

# *Turbidity Sensor*

## ***TS1000 User Manual***

**Version 1.0**



***TS1000 User Manual***

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# **I Introduction**

## **1.1 System Description**

Thank you for purchasing the Greenspan Turbidity Sensor Model TS1000. This manual provides a guide to the configuration, operation and maintenance of the sensor to provide long term reliable and accurate monitoring.

The TS1000 turbidity probes are designed for monitoring and process applications where turbidity levels of up to 1,000NTU may be encountered. Standard ranges are 100NTU, 400NTU and 1,000NTU. The TS1000 probes, with their integral wiper assembly, are designed where bio-fouling or sedimentation build-up is possible. The probes may be submerged to a depth of 100 meters (approx. 330 feet).

The TS1000 probe use 90° optics and employs infrared light in accordance with ISO7027. The optical system transmits a beam of 860nm wavelength. The effective working area around the sensor is approximately 50mm forward and 50mm circumference. The sensor uses a unique modulation technique that ensures almost total rejection of ambient light conditions as well as a unique microprocessor controlled differential sample and hold circuit for enhanced performance particularly at low turbidity levels.

Designed for applications where an analogue output is required. The sensor provides both a 4-20mA and a 0-2.5V output. The sensor requires power from a DC source between 8 and 30 Volts. The wiper is activated by connecting the wiper control wire to ground for a brief pulse.

The Sensor is packaged in an Acetal or 316 Stainless Steel tube, with Double O ring connections for the cable and sensor head. This fully submersible sensor design is rugged and well proven and can withstand the harsh conditions found in remote field applications. The sensors are suitable for applications in harsh remote applications including groundwater, salty or acidic water conditions.

## **1.2 How to Use the Manual**

Along with this manual, there are several other documents that may assist in the successful configuration and operation of the Greenspan TS1000 Sensor. These should be maintained on file as a permanent reference as to the features, applications and use of the TS1000.

***Greenspan TS1000 – Specifications Brochure***

***Greenspan TS1000 – Certificate of Conformance***

***Greenspan TS1000 – Quick Start Guide***

## 1.3 Certification

The TS probes are assembled and tested in accordance with Greenspan's ISO 9001 Quality Certified System. Each Sensor is individually manufactured and certified against a traceable Standard ([See Section 2.7](#))

Following calibration the sensors undergo a range of additional control processes to ensure that all specifications are consistent and documented.

- ***The instrument is visually inspected, marked and labelled.***
- ***The complete sensor calibration record is archived for reference, and batch number information is kept on file for statistical analysis.***
- ***An individual Certificate of Conformance is issued to the customer.***

## 1.4 Unpacking and Inspection

All Greenspan Analytical Sensors are made to order and are individually calibrated and inspected. This ensures that they leave the factory in a working condition. They are packed in new cartons for shipping. On receipt, the customer should inspect the packaging and contents for any signs of damage during transportation. The customer should also check that all items on the delivery note have been received.

Please contact the factory in case anything has been damaged or missing. A full set of documentation including Certificate of Conformance, Quick Start Guide, and Full Operator Manual will be provided with all equipment – either in hard copy format or in electronic format on the CD shipped with the goods.

If fitted with a 316 Stainless Steel body, the unit should only be used in low EC situations. Care should be taken against possible corrosion in high Chloride or Ferric solutions, water with high iron or sulphate reducing bacteria, or low dissolved oxygen. The Sensor can be fitted with an Acetal body which provides superior corrosion protection in a wide range of chemically active waters.

Because an individual sensor may be used in a variety of locations, media compatibility should be checked before installing and advice sought from Greenspan if any doubt exists.

## 1.5 Serial Number

Checking the Model Number and Range

Before installing your Greenspan TS1000 sensor check the information on the label is correct to confirm you have received the instrument you have ordered. The label will look similar to this.

<b>MODEL</b>	<b>TS1000</b>
<b>RANGE</b>	<b>0 – xxxx NTU</b>
<b>S/N</b>	<b>012345</b>

The customer is advised to keep a record of the serial numbers in case the sensor is lost or the label damage. Greenspan Analytical keeps records of all sensors sold including a calibration history.

## 1.6 Warranty Policy

Greenspan Analytical warrants all new Greenspan products against defects in materials and workmanship for **12 months** from the date of invoice.

Products that prove to be defective during the warranty period will be repaired or replaced at the discretion of Greenspan Analytical.

Under Greenspan Analytical warranty conditions; it is the responsibility of the customer to cover shipping charges back to the factory. Upon repair/replacement Greenspan Analytical will cover the return shipping charges to the customer.

This warranty does not apply to products or parts thereof which have been altered or repaired outside of the Greenspan Analytical factory or other authorised service centre; or products damaged by improper installation or application, or subjected to misuse, abuse neglect or accident. This warranty also excludes items such as reference electrodes and Dissolved Oxygen membranes that may degrade during normal use.

Greenspan Analytical will not be liable for any incidental or consequential damage or expense incurred by the user due to partial or incomplete operability of its products for any reason whatsoever or due to inaccurate information generated by its products.

