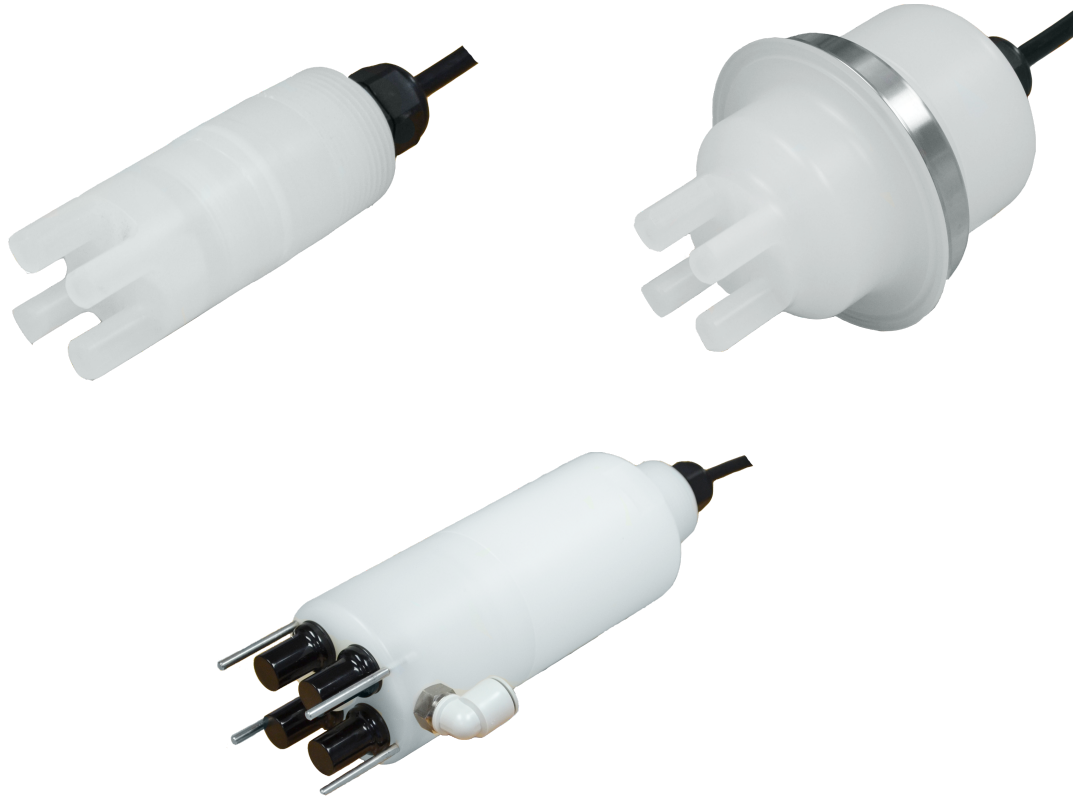
QUADBEAM
TECHNOLOGIES

NEXT LEVEL EFFICIENCY

S Series Suspended Solids Sensors and T Series Turbidity Sensor Installation Guidelines



Contents

Intended Use, Warranty Information, Disclaimer 2

Technologies commonly used in Suspended Solids and Turbidity Sensors 3

Sensor Types 4

Sensor Installation 6
- Hygienic Pipe Installation 6
- Immersion Style 6
- Things that can affect the output of the sensor 6
- Keep a Clear Zone 6

- Things that will reflect or absorb light 7

Pipe Installation 8

Drain Installation 10

Vertical Mount 11

Horizontal Mount 12

Tank Installation 13

Manifold Installation 13

Calibration 14
- Relative measurement 14
- MXD70 Manuals 14
- Relative Measurement - Probe Signal 14
- Calibration Standards 14

Simple Calibrations 15
- Refining 15
- Better Calibration 15

Best Calibration Method for Tight Control Applications 16

Input Filter 17

CIP 17

Appendix A 18

Intended Use

Responsibility for use of the Quadbeam Technologies sensors with regards suitability for application, intended use, resistance of the sensor components against degradation in the environment used is solely with the operator of the sensor.

The manufacturer is not liable for any damages resulting from the use of the sensor beyond the cost of the sensor.

