**Congratulations !**

The **90-D** is a precision field logger for Dissolved Oxygen, and Temperature.

Despite its impressive list of features, the **90-D** is a breeze to operate. This manual has been designed to help you get started, and also contains some handy application tips. If at any stage you require assistance, please contact either your local TPS representative or the TPS factory in Brisbane.

The manual is divided into the following sections:

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1. **Table of Contents**
   Each major section of the handbook is clearly listed. Sub-sections have also been included to enable you to find the information you need at a glance.

2. **Introduction**
   The introduction has a diagram and explanation of the display and controls of the **90-D**. It also contains a full listing of all of the items that you should have received with unit. Please take the time to read this section, as it explains some of items that are mentioned in subsequent sections.

3. **Main Section**
   The main section of the handbook provides complete details of the **90-D**, including operating modes, calibration, troubleshooting, specifications, and warranty terms.

4. **Appendices**
   Appendices containing background information and application notes are provided at the back of this manual.

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**90-D**
**Dissolved Oxygen, Temperature Logger**

Date : 26-Mar-2009
Version : 6.31

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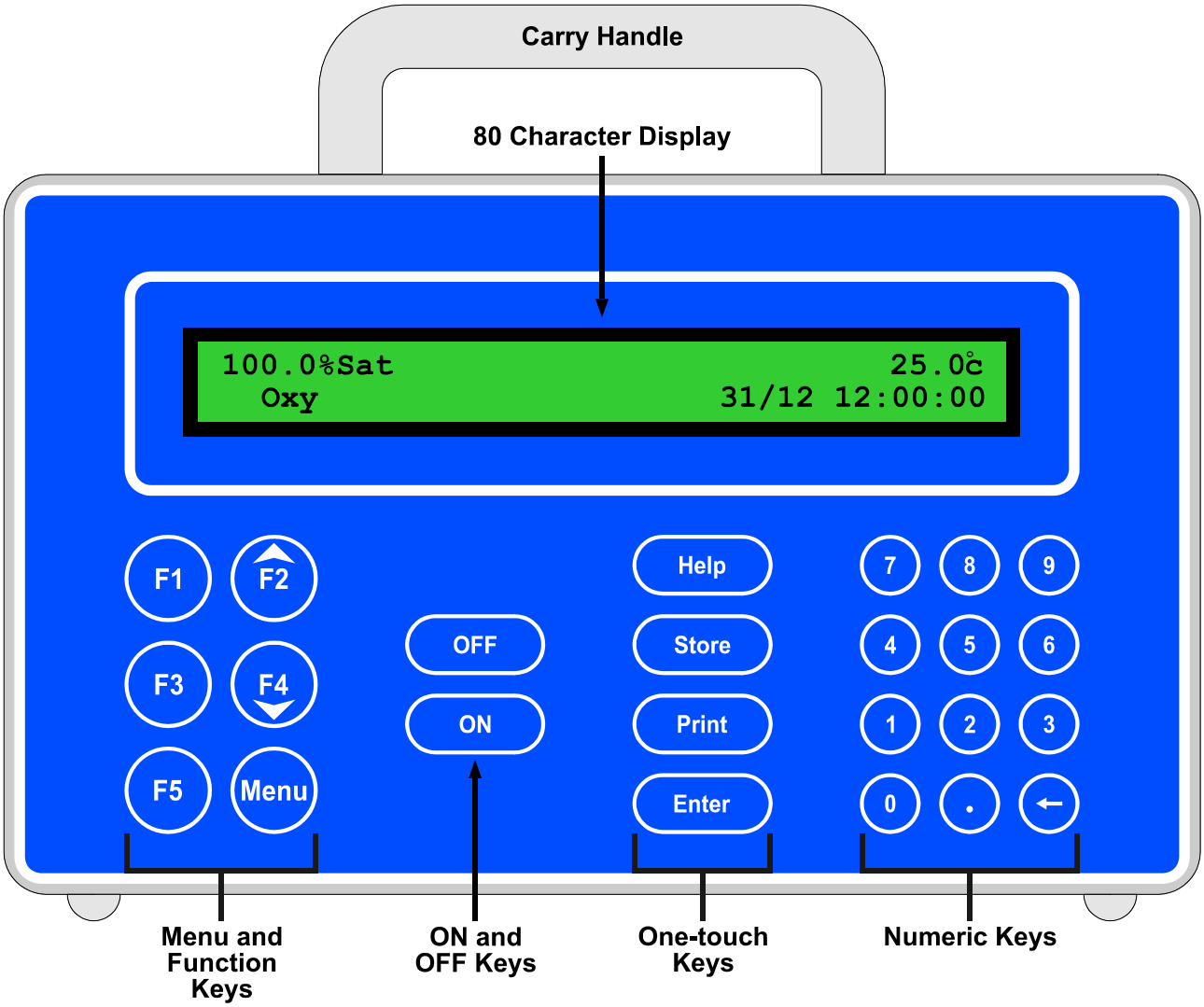
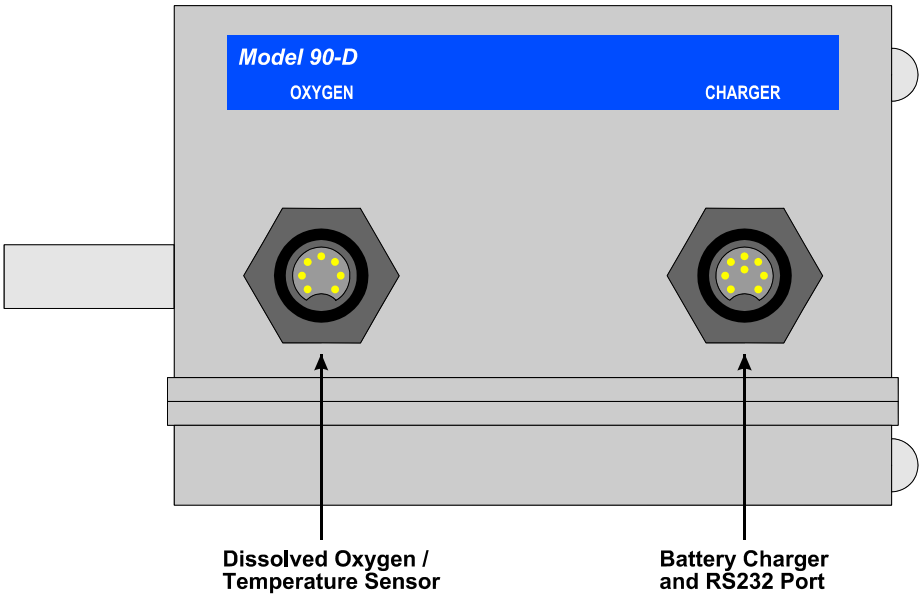
# 1. Introduction

## 1.1 90-D Display and Controls




## 1.2 90-D Rear Panel Connectors



### 1.3 Menu and Function Keys

Press the F1 to F5 function keys to select desired options within the menu system.

Additionally, these keys perform the following function directly in normal measurement mode…

F1 : Press to record readings into the Logger. See section 6.

F2 : Press to start and stop the optional Dissolved Oxygen stirrer. See section 3.6.

F3 : Press to transmit current reading plus date and time to the RS232 port. See section 7.2.

F4 : Press to start automatic datalogging in the Sampling Period and Duration mode. See section 6.3.3.

F5 : Press to obtain context-sensitive help messages. This function is disabled within menus.

### 1.4 Numeric Keys

Used to enter values during set-up and calibration. A negative sign and decimal point are provided.

### 1.5 Enter Key

Press the Enter key to accept default values or those entered on the Numeric Keypad.

### 1.6 Delete Key

Press the ← key to make corrections to values entered on the Numeric Keypad.

### 1.7 ON and OFF Keys

Press the relevant key to switch the **90-D** on and off as required.

### 1.8 80 Character Display

80 character alphanumeric display with user-friendly menu and context-sensitive help system. Shows Dissolved Oxygen, Temperature, Date and Time simultaneously. The manual salinity correction value is also displayed when the unit is in salinity-corrected ppM mode.

## 1.9 Unpacking Information

Before using your new **90-D**, please check that the following accessories have been included:

| | Part No |
|---|---|
| ***Standard Kit…*** | |
| 1. **90-D** Field Lab | 123145 |
| 2. Plug-Pack Power Supply | 130009 |
| 3. **90-D** Handbook | 130050 |
| ***Sensors…*** | |
| 1. YSI Field type $DO_2$ sensor | 123204 |
| 2. 3m Cable for YSI Field $DO_2$ sensor | 123215 |
| 3. 5m Cable for YSI Field $DO_2$ sensor | 123219 |
| 4. 7.5m Cable for YSI Field $DO_2$ sensor | 123216 |
| 5. 15m Cable for YSI Field $DO_2$ sensor | 123217 |
| 6. 60m Cable for YSI Field $DO_2$ sensor | 123218 |
| 7. YSI Non-stirring $DO_2$ sensor for BOD bottles | 123214 |
| 8. YSI Self-stirring $DO_2$ sensor for BOD bottles | 123213 |
| ***Options…*** | |
| 1. Dissolved Oxygen stirrer, 5m | 123306 |
| 2. Extended cable for sensors (order by the metre) | 130040 |
| 3. RS232 Serial Interface Cable | 130015 |
| 4. Communication software for Windows 95, 98, XP, 2000 and NT | 130086 |
| 5. Solar Panel | 130012 |
| 6. Clip lead for external 12V DC battery | 130013 |
| 7. Hard Carry case for meter and accessories | 130058 |
| ***Spares…*** | |
| 1. 7.2V NiCad Battery Pack | 130027 |
| 2. Senson® Vapaguard™ Tab corrosion inhibitor | NRP2 |
| 3. Membrane, Filling Solution and Zero $DO_2$ kit | 123300 |

## 1.10 Specifications

### *1.10.1 Dissolved Oxygen*

| Range | Resolution | Accuracy |
|---|---|---|
| 0 to 32.00 ppM | 0.01 ppM | ±0.02 ppM |
| 0 to 320.0 % Saturation | 0.1 % Saturation | ±0.3 % Saturation |
| 0 to 66.0 % Gaseous | 0.1 % Gaseous | ±0.1 % Gaseous |
| ***Note : Full scales are subject to sensor performance.*** | | |

**Sensor Type**..... Clark type polarographic sensor with in-built ATC.

**Salinity Correction for ppM**..... 0 to 50.0 ppK, manual by direct keypad entry of value.

**Temperature Compensation**..... Automatic for membrane permeability.
Automatic for Dissolved Oxygen solubility in ppM mode.