All Warranty service will be completed as soon possible. If delays are unavoidable customers will be contacted immediately.

Any sensor should not be dismantled unless under instruction from Greenspan Analytical Technical Service staff. Incorrect handling will void the warranty.

## 1.7 Factory Service & Repair

The correct choice of sensor and assistance with field installation can be provided by Greenspan and their sales offices. A correct choice of equipment, together with technical advice and field experience should result in long term success in the field. **Greenspan Technical Services** is dedicated to customer support and provides assistance in the selection, installation, deployment and commissioning of sensors with a full range of consulting services. All Greenspan products are designed, developed and manufactured in Australia and can be supplied at short notice.

If for some reason sensors are required to be returned to our factory or your sales representative, please note the model and serial number, Describe the problem, including how and under what conditions the instrument was being used at the time of malfunction. Clean the product and cable. Decontaminate thoroughly if used in toxic or hazardous environment. Carefully pack product in original packaging if possible & include a statement certifying product and cable have been decontaminated with supporting information. Products returned for repair must be accompanied by a completed GRA (Goods Return Advice) form. All sensors returned for service and repair work must be properly decontaminated prior to return. A cleaning charge may be applied to sensors that require further decontamination. Service work will not commence until the quotation has been accepted by the customer. A purchase order for all repair and service work will be required before work is carried out.

## 1.8 Contact Details

### Australia

**Head Office**  
Goyen Controls Co Pty Ltd  
268 Milperra Road  
Milperra, NSW 2214

Telephone: 1800 805 372  
Facsimile: 1300 658 799

### Sales and Service

**Queensland, South Australia  
Victoria, Western Australia**

Telephone: 1800 805 372  
Facsimile: 1300 658 799

### USA

Goyen Valve Corporation  
1195 Airport Road  
Lakewood  
New Jersey 08701, USA

Telephone: 1 732 364 7800  
Facsimile: 1 732 364 1356

### Asia

Goyen Controls Co Pty Ltd  
Shanghai Representative Office  
1209 Greenland Business Centre  
1258 Yu Yuan Road  
Shanghai PC200050, CHINA

Telephone: 86 21 5239 8810  
Facsimile: 86 21 5239 8812

Goyen Controls Co Pty Ltd  
73-M Jalan Mega Mendung  
Kompleks Bandar OUG  
58200 Kuala Lumpur, MALAYSIA

Telephone: 60 37 987 6839  
Facsimile: 60 37 987 7839

Greenspan Singapore Pte Ltd  
02-01, Minwa Industrial Building  
39 Genting Lane  
Singapore 349554

Telephone: 65 6748 0140  
Facsimile: 65 6748 2534

### Europe

Goyen Controls Co UK Ltd  
Unit 3B Beechwood  
Chineham Business Park  
Basingstoke, Hampshire, RG24 8WA  
UNITED KINGDOM

Telephone: 44 1256 817 800  
Facsimile: 44 1256 843 164

**Tyco Umwelttechnik GmbH**  
Im Petersfeld 6  
D-65624 Altdiez  
GERMANY

Telephone: 49 6432 1001/1002  
Facsimile: 49 6432 63810

**Mecair S.r.l.**  
Via per Cinisello 97  
20054 Nova Milanese  
Milano,  
ITALY

Telephone: 39 362 375 118  
Facsimile: 39 362 375 124

### Address:

*Tyco Environmental Systems  
Greenspan Analytical Manufacturing Plant  
22 Palmerin Street  
WARWICK QLD 4370  
AUSTRALIA*

### Phone:

+ 61 (0)7 46601888

### Fax:

+ 61 (0)7 46601800

### Internet:

[www.tyco-environmental.com](http://www.tyco-environmental.com)

## 2 Sensor Overview

### 2.1 Theory of Measurement

Turbidity is the measurement that indicates the clarity of water due to fine suspended particles. In the environment, turbidity is often due to clay or silt. These fine particles have the ability to scatter light. The TS1000 has a light source that is projected into the water. A detector measures the light that has been scattered at 90 deg to the source. As the number of particles increase, more light is scattered and sensed by the detector and the higher the turbidity reading.

### 2.2 Applications

Applications in which the Greenspan TS1000 can be used include:

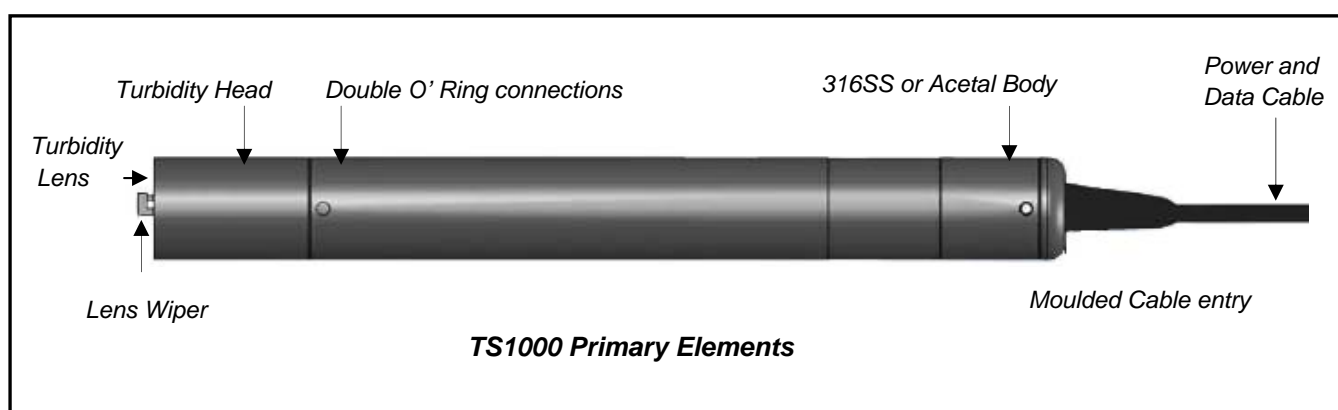
- Monitoring of streams and rivers.
- Monitoring of water storage bodies including stratification studies.
- Intermediate and final effluent treatment monitoring.
- Hydrological run off studies.
- Ground and bore water analysis.
- Drinking water filtration efficiency.
- Industrial process monitoring.
- Sludge and dredge monitoring.

### 2.3 Instrument Details

#### 2.3.1 Sensor Design

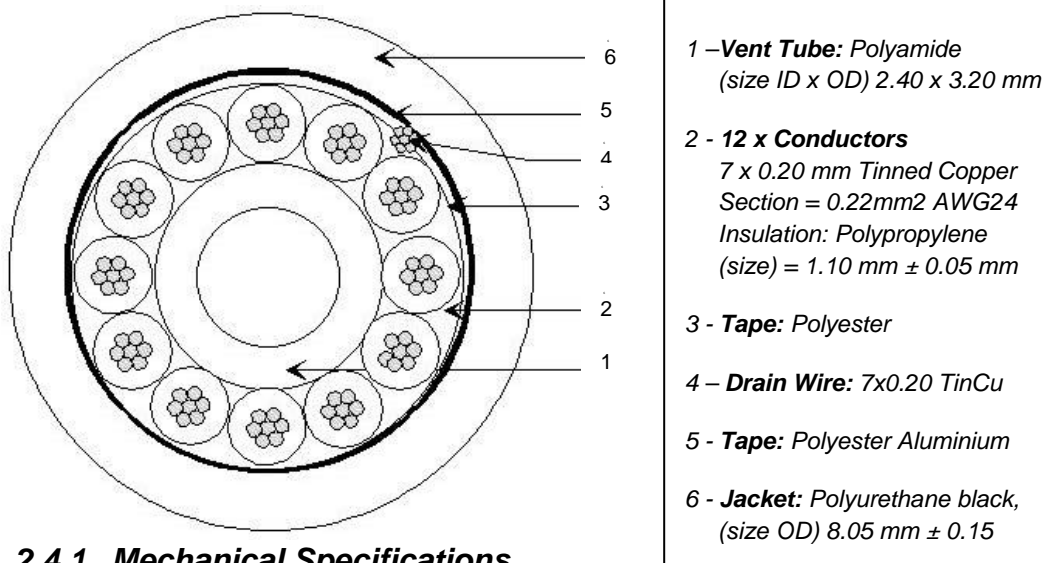
The Greenspan TS Sensor consists of the following primary elements:

- Microprocessor controlled signal conditioning and logging device
- Stainless steel or Acetal Body Material
- Sensor Head Shroud (removable for cleaning)
- Data cable or Battery Pack option



## 2.4 Cable Details

All Greenspan Sensors utilise a specially designed Polyurethane Cable. The cable contains 12 x conductors, 1 x drain wire, and an internal vent tube. The outer jacket is made from UV stabilized Polyurethane and is suitable for all external, underwater or harsh environment applications. This common cable construction is utilized for vented and non vented sensors and all Greenspan Water Quality Sensors. Cables are generally factory fitted at time of manufacture in specified lengths. Cables can be joined or repaired in the field providing a waterproof connection can be maintained. Alternatively, cables can be terminated in waterproof junction boxes where cabling to other devices or longer cable runs are required.



### 2.4.1 Mechanical Specifications

- Specially Manufactured Greenspan Cable with 12 cores and Internal Vent
- High chemical resilience and abrasive resistance
- Conductor cross section : AWG 24,
- Electrical Resistance 9 ohm per 100m (per conductor)
- Operating temperature: 85°C (max.),
- Bending radius (static) : 6 ,
- Bending radius (dynamic) 12.
- Max Operating voltage : 250V
- Jacket Printing (white colour each meter)
- Conductor colour codes : green, yellow, white, black, brown, turquoise, violet, pink, red, blue, grey
- Tensile Strength is sufficient to self suspend the Greenspan Sensor to depths of 300m.
- Long term creep due to temperature effects or tensile loading is negligible.

The moulded cable is fitted to the sensor using a double o ring seal and located using 2 x grub screws. The length of the cable is not critical to the long term calibration and operation of the sensor (provided the electrical requirements such as minimum supply voltage are maintained).