The intended use of the Quadbeam Technologies Suspended Solids Sensors and Turbidity sensors is the continuous monitoring of Suspended Solids concentration in *an industrial, storm water, raw water or waste water installation.*

Product Warranty

The Suspended Solids and Turbidity Sensors have a warranty against defects in materials and workmanship for one year from the date of shipment. During this period Quadbeam Technologies will, at its own discretion, either repair or replace products that prove to be defective.

Limitation of Warranty

No warranty of fitness for a particular purpose is offered. The user assumes the entire risk of using the product. Warranty does not cover damage caused by accidental misuse, abuse, neglect, misapplication or modification. Any liability of Quadbeam Technologies Ltd is limited exclusively to the replacement of defective materials or workmanship.

Disclaimer

Quadbeam Technologies Ltd reserves the right to make changes to this guide or the instrument without notice, as part of our policy of continued developments and improvements.

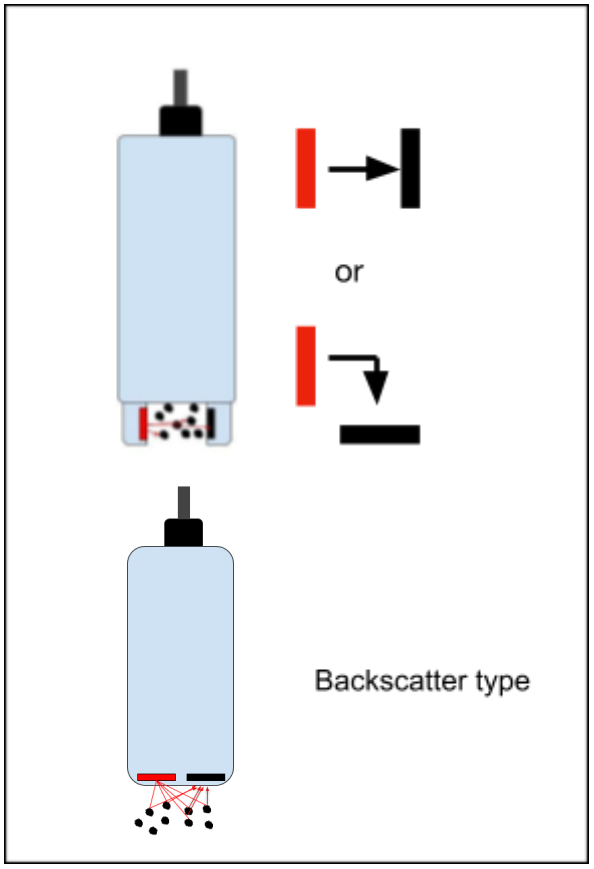
All care has been taken to ensure accuracy of the information contained in this manual. However, we cannot accept responsibility for any errors or damages resulting from errors or inaccuracies of information herein.

Technologies commonly used in Suspended Solids and Turbidity Sensors

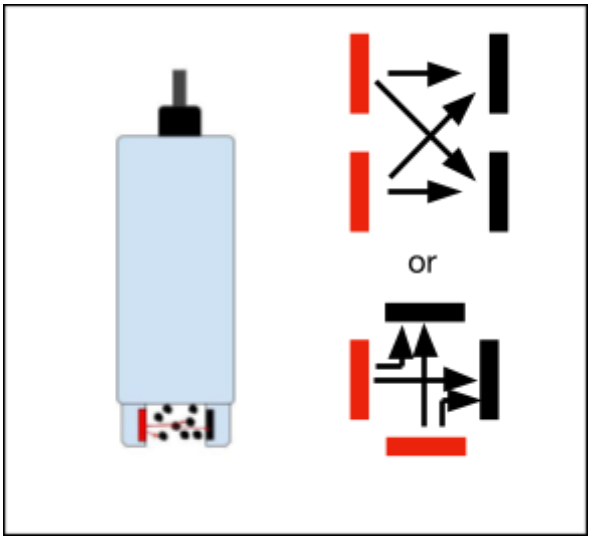
Quadbeam uses the four beam alternating light ratio-metric system of measurement for its sensors.