**Calibration**..... Automatic zero and span calibration.

**Sensor Span Range**..... 65 to 200 %

### *1.10.2 Temperature*

| Range | Resolution | Accuracy |
|---|---|---|
| -30.0 to 110.0 $^{O}$C | 0.1 $^{O}$C | ±0.2 $^{O}$C |
| ***Note : The dissolved oxygen sensor is limited to 60 $^{O}$C.*** | | |

**Sensor Type**..... Thermistor built into tip of Dissolved Oxygen sensor.

**Calibration**..... Automatic offset and span calibration.

**Sensor Offset Range**..... -15.0 to 15.0 $^{O}$C

**Sensor Span Range**..... 93 to 107 %

### *1.10.3 General Specifications*

**Memory**.....9340 readings including date and time with A&B function disabled.

7230 readings including date and time with A&B function enabled.

**Automatic Logging** .....**Rate per Day**
1 to 288 readings per day.

**Time of Day**
1 to 12 discrete times of the day, in 24 hour format.

**Sampling Period and Duration**
One reading every 1 to 300 seconds for a duration of 1 to 720 minutes or continuous.

**RS232 Port**.....300, 9600 & 19200 baud.
8 bits, no parity, 1 stop bit, XON/XOFF Protocol.

**Clock** .....Calendar clock displays date, month, hours, minutes & seconds. Year is Y2K compliant and is attached to all stored data.

**Good Laboratory Practices**.....Date, time and results of last calibration for all parameters are stored. This information can be recalled or sent to the RS232 port at any time.

**Power** .....7.2V, 1300mAH NiCad battery built in.

Battery charger for country of destination is included.

Solar panel and external battery clip lead optionally available.

**Battery Saver**.....Auto switch-off after 5 minutes or 1 hour. Battery saver can be switched off to allow continuous use.

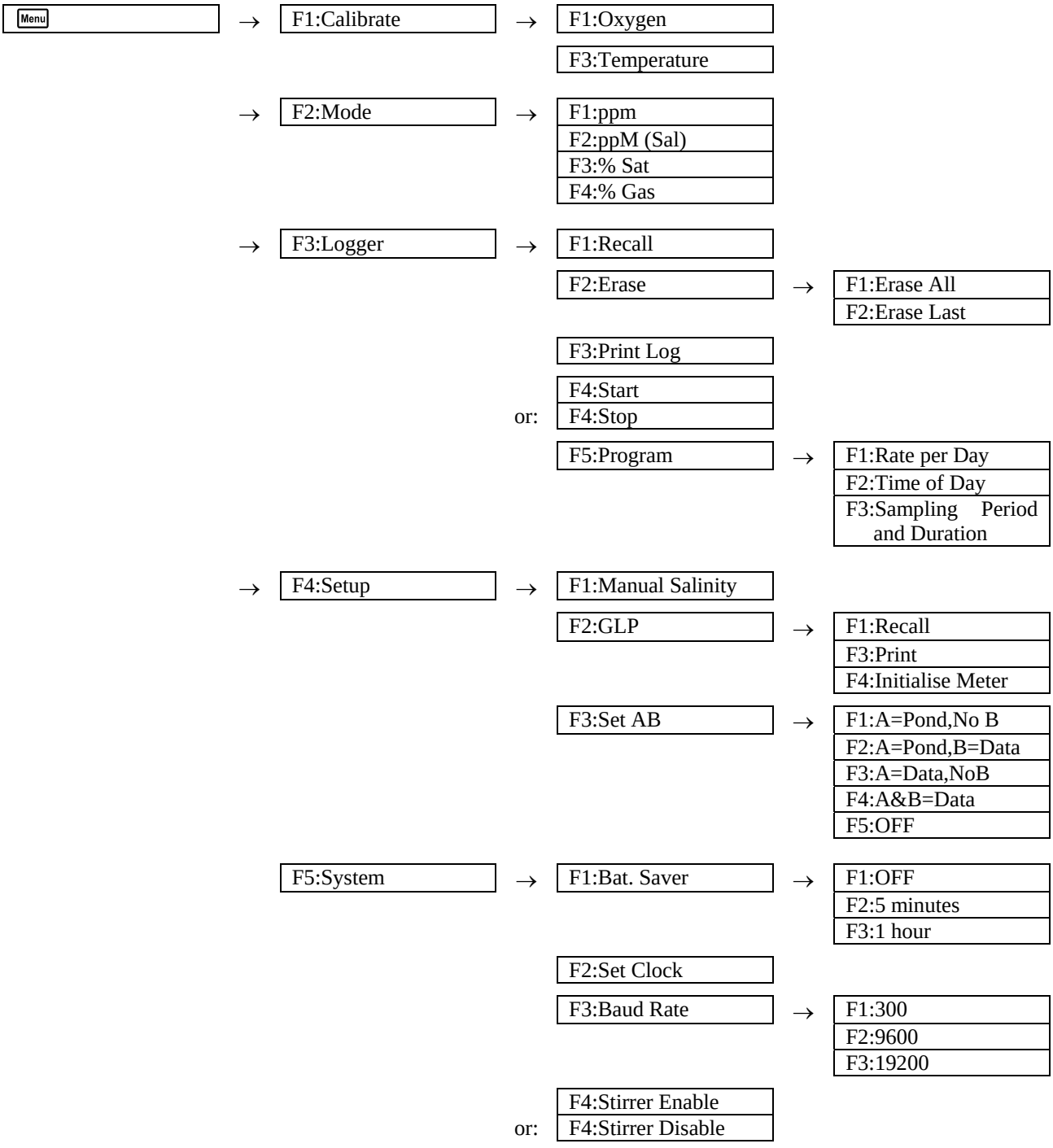
**Dimensions**.....230 x 140 x 100 mm

**Mass** .....Instrument only : Approx. 1.5 kg
Full Kit : Approx. 5.0 kg

**Environment**.....Temperature : 0 to 45 $^{O}$C
Humidity : 0 to 90 % R.H.

## 2. 90-D Menu Structure

A detailed breakdown of the menu system of the **90-D** is shown below. This diagram provides a quick reference for the menu functions available for the **90-D**.



# 3. Dissolved Oxygen Mode

## 3.1 Selecting the desired Dissolved Oxygen mode

1. Select Dissolved Mode (Menu → **F2:Mode**).
2. The Dissolved Oxygen readout units selection screen is now displayed…


The arrow indicates the current selection.

Press F1 to select Dissolved Oxygen readout in ppm units. This selection will not apply Salinity correction to the displayed readings.

Press F2 to select Dissolved Oxygen readout in Salinity-corrected ppM units. This selection will apply the manually entered salinity value (see section 3.2) for salinity correction.

Press F3 to select Dissolved Oxygen readout in % Saturation units.

Press F4 to select Dissolved Oxygen readout in % Gaseous units.

Press Menu to quit without changing the current setting.

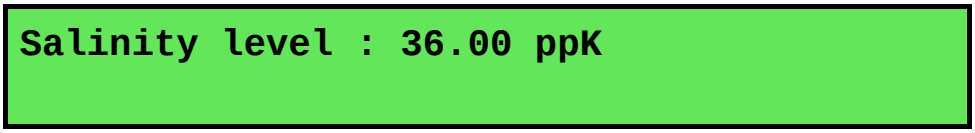
## 3.2 Setting the Salinity Correction Value

This section is applicable only when the **90-D** is in Salinity-corrected ppM mode (see section 3.1).

Please see section 14.5 if details regarding the effect of Salinity on the solubility of Dissolved Oxygen are required.

To enter the Salinity Correction Value…

1. Measure the Salinity of the sample solution. This can be done using a Salinity meter, refractometer or other method. Convert the measured value to parts per Thousand (ppK).
2. Switch the meter on.
3. Select Manual Salinity Entry (Menu → **F4:Setup** → **F1:Manual Salinity**).
4. The Manual Salinity entry screen is now displayed. For example…




Use the numeric keypad to enter the measured Salinity value of the sample solution.

Press the ← to correct any errors.

Press Enter to save the setting.

Press Menu to quit and retain the current setting.

## 3.3 Dissolved Oxygen Calibration

1. Plug the Dissolved Oxygen sensor into the **Oxygen** socket.
2. Switch the meter on.
3. Select the Dissolved Oxygen readout mode to be used, as detailed in section 3.1.
4. Ensure that the Temperature readout has been calibrated when calibrating either of the ppM modes (see section 4.1).

   Ensure that the Manual Salinity value has been correctly set when calibrating the Salinity-corrected ppM mode (see section 3.2).
5. Rinse the Dissolved Oxygen sensor in distilled water and blot dry.

### *3.3.1 Zero Calibration (all Oxygen modes)*

1. Place the Dissolved Oxygen sensor into an oxygen-free solution. This solution may be prepared by dissolving 2g of Sodium Sulphite in 100mL of distilled water. A 50g bottle of Sodium Sulphite powder (part number 123302) is supplied with a new Dissolved Oxygen sensor or Membrane Kit for this purpose.
2. Allow the reading to stabilise at or near zero. This may take 2-3 minutes.
3. Select Oxygen Calibration. (Menu → **F1:Calibrate** → **F1:Oxygen**)

   When the reading is below approximately 25 % Saturation, 2 ppM or 5% Gaseous, the **90-D** will display the ZERO calibration screen…

   ```
    1*0%Sat                          25.0°c
   Oxygen   ZERO   Calibration, Press Enter
   ```
4. Press Enter to calibrate.

   A "*" will not be removed from the display after a Zero Calibration.
5. Remove the sensor from the Zero solution, rinse well in distilled water and blot dry.

   The **90-D** will now prompt you to perform an AIR calibration.

### *3.3.2 Span Calibration in Air (all Oxygen modes)*

1. Hang the Dissolved Oxygen sensor in air. The tip of the Dissolved Oxygen sensor should be pointing downwards.

   Allow the reading to stabilise. After a zero calibration, this may take up to 5 minutes.
2. Select Oxygen Calibration. (Menu → **F1:Calibrate** → **F1:Oxygen**)

   When the reading is above approximately 25% Saturation, 2 ppM or 5% Gaseous, the **90-D** will display the AIR calibration screen…

   ```
    101.0%Sat                        25.0°c
   Oxygen   AIR    Calibration, Press Enter
   ```

   Press Enter to calibrate.

   A "*" in the display will be replaced by a decimal point after a successful air calibration.
3. The **90-D** is now calibrated and is ready for Dissolved Oxygen measurements. Rinse the Dissolved Oxygen sensor in distilled water and blot dry before placing it into unknown samples.

### *3.3.3 Span Calibration in Solution (Salinity-corrected ppM Mode only)*

This span calibration provides an alternative to calibrating the Dissolved Oxygen sensor in air. It is only available when the **90-D** is in Salinity-corrected ppM mode. Please note that the normal AIR calibration (section 3.3.2) is still available for Salinity-corrected ppM mode.

1. Measure the Dissolved Oxygen content of the solution to be used for calibration. This is generally done with a Winkler titration. The **90-D** span calibration should be performed immediately the Dissolved Oxygen content of the solution is known, as the value may not be stable.

2. Measure the Salinity value of the solution to be used for calibration. The Manual Salinity function can be set accordingly now (see section 3.2), or the Salinity value can be entered during the calibration process, as detailed later in this section.

3. Place the Dissolved Oxygen sensor into the calibration solution. The solution must be stirred at a moderate rate.

   Allow the reading to stabilise. After a zero calibration, this may take up to 5 minutes.