## **2.5 Options and Accessories**

### **2.5.1 Sensor Body**

Sensor is available with a black Acetal or passivated 316 Stainless Steel body. For applications in harsh environments it is recommended that the Acetal body material be specified.

### **2.5.2 Cable Options (Inc Detachable Cables)**

A standard sensor is supplied with a fixed moulded cable entry. The cable is supplied with bare wires at the end opposite to the sensor.

As an option, your sensor can be ordered with a detachable cable. Detachable cables are available in a range of standard lengths and are interchangeable amongst the range of Greenspan sensors. This option can provide benefits and cost savings. Detachable cables are supplied with a 7 pin Hirschman connector at the end opposite to the sensor. An adapter cable with a mating 7 socket Hirschman connector broken out to bare wires is available (Part # 5CC-750).

Please refer to the [Engineering Note](#) in the appendix section of the manual for detailed instructions on connecting and disconnecting the detachable cable.

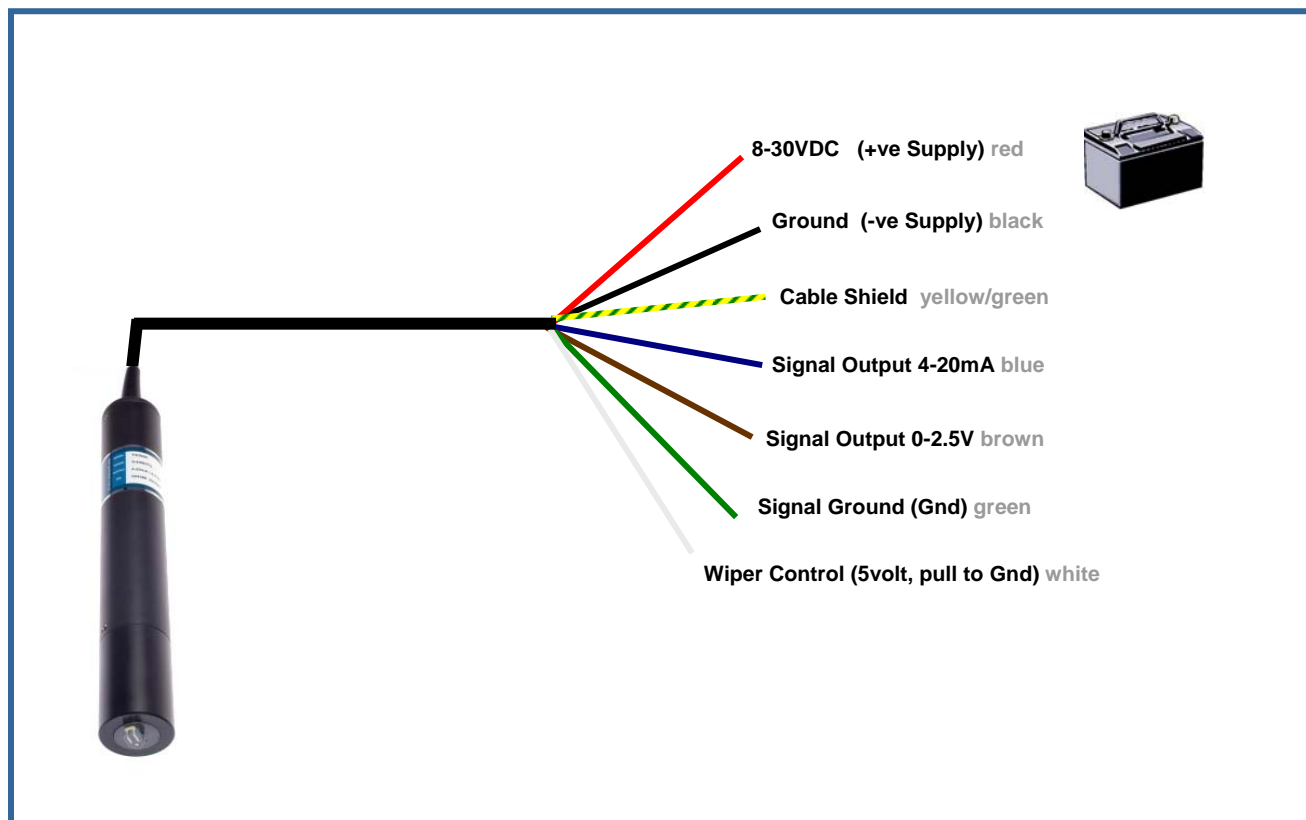
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## **2.6 Sensor Factory Calibration**

- Sensors are calibrated using AMCO CLEAR® TURBIDITY STANDARD, for ANALITE ISO 7027 PROBES.
- An extensive range of final calibration and inspection tests are carried out on every sensor.
- The sensor is visually inspected and packed, ready for despatch.
- The complete calibration records, sensor history and batch number are placed on file and archived.

## 3 Sensor Operation

### 3.1 Wiring & Connections



## 3.2 Calibration Quick Check

The Factory supplied Calibration Certificate will provide detailed information on the calibration of the sensor and should be retained for future reference.

