 14 | 9.97 | 35 | 7.04 |
| 15 | 9.76 | 36 | 6.94 |
| 16 | 9.56 | 37 | 6.86 |
| 17 | 9.37 | 38 | 6.76 |
| 18 | 9.18 | 39 | 6.68 |
| 19 | 9.01 | 40 | 6.59 |
| 20 | 8.84 | | |

Section **4**

# Data Storage and Printout

The U-10 can store up to 20 sets of data, 120 data points, of the values measured for each of the six parameters: pH, COND, TURB, DO, TEMP, and SALINITY. Values stored in memory can be recalled to the readout as desired.

If a printer is connected to the U-10 printer port, whenever a Data-Set is either stored in memory or recalled to the readout, it can also be simultaneously output to the printer.





## Storing data

MODE 1. Press the MODE Key to put the U-10 in the MAINT mode.

MODE 2. Continue to press the MODE Key to move the lower cursor to IN, the *Input* Sub-Mode.

SELECT 3. Use the SELECT Key to move the upper cursor to the parameter you wish to see on the readout.

ENT 4. When the readout stabilizes on a value, press the ENT Key. This will automatically input the set of six parameters for this measurement into memory.


The readout will first show the Data-Set No. for about two seconds. At the top right-hand corner, a dashed arrow points to IN, showing that data is being input. Then each parameter is automatically read into memory, one-by-one from pH to salinity. The upper cursor skips along to show this. If a printer is connected, these six values will also be printed out at the same time.

The upper cursor then returns to pH, with the U-10 still in the IN Sub-Mode.

ENT 5. You may now continue and input another set of data: simply press the ENT Key again.

The Data-Set No. will automatically advance one digit, and the next set of six parameters will be read into memory in the same manner. This procedure can be repeated for up to a total of 20 Data-Sets.

If 20 Data-Sets have been read into memory, the storage capacity is full and no more data may be input. The U-10 will beep three times to indicate the memory is full.

MODE

6. To return the readout to the previous setting in the MEAS mode, press the MODE Key again.



## Recalling data

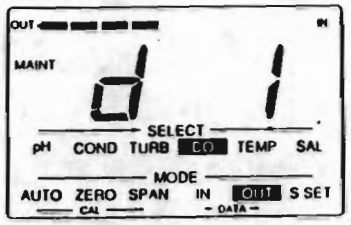
MODE

1. Press the MODE Key to put the U-10 in the MAINT mode.

MODE

2. Continue to press the MODE Key to move the lower cursor to OUT, the *Output* Sub-Mode. The readout will show d.1, meaning Data-Set No. 1.

At the top left-hand corner, a dashed arrow points to OUT, showing that data can be output now to the readout.




▲ ▼

3. Use the UP/DOWN Keys to display the Data-Set No. of the values you wish to recall.

SELECT

4. Use the SELECT Key to move the upper cursor to the parameter you wish to view.

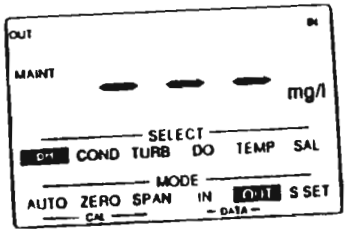
ENT

5. Press the ENT Key to display the data on the readout.


If a printer is connected, all six parameters in this Data-Set will also be printed out at the same time.

ENT

6. When the ENT Key is pressed again, the next Data-Set No. is displayed in order, i.e., d2, if two data sets are in memory. At this point, you can either press the ENT Key again to view the contents of this Data-Set, or you can use the UP/DOWN Keys to go up or down to another Data-Set No.
   If a particular Data-Set is empty, three dashes appear on the readout.




MODE

7. To return the readout to the previous setting in the MEAS mode, press the MODE Key again.



## Deleting data

Set the U-10 as if you were going to input data:

MODE

1. Press the MODE Key to put the U-10 in the MAINT mode.

MODE

2. Continue to press the MODE Key to move the lower cursor to IN, the Input Sub-Mode.


CLR

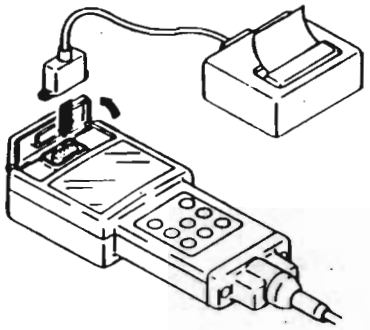
3. Then, to erase all the data from all the Data-Sets in memory, press the CLR Key. The readout will show the message CLr for about two seconds.