4. Select Oxygen Calibration. (Menu → **F1:Calibrate** → **F1:Oxygen**)

   When the reading is above approximately 2 ppM, the **90-D** will display the AIR/SPAN calibration screen. Note the cursor underlining the "**A**" in "**Air**".

   ```
     9*10ppM                          25.0°c
   Oxygen AIR/SPAN Calibration, Press Enter
   ```

   Use the numeric keypad to enter the Dissolved Oxygen value of the solution. The words "AIR/SPAN" are deleted and the value being entered is displayed.

   Press the ← to correct any errors.

   Ensure that the Dissolved Oxygen and Temperature readings are fully stable.

   Press Enter to calibrate.

5. The **90-D** now prompts you to enter the Salinity value of the calibration solution.

   ```
     9*10ppM                          25.0°c
   Enter Salinity : 36.00 ppK
   ```

   If this was entered earlier (step 2, above), simply press Enter.

   Otherwise, enter the Salinity value of the calibration solution now. Press the ← to correct any errors. Press Enter to calibrate.

   A "*" in the display will be replaced by a decimal point after a successful span calibration.

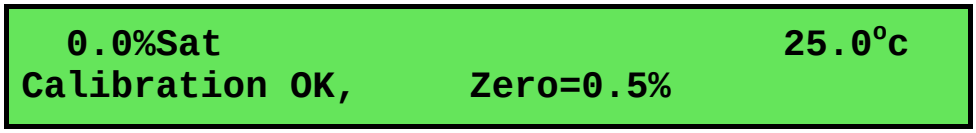
6. The **90-D** is now calibrated and is ready for Dissolved Oxygen measurements. Rinse the Dissolved Oxygen sensor in distilled water and blot dry before placing it into unknown samples.

### 3.4 Dissolved Oxygen Calibration Notes

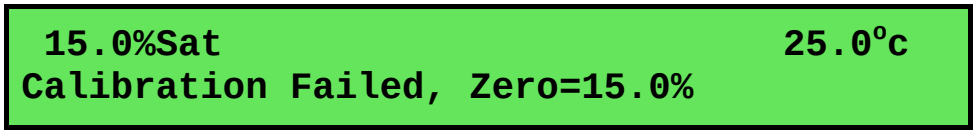
1. The relationship of % Saturation and ppM depends on a number of variables, so ***always calibrate in the mode required***. Do not try to infer Oxygen content from one mode to another.
2. A zero calibration should be performed at least monthly. In applications where there is a low level of dissolved oxygen, a zero calibration may have to be done weekly.
3. An air calibration should be performed at least weekly. Of course, more frequent calibration will result in greater confidence in results.
4. All calibration information is retained in memory when the **90-D** is switched off. This information can be recalled or printed later using the GLP function (see section 5).

### 3.5 Dissolved Oxygen Calibration Messages

1. If a Zero calibration has been successfully performed, the **90-D** will display the following message and the Zero value of the sensor…




2. If a Zero calibration has failed, the **90-D** will display the following message and the failed Zero value of the sensor. The unit will return to normal display mode with a " ∗ " in place of the decimal point in the Dissolved Oxygen reading.




3. If an Air/Span calibration has been successfully performed, the **90-D** will display the following message and the Span value of the sensor…


4. If an Air/Span calibration has failed, the **90-D** will display the following message and the failed Span value of the sensor. The decimal point will be replaced by a " ∗ " when the unit returns to normal display mode.


5. The allowable Span range for a Dissolved Oxygen sensor is 65.0 to 200.0 %. If calibration fails due to the Span value being outside these limits, then please consult the Troubleshooting guide (section 13.2) for possible remedies.

## 3.6 Dissolved Oxygen Stirrer

The **90-D** is equipped with a 4.5V DC output to power a stirrer for the Dissolved Oxygen sensor. This power output is suitable for the TPS submersible $DO_2$ stirrer (part number 123306).

### *3.6.1 Enabling and Disabling the Dissolved Oxygen stirrer output*

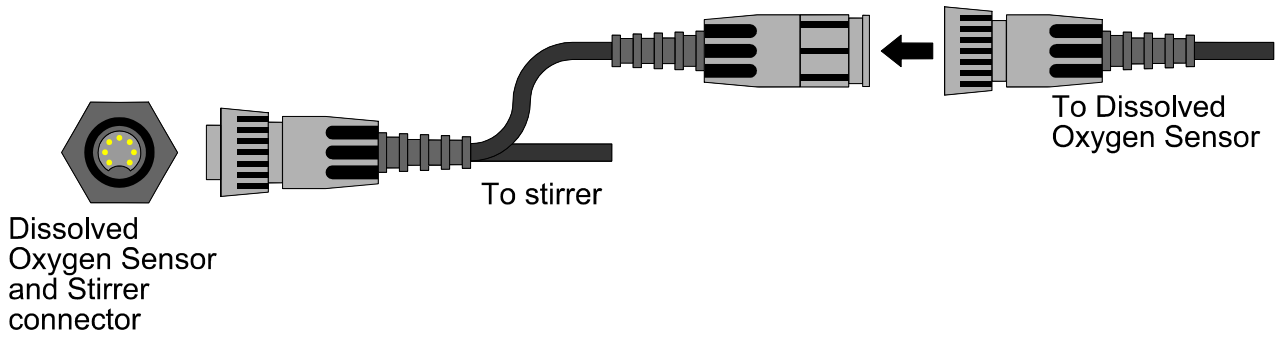
1. Select the System menu (Menu → **`F5:System`**).
2. Select **`F4:Stirrer Enable`** or **`F4:Stirrer Disable`** from the menu as required.

### *3.6.2 Connecting the Dissolved Oxygen stirrer*

To connect the Dissolved Oxygen stirrer…

1. Plug the Dissolved Oxygen stirrer into the **Oxygen** socket on the meter.
2. Plug the Dissolved Oxygen sensor into the in-line socket that is provided on the stirrer cable.

Please refer to the diagram below.




### *3.6.3 Starting and Stopping the Dissolved Oxygen stirrer*

1. Ensure that the Dissolved Oxygen stirrer output has been enabled, as per section 3.6.1.
2. Press F2 once in normal display mode to start the stirrer. The stirrer will stay on for 40 seconds and then stop. A countdown is provided on the screen.
3. Press F2 a second time any time during the 40 second period to set the Dissolved Oxygen stirrer to operate continuously.
4. Press F2 a third time to stop the Dissolved Oxygen stirrer.

The Dissolved Oxygen stirrer starts and stops automatically when the 90-D is in Rate per Day or Time of Day automatic datalogging mode. See sections 6.3.1 and 6.3.2.

# 4. Temperature Mode

The temperature readout must be calibrated before attempting ppM Dissolved Oxygen calibration and measurements. The decimal point is replaced by a " ∗ " if the reading is not calibrated.

## 4.1 Temperature Calibration

1. Plug Dissolved Oxygen sensor into the **Oxygen** socket.
2. Switch the meter on.
3. Place the sensor into a beaker of water, alongside a good quality mercury thermometer.

   An insulated container with around 1 Litre or more of water will provide a stable environment for Temperature calibration. The Temperature of the water in a small, uninsulated container will change too rapidly, making the resultant Temperature readings less accurate.

   Due to the non-linear response of the thermistor built into YSI Dissolved Oxygen sensors, it is necessary to calibrate the first point between 18.0 and 22.0 $^{O}$C.

   Stir the sensor and the thermometer gently to ensure an even temperature throughout the beaker.
4. Select Temperature Calibration (Menu → **F1:Calibrate** → **F3:Temperature**).

   The Temperature Calibration screen is now displayed…

```
Enter Actual Temperature : _      21*0°c
Need Temp 20 +/-2°c             Menu Quits
```

5. The current reading from the sensor is displayed on the far right of the top line.

   When this reading has stabilised, use the Numeric Keypad to enter the same temperature as measured by the mercury thermometer.
6. Press the Enter key to calibrate the temperature readout.

   Alternatively, press the Menu key to abort temperature calibration.

   The **90-D** is now 1 point temperature calibrated. This will provide precision to approximately ±0.5 $^{O}$C. The following screen is now displayed…

```
1 Point Calibration OK,     Offset=0.1°c
Press Enter for Span Cal. or Menu Quits
```

   Press Menu if ±0.5 $^{O}$C is adequate for your application. The **90-D** will now return to normal measurement mode and the " ∗ " in the Temperature readout will have been replaced by a decimal point.

   Press Enter to go on to a second point calibration if a higher degree of precision is required.
7. When a second point calibration is being performed, the **90-D** will now display the second calibration screen.

```
Enter Actual Temperature : _      31.0°c
Need Temp 30 +/-2°c             Menu Quits
```

   Due to the non-linear response of the thermistor built into YSI Dissolved Oxygen sensors, it is necessary to calibrate the second point between 28.0 and 32.0 $^{O}$C.

   Stir the sensor and the thermometer gently to ensure an even temperature throughout the beaker.

8. The current reading from the sensor is displayed on the far right of the top line.

   When this reading has stabilised, use the Numeric Keypad to enter the same temperature as measured by the mercury thermometer.

9. Press the Enter key to calibrate the temperature readout.

   Alternatively, press the Menu key to abort the second point temperature calibration. The first point calibration settings will still be preserved.

10. The **90-D** is now Temperature calibrated and is ready for use in this mode.

    The full ±0.2 $^{O}$C accuracy specification will apply after a successful 2 point calibration.

### 4.2 Temperature Calibration Notes

1. Temperature calibration information is retained in memory when the **90-D** is switched off. This information can be recalled later using the GLP function (see section 5).
2. Temperature does not need to be re-calibrated unless the Dissolved Oxygen sensor is replaced or the meter is initialised.

### 4.3 Calibration Messages

1. If a 1 point temperature calibration has been successfully performed, the **90-D** will display the following message and the offset value of the sensor. The bottom line appears after 3 seconds.

   ```
   1 Point Calibration OK,     Offset=0.1°c
   Press Enter for Span Cal. or Menu Quits
   ```

2. If a 1 point temperature calibration has failed, the **90-D** will display the following message and the failed offset value of the sensor.

   ```
   1 Point Calibration Failed, Offset=16.0°c
   ```

3. The **90-D** has an allowable Offset range of -15.0 to +15.0 $^{O}$C. If calibration fails due to the Offset being outside these limits, then please consult the Troubleshooting guide (section 13.3) for possible remedies.

4. If a 2 point temperature calibration has been successfully performed, the **90-D** will display the following message and the span value of the sensor.

   ```
   2 Point Calibration OK,     Span=101.0%
   ```

5. If a 2 point temperature calibration has failed, the **90-D** will display the following message and the failed span value of the sensor.

   ```
   2 Point Calibration Failed, Span=200.0%
   ```

6. The **90-D** has an allowable span range of 93.0 to 107.0 %. If calibration fails due to the Span being outside these limits, then please consult the Troubleshooting guide (section 13.3) for possible remedies.