To maintain high quality control over monitoring programs, it is recommended TS calibration is checked every 3-6 months. The TS1000 has no facility to adjust the analogue outputs. If any gain or offset correction is required the factors should be entered into the datalogger or measuring device. Alternatively sensors may be returned to an authorised Greenspan agent for re-calibration.

The sensor can be checked by use of known laboratory Turbidity standards. Sensors are calibrated using AMCO CLEAR® TURBIDITY STANDARD, for ANALITE ISO 7027 PROBES.

The claimed advantages of these standards are-

- Safe, non-toxic and disposable
- Easy-to-use/No dilutions or preparations
- Accurate to 1% lot-to-lot
- Available in a wide range of values
- Stable/does not settle out of suspension
- Guaranteed One Year Shelf Life
- N.I.S.T. Traceable

### 3.2.1 Quick check

1. Remove the sensor from the water, ensure the sensor is clean. Dirty optics could be a key source of calibration errors.
2. Connect the sensor to a DC power source and a meter (ideally the measuring device the sensor is connected to in its application) to measure the sensor output.
3. Place the sensor in clean water so that the sensor face is at least 50mm clear of the bottom of the container. Record the measured output value.
4. The Turbidity value should read Zero +/- 3% of the full scale range of the sensor (eg. 4mA +/- 0.48mA for the current output or 0V +/- 75mV for the voltage output).
5. Place the sensor in a full scale Turbidity solution so that the sensor face is at least 50mm clear of the bottom of the container. Record the measured output value.
6. The Turbidity value should read +/- 3% of the full scale range of the sensor (eg. 20mA +/- 0.48mA for the current output or 2.5V +/- 75mV for the voltage output).
7. This confirms that the sensor electronics has remained stable and no further action should be required if the sensor is within +/- 3 % FS.

### Calculating Gain and Offset Correction Factors

Most dataloggers or SCADA devices have the ability to enter gain (or multiplier) and offset factors to correct for small changes in the sensor output. If the quick check values are outside allowable tolerances, correction factors can be calculated and entered into the measuring device or used to post process any data recorded.

The gain correction can be calculated with the formula-

$$\text{Gain correction} = \frac{(\text{expected reading at Full Scale} - \text{expected reading at Zero})}{(\text{Reading at Full Scale} - \text{Reading at Zero})}$$

The offset correction can be calculated with the formula –

Offset correction = expected value at Zero – (reading at Zero x Gain correction)

E.g. A quick check was done on a TS1000 with the current output connected to an ammeter. The results recorded were 3.28 mA at Zero (clean water) and 18.96 mA at Full scale.

Gain correction =  $(20 - 4) / (18.96 - 3.28)$

= 16 / 15.68

= 1.0204

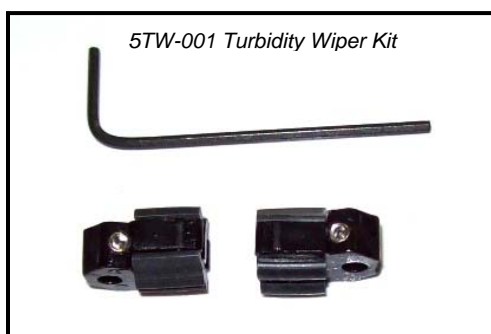
Offset correction =  $4 - (3.28 \times 1.0204)$

= 0.653

### 3.2.2 Wiper Replacement

The effectiveness of the wiper in maintaining a clean optical surface will eventually be compromised, the time being dependent on the water under investigation and the number of wiping cycles carried out. We recommend periodic inspection of the wiper pad to determine if the material is deteriorating or is impregnated with material from bio-fouling.

The wiper is a consumable item and a spare is provided with each TS1000 sensor along with a hex key to loosen and fasten the wiper set screw. Wiper packs containing two wipers and a hex key are available as a standard accessory. The Greenspan part number is 5TW-001 (pictured below left)



To change the wiper, loosen the set screw in the wiper arm until the wiper assembly can be removed from the wiping shaft. Place a new wiper assembly on the shaft with the set screw aligned squarely with the flat on the wiping shaft. Gently press the wiper arm down until the wiper arm hits the stop on the shaft. The wiper pad should now be compressed to roughly one half its original thickness. Tighten the set screw - do not over tighten.

**NOTE:** It is imperative that the set screw be fastened squarely aligned onto the flat on the shaft otherwise proper operation will be affected.

**CAUTION:** Do not over tighten the set screw or manually attempt to rotate the wiper arm once set onto the shaft. Any attempt to manually rotate the wiper may cause gearbox damage and void the warranty.

## **3.3 Installation**

### **3.3.1 Field Deployment Considerations**

The sensor head should always be completely submerged and positioned such that the possibility of air bubbles becoming entrapped on the sensor face is minimised. Bubbles may cause errors if trapped. For applications in harsh environments it is recommended that the optional Acetal casing be specified.

The sensor head should be periodically inspected for fouling, and can be cleaned with fresh water and damp cloth. In marine environments crustaceans may need removal at regular intervals.

The body should always be fully immersed under the water to ensure the electronic module is at water temperature and to avoid any possible anodic/cathodic action taking place on the stainless body due to the oxygen difference across the boundary.

