



The water quality monitoring specialists

PS2100

Logging Depth Sensor



User Manual

UM-010-0057

Version 1.02

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1 System Description

1.1 Product Overview

Thank you for purchasing the new Greenspan Analytical PS2100 pressure sensor.

The Greenspan PS2100 performs measurement, processing and storage of pressure/temperature data within a compact, rugged unit capable of withstanding harsh operating environments.

Each sensor is calibrated over its nominated temperature and pressure range using a thirty six-point calibration matrix across the entire operating temperature range. This process provides error correction of an order of magnitude, of up to 50% better than traditional technologies and provides the user with accurate and stable calibration.

The Greenspan Analytical PS2100 includes a low power sleep mode to conserve battery power providing the user with increased times between field service resulting in a lower cost of ownership.

Easy to use software programs (Smartcom and Aquagraph) are supplied with the sensor. These enable the user to set up the optimum logging profiles for monitoring with respect to their application and graphical analysis requirements.

1.2 Applications of use/operating specifications

The Greenspan Analytical PS2100 is designed for use as a water depth/level measurement and data recording instrument.

Although the major application area for deployment is in bore holes for groundwater monitoring, the sensor is also very suitable for surface water applications.

Maximum safe operational depth	300 metres
Safe operational temperature	0°C to 50°C
Storage temperature	-10°C to 60°C (with batteries removed)
External power supply	9 to 30V DC

1.3 Approvals

- EMC Directive 89/336/EEC
- EMC Directive 92/31/EEC

1.4 Functional Specification

1. 2Mb of battery backed data storage, providing approximately 50,000 date and time stamped readings for a single channel.
2. 16-bit 10MHz CISC CPU
3. 24 -Bit analogue to digital converter
4. Alarm types: rising, falling and variation
5. Averaging per schedule: Maximum number of readings: 255, Maximum time between readings: 255 seconds, Minimum time between readings: 1 second
6. Field up-gradable firmware
7. Graph, view and convert utility Aquagraph, accessible from SmartCom.
8. Intelligent interface software SmartCom for Windows for PCs
9. Internal battery backed real time clock
10. Internal battery pack
11. Low battery indication
12. Maximum single channel logging rate is 5 Hz
13. Passivated 316 stainless steel body
14. Polynomial correction calculation for all channels
15. Record interval 0.2 sec to 24 Hours
16. Reverse polarity and transient protection
17. Schedule Start/Stop: time based, trigger based, automatic
18. Up to 4 alarm settings per channel:
19. User selectable measurement units. User definable channel names and units
20. User settable datum and TOC reference for pressure channel
21. User settable density correction for pressure parameter

2 System Components – supplied with a standard sensor

2.1 Checklist

1. 1 x Greenspan PS2100 sensor supplied with sensor membrane protector and screw on transport cap
2. 2 x ½ AA lithium batteries 3.6 V, 1.2AH (Greenspan Part Number 069-0300)
3. 2 x Spare o-rings for Sensor Plug (Greenspan Part Number 011-0312-small ring)
4. 2 x Spare o-rings for Cable Plug (Greenspan Part Number 011-0311-large ring)
5. 1 x 2mm Hex Key (for removing screws during battery installation/replacement)
6. 1 x Silicone grease pack and grease applicator (for lubricating o-rings)
7. 2 x Spare M2 screws (Greenspan Part Number 512-M2.5X6CP316P)
8. 1 x CD containing user manual, Smartcom and Aquagraph applications
9. 1 x Communications cable, (Greenspan Part Number 5CC-700)
10. 1 x Sensor Cable with Waterproof Connector
11. 1 x Closed Vent System to match cable

2.2 CD Contents

1. PS2100 User manual UM-010-006 – this document
2. SMARTCOM for Windows runs on a PC and facilitates manipulation of system set-up information, processing and data retrieval. The program requires at least 580K to run and is supplied on a CD disk along with support files. It is compatible with WIN95, WIN98, WIN2000 and NT operating systems. Both mouse and keyboard operations are fully supported.
3. A utility program called AQUAGRAPH allows the user to view, graph and export the data. AQUAGRAPH may be accessed from within SMARTCOM. Online help is available from within the program.
4. The CD contains two auxiliary programs to assist with managing battery and memory usage.