# 5. Good Laboratory Practices (GLP)

The **90-D** keeps a record of the date and time of the last calibrations for all parameters as part of GLP guidelines.

## 5.1 To recall GLP information on the display

1. Switch the meter on.
2. Select the GLP menu (Menu → **F4:Setup** → **F2:GLP**).
3. Select **F1:Recall** from the menu.
4. The instrument model, firmware version number, and instrument serial number are displayed, along with a prompt describing how to scroll through the GLP information.

```
90Dm  V6.1 S1234        @ 31/12/01 12:00
                                F4:Next
```

   The "**m**" after the model name is displayed when the Dissolved Oxygen stirrer is enabled.

5. Press the F4 key to sequentially scroll through the GLP information for all parameters. Press the F2 key to scroll back to previous data. The sequence of information displayed is shown below. Press Menu to abort at any time.

***GLP Display sequence…***

```
90Dm  V6.1 S1234        @ 31/12/01 12:00
                                F4:Next
```

↑F2 ↓F4

```
Oxygen Zero=0.1%          31/12/01 12:00
Oxygen Calibrated       F2:Back F4:Next
```

↑F2 ↓F4

```
Oxygen Span=100.0%        31/12/01 12:10
Oxygen Calibrated       F2:Back F4:Next
```

↑F2 ↓F4

```
Temperature Offset=1.0°c  31/12/01 14:30
Temp Probe Calibrated   F2:Back F4:Next
```

↑F2 ↓F4

```
Temperature Span=100.0%   31/12/01 14:40
Temp Probe Calibrated   F2:Back F4:Ends
```

## 5.2 Failed Calibration

If calibration has failed, the GLP function will reset the date and time for the failed parameter to zero. The **90-D** still shows the results for the last successful calibration, as shown in the following example of a failed pH calibration….


## 5.3 Printing GLP Information to the RS232 Port

The GLP information stored in the instrument's memory can be sent to a printer or PC via the RS232 port.

1. Switch the meter on.
2. Connect one end of the RS232 cable to the **Charger** socket of the **90-D**. The battery charger, optional battery adaptor, or optional solar panel may be connected to the in-line socket on the RS232 cable, if required.
3. Connect the other end of the RS232 cable to an RS232 Printer, or to the COM1 or COM2 ports of a PC.
4. Send the GLP information to the RS232 port:

   Menu → **F4:Setup** → **F2:GLP** → **F3:Print**

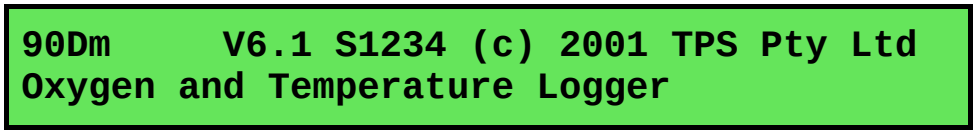
   The message "**Printing GLP Data**" is displayed while sending the data to the RS232 port.
5. The GLP information is sent to the RS232 port in formatted ASCII text. For example…

```
90D V6.1 S1234 @ 31/12/2001 13:00
Oxygen       Zero=       0.1%     @ 31/12/2001 12:00
Oxygen       Span=     100.0%     @ 31/12/2001 12:10
Temperature  Offset=     1.0oC    @ 31/12/2001 12:20
Temperature  Span=     100.0%     @ 31/12/2001 12:30
Ends
```

## 5.4 Instrument Serial Number

In case the serial number that is fitted to the rear of the **90-D** is removed or becomes illegible, it is also available on the **90-D** display.

1. The serial number is displayed at turn-on, for example…




   The "**m**" after the model name is displayed when the Dissolved Oxygen stirrer is enabled.

2. The serial number is displayed when recalling the GLP information (section 5.1).
3. The serial number is included on the print-out of GLP information (section 5.3).
4. The GLP information can be downloaded to a PC using the optional Windows® software (part number 130086).

## 5.5 Additional GLP Features

Another GLP requirement is to record the date and time of every reading. The **90-D** does this for you when readings are recorded either with the Manual Datalogging function (section 6.2) or the Automatic Datalogging function (section 6.3).

# 6. Datalogging

## 6.1 Setting the A & B Data Input Function

The A & B Data Input function allows the operator to enter extra numerical data whenever datalogging manually. The A & B Data Input function can also be set for any one of the following…

- "A" as Pond number with no extra "B" data input.
- "A" as Pond number with extra "B" data input.
- "A" as data input with no extra "B" data input.
- "A" and "B" both as data input.
- A & B Data Input Function switched OFF.

The Logger memory must be erased before changing the A & Data Input setting.

To set the A & B Data Input function…

1. Select the A & B setup menu (Menu → **F4:Setup** → **F3:Set AB**). The **90-D** will prompt you to erase the Logger before proceeding, if any data is stored in memory.

   ```
   SET  F1:A=Pond,No B  F2:A=Pond,B=Data
   A/B  F3:A=Data,No B  F3:A&B=Data >F5:OFF
   ```

   The arrow indicates the current selection.

2. Press F1 to set "A" as Pond number with no extra "B" data input.
   Press F2 to set "A" as Pond number with extra "B" data input.
   Press F3 to set "A" as data input with no extra "B" data input.
   Press F4 to set "A" and "B" both as data input.
   Press F5 to switch the A & B Data Input function OFF.
   Press Menu to quit and retain the current setting.

3. The A & B Data Input function is now set and is ready for use during Manual Datalogging.

## 6.2 Manually Recording Readings into the Logger

### *6.2.1 When A & B Data Input has been set to OFF*

1. Press F1 in normal display mode. The display should now look like this…

   ```
    100.0%Sat                          25.0°c
   Log#1,    <Enter>          31/12 12:00:00
   ```

2. Press Enter to record all parameters plus Date and Time into the Logger memory. This will be labelled as reading number 1.

   Alternatively, press Menu to quit without recording the reading.

3. Repeat steps 1 & 2 as often as required. The maximum number of readings that can be stored in the Logger with the A & B Data Input function switched OFF is 9340.

### 6.2.2 When A is set to Pond, with no extra B data

1. Press F1 in normal display mode. The display should now look like this…


2. Use the numeric keypad to key in the Pond number, then press Enter to record all parameters, Date, Time and the Pond number into the Logger memory. This will be labelled as reading number 1.

   Alternatively, press Menu to quit without recording the reading.

3. Repeat steps 1 & 2 as often as required.

   The Pond number will automatically increment by one from the last recorded reading.

   The maximum number of readings that can be stored in the Logger with this A & B Data Input setting is 7230.

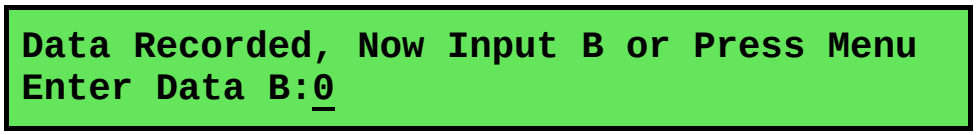
### 6.2.3 When A is set to Pond, and B is set to data

1. Press F1 in normal display mode. The display should now look like this…


2. Use the numeric keypad to key in the Pond number, then press Enter to record all parameters, Date, Time and the Pond number into the Logger memory. This will be labelled as reading number 1.

   Alternatively, press Menu to quit without recording the reading.

3. The **90-D** now proceeds to the B data entry screen…




   Use the numeric keypad to key in up to four characters for the “B” data item. The decimal point is available. Press Enter to record the “B” data item, or press Menu to quit. Quitting at this point records a Zero as the “B” data item.

4. Repeat steps 1 to 3 as often as required.

   The Pond number will automatically increment by one from the last recorded reading.

   The maximum number of readings that can be stored in the Logger with this A & B Data Input setting is 7230.

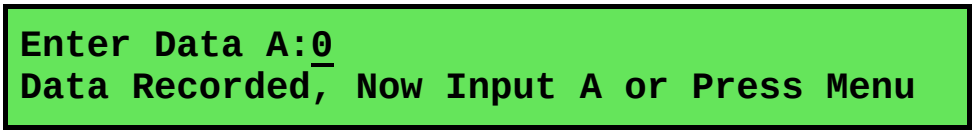
### 6.2.4 When A is set to Data with no B data

1. Press F1 in normal display mode. The display should now look like this…


2. Press Enter to record all parameters, plus Date and Time into the Logger memory. This will be labelled as reading number 1.

   Alternatively, press Menu to quit without recording the reading.

3. The **90-D** now proceeds to the A data entry screen…




   Use the numeric keypad to key in up to four characters for the "A" data item. The decimal point is available. Press Enter to record the "A" data item, or press Menu to quit. Quitting at this point records a Zero as the "A" data item.

4. Repeat steps 1 to 3 as often as required.
   The maximum number of readings that can be stored in the Logger with this A & B Data Input setting is 7230.

### 6.2.5 When A and B are both set to Data

1. Press F1 in normal display mode. The display should now look like this…

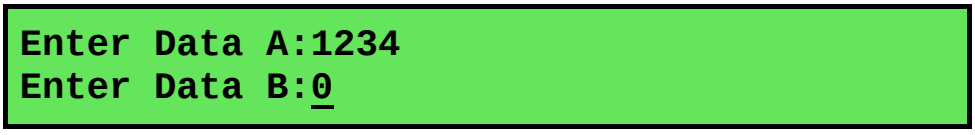

2. Press Enter to record all parameters, plus Date and Time into the Logger memory. This will be labelled as reading number 1.

   Alternatively, press Menu to quit without recording the reading.

3. The **90-D** now proceeds to the A data entry screen…


   Use the numeric keypad to key in up to four characters for the "A" data item. The decimal point is available. Press Enter to record the "A" data item, or press Menu to quit. Quitting at this point records Zero's as the "A" and "B" data items.

4. The **90-D** now proceeds to the B data entry screen…




   Use the numeric keypad to key in up to four characters for the "B" data item. The decimal point is available. Press Enter to record the "B" data item, or press Menu to quit. Quitting at this point records a Zero as "B" data item.

5. Repeat steps 1 to 4 as often as required.

   The maximum number of readings that can be stored in the Logger with this A & B Data Input setting is 7230.

## 6.3 Automatic Datalogging

The **90-D** can automatically log records into the Logger. There are three automatic datalogging modes to choose from…

1. Rate Per Day
   - Logs from 1 to 288 readings per day, evenly spaced throughout each 24 hour period.
   - Unit is dormant between readings and "wakes up" when a reading is due.
   - Dissolved Oxygen stirrer is switched on for 40 seconds before each reading is logged (if Dissolved Oxygen stirrer output is enabled).
   - Unit continues to log until automatic datalogging is disabled, or until the memory is full.
2. Time of Day
   - Logs at up to12 discrete times of the day, which can be unevenly spaced throughout each 24 hour period.
   - Unit is dormant between readings and "wakes up" when a reading is due.
   - Dissolved Oxygen stirrer is switched on for 40 seconds before each reading is logged (if Dissolved Oxygen stirrer output is enabled).
   - Unit continues to log until automatic datalogging is disabled, or until the memory is full.
3. Sampling Period and Duration
   - Logs a reading every 1 to 300 seconds for a duration of 1 to 720 minutes.
   - Duration can be set to log continuously until the memory is full.
   - Unit is turned on continuously in this logging mode.
   - Dissolved Oxygen stirrer is switched on continuously in this logging mode (if Dissolved Oxygen stirrer output is enabled).