Care should be taken if clamps are to be attached to the Stainless Steel body as the depletion of oxygen to the clamp/probe interface can cause corrosion due to anodic/cathodic action. It is recommended that Acetal body sensors be used if clamping.

Sensors should generally be installed such that they can be easily and safely removed for cleaning, servicing, replacement of the wiper etc. For environmental applications the sensor can often be mounted inside a section of PVC or steel pipe which enters the water body. The sensor can then be slid down inside the pipe until the sensor head just protrudes into the water body. This provides a high degree of protection for the sensor from environmental (sunlight, heat, flood debris etc) as well as from other influences such as Cattle, vandalism etc. Most sediment transport occurs during storm events and flood conditions. Protection from floating debris damage is an important consideration along with adequate tethering of sensors.

Another widespread application of the sensors is to hang the sensors in the water body from a fixed structure or a floating buoy or pontoon. Generally in lakes or estuary applications the sensor can hang on its own cable, and easily retrieved for routine servicing.

### **3.3.2 Wiper control**

The TS1000 wiper is activated by connecting the wiper control wire to ground. This is usually done by connecting the wiper control wire to a switching device e.g. Relay or FET. The switching device can be controlled by the datalogger or SCADA system. The recommended time to connect the wiper control to ground is between 50 – 450 mS.

### **3.3.3 How often should the wiper be activated?**

The frequency of wiping will depend on the environmental conditions where the sensor is installed. Waters with high biological activity or high suspended organic or inorganic materials will require more frequent wiping to keep the optics clean. However, excessive wiping will increase power consumption and wear of the wiper.

### **3.3.4 Cabling Considerations**

Care should be taken with installation and field servicing to ensure the cable is not subjected to persistent pulling snagging or severe compression. Cyclic loading of the cable should also be avoided through careful sensor deployment. Additional stilling wells or mounting brackets may be required to prevent sensor movement which may cause long term cable movement. Where cable runs are required which may be subject to environmental effects (heat, water movement, sunlight, flood debris etc) it is advisable to protect the sensor cable inside a slightly larger diameter conduit such as PVC, steel or polyethylene. This also allows the sensor cable to be pulled out – should a sensor change-over be required at the site. Maximum cable runs up to several hundred meters are possible without affecting electrical signals. The maximum cable length is dependant on the capability of the com port of the computer. Most computers should be capable of driving a 150 to 200m cable length.

### **3.3.5 Typical Sensor Installations**

1. Edge of river/stream/lake embankment.
2. Side of boat/vessel.
3. Mounted within a stilling well off stream from main flow.
4. Mounted within drainage channels/pipes.
5. Suspended from dam walls or floating pontoon.
6. Sensor anchored to bed of lake/stream.

### **3.3.6 Field Installation must ensure:**

- The sensor is anchored or held in position or located so it is not subject to any movement during normal operations.
- Sensor is protected from direct sunlight to avoid high temperature fluctuations
- Sensor is protected against high turbulence and possible debris loading during flow events

### **3.3.7 Other Considerations**

Environmental compatibility should be checked before using the sensors and advice sought from Greenspan if any doubt exists. The sensor utilises some 316 stainless components that are suitable in a majority of situations but care should be taken against possible corrosion in high Chloride, Sulphate or Ferric solutions. The body should always be totally immersed under the water to ensure that the sensor is at water temperature and to also avoid any possible anodic/cathodic action taking place on the components at the water-air interface. If using clamps to mount the sensor – these should be of a type that evenly clamps the sensor body without excessive loading that could damage the sensor body.

### **3.3.8 Guidelines for cleaning equipment**

The sensor may be cleaned using a soft cloth, mild detergents and warm water. If the sensor shows signs of marine growth a light biocide can be used to clean and kill any biological growth on the sensor.

## 4 Appendix A -Additional Information

### 4.1 Specifications

Measurement Technique	90° Infra-red (ISO7027)
Standard EC ranges available (factory set)	100NTU, 400NTU and 1000NTU
Resolution	0.1 NTU 0.2 NTU 0.3 NTU
Linearity	+/- 1% +/- 1% +/- 3%
Sensor Outputs	Internal data logger- serial output via software Optional adaptor provides SDI12 output (3 Wire)
Calibration Standard	APS AEPA polymer solutions 0, 100NTU, 400NTU, 1000NTU
Cable Type	Polyurethane sheathed cable, OD 8mm with 3mm vent tube, moulded entry
Cable Lengths	10, 20, 30, 50, 100, 150m (32, 65, 100, 165, 325, 490 FT)
Power Supply	8-30Vdc (at sensor)
Power ESD Protection	2000 volts
Current Consumption	Sensor 15-40mA while operating Plus extra 30-35mA while wiping
Sensor warm up time	10 seconds
Wiper arrangement	Disposable foam pad on PVC arm. Field replaceable
Wiper Control	Pull control wire to GND momentarily Pulse time required >50ms, and <4 sec
Wiper Time	6 seconds (1 revolution)
Operating Temperature	0-50°C
Depth rating (water column)	100m
Storage Temperature	-5°C - +60°C
Weight	500g plus cable weight (665g per 10m length)
Dimensions (L x OD)	322.90mm x 47mm (16.46" x 1.85")
Wetted Materials	UPVC, acetal, 316 passivated stainless steel, polyurethane, viton