Suspended Solids Sensors and Turbidity Sensors measure the change in light intensity to produce a relative measure of the solids or turbidity concentration in the liquid being monitored. Most commonly sold suspended solids sensors and turbidity meters use only a single beam of light. When a single beam of light is used the intensity of the light can be influenced by not only the solids particles suspended in the liquid, but also any solids/contamination that are stuck to the surface of the sensor and variability of the light source and photo diode as they age. Therefore it is critical to keep single beam sensors very clean to get accurate readings.

Multi-beam sensors like the Quadbeam, measure across multiple light paths. This allows them to use mathematical algorithms where the change in ratio of intensity of light is measured. This system automatically compensates for contamination stuck to the surface of the sensor and variation of the light components in the sensor. For this reason it is common for multi beam sensors to be used in Process Control installations where a repeatable output is very important.



Common Single Beam Configurations. Signal drifts as sensor ages or gets contaminated



Multi-Beam Configurations. Algorithm compensates for contamination and ageing giving very repeatable signal.

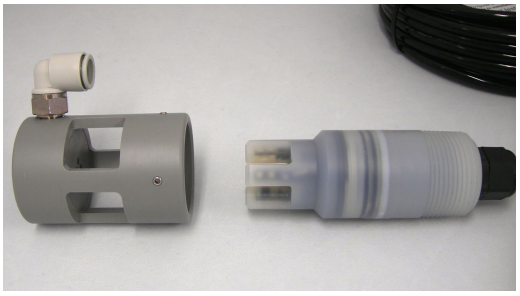
SENSOR TYPES

S10-IMM		Single piece polymer body 0 to 25g/L in normal activated sludge Operating temp 0 to 85°C
S20-IMM		Single piece polymer body 0 to 10g/L in normal activated sludge Operating temp 0 to 85°C
S40-IMM		Single piece polymer body 0 to 2.5g/L in normal activated sludge Operating temp 0 to 85°C
S10-2HY		Single piece polymer front section 2” Tri-clamp fitting 0 to 40% milk fat Operating temp 0 to 85°C
S10-3HY		Single piece polymer front section 3” Tri-clamp fitting 0 to 40% milk fat Operating temp 0 to 85°C
S20-3HY		Single piece polymer front section 3” Tri-clamp fitting 0 to 20% milk fat Operating temp 0 to 85°C
S40-3HY		Single piece polymer front section 3” Tri-clamp fitting 0 to 1.5% milk fat Operating temp 0 to 85°C
S10HT-3HY		Single piece polymer front section Hygienic Style Body with 3” Triclover fitting Operating temp 0 to 105°C
S20HT-3HY		Single piece polymer front section Hygienic Style Body with 3” Triclover fitting Operating temp 0 to 85°C

S20-VN		Hygienic Style Body to fit Type N Varinline® access unit
S40-VN		Hygienic Style Body to fit Type N Varinline® access unit
T30-IMM		Measuring range 0 to 50 through to 0 to 1000 FNU / FTU / NTU (depending on media and particle characteristics) Built-in cleaner Stainless Steel support rods
T30-3HY		Measuring range 0 to 50 through to 0 to 1000 FNU / FTU / NTU (depending on media and particle characteristics)

Cleaner option

Because of the use of the four beam principle the sensors will continue to give accurate outputs while light can pass between the fingers. If there is too much contamination it can be removed using our air-jet cleaner.



SENSOR INSTALLATION

Hygienic Pipe Installation

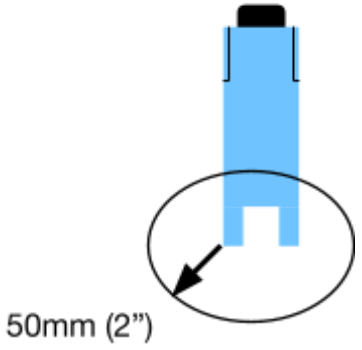
Quadbeam Hygienic sensors come in HY and VN configurations.
All 3HY sensors fit the standard 3” Tri-Clamp fitting.
The S10-2HY fits a standard 2” Tri-Clamp fitting.
The VN sensors fit the GEA Varinline® Type N access unit.