The automatic datalogging parameters of the **90-D** must first be programmed, then logging can be started and stopped as required.

### *6.3.1 Rate per Day Datalogging*

***Programming Rate per Day Datalogging***

1. Select the Logger Program menu (Menu → **F3:Logger F5:Program**)
2. Select **F1:Rate per Day** from the menu.

   The display should now look similar to that shown below. The current Rate per Day is displayed…

   ```
   Number of Readings per Day : 24
   ```

3. Use the Numeric Keypad to set the number of readings per day which the **90-D** will automatically log into memory. This can be set from 1 to 288 (ie. 1 reading every 24 hours to 1 reading every 5 minutes).

   Press Enter to save the Rate per Day.

   Press Menu to quit without changing the current setting.
4. The Rate per Day datalogging is now programmed, and can be started and stopped as required.

**Notes**

1. The **90-D** distributes the number of readings evenly throughout a 24 hour clock cycle, regardless of what time automatic logging is started and stopped. For example, if the **90-D** is programmed to log 4 readings per day, they will be logged at 24:00, 6:00, 12:00 and 18:00 o'clock.

***Starting and Stopping Rate per Day Datalogging***

Starting Rate per Day datalogging is a two step process…

1. Select the Logger menu (Menu → **F3:Logger**)

   Select **F4:Start** from the menu.
2. Switch the **90-D** OFF.

   This step is essential, as the Rate per Day datalogging is only enabled when the **90-D** is switched OFF.

Stopping Rate per Day datalogging is a one step process…

3. Select the Logger menu (Menu → **F3:Logger**)

   Select **F4:Stop** from the menu.

**Notes**

1. The **90-D** remains dormant between readings and only switches itself ON when a reading is due.
2. If the Dissolved Oxygen stirrer is enabled, it is switched on for 40 seconds before the reading is recorded.
3. The **90-D** is switched on 3 minutes before the next reading is due to ensure that the Dissolved Oxygen sensor is fully polarised. The unit will therefore not automatically log any readings for at least 3 minutes after it has been switched OFF, even if a reading is due during that time.

### *6.3.2 Time of Day Datalogging*

***Programming Time of Day Datalogging***

1. Select the Logger Program menu (Menu → **F3:Logger F5:Program**)
2. Select **F2:Time of Day** from the menu.

   The display should now look similar to that shown below. Any currently programmed times are displayed…

```
Log  00:00 00:00 00:00 00:00 00:00 00:00
Time 00:00 00:00 00:00 00:00 00:00 00:00
```

3. Use the Numeric Keypad to set the first time of the day at which the **90-D** will automatically log into memory.
4. Press Enter to move to the next time of the day.
5. Repeat steps 7 and 8 to enter up to 12 times of the day. The times do not need to be evenly spread throughout the day. Times must be entered in 24 hour clock format.
6. Press Menu to save the programmed times of the day and quit.
7. The Time of Day datalogging is now programmed, and can be started and stopped as required.

**Notes**

1. For 12:00 o'clock midnight, enter the time as "**24:00**".
2. The times of the day do not need to be entered in chronological order. The **90-D** will sort them after pressing Menu.

***Starting and Stopping Time of Day Datalogging***

Starting Time of Day datalogging is a two step process…

1. Select the Logger menu (Menu → **F3:Logger**)

   Select **F4:Start** from the menu.
2. Switch the **90-D** OFF.

   This step is essential, as the Time of Day datalogging is only enabled when the **90-D** is switched OFF.

Stopping Time of Day datalogging is a one step process…

4. Select the Logger menu (Menu → **F3:Logger**)

   Select **F4:Stop** from the menu.

**Notes**

1. The **90-D** remains dormant between readings and only switches itself ON when a reading is due.
2. If the Dissolved Oxygen stirrer is enabled it is switched on for 40 seconds before the reading is recorded.
3. The **90-D** is switched on 3 minutes before the next reading is due to ensure that the Dissolved Oxygen sensor is fully polarised. The unit will therefore not automatically log any readings for at least 3 minutes after it has been switched OFF, even if a reading is due during that time.

### 6.3.3 Sampling Period and Duration Datalogging

***Programming Sampling Period and Duration Datalogging***

1. Select the Logger Program menu (Menu → **F3:Logger F5:Program**)
2. Select **F3:Sampling Period and Duration** from the menu.
3. The **90-D** now prompts you to enter the sampling period in seconds. The current sampling period is displayed…

   ```
   Enter Sampling Period (secs) : 5
   ```

   Use the Numeric Keypad to set the **90-D** to log a reading every 1 to 300 seconds.

   Press Enter to save the new sampling period and move to setting the duration.

   Press Menu to retain the previous sampling period and move to setting the duration.
4. The **90-D** now prompts you to enter the duration in minutes. The current duration is displayed…

   ```
   Enter Duration of Sampling (mins) : 10
   Enter 0 for continuous
   ```

   Use the Numeric Keypad to set the total duration for which the **90-D** will log readings into memory from 1 to 720 minutes. Alternatively, enter 0 to log continuously until logging is stopped by the user or the memory is full.

   Press Enter to save the new duration.

   Press Menu to quit and retain the previous duration.
5. The Sampling Period and Duration datalogging is now programmed, and can be started and stopped as required.

***Starting and Stopping Sampling Period and Duration Datalogging***

Starting and stopping Sampling Period and Duration datalogging is a two step process…

1. Press F4 in normal measurement mode.
2. The **90-D** now prompts you to press Enter to begin logging. For example…

   ```
   Press Enter to Sample every 5 seconds,
   For 10 minutes, or Menu to Quit 12:00:00
   ```

   The time is shown to enable the user to synchronise the sampling times if required.
4. Press Enter to start logging.

   To stop logging before the end of the duration press F4.

**Notes**

1. The **90-D** remains switched on continuously for Sampling Period and Duration datalogging.
2. If the Dissolved Oxygen stirrer is enabled, it is switched on continuously for Sampling Period and Duration datalogging.

## 6.4 Recalling Readings from the Logger

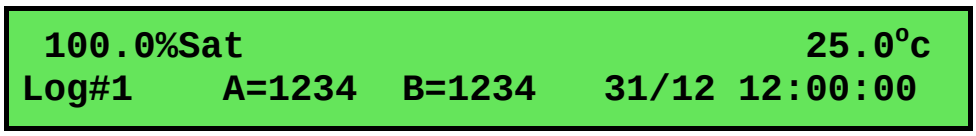
To recall records from the Logger onto the **90-D** display…

1. Select the Logger menu (Menu → **F3:Logger**)
2. Select **F1:Recall** from the menu.

   Record number 1 is now displayed.

   The following example shows the display when the A & B Data Input function was switched off during logging…


   The following example shows the display when "A" and "B" were both set to data during logging…




3. Press F2 to display the next record.

   Press F4 to display the previous record.

   Press and hold F2 or F4 to scroll continuously through the readings.

   To display a specific record, type in the desired record number using the Numeric Keypad and press Enter.

   Press F3 to send the displayed record to the RS232 port.

## 6.5 Erasing Records from the Logger

To erase records from the Logger…

1. Select the Erase Logger menu (Menu → **F3:Logger** → **F2:Erase**)
2. The **90-D** now displays the Erase menu, for example…

```
Erase Logger, (  100 )  Select Option
F1:Erase All  F2:Erase Last   Menu Exits
```

   The number of readings stored in the Logger is displayed. See the "**100**" in the example above.

3. Press F1 to erase all of the readings stored in the Logger.
   Press F2 to erase the last recorded reading only.
   Press Menu to quit without erasing any records.

## 6.6 Printing Records from the Logger to the RS232 Port

1. Connect one end of the RS232 cable to the **Charger** socket of the **90-D**.
2. Connect the other end of the RS232 cable to an RS232 Printer, or to the COM1 or COM2 ports of a PC.
3. Ensure that the baud rate for the printer or PC and the **90-D** are the same. If necessary, alter the baud rate of the **90-D** (see section 7.1).

   The **90-D** uses XON/XOFF protocol. Ensure that the printer is set accordingly.

4. Select the Logger menu. (Menu → **F3:Logger**).
5. Select **F3:Print Log** from the menu.
6. Printing starts as soon as F3 is pressed. The display shows the word "**Printing**" until printing is completed.

# 7. RS232 Port

## 7.1 Setting the Baud Rate

1. Select the Baud Rate menu (Menu → **F5:System** → **F3:Baud Rate**)
2. The available baud rates are listed, along with the RS232 port configuration…

```
Baud Rate:  F1:300  >F2:9600   F3:19200
8 bits, No Parity, 1 Stop bit, XON/XOFF
```

   The arrow indicates the current selection.

3. Press F1 to select 300 baud.
   Press F2 to select 9600 baud.
   Press F3 to select 19200 baud.
   Press Menu to quit and retain the current setting.

## 7.2 Sending Readings to the RS232 Port

Press F3 to instantly send readings to the RS232 port whenever the **90-D** is in normal display mode.

Each time the **90-D** logs a reading, that reading is sent directly to the RS232 port.

Press F3 while recalling data on the display (see section 6.4) to send that record to the RS232 port.

## 7.3 RS232 Configuration

The **90-D** RS232 configuration is 8 Bits, No Parity, 1 Stop Bit, XON/XOFF Protocol.

This information is displayed when setting the baud rate (see section 7.1)

## 7.4 Communication and Statistical Software

Communication between the **90-D** and a PC can be handled with any RS232 communication software. A TPS communication software package for Windows® is optionally available (part number 130086).

Once the data is saved to disk, the next problem is how to use it. The data sent by the **90-D** is formatted in fixed-width columns that can be imported by programs such as Microsoft® Excel® and Lotus 123®.

Help on importing the data into Microsoft® Excel® is provided in section 7.8 and the "excel.txt" file in the folder where you installed the WinTPS program.