2.3 Communications Cable

A RS232 adapter cable allows the Smart Series II PS2100 sensor to be connected to a PC or laptop enabling easy programming of the sensor.

2.4 Sensor Cable with Waterproof Connector

The PS2100 sensor can be ordered as a Gauge or Vented type Sensor and must be operated with a properly fitting waterproof cable. Cables are interchangeable between sensors and in order to prevent the entry of subtle levels of moisture should always be fitted out with the Greenspan Closed Vent system.

3 Getting Started

3.1 Unpacking your PS2100 Sensor

Your PS2100 was manufactured and tested to the highest standards prior to shipping.

To check that no damage has been sustained during shipping, slide the sleeve from the PS2100 box to reveal the components.

Labels have been provided on the box and the sensor to identify the sensor's range, output and serial number. The label will look similar to that shown below:

MODEL	PS2100
RANGE	0-10m/0-50°C
OUTPUT	RS232
S/N	001243

3.2 Battery Options

The sensor can operate from an internal lithium battery pack or an external 9-30V battery connected via flying leads at the end of the cable.

3.3 Installing/Replacing the Internal Batteries

If using the internal battery pack, batteries supplied with the sensor must be installed prior to use as follows (see Figure 1):

- If fitted, remove the sensor cable from the sensor
- With the 2mm hex key provided remove the two screws from the connector body. Store screws in a safe place
- Gently pull axially on the connector body to reveal the battery compartment
- Install two ½ AA 3.6 Volt, 1.2A/hr Lithium batteries into the battery housing ensuring that orientation is as per the label on the connector arm, see Figure 1.
- Ensure that the o-rings on the battery compartment are clean and lubricated with silicone grease (supplied). If the o-rings appear damaged replace the o-rings with the spares (Greenspan Part Number 011-0312) provided.
- Gently push the connector body back into the sensor until the fixing holes are visible and centralised with the clearance holes of the sensor body.
- Insert the screws and firmly tighten them (being careful not to strip the threads) using the 2mm hex key supplied.

During Log mode the PS2100 automatically enters a low power condition when the communications cable is removed from the PC. This ensures that minimal power is drawn from the battery between logged records. The system will return to normal power each time a reading is required, and then revert to low power mode again.

The Internal Battery life will be significantly reduced if the PS2100 is connected to a PC for long periods. It is good practice to remove the batteries while not in use and to use fresh batteries for long periods of field deployment.

The battery voltage may be checked in Monitor mode in SmartCom. A battery voltage below 6.0V indicates the batteries are low.