**Be careful!**
You cannot delete individual Data-Sets. The CLR Key always erases all data from memory.

## Printing out data

If a printer is connected to the U-10 printer port, whenever a Data-Set is either stored in memory or recalled to the readout, it is also simultaneously output to the printer.

The U-10 printer port is a standard Centronics parallel port. To connect a parallel printer to the U-10: Open the rubber printer-port cover, located directly over the readout on the main unit, and connect the printer cable.



**Note:**
When a printer is not being used, disconnect the cable from the U-10 printer port, and close the cover tightly.

- **Sample printout**

```
NO. 1 DATE  /  /
 pH      5.0
 COND    1.5    mS/cm
 TURB 390       NTU
 DO      0.5    mg/l
 TEMP   23      °C
 SAL     3.0    %
NO. 2 DATE  /  /
 pH      3.1
 COND    1.3    mS/cm
 TURB 270       NTU
 DO      0.7    mg/l
 TEMP   25      °C
 SAL     0.1    %
NO. 3 DATE  /  /
 pH      3.1
```



Section **5**

# Daily Maintenance and Troubleshooting

For accurate measurements and prevention of malfunction, routine careful maintenance of the U-10 is important. In particular, failure to maintain the sensors properly can lead to serious trouble or incorrect measurements. The U-10 is provided with error-code functions for the ready detection of potential problems.

# Error Codes

The U-10 has an easy-to-understand error message function so you can spot trouble readily. Error codes are displayed on the readout and the unit will beep if an error occurs.
(Note that if you press an incorrect sequence of keys, the unit will beep three times to indicate you have pushed the wrong key.)

| Error Code | Cause | Action |
|---|---|---|
| **Bad battery** Er 1 | • Defective or low battery | • Replace battery |
| **Failure in main unit** Er 2 | • Malfunction of memory backup IC | • Push POWER Key to turn the U-10 ON again. If this error code is still displayed, contact your Horiba dealer for repair or replacement. |
| **Zero-calibration error** Er 3 | *for all parameters* | |
| | • Poor connection in probe-to-main unit cable | • Connect the cable securely. |
| | • Water in one of the sensor sockets | • Dry out the sensor sockets. |
| | • Temperature of sample exceeds maximum scale of U-10 | • Replace the probe. |
| | *for pH* | |
| | • Contaminated pH sensor. | • Clean the pH sensor. |
| | • Improper concentration of reference solution in reference sensor | • Replace the reference solution. |
| | *for COND* | |
| | • Contaminated COND sensor | • Clean the sensor, using tooth brush and neutral detergent. |





| Error Code | Cause | Action |
|---|---|---|
| | *for TURB* | |
| | • Contaminated or defective LED sensor | • Clean out the tube containing the LED turbidity sensor, using test tube brush and neutral detergent. Never use an abrasives or cleansers for this. |
| | *for DO* | |
| | • Broken DO sensor membrane. | • Check the LED turbidity sensor. If it defective, the entire probe must be replaced. Check DO sensor. If defective, replace. |
| **Span-calibration error** Er 4 | *for all parameters* | |
| | • Poor connection in probe-to-main unit cable | • Connect the cable securely. |
| | • Water in one of the sensor sockets | • Dry out the sensor sockets. |
| | • Temperature of sample exceeds maximum scale of U-10 | • Replace the probe. |
| | *for pH* | |
| | • Contaminated pH sensor. | • Clean the pH sensor. |
| | • Improper concentration of reference solution in reference sensor | • Replace the reference solution. |
| | *for COND* | |
| | • Contaminated COND sensor | • Clean the sensor, using tooth brush and neutral detergent. |
| | *for TURB* | |
| | • Contaminated or defective LED sensor | • Clean out the tube containing the LED turbidity sensor, using test tube brush and neutral detergent. Never use an abrasives or cleansers for this. • Check the LED turbidity sensor. If it defective, the entire probe must be replaced. |