## 7.5 Commands

The following commands can be sent from a PC to the **90-D**. Note that <cr> denotes carriage return and <lf> denotes a line feed.

| Action | Command | Notes |
|---|---|---|
| Request current data | ?D<cr> | Returns the current data of all parameters plus date and time from the **90-D**. The log number returned is set to Zero. |
| Request logged data | ?R<cr> | Returns all logged records from the **90-D** memory. The data ends with the message **ENDS**<cr> . |
| Erase logged data | ?E<cr> | Erases all logged records from the **90-D** memory. Returns the message **ERASED**<cr> to confirm that the records have been erased. |

***Continued over the page…***

***RS232 Commands, continued…***

<table>
<tr><td>Request status information</td><td>?S<cr></td><td>Returns the model name, firmware version number, instrument serial number and number of logged readings in memory, for example…<br>90D•V6.1•S1234•7230•mASLB+v%<cr><br>where • are spaces. Note that the number of logged readings is right-justified. The meaning of the last group of characters is as follows…
<table>
<tr><td>m</td><td>Dissolved Oxygen stirrer output is enabled.</td></tr>
<tr><td>A or P</td><td>A indicates A & B function is enabled.<br>P indicates A is set to Pond Number.</td></tr>
<tr><td>S</td><td>Unit is powering Dissolved Oxygen stirrer.</td></tr>
<tr><td>L</td><td>Automatic datalogging is enabled.</td></tr>
<tr><td>B</td><td>Low Battery warning.</td></tr>
<tr><td>+</td><td>Extended datalogging function is fitted.</td></tr>
<tr><td>v</td><td>Battery volts is available with ?V command.</td></tr>
<tr><td>%</td><td>Indicates new 90 series, V6.0 and up.</td></tr>
</table></td></tr>
<tr><td>Request GLP information</td><td>?G<cr></td><td>Returns all calibration GLP information, plus the instrument model, serial number and current date (see section 7.7 for data format and hand-shaking).</td></tr>
<tr><td>Enable Rate per Day or Time of Day automatic datalogging</td><td>?J<cr></td><td>Starts automatic datalogging when the 90-D is set up for Rate per Day or Time of Day automatic datalogging (see sections 6.3.1 and 6.3.2).<br>The meter must then be powered down with the OFF key or with the ?K command (see below).</td></tr>
<tr><td>Disable Rate per Day or Time of Day automatic datalogging</td><td>?F<cr></td><td>Stops automatic datalogging when the 90-D is set up for Rate per Day or Time of Day automatic datalogging (see sections 6.3.1 and 6.3.2).</td></tr>
<tr><td>Power ON</td><td>Any 10 characters</td><td>Switches the 90-D ON.<br>A specific command is not available while the 90-D is off, so RS232 activity caused by the 10 characters switches the unit ON.</td></tr>
<tr><td>Power OFF</td><td>?K<cr></td><td>Switches the 90-D OFF. Use the command after the ?G command (above) to actually start rate per Day or Time of Day automatic datalogging.</td></tr>
<tr><td>Turn Dissolved Oxygen stirrer ON</td><td>?M<cr></td><td>Starts the Dissolved Oxygen stirrer to run continuously until stopped. The stirrer output must be enabled (see section 3.6.1)</td></tr>
<tr><td>Turn Dissolved Oxygen stirrer OFF</td><td>?N<cr></td><td>Stops the Dissolved Oxygen stirrer.</td></tr>
<tr><td>Request battery volts</td><td>?V<cr></td><td>Returns the current voltage level in the battery pack, for example…<br>7.20V<cr></td></tr>
<tr><td>Positions of Data Fields</td><td>?P<cr></td><td>Returns the number of data fields, along with their position and length. When the A&B Data Input function is disabled…<br>6,1,10,12,8,21,4,26,5,35,7,46,5<br>This denotes 7 fields, the first of which is at column 1 and is 10 characters long. The second field is at column 12 and is 8 characters long and so on.<br>When the A&B Data Input function is enabled…<br>8,1,10,12,8,21,4,26,5,35,7,46,5,54,4,60,4</td></tr>
<tr><td>Data Column Header</td><td>?H<cr></td><td>Returns a text string which can be used to provide headers for each data field. Spaces are included to ensure that the headers are correctly aligned with the data.</td></tr>
</table>

## 7.6 Data Format

Data is returned to the RS232 Port by the **90-D** in the following format.

Please note that a " • " shown anywhere in this section denotes one space.

**dd/mm/yyyy•hh:mm:ss•LLLL•DDDDDuuu•SSSSSSSuuu•TTTTTuuLaaaaA•bbbbB**

where….

**dd/mm/yyyy** is the date, month and year data.

**hh:mm:ss** is the hours, minutes and seconds data.

**LLLL** is the Log Number, 4 characters, right justified. The **90-D** sends a Zero for instant readings (see section 7.2).

**DDDDD** is Dissolved Oxygen data. 5 characters, right justified.

**uuu** is the Dissolved Oxygen units description, which can be any of the following…

| | |
|---|---|
| **ppm** | for parts per Million readout without Salinity correction. Note the lower case "**m**". |
| **ppM** | for parts per Million readout with Salinity correction applied. Note the upper case "**M**". |
| **%S•** | for % Saturation readout. |
| **%G•** | for % Gaseous readout. |

**SSSSSS** is Manual Salinity Correction data. 7 characters, right justified.

**uuu** is the Manual Salinity Correction units description, which is set to "**ppK**".

**TTTTT** is Temperature data, 5 characters, right justified.

**uu** is the Temperature unit description, which is set to "**oC**".

**L** is the Low Battery indicator. Sent as "**L**" when the battery is below 5.60 volts.

**Caution** : Data recorded with a low battery may be unreliable.

The **90-D** sends a space when the battery is above 5.60 volts.

**aaaa** A-Data input, 4 characters, left justified.

**A** A-Data input identifier. Sent as "**A**" for A-Data or "**P**" for Pond number. See section 6.1 for further details on the A and B Data input function.

**bbbb** B-Data input, 4 characters, left justified.

**B** B-Data input identifier. Sent as "**B**". See section 6.1 for further details on the A and B Data input function.

**Notes**

1. The "**aaaaA**" and "**bbbbB**" sections of the data string are not sent at all when the A and B data input function is switched off (see section 6.1).
2. When requested by a PC with the ?D or ?R commands (section 7.5), the data is terminated with a carriage return.
3. When the data is sent by the **90-D** using the Print function (section 6.6) or the Instant Send function (section 7.2), the data ends with a carriage return and a line feed.

## 7.7 GLP Data Format

GLP information is returned as 12 lines terminated by a carriage return. When using the "?G" command (section 7.5), the computer must respond with a character after receiving each line.

For example…

```
90D V6.1 S1234 @ 31/12/2001 13:00
Oxygen       Zero=       0.1%     @ 31/12/2001 12:00
Oxygen       Span=     100.0%     @ 31/12/2001 12:10
Temperature  Offset=     1.0oC    @ 31/12/2001 12:20
Temperature  Span=     100.0%     @ 31/12/2001 12:30
Ends
```

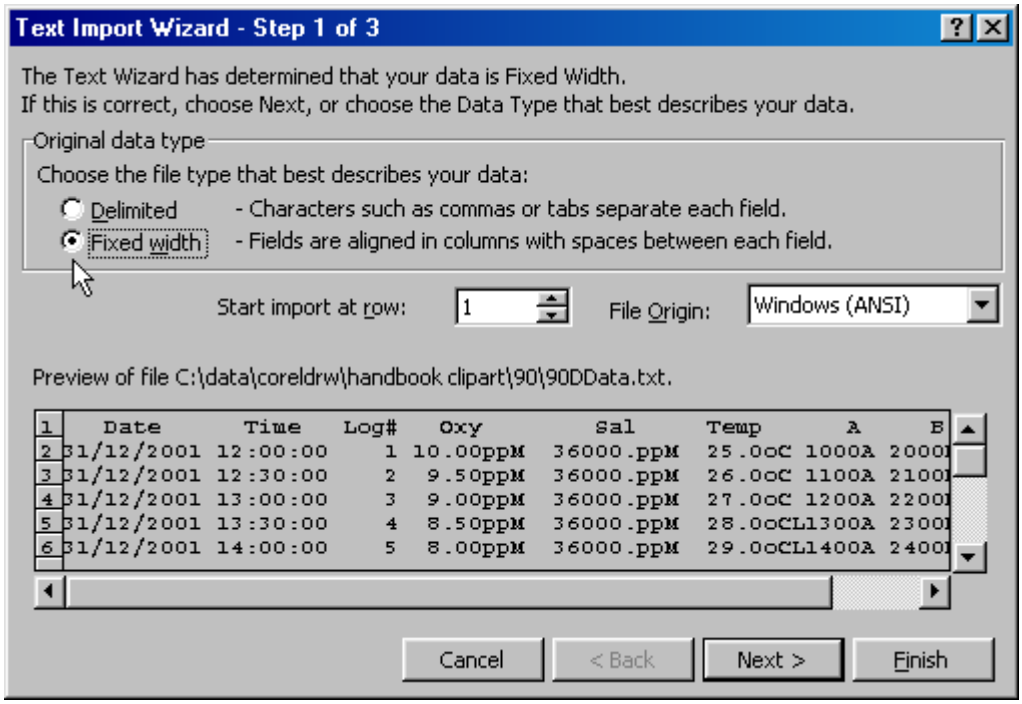
## 7.8 Importing Data into Microsoft Excel

The following procedure details the method for importing a **90-D** text data file into Microsoft® Excel®.

1. Start Microsoft® Excel® and select File → Open
2. In the "Files of type:" pull-down box, choose "Text Files (*prn; *.txt; *.csv)".
3. Navigate to the folder where your data file is stored and double-click it to start the Text Import Wizard.

   Note : The default data folder for the WinTPS software is "C:\My Documents\WinTPS".
4. In step 1 of the Text Import Wizard select "Fixed width", as per the sample screen below, then press "Next >".

   Note that the data column headers in row appear only when the data is downloaded using the WinTPS software.

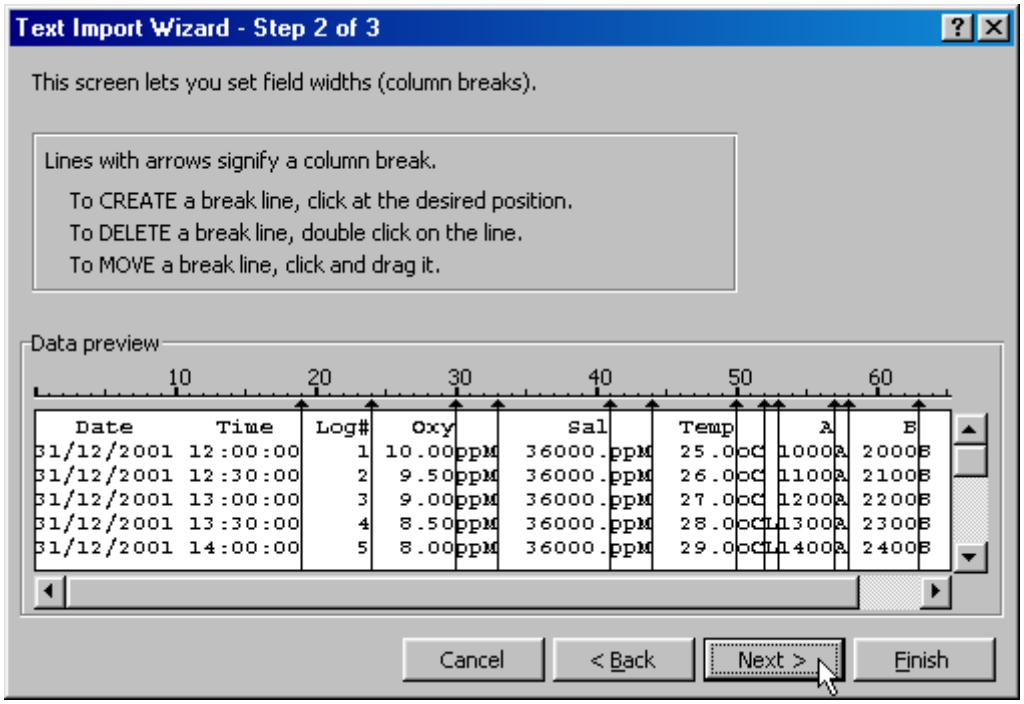



***Continued over the page…***

5. Step 2 of the Text Import Wizard allows you to select the points at which each data field will break into a new column. The sample screens below show where TPS recommends the breaks be inserted.