Immersion Style

The sensors work by measuring the change in light intensity. Therefore anything that can reflect, deflect or absorb the light will affect the output of the sensor.

Keep a Clear Zone

To reduce the chance of reflection off walls of flumes, tanks, channels, sumps etc, it is recommended where possible to have a “Keep Clear” zone from all objects of at least 50mm (2”)



Ensure that the sensor is fixed in place. The thread at the back of the immersion-style sensor is 1 1/4 “ NPT and will fit many standard 32mm plastic fittings.

Things that can change the reflected or absorbed light, and therefore affect the output of the sensor include:

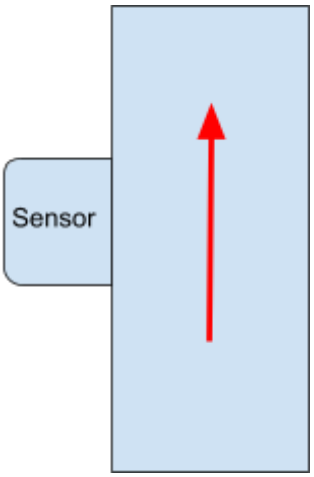
- Suspended solids
- Some background chemicals (copper)
- Air bubbles
- low level balance tanks
- Centrifugal pumps
- Bends, valves and other instruments that could engender entrained air.
- Aeration sparge pipes.
- Liquid inflows into sumps and drains
- Pressure drop
- Light
- Pipe walls
- Different materials have different reaction to 880 NIR, e.g. protein and fat
- Temperature on material NIR absorption
- Particle size, colour and shape

PIPE INSTALLATION

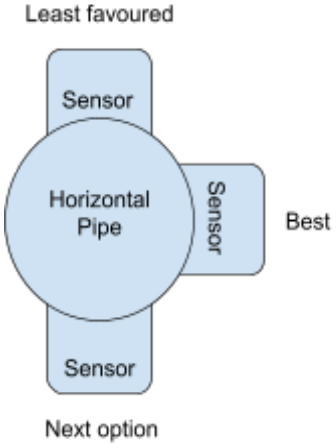
1. The minimum pipe diameter for S10-2HY is 50mm (2”). For S10-3HY, S20-3HY and S40-3HY and T30-3HY is 75mm (3”). For best results for S40-3HY and T30-3HY we recommend 100mm (4”).

2. The sensor should be mounted in a straight pipe where there are 10 pipe diameters upstream and 5 pipe diameters downstream that are free from valves and bends.

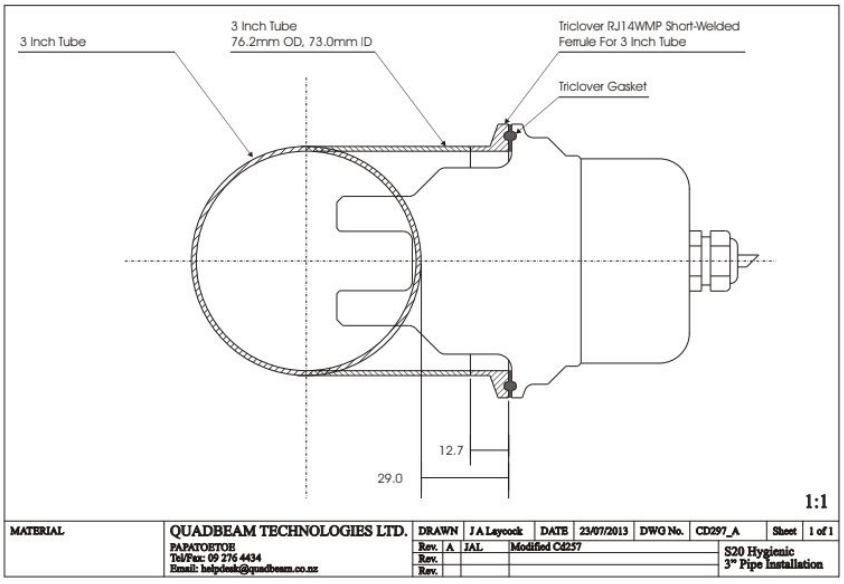
3. It is preferable that the sensor is installed at a vertical pipe where the flow is upwards. This ensures that the pipe is always full. A downwards flow is not recommended as the fluid could have some turbulence which could result in an unstable reading.
   If there is a bend within 10 pipe diameters place the sensor on the side of the pipe closest to the inside of the bend.