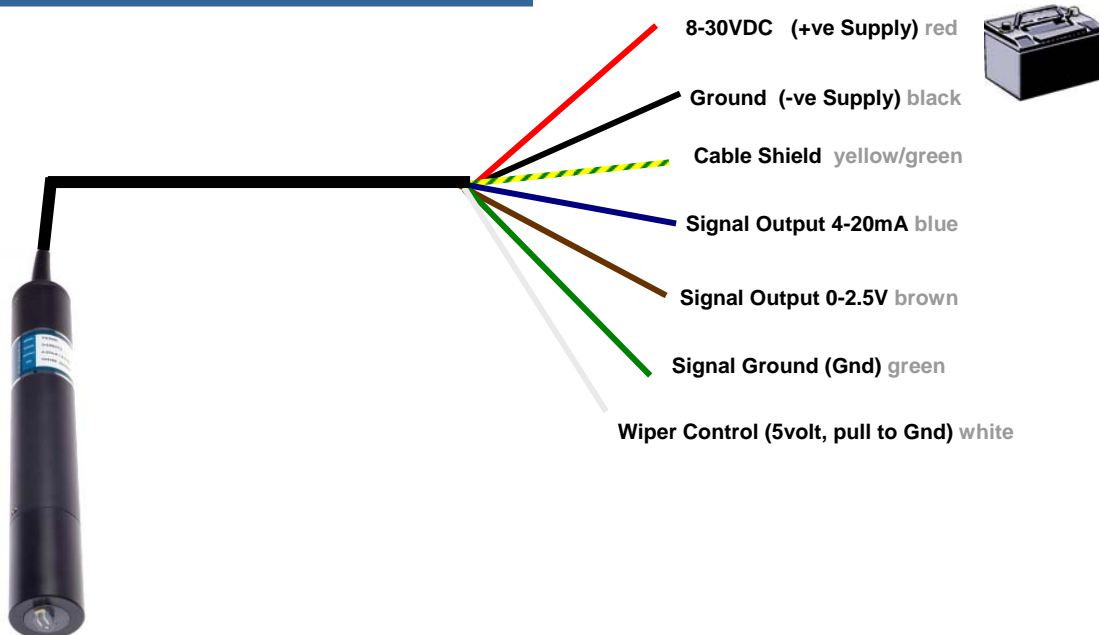


## 4.2 Quick Start Guide – TS1000 Turbidity Sensor

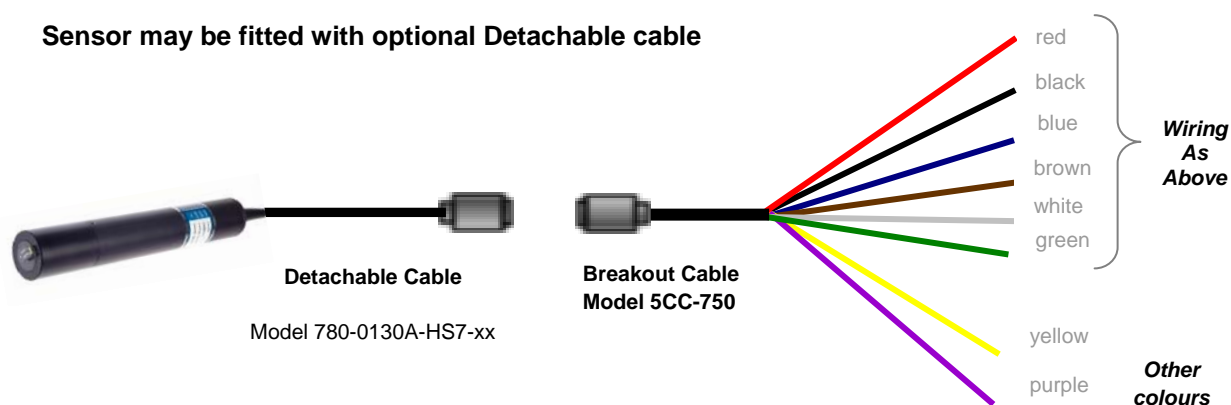
Procedures for connecting and configuring the Greenspan TS1000 Sensor.  
Further details in the Sensor Manual included on the Greenspan CD.