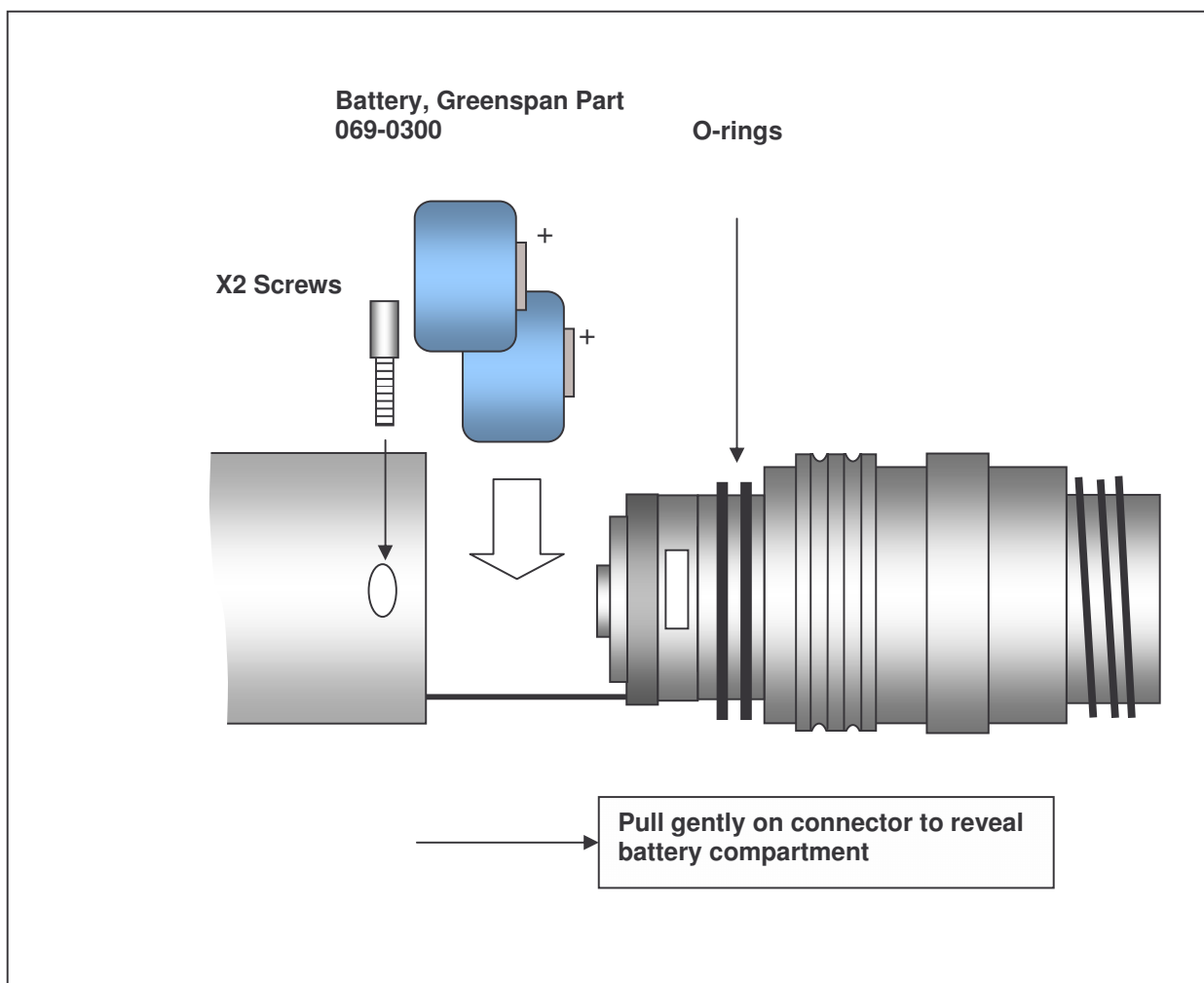


Figure 1: Battery Installation

3.4 External Battery Connection

For connection to an external battery, connect the red wire of the sensor cable to positive and the black wire to negative (See Figure 4). If the voltage of the external battery is higher than the internal batteries it overrides the battery pack and consequently conserves its power. For external power a 12V gel cell battery rated at 5.2 A/Hr is recommended for long logging periods.

When using an external power supply ensure that the voltage range is within 9 to 30V. If the voltage is below 9V, the logger may cease logging while voltages higher than 30V may damage the sensor.

3.5 Powering Off

If the PS2100 is to be placed in storage it is recommended that the logger be powered down and internal batteries (if fitted) be removed as per paragraph 3.3. The connector transport cap should also be refitted as per paragraph 3.6.

After a power down (for example a battery changeover) the sensor will automatically resume to the mode it was operating in before power was removed. That is, if it was logging it will automatically restart.

As removing power from the sensor will not affect any data stored in memory, data may be downloaded at a different location away from the installation site if required.

3.6 Connector Preparations and Cable Attachment

To prevent entry of moisture into the sensor body during shipping, the sensor connector was fitted with a transport cap. The transport cap needs to be removed (store in a safe place) to allow the sensor cable to be connected. The connector transport cap should be refitted to the sensor whenever the sensor is stored or shipped to minimise moisture ingress into the sensor body.

The PS2100 is fitted with a “quick connect” waterproof connector (see figures 2 and 3). The “quick connect” feature allows the cable to be removed from the body of the sensor. This allows for easy storage and different cable lengths to be fitted to the sensor to suit the field application.

Prior to connecting the cable to the sensor body, ensure that the o-ring located in the base of the sensor connector is seated correctly. Rotate the cable connector until the key aligns with the key-way of the sensor connector and push these parts together carefully. Tighten the knurled connector locking ring by hand to fully seat the connector. Failure to follow above procedure may cause damage to connector pins or lead to sensor damage due to moisture ingress.