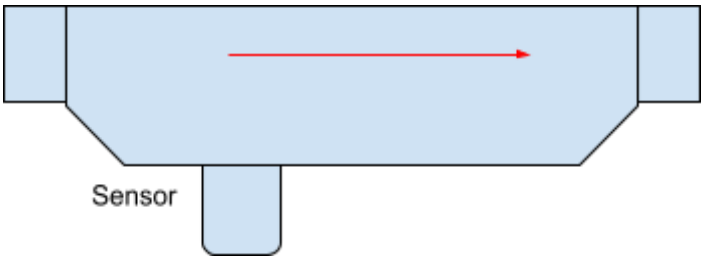
4. If only a horizontal pipe is available the sensor should be installed in the horizontal plane ± 45°. Avoid placing the sensor at the top of the pipe as the pipe may not always be full or there could be an accumulation of bubbles. The bottom is avoided as it could have a higher than normal concentration of solids.



For sensor installation drawings, as below, contact your Quadbeam Technologies Distributor.

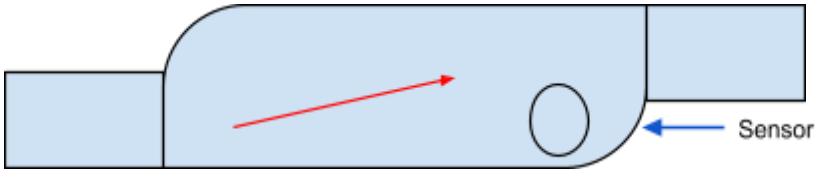


5. In installations where there is a very high chance of entrained air, for example CIP monitoring and control applications, the best position is in fact at the bottom of a horizontal pipe. For added protection against the chance of entrained air, expand pipe eccentrically keeping the top of the pipe inline and the eccentric expansion at the lower section of the pipe.
Increasing the pipe diameter effectively slows the flow encouraging the bubbles to the top of the pipe.



Possible CIP monitoring option when a large amount of entrained air is present.

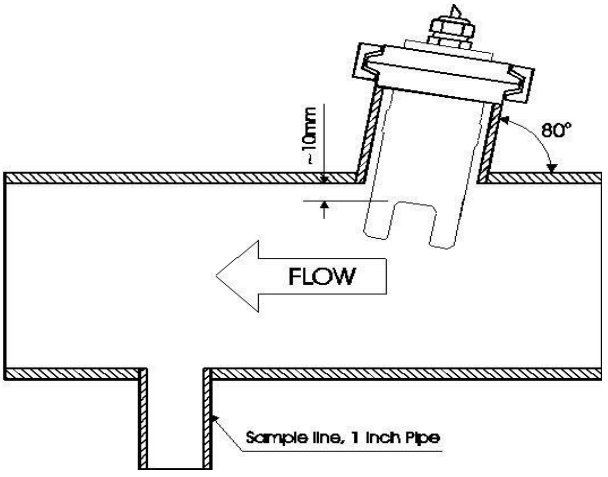
COW Water solids monitoring applications are tricky as the concentration of solids is very low and entrained air can be present. If the pipe is vertical increasing the diameter can help reduce the potential for entrained air being detected.
If there is only a horizontal option eccentric expansion has proven to give good results with the feed being lower than the outflow and the sensor positioned away from the feed.



A COW monitoring option when horizontal pipe the only option

6. For applications where solids will have a propensity to stick, to assist in sensor cleaning by the flow of the solution, the sensor can be mounted at an 80° angle to the pipe as shown in the diagram below.

7. A sample line should be added after the sensor as shown. It should not be at the same point as the sensor or immediately before it.



Sensor mounting at an angle to assist cleaning, with a sample line.

For Immersion sensors the pipe neck is terminated with a flange. A mating flange with a 1¼ inch hole should be used to hold the sensor. This installation should not be used in hygienic applications.