### You should have received:

- Certificate of Conformance Sheet
- Greenspan TS1000 Sensor
- Cable Options per order



### Sensor may be fitted with optional Detachable cable



TS1000 provides 2 x calibrated analogue outputs 4-20mA and 0-2.5V over the Sensor Full Scale range. (e.g. 0-100NTU) Sensor requires a nominal 12V DC power supply, but will operate from 8-30V DC

## 4.3 Certificate of Conformance



### TS1000 Turbidity Sensor

# CERTIFICATE of CONFORMANCE

Customer: "Click here & type Customer name"  
Model No. TS1000 Turbidity Sensor (Tyco Environmental Systems material # 700-4000)  
Sales Order Reference: "Click here & type SO Reference"  
Serial Number: "Click here & type S/N"

#### Product Information



TS1000 Turbidity Sensor

<b>Range</b>		0 – "Type Range here" NTU	
<b>Output</b>	Current & Voltage	FS 20.00mA or 2.5V	
		Zero 4.00mA or 0V	
<b>Linearity</b>		See note 5	
<b>Zero Reading</b>		0 V or 4 mA	
<b>Full Scale Reading</b>		2.5 V or 20 mA	
<b>Cable Length</b>		"Click here & type Cable length" M	
<b>Supply Voltage</b>		8 - 30 VDC	
<b>Connection</b>		<b>0-2.5V output</b>	Brown
		<b>+8 to 30Vdc Power</b>	Red
		<b>Signal Ground</b>	Green
		<b>Cable Shield</b>	Green/Yellow
		<b>Wiper</b>	White
		<b>4-20mA NTU Output</b>	Blue
		<b>-Power</b>	Black
<b>Connection Code</b>		Bare Wire	

#### User Notes

1. The sensor is protected against reverse polarity.
2. If the sensor is dismantled Greenspan accepts no responsibility for any damage that may occur. Contact your agent for technical advice.
3. Do not use Methylated Spirits or Alcohol on the lens when cleaning.
4. The calibration of this sensor is verified against N.I.S.T Traceable AMCO Clear® Copolymer Suspension solutions.
5. +/- 1% for 100 & 400 NTU Ranges; +/- 3% for 1000NTU Range
6. Maximum submersible pressure 100m H<sub>2</sub>O

Inspected By: \_\_\_\_\_ 19 November, 2009

Manufactured By:  
Tyco Environmental Systems (Greenspan Analytical Plant)  
22 Palmerin Street  
WARWICK QLD 4370  
AUSTRALIA Phone: + 61 (0)7 46601888



## 4.4 Engineering Note – Detachable Cables

### ENGINEERING NOTE

RELEASE DATE: 28/4/2008

SUBJECT: Connecting and Disconnecting the Detachable Cable for Greenspan Sensors (packaged in 47mm & 65mm Tubes)

#### IMPORTANT NOTE:

You have been supplied with:

2 x O-Rings (Greenspan part number 011-OR16X2.5)

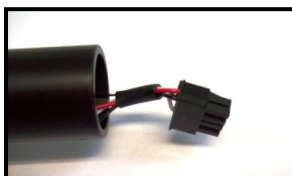
2 x Grub Screws (Greenspan part number 512-M4X6SS316P)

1 x Allen Key

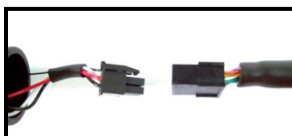
**Prior to connecting your sensors to the detachable cable, please ensure that the detachable cable entry has been fitted with O-Rings supplied as detailed above. Ensure O-Ring grooves are greased and then slide O-Rings and fit into the recessed grooves.**



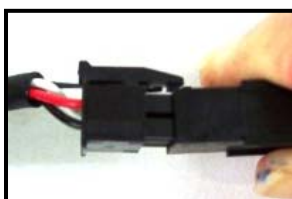
Refer to the following instructions for **connecting** to your sensor to the detachable cable



1. The sensor connector is exposed and ready to connect to the cable connector.



2. Align the cable connector with the sensor connector and push together. The connector is polarized and will only fit together one way.



3. Once connectors are completely pushed together, the rocker arm on the sensor connector will clip in with the cable connector and secure the connection.



4. Carefully feed the connection back into the sensor tube taking caution not to crimp or damage any wiring. Ensure the O-Rings have been fitted to the moulded cable entry as directed at the beginning of this document



5. Twist carefully to align the grub screw holes. Firmly push the tube back onto the moulded cable entry



7. Screw in two (2) 512-M4X6SS316P grub screws to secure the cable and the sensor with supplied Allen key



8. The cable is now securely fitted to the sensor.

Refer to the following instructions for **disconnecting** your sensor to the detachable cable



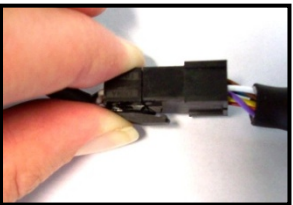
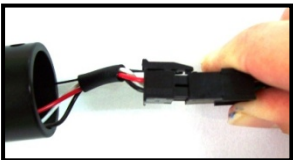
1. Sensor with cable attached and ready for cable disconnection.



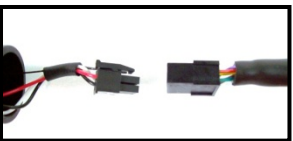
2. Remove the two (2) grub screws (Greenspan part #512-M4X6SS316P) using the Allen key supplied. (N.B Allen key is supplied in spare parts kit with original packaging)



3. CAREFULLY pull tube away from cable mould. Once the tube has been pulled away from cable mould, the connector will be revealed as pictured left.



4. Release locking device on the connector by gently pinching rocker arm on the cable connector and pull apart.



5. The sensor and cable are now detached.

**Note:** When the cable is not connected to a sensor, please ensure the supplied vent cap is fitted to the vent tube (if applicable)