The sensor cable supplied is fitted with a HS7 (7-pin) connector at the “surface” end. This connector has a red and black flying lead for connection of external power and also provides access to the vent tube and ground wire. A second communications cable, 5CC-700 is supplied to facilitate connection to the PC for downloading of data (See figure 4).

Note the Yellow/Green ground wire is connected to the shield of the sensor cable only. It must be connected to the installation's earth point with the lowest resistance in order to provide an efficient discharge path for induced transients that may occur during electrical storm activity.

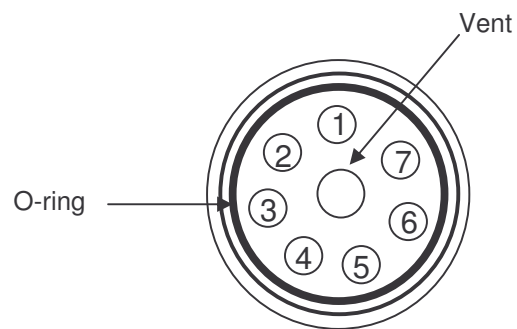
3.7 Final Checks

Before putting the sensor in the water the following checks should be conducted:

1. Ensure that screws for the internal battery pack have been fitted and are properly tightened
This will prevent the entry of moisture.
2. Ensure that o-rings in the connector which connects the cable to the sensor have been fitted correctly to prevent moisture entry into the sensor.
3. Ensure that cable connector locking ring is fully tightened but not over tightened.
The force of tightening with a firm hand is adequate and suitable.
4. Ensure that the cable run for the installation is planned such that damage is not likely.
5. Ensure minimum visibility of installation to attempt prevention of vandalism.

3.8 Figure 2: PS2100 Sensor Connector Detail

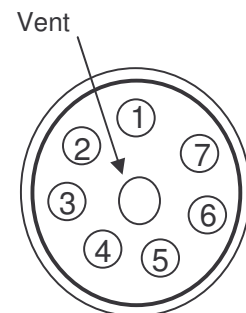
Pin	Function
NC	BATT +VE
1	+VE
2	TXD
3	RXD
4	NC
5	GND
6	NC
7	NC



FRONT VIEW
Impulse Connector (MALE)

3.9 Figure 3: PS2100 Cable Connector Detail

Pin	Function	Cable Colour
1	+12V	Red and Pink
2	TXD	Yellow
3	RXD	Violet
4		White
5	GND	Green and Black
6		Blue
7		Brown



FRONT VIEW
Impulse Connector
(FEMALE)