| Error Code | Cause | Action |
|---|---|---|
| **Span-calibration error** | | |
| Er4 | *DO Auto-calibration* | |
| | • Broken DO sensor membrane. | • Check DO sensor membrane. If defective, replace. |
| | • Excessive difference between DO sensor temperature and atmospheric temperature. | • Leave DO sensor in atmosphere for 30-60 min. |
| | *DO aqueous solution calibration* | |
| | • Broken DO sensor membrane. | • Check DO sensor membrane. If defective, replace. |
| | • Contaminated electrode. | • Clean the electrode using a soft brush, taking care not to scratch membrane. |
| | • Insufficient agitation of solution. | • Agitate solution thoroughly. |
| **Memory full** | | |
| Er5 | • Data-sets for 20 samples are already in memory. | • To delete all data from memory, put the U-10 in the IN Sub-Mode mode and press the CLR Key. |
| **Printer error** | | |
| Er6 | • Jammed printer paper. | • Eliminate jamming of printer paper. |
| | • Poor cable connection . | • Replace the cable. |
| | • Wrong printer. | • Use proper parallel Centronics printer. |
| | • Defective printer. | • Replace the printer as necessary. |



# Normal probe maintenance

## Washing the turbidity sensor

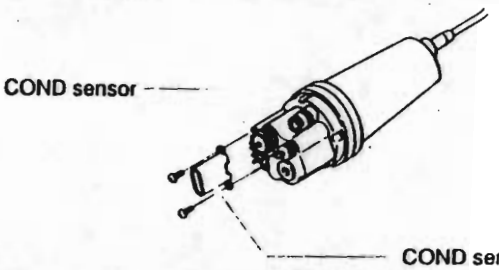
The sensor is a glass tube. Wash out the tube and remove stains carefully, using tap water and a test tube brush.

Be careful not to scratch the inside of the glass tube. Never use abrasives or cleansers.

## Cleaning the conductivity sensor

Remove COND sensor guard, and carefully use a soft brush to clean off any dust from the sensor unit.

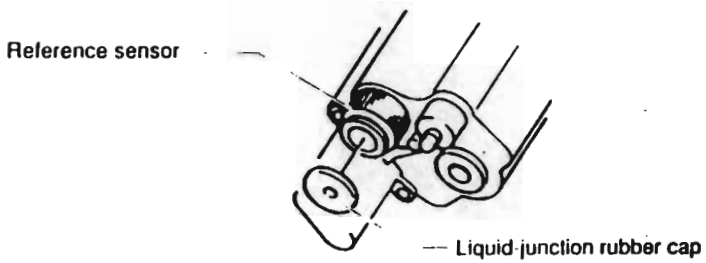
Be sure to replace the COND sensor guard before taking measurements.



## Recharging the reference sensor with reference solution

Recharge the reference sensor with reference solution about once every two months, as follows.

1. Remove the liquid-junction rubber cap from the reference sensor, and pour out the old solution.
2. Fill the reference sensor completely with new reference solution. Make sure there are no air bubbles.
3. Replace the liquid-junction rubber cap.
4. Carefully wash off all excess reference solution from the probe.



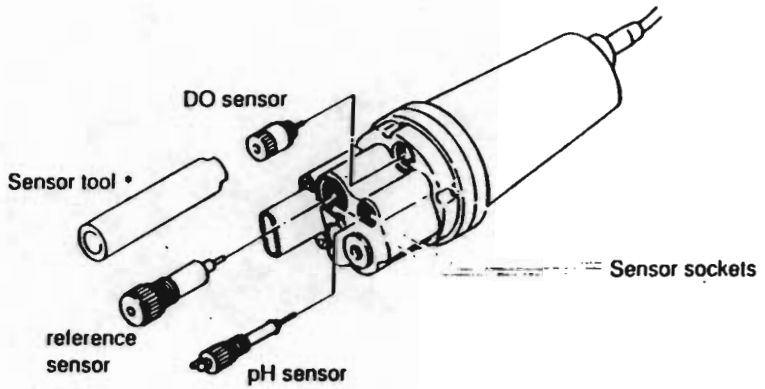





## Replacing faulty sensors

Three of the U-10's sensors are replaceable: the *pH sensor*, the *reference sensor*, and the *DO sensor*.
These may be replaced as follows.

1. Wipe off any water droplets from the probe.
2. Remove faulty sensor.
3. Insert the new sensor carefully with your fingers.
4. Be careful not to let the sensor sockets get wet.