   The date and time have been incorporated into a single column to ensure that the X-axis is correctly formatted if the data is to be charted later.

   Press “Next >” after all the column breaks have been inserted.




6. Simply press “Finish” at step 3 of the Text Import Wizard. TPS recommends that the data format for each column be set once the data is in spreadsheet format.

   For help on formatting the data columns, charting, graphing or other operations please consult the Microsoft® Excel® help file. Alternatively please contact TPS and we will try to provide further assistance.

## 8. Setting the Clock

1. Select the Clock Set-up menu (Menu → **F5:System** → **F2:Set Clock**)
2. The display now shows the current time, for example…

```
Time is now    12:00
Enter new Time 12:00
```

3. Use the Numeric Keypad to enter the current time in 24 hour format, then press Enter.

   Alternatively, press Menu to quit and retain the current setting.
4. If you pressed Enter above, the display will now show the current date, for example…

```
Date is now    31/12/2001
Enter new Date 31/12/2001 dd/mm/yyyy
```

5. Use the Numeric Keypad to enter the current date in dd/mm/yyyy format, then press Enter.

   Alternatively, press Menu to quit and retain the current setting.

### Notes

1. Press the ← key to make any corrections as required.
2. The **90-D** tests that a valid time of the day is entered. If an invalid time is entered (eg. 25:00), the **90-D** displays the message "**Invalid Time**", then returns to the time setting screen so that the correct time can be entered.
3. The **90-D** tests that a valid day of the month is entered. If an invalid date is entered (eg. 31/02/2001), the **90-D** displays the message "**Invalid Date**", then returns to the date setting screen so that the correct date can be entered.
4. The **90-D** also tests for leap years.

## 9. Initialising the 90-D

If the calibration settings of the **90-D** exceed the allowable limits, the unit may need to be initialised to factory default values. This action may be required if a sensor is replaced or if the memory is corrupted.

To initialise the **90-D**…

1. Select the GLP menu ( Menu → **F4:Setup** → **F2:GLP**).
2. Select **F4:Initialise Meter** from the menu.
3. The **90-D** will now ask if you are sure that you wish to initialise the unit…

   ```
   Initialise Unit, Are you sure ?
   F1:Yes    F2:No
   ```

   Press F1 to initialise the **90-D** and reset all calibration data and erase all logged readings.

   Press F2 to quit and retain the current calibration settings and logged readings.
4. If **F1:Yes** was selected above, the **90-D** will display the number of logged readings in memory and provide an additional warning that these will be erased. For example…

   ```
   Logger contains Data. 9340 readings
   will be Erased. Continue ?  F1:Yes F2:No
   ```

   Press F1 to initialise the **90-D** and reset all calibration data and erase all logged readings.

   Press F2 to quit and retain the current calibration settings and logged readings.
5. If **F1:Yes** was selected above, the 90-D will display the following messages to indicated that the unit has been successfully initialised.

   ```
              Initialising
   ```

   then…

   ```
              Initialised
   Re-Calibrate unit before use.
   ```
6. The meter then goes back to the GLP menu. When returning to display mode later, note that each of the decimal points has been replaced with a " * " to indicate that each parameter requires re-calibration.

## 10. Instrument firmware version number

If you need to phone or fax TPS for any further technical assistance, the version number of your **90-D** firmware may of benefit to us. The version number is displayed by the **90-D** at turn-on.

## 11. Battery Saver Function

The **90-D** is equipped with a battery saver function. If no button has been pressed for 5 minutes or 1 hour, the unit beeps and flashes the display for 20 seconds and then shuts off. This function can also be switched off for continuous use.

To program the battery saver function:

1. Select Battery Saver menu (Menu → **F5:System** → **F1:Bat. Saver**).
2. The battery saver menu is now displayed…

   ```
   Battery Saver:   F1:OFF    >F2:5 minutes
   Volts= 7.20V     F3:1 hour
   ```

   The arrow indicates the current selection.
3. Press F1 to disable the battery saver function for continuous use.

   Press F2 to set the battery saver function to 5 minutes. The meter will switch itself off if no key has been pressed for five minutes.

   Press F3 to set the battery saver function to 1 hour. The meter will switch itself off if no key has been pressed for 1 hour.

   Press Menu to quit the battery saver menu and retain the current setting.

### Notes

1. The symbol flashes when the battery volts drops below 5.60 volts. At approximately 5.10 volts the meter turns itself off.
2. The accuracy of the data degrades when the symbol is flashing. The **90-D** should not be used to take readings or calibrate while the is flashing.

# 12. Moisture Protection

## 12.1 Silica Gel Pack

Due to the size of the **90-D** enclosure, it tends to expand in hot environments and contract in cold environments. This process can cause moist air to be drawn into the enclosure, which would then cause corrosion damage to the circuit.

To avoid this problem, TPS has mounted a breathing system inside the enclosure. This system consists of a long, thin tube which is vented to the atmosphere at one end and into a bottle of Silica gel at the other end. This ensures that the **90-D** breathes dry air. In humid environments, the Silica gel pack should be regularly checked.

To check the Silica gel pack…

1. Undo the 4 plastic screws on the rear of the unit.
2. Inspect the bottle of Silica gel.

   Blue indicates that the Silica gel is still dry (proceed to step 5).

   Pink indicates that the Silica gel is moist (proceed to step 3).
3. Empty the Silica gel into a microwave proof dish and place it into a microwave oven.

   Place approximately 100mL water in a microwave proof cup into the microwave oven. This will absorb some of the microwave energy and stop the Silica gel balls bursting.

   Turn the microwave oven ON using a moderate setting for approximately 1 minute, or until the Silica gel turns blue.

   **CAUTION : THE SILICA GEL MAY BE VERY HOT AT THIS POINT.**
4. Remove the Silica gel from the microwave oven and allow to cool.

   Pour the Silica gel back into the bottle and re-fit the bottle onto the rear cover of the instrument.
5. Re-fit the rear cover onto the instrument, ensuring that is the correct way around. The cover has locating lugs in two of the corners to make correct fitment simple.

## 12.2 Corrosion Inhibitor Tab

To provide extra protection against corrosion, the **90-D** is fitted with a Senson® Vapaguard™ corrosion inhibitor tab. This tab disperses a special vapour throughout the enclosure which actively fights corrosion on any of the components.

The corrosion inhibitor tab has a limited life and should be replaced every 2 to 3 years to ensure effective protection.

The TPS part number for a new corrosion inhibitor tab is NRP2.

# 13. Troubleshooting

## 13.1 General Errors

| Error Message | Possible Causes | Remedy |
|---|---|---|
| **Factory Calibration Data Failure** | The EEPROM chip which contains the factory calibration information has failed. | The unit must be returned to TPS for service. |
| **EEPROM Write Failure**<br>**Return to Factory for Service** | User calibration settings have been lost or corrupted. | Switch the meter OFF and switch back ON. If the problem persists, return the unit to TPS for service. |
| Flashing  symbol. | Battery is below 5.60 volts. | Recharge the battery. A full charge will take approximately 18 hours. Note that the unit will switch itself off when the battery falls below 5.10 volts.<br>Data obtained while the  is flashing may be unreliable. Do not take readings or calibrate while the  is flashing. |
| Meter displays the word **OFF**, and switches off. | Battery is below 5.10 volts. | Recharge the battery.<br>If this fails, check the charger.<br>If charger is OK, replace the battery. |
| Meter will not turn on. | Battery is exhausted. | Recharge the battery for approximately 18 hours.<br>If this fails, check the charger.<br>If charger is OK, replace the battery. |
| Battery does not charge up when charger is connected. | 1. Faulty battery charger.<br>2. Faulty battery. | 1. Connect the charger and switch the power on.<br>2. Display the battery volts in the battery saver menu (see section 11).<br>3. If the battery volts are increasing then the charger is OK. If the battery volts do not increase, then the charger is faulty.<br>4. Replace the charger or the battery, as required. |

## 13.2 Dissolved Oxygen Troubleshooting

| Symptom | Possible Causes | Remedy |
|---|---|---|
| Unit fails to calibrate, even with new sensor. | Calibration settings outside of allowable limits due to previous failed calibration. | Initialise the unit. See section 9. |
| • Zero calibration fails (Zero is greater than 7.0%)<br>• Air calibration fails (Span is less than 65% or greater than 200%).<br>• Unstable or inaccurate readings. | 1. Membrane is leaking or broken.<br>2. Gap between membrane and gold cathode is dry.<br>3. Incorrectly fitted membrane.<br>4. Electrode is empty.<br>5. Electrode is faulty. | Replace membrane and refill electrode.<br>Gently pump the pressure compensation diaphragm several times.<br>Membrane should be smooth and convex with no wrinkles. Re-fit membrane if necessary.<br>Replace membrane and re-fill electrode.<br>Return electrode to factory for repair or replacement |
| Blackened Silver anode. | Electrode has been exposed to sulphides or other chemical poisoning. | Remove pressure compensation diaphragm and membrane, then soak in 5% Ammonia solution for 10 minutes.<br>If cleaning is unsuccessful, return the sensor to the TPS factory for cleaning and service. |
| Tarnished or scratched Gold cathode. | Electrode has been chemically poisoned or physically damaged. | Return to the TPS factory for cleaning and service. |
| Meter displays **OVR ppM** or **OVR%** instead of Dissolved Oxygen data. | 1. Electrode has not yet polarised.<br>2. Electrode is faulty | Wait for 2-3 minutes for the electrode to polarise after the **90-D** is switched on.<br>Return electrode to factory for repair or replacement. |

## 13.3 Temperature Troubleshooting

| Symptom | Possible Causes | Remedy |
|---|---|---|
| Temperature inaccurate and cannot be calibrated. | 1. Faulty connector.<br>2. Faulty sensor cable.<br>3. Faulty sensor. | Check the connector and replace if necessary.<br>Return cable for repair, or replace cable.<br>Return sensor for repair, or replace sensor. |
| Displays over-range temperature reading (**OVR°C**)when Dissolved Oxygen sensor plugged in. | 1. Faulty instrument socket.<br>2. Faulty sensor cable.<br>3. Faulty sensor. | Return the instrument to the TPS factory for service.<br>Return cable for repair, or replace cable.<br>Return sensor for repair, or replace sensor. |

# 14. Appendices

## 14.1 Dissolved Oxygen Sensor Fundamentals

The electrode used is the amperometric type of Clark Electrode and is suitable for the measurement of oxygen pressures in the range 0 to 100 cm of mercury. While the probe actually reads partial pressure of oxygen, the circuit is calibrated to be read in percentage saturation or parts per million (Milligrams/litre). The operation of the Clark type probe relies on the diffusion of oxygen through a suitable membrane into a constant environment of potassium chloride. Solution measurements are best performed with a reasonable flow past the membrane. At sufficiently high flow rates, the oxygen current is totally independent of the flow (a few cm/sec is sufficient). The cell must not be shaken however or unstable readings will result from electrolyte surge bringing new oxygen from the reservoir to the working cathode surface.