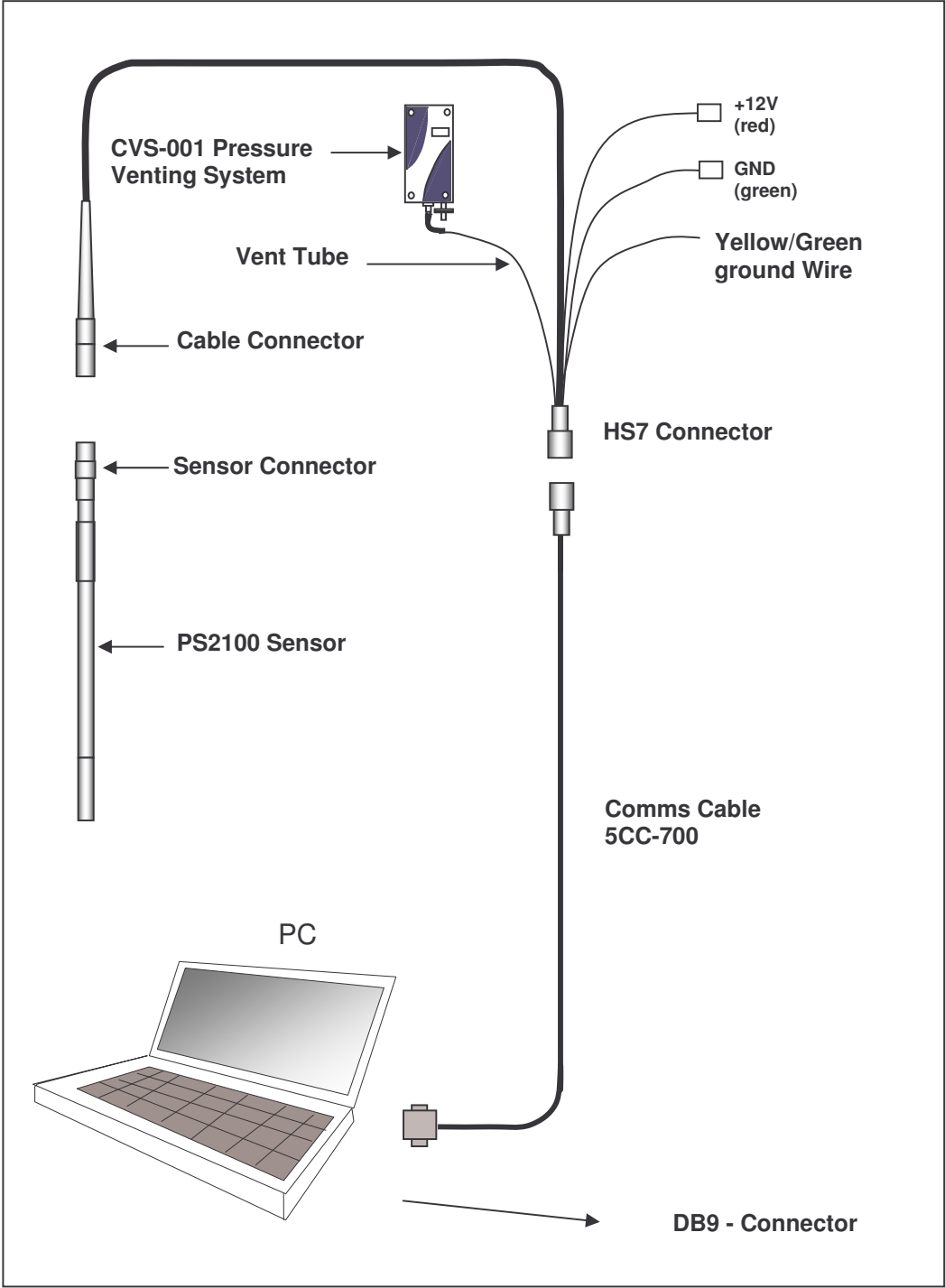


Figure 4: System Connection Diagram

3.10 Closed Venting System for Gauge sensors

General operation

During long-term field deployment it is usual for a temperature difference to exist between the air and the liquid in which the sensor is submerged. When vented pressure sensors are deployed, this potential temperature differential stimulates a pumping effect whereby moisture-laden air from the surface may be drawn into the sensor through the vent line. The moisture in the usually warmer surface air can condense on sensitive electronic components inside the sensor and may not only be the cause of inaccurate readings but also result in considerable damage to the sensor. Sealing the system against exposure to the atmosphere and conditioning the existing air prior to entering the vent tube will alleviate this problem. It is strongly recommended that a CVS-001 be installed on all Greenspan vented sensors (see figure 5).

The Greenspan CVS-001 closed venting system is designed to prevent these problems. This hardware comprises a special plastic bag, which is connected to the vent-tube and converts the contained air-column into a "Closed System". A small sachet of Silicon desiccant crystals is used to absorb any residual moisture. The CVS-001 is shipped with a protective seal on the joiner tube to prevent moisture ingress, please ensure that this seal is removed when installing (see figure 5).

A single CVS-001 unit is designed to service a sensor cable up to 70 metres. Multiple CVS-001 units can be "daisy chained" to accommodate sensor cable lengths in excess of 70 metres.

Installation

The CVS system must be shielded from direct exposure to rain, hail and sunshine as such influences may have adverse affects on data integrity and long term reliability. Installation and setting up of the system must be carried out with attention to detail in order to ensure correct operation. Following are the main items of concern:

- All joints must be airtight to ensure that no moisture enters the system
- No direct sunlight must fall upon the installation
- If mounted inside an enclosure, ample ventilation must be present
- No kinks or blockages must be present in any of the lines
- The breather bag inside the CVS unit must be partially inflated to enable it to expand and contract during atmospheric pressure changes.

Detailed procedures

When the system is assembled, disconnect the joiner tube from cable vent tube. See Figure 5. If installing a new CVS-001 it is necessary to remove the black seal on the joiner tube.