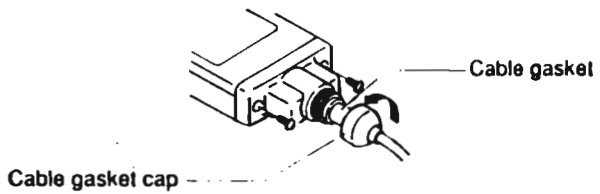



• When replacing the DO sensor, use the sensor tool provided as an accessory.

# Replacing a faulty probe

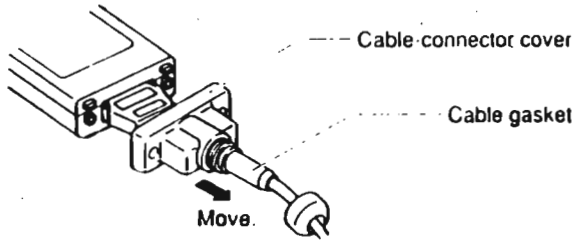
## Disconnect the cable from the main unit

1. Loosen the cable gasket cap, and remove cap from gasket.



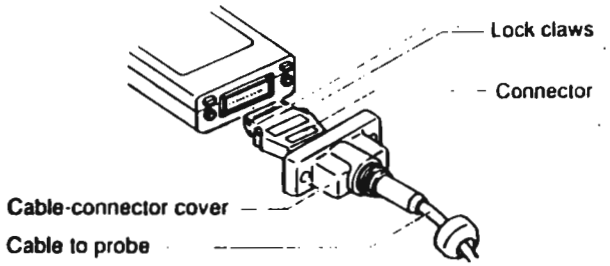

2. Slide back the gasket.

3. Back off the two screws on the cable-connector cover.




4. Slide off the cable-connector cover to expose the connector lock claws.

5. Press lock claws on both sides with your fingers to release the connector. Pull out the connector from the main unit.








## Connect the new probe

1. Insert the connector until it clicks.

2. Re-attach the cable-connector cover to the main unit.

3. Slide the cable gasket toward the cable-connector cover, and screw on the cable gasket cap.

Before you use a new probe for the first time, it is necessary to calibrate it manually for all four parameters. Refer to Section 3, "Calibrating the U-10," for instructions on manual calibration.

MALCOLM PIRNIE

Well No. _____

# Well Development/Purging Log

PROJECT NAME: _____

PROJECT NUMBER: _____

DATE: _____

SAMPLERS: _____

_____

| | | | Well I.D. | Vol. Gal./Ft. |
|---|---|---|---|---|
| ① | Total Casing and Screen Length (ft.) | _____ | 1" | 0.04 |
| | | | 2" | 0.17 |
| ② | Casing Internal Diameter (in.) | _____ | 3" | 0.38 |
| | | | 4" | 0.66 |
| ③ | Water Level Below Top of Casing (ft.) | _____ | 5" | 1.04 |
| | | | 6" | 1.50 |
| ④ | Volume of Water in Casing (gal.) | _____ | 8" | 2.60 |

$v = 0.0408 ( ② )^2 \times ( ① - ③ ) = ④$

$v = 0.0408 (\quad )^2 \times (\quad - \quad ) =$ _____ gal.

| PARAMETER | ACCUMULATED VOLUME PURGED | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Gallons | | | | | | | | | | | |
| Time | | | | | | | | | | | |
| Conductivity (mohm/cm) | | | | | | | | | | | |
| Dissolved Oxygen (ppm) | | | | | | | | | | | |
| Eh (mV) | | | | | | | | | | | |
| pH | | | | | | | | | | | |
| Temp (°C) | | | | | | | | | | | |
| Turbidity (NTUs) | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

_____

COMMENTS:

# CHAIN OF CUSTODY RECORD

| Project Name: | | Project Number: | | | | Number of Containers | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Time | Sample Identification | | Comp. | Grab | Sample Pres. | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| Sampled by: (Signature) | | Date/Time | | Received by: (Signature) | | | Relinquished by: (Signature) | | | Date/Time | | Received by: (Signature) | | | | | | | |
| Relinquished by: (Signature) | | Date/Time | | Received by: (Signature) | | | Relinquished by: (Signature) | | | Date/Time | | Received by: (Signature) | | | | | | | |
| Relinquished by: (Signature) | | Date/Time | | Received for Laboratory by: (Signature) | | | Date/Time | | Remarks: | | | | | | | | | | |