## 14.2 Operating Principle

The Clark oxygen electrode consists of a gold cathode and a silver/silver chloride anode, placed in an electrolyte solution. This solution is contained behind a plastic membrane. In this case the plastic is 0.001 inch PTFE (Teflon) sheet. It must be realised that using membranes of very different thicknesses will result in an error in the temperature compensation that is applied in the instrument for the membrane permeability. This coefficient is +4.2%/$^{o}$C at 25$^{o}$C for this thickness membrane.

A polarising voltage of about 800 millivolts is applied between the two electrodes. The gold electrode is placed close to the membrane and because of the polarising voltage, oxygen diffusing through the membrane will be reduced at the gold electrode.

Equation : $O_2 + 2H^+ + 2 \text{ electrons} \rightarrow H_2O_2$

This reduction process will produce a current through the oxygen electrode. A load resistor (actually a thermistor in this case) situated in the electrode itself, converts this current into a voltage proportional to the oxygen partial pressure. The thermistor provided within the body of the electrode has a temperature coefficient of -4.2%/$^{O}$C. This gives an accurate temperature compensation for the temperature/permeability effect of the membrane, over a range of about 5 to 45 $^{O}$C about a centre value of 25$^{O}$C. Note this compensation is not for the solubility effects. A separate sensor also built into the tip of the probe achieves this.

## 14.3 Probe Storage

The Oxygen probe should be kept moist when not in use to prevent the thin film of electrolyte behind the membrane from drying out. To achieve this, the probe can be stored with the tip in water or in a humid environment.

For long term storage of several weeks or more, remove the membrane and empty out the electrolyte. Replace the membrane without electrolyte to avoid contamination of the gold and silver surfaces. When the electrode is stored in this way, the membrane should be replaced and the electrode refilled before use.

## 14.4 Maintenance Of The Membrane

The membrane does not require replacement as long as it remains intact. If punctured or suspected of leaking around the edges, it must be replaced. To replace the membrane, please see the separate instruction leaflet supplied with your sensor.

## 14.5 Notes On Units Of Dissolved Oxygen

The terms "Oxygen Concentration" and "Oxygen Partial Pressure" frequently give rise to some confusion.

- Oxygen Concentration is the absolute quantity of oxygen present per unit mass of the liquid.
- Oxygen Partial Pressure is the oxygen fraction of the total pressure of all of the gases present.

For any one liquid system, Oxygen Concentration and Oxygen Partial Pressure are proportional. However, if the solubility of oxygen in the liquid should change owing to increased quantities of solutes, etc., then the ratio of the Concentration to the Partial Pressure must change. Thus, if one saturates distilled water and a 25% solution of Sodium Chloride with air at atmospheric pressure ($25^{o}$C) both solutions will have almost exactly the same Oxygen Partial Pressure, namely 15.5 cm of mercury. However, the dissolved Oxygen Concentration parts per million (milligrams per litre) will be 8.2 in the distilled water and 2.01 in the salt solution. This is a rather extreme example, as ocean water is only 3.6% saline. It does however stress the importance of correct interpretation of the salinity.

The Clark Electrode measures the partial pressure of oxygen diffusing through a membrane. The current is a linear measure of this partial pressure, assuming sufficient liquid flow conditions.

With air at sea level, the 20.9% oxygen exerts about 15.5 cm of Mercury pressure. Water in equilibrium with air and with no oxygen demand (C.O.D., B.O.D. etc.), is saturated and has this dissolved oxygen partial pressure. If we define 100% Saturation in Partial Pressure terms, then 15.5 cm. Hg = 100% Saturation. This is a practical unit to use. The probe linear readout is then a linear function of % Saturation. Organic cell walls behave like the probe and pressure units are valuable.

% Saturation is the best unit for industrial control and not ppM, contrary to popular beliefs. The partial pressure (and consequently the pressure defined % Saturation) varies only slightly with temperature. (Recall at this stage that the permeability of the membrane has a temperature coefficient, but the electronics has scaled this out by the operation of the Automatic Membrane Temperature Compensator Thermistor incorporated in the D.O. probe).

If mass units are used for measurement of Dissolved Oxygen, the temperature problem of relating the linear partial pressure reading of the probe to the mass (ppM or mg/L) at different temperatures becomes more involved. As well, there is the mass variation due to dissolved salts (salinity correction). Therefore, the fully corrected instrument would need 3 correction systems.

(a) Membrane correction for temperature permeability effects ;

(b) Solubility correction of Dissolved Oxygen with temperature and ;

(c) Salinity correction of Dissolved Oxygen by weight (Salinity has no effect on pressure units readout).

In the **90-D** instrument,

(a) Membrane correction is achieved AUTOMATICALLY ;

(b) To provide the mass units (ppM) readout (so popular due to the Winkler process used in the past), the **90-D** Meter has Solubility Correction via an additional temperature sensor in the electrode ;

(c) Salinity correction is performed via the manually entered Salinity value when the **90-D** is in Salinity-corrected ppM mode.

## 14.6 Equilibrium Conditions

Whilst Saline Water has a lower ppM than does Fresh Water, it does not mean it necessarily has less biologically available oxygen. Both have 100% Saturation (presuming no Chemical Oxygen Demand (C.O.D.), Biological Oxygen Demand (B.O.D.), etc.) because both are in partial pressure equilibrium with air. Any usage of oxygen is immediately replenished by the dissolving of more from air to meet partial pressure equilibrium requirements. This is so for both saline and fresh water. The reporting of oxygen at a lower level (in ppM units) in the Salt Water is therefore QUITE MISLEADING !

In closed systems, such as tanks, pipes and deep waters, equilibrium is not so readily available and the Salinity Effect gains the importance in the reporting of Dissolved Oxygen. It is suggested, unless such closed (or deep, low diffusion) systems are encountered, that Oxygen should be reported in % Saturation or ppM of equivalent Fresh Water.

## 14.7 Velocity Past The Membrane

Workers have shown that the relationship between the diffusion current (oxygen current) and the external velocity of the liquid is expotential. Some workers using thicker membranes have shown even less dependence of the diffusion current on liquid velocity. Because of the expotential nature of the relationship, considerable changes in velocity have to be made before noticing any change in the diffusing current once the flow is sufficiently high. Tests with this electrode have shown that flow rates above 0.2 litres/minute past the membrane give results indistinguishable from those with appreciably higher flow rates (5 litres/minute). Fluctuations in readings due to air bubbles passing through the membrane are a different matter, however.

With the type of electrode to be used with this instrument, very little change in diffusion current is caused by altering the pH of the external environment. Pressure changes over a moderate range exerted on the membrane also cause no change. The EDYSI has a pressure compensation diaphragm to allow submersion to 60 metres.

## 15. Warranty

TPS Pty. Ltd. guarantees all instruments and electrodes to be free from defects in material and workmanship when subjected to normal use and service. This guarantee is expressly limited to the servicing and/or adjustment of an instrument returned to the Factory, or Authorised Service Station, freight prepaid, within twelve (12) months from the date of delivery, and to the repairing, replacing, or adjusting of parts which upon inspection are found to be defective. Warranty period on electrodes is three (3) months.

There are no express or implied warranties which extend beyond the face hereof, and TPS Pty. Ltd. is not liable for any incidental or consequential damages arising from the use or misuse of this equipment, or from interpretation of information derived from the equipment.

Shipping damage is not covered by this warranty.

**PLEASE NOTE:**

A guarantee card is packed with the instrument or electrode. This card must be completed at the time of purchase and the registration section returned to TPS Pty. Ltd. within 7 days. No claims will be recognised without the original guarantee card or other proof of purchase. This warranty becomes invalid if modifications or repairs are attempted by unauthorised persons, or the serial number is missing.

**PROCEDURE FOR SERVICE**

If you feel that this equipment is in need of repair, please re-read the manual. Sometimes, instruments are received for "repair" in perfect working order. This can occur where batteries simply require replacement or re-charging, or where the electrode simply requires cleaning or replacement.

TPS Pty. Ltd. has a fine reputation for prompt and efficient service. In just a few days, our factory service engineers and technicians will examine and repair your equipment to your full satisfaction.

To obtain this service, please follow this procedure:

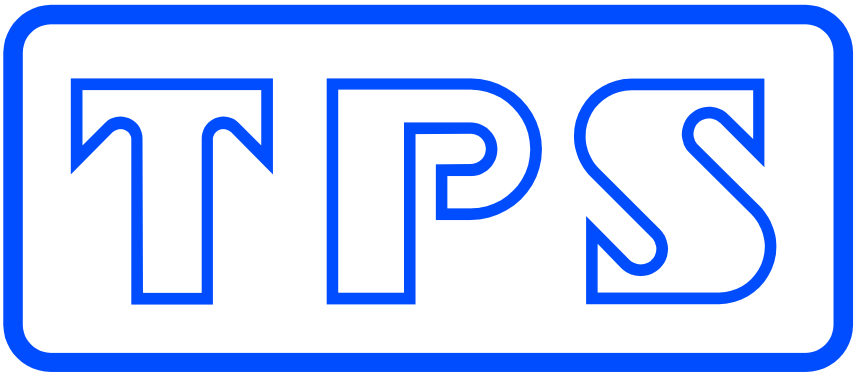
Return the instrument AND ALL SENSORS to TPS freight pre-paid and insured in its original packing or suitable equivalent. INSIST on a proof of delivery receipt from the carrier for your protection in the case of shipping claims for transit loss or damage. It is your responsibility as the sender to ensure that TPS receives the unit.

Please check that the following is enclosed with your equipment:

- **Your Name and daytime phone number.**
- **Your company name, ORDER number, and return street address.**
- **A description of the fault. (Please be SPECIFIC.)**
  **(Note: "Please Repair" does NOT describe a fault.)**

Your equipment will be repaired and returned to you by air express where possible.

For out-of-warranty units, a repair cost will be calculated from parts and labour costs. If payment is not received for the additional charges within 30 days, or if you decline to have the equipment repaired, the complete unit will be returned to you freight paid, not repaired. For full-account customers, the repair charges will be debited to your account.


TPS