Attach 60ml syringe to the joiner tube and withdraw all air from breather bag. This may take more than one suction.

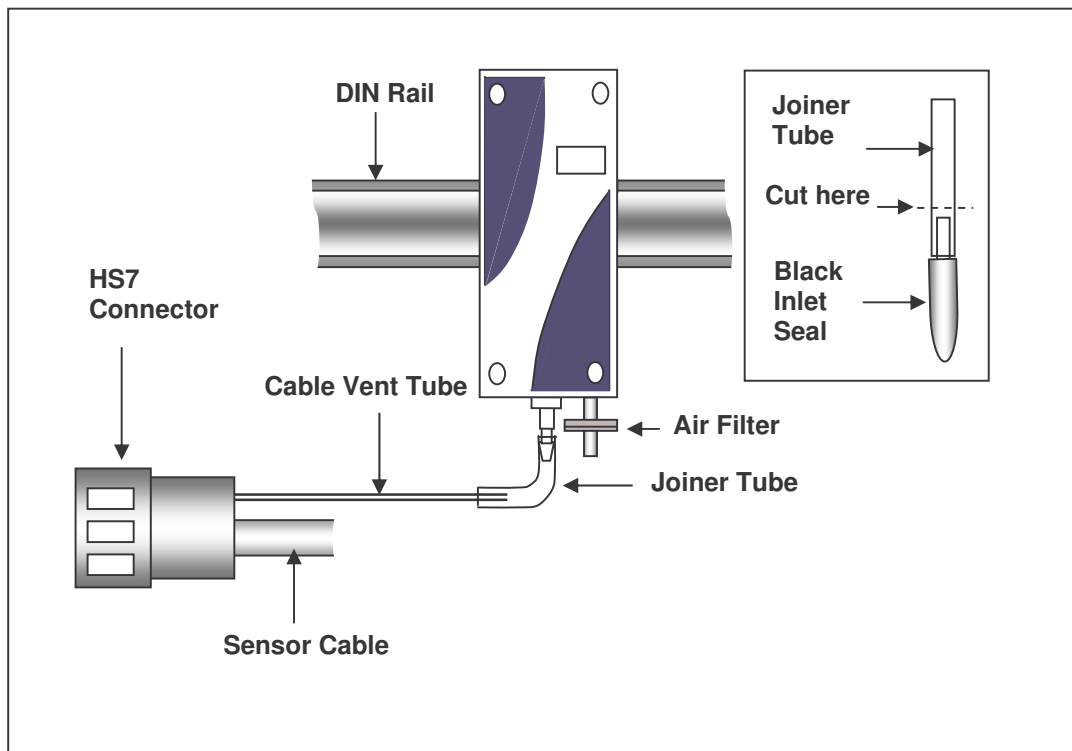
Remove syringe and recharge with air. Reattach the syringe to the joiner tube and charge the breather bag with 60ml of air. Remove the syringe, recharge with air

and charge the breather bag with a further 60ml (total 120ml = half of the maximum capacity of 240ml).

Re-connect the joiner tube to the cable vent tube.

If multiple units are being used, the volume of air required for priming must increase by approximately 120ml for every unit connected.

Note: Only remove the inlet seal on the CVS-001 when ready to install the sensor vent tube. If dismantling the system ensure that the unit is sealed as quickly as possible in order to prevent the entry of moisture laden air.



**Figure 5. CVS-001 Single Installation
(Suggestion Only)**

4 Field Installation

The Greenspan PS2100 Sensor can be installed into a variety of applications including:

- rivers, lakes and streams
- bore holes and groundwater wells
- tanks and reservoirs
- wet wells for water and sewer systems

In all field applications, mechanical, electrical and physical protection of the sensor, cabling and associated fittings must be provided as collision with solid objects will lead to mechanical damage which will not be covered by Greenspan's normal warranty conditions.

If the sensor is installed in open water, the preferred location for installation is where existing protective elements can be utilised such as a pylon of a bridge (downstream) in order to avoid damage by floating or suspended debris especially during flood conditions.

Field Installation must ensure:

- The sensor is fully submerged in the liquid to allow full temperature equilibration
- That the sensor is anchored or held in position or located so it is not subject to movement during normal operations.
- That the sensor is protected from direct sunlight to avoid high temperature fluctuations.
- That the sensor is protected against high turbulence and possible debris loading during flow events.

The minimum bending radius of 150mm is observed in relation to the sensor cable

Ensure that the sensor connector o-ring is properly positioned to prevent water penetration when immersing. Two spare o-rings are supplied with the sensor and replacements can be obtained from Greenspan Technology.

It is recommended that the transport cap is fitted to both the cable connector and the sensor whenever the sensor is shipped or relocated to prevent moisture penetration into the sensor chamber.

4.1 Non Turbulent Conditions

Installations free from flow, movement and/or turbulence will enable the sensor to simply be suspended from its cable.

4.2 Highly Turbulent Conditions

Where turbulence and/or water movement act on the sensor, mounting in a stilling well is recommended. This can simply be a length of PVC pipe bolted to the wall of the well in which the sensor is located or to a pylon in the river. Potential debris build up (ragging) on the sensor and cable must be overcome by extending the stilling well to above the

high water. The PCV pipe must extend beyond the sensor extremity so that it fully contains the sensor.

Conditions having a need for installation as described above may be Sewage Wet Wells and installations in rivers and streams.

4.3 Other Considerations

The sensor body must always be totally immersed under the water to ensure that the whole sensor is at water temperature and also to avoid any possible anodic/cathodic action taking place on the stainless body at the water-air interface. At some sites it has also been noticed that clamps used to support the sensor made of a dissimilar metal to the 316 stainless body can cause spot corrosion due to electrolysis.

It should be noted that – under certain conditions - clamping of the sensor body with any material is capable of corroding the sensor casing due to the formation of a condition known as “oxygen depletion”. Elevated water temperatures will accelerate such processes.

Environmental compatibility must be checked before using the sensor. Please obtain advise from Greenspan Analytical if any doubt exists. The passivated, stainless steel 316 body can be used in a majority of situations but care should be taken against possible corrosion in high Chloride, Sulphate or Ferric solutions.

5 Sensor Maintenance

5.1 Operating Specification Considerations

The PS2100 is a sensitive electronic device and as such the accuracy of this instrument may be adversely affected if not properly cared for. The instrument may provide inaccurate data or even sustain permanent damage if it is operated outside its operating specification (see section 1.2).

The PS2100 has been designed to require only a minimum amount of maintenance and therefore the overall operating costs are greatly reduced and the data security is enhanced.

Implementation of regular routine checks by following the guidelines as set out below, will further enhance the sensor's reliability and help ensure many years of trouble free operation.

5.2 Replacing the Internal Batteries: Refer to section 3.3 of this manual

5.3 General Cleaning

The sensor may be cleaned using a soft cloth and warm water, encrustation or barnacle growth may have to be removed with a gentle wiping action.

If the well in the front of the sensor should become clogged with silt or mud, clean with a squeeze of water from a wash bottle or by swishing the instrument in a bucket of clean water. Do not insert any object into the hole as this may result in permanent damage to the pressure transducer.

5.4 Removal of the cable from the sensor

If the cable needs to be removed from the sensor ensure that the following procedure is observed:

The sensor must be held vertically with the sensing membrane pointing skywards and the cable leading onto the ground in a gentle flowing action – this will prevent water from entering the sensor body via the connector vent.

5.5 Field Calibration

To check calibration, a Dead Weight Tester for generating pressure is required. If this is not available please contact Greenspan Analytical for the location of your nearest service centre. Greenspan Analytical recommends that the calibration is checked at least every 12 months.

To calibrate the Pressure Sensor:

1. Ensure sensor head is clean and that sensor is connected to power and a computer. Allow the sensor to equilibrate to ambient temperature for at least an hour prior to calibration.
2. Ensure that the sensor is and will remain shielded from direct sunlight during the following procedures as considerable errors may be introduced.
3. For gauge pressure sensors ensure that the vent tube has the sealing plug removed and the CVS-001 venting system is fitted.
4. Set up a reference pressure calibrator or Dead Weight Tester for full scale calibration.
5. In SmartCom for Windows, select User Cal from Logger Control menu.
6. Select the Pressure Channel.
7. Select 3 Decimal Places.
8. Select 2 point Span and Offset Calibration Type
9. The screen should display a window to allow entry of the new low value. With zero pressure applied, type in the new value to be read by the Smart Sensor for the low point, e.g. (000.000), click OK.
10. Connect the sensor to the pressure calibrator and set the pressure gauge value to the full scale range value of the sensor.
11. The screen now displays a window that allows for entry of the new high value, type in the new value to be read by the Smart Sensor for full scale, eg: (020.000, for 20 metre range), click OK.

12. The Smart Sensor will calculate a new calibration curve based on this data. The Pressure channel is now re-calibrated and ready for use.

6 Trouble Shooting

6.1 Checklist

Problem	Possible cause	Suggestions
No Communication	Internal batteries are flat	Replace internal batteries or check sensor operation using an external power source.
	External battery connection open circuit	Check Battery Connections. Place milli-amp meter in series with power supply (Current should read between 3 and 20 mAmps).
	Cables connected incorrectly	Check cable connections (Refer Figure 4).
	Sensor cable not sealed correctly	Firmly tighten knurled connector locking ring. Check sensor for moisture entry if it has been in the water.
	Faulty communications cable	Check continuity of cable conductors with ohm-meter. Replace cable if found to be faulty.
	Physical damage	Inspect sensor for physical damage.
	High level power spike caused by lightning has "locked" micro-processor	Hard reset the micro-processor by disconnecting the power supply and/or removing the batteries for 10 seconds
	Software problems	Check the software has been installed correctly. Check the operating system is supported. (Refer section 2.2)
Unable to change parameter properties	Sensor is logging	Stop logging and try again as sensor parameters cannot be changed while sensor is logging.
Data contains diurnal changes	Vent-tube has become blocked	With a syringe gently apply pressure into the vent tube (after disconnecting the CVS system) and observe if the reading in monitor mode changes. If not, it is likely that the vent-tube has kinked and/or is blocked.
	Vent system has been under or over inflated	Remove the CVS and observe if this causes a permanent change in the sensor reading (Monitor mode). If so, re-inflate the CVS breather bag (refer section 3.7)
Data has an offset	Dirt or scale growth causes pressure on the sensing membrane	Clean the membrane as outlined in section 5.3 General Cleaning While sensor is out of the water, hold vertical and observe the current reading. This should read approx ZERO (Take datum offset into account)

7 Technical Support

Greenspan Analytical is dedicated to customer support and provides assistance in the selection, installation, deployment and commissioning of sensors with a full range of consulting services.

Contact your nearest Technical Support Centre who will happily assist with your enquires.

Technical Support Contact:

Asia, Australia & Europe

Tyco Environmental Systems

Phone: + 61 7 46601888

Fax: + 61 7 46601800

Email: techsupport@greenspan.com.au

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NIWA

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Fax: + 64 3 343 7891

USA

Goyen Controls

Phone: + 1 512 267 4740

Fax: + 1 512 267 4744

Email: jharrington@goyen.com

8 Warranty Conditions

Tyco Environmental Systems warrants this product and accessories against defective materials or workmanship for a period of 1 year from the date of invoice.

Tyco Environmental Systems will repair or at our option, replace at no charge a product that proves to be defective.

Tyco Environmental Systems' liability and obligations in connection with any defects in materials and workmanship is expressly limited to repair or replacement as the sole and exclusive remedy in the event of such defects. Tyco Environmental Systems' obligations under this warranty are conditional upon receiving prompt written notice of claimed defects within the warranty period.

Tyco Environmental Systems will not be liable for any incidental or consequential damage or expense incurred by the user due to partial or incomplete functionality of its products due to inaccurate information generated by its products.

Warranty Conditions:

1. This warranty is only valid for products installed, operated and maintained as described in this user manual.
2. Products and accessories modified or repaired by an unauthorized service center will void this warranty.
3. Products and accessories damaged by lightning strikes are not covered by this warranty.
4. Products and accessories subject to a warranty claim are to be returned postage paid to the nearest Tyco Environmental Systems service center.

Warranty Service Centres:

Tyco Environmental Systems
22 Palmerin Street
Warwick, Queensland, 4370
Australia

Tel:+61 7 4660 1888
Fax:+61 7 4660 1800

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