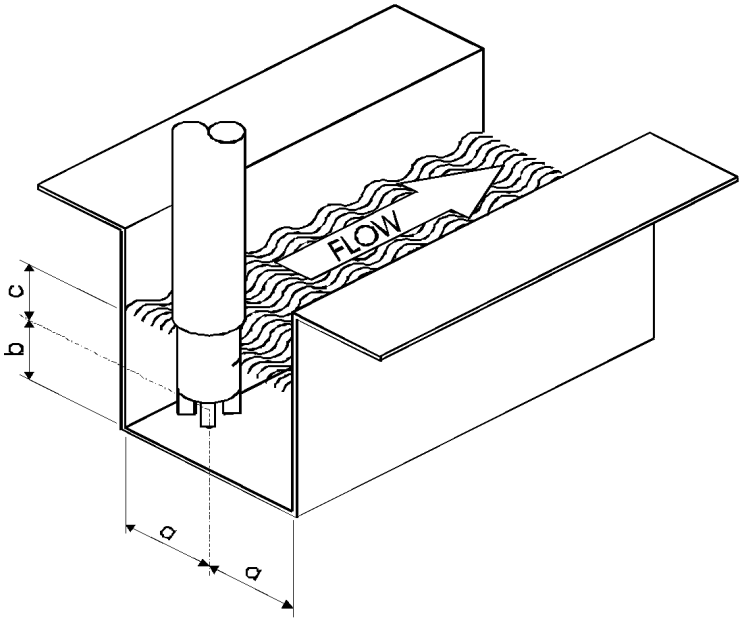
DRAIN INSTALLATION

There are two main issues to consider for drain installations. First is to make sure that the drain is always full such that the front part of the sensors - the fingers - are always immersed in the solution. Failure to do so could result in unpredictable readings.The second issue is the variability of ambient light. Ideally the ambient light should be kept constant in order to avoid variations in reading between day and night.
Foaming or large amounts of bubbles from turbulence can have an impact on readings. Work to position the sensor in a position with the lowest possibility of foam or bubbles.
If the drain or flume is open to the atmosphere, protection from sunlight will reduce the chance of abnormal readings produced by scattered or direct sunlight.

VERTICAL MOUNT

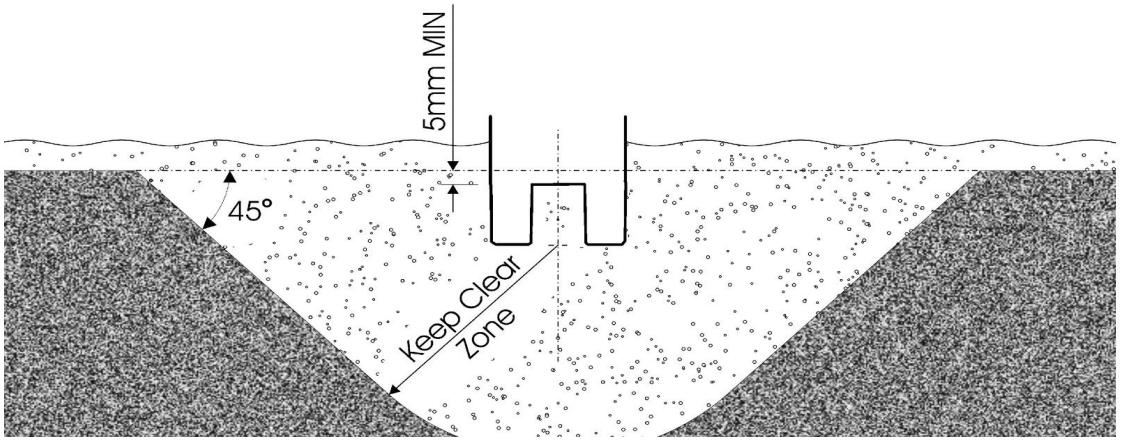
The vertical mount is most common as it can be implemented in shallow channels. Horizontal mount is used in covered drains where it is not possible to implement a vertical mount. An Immersion style sensor should be used for drain installations.

In this setup, a pipe is attached to the 1 ¾ inch thread at the back of the sensor. This pipe is then fixed to the drain by pipe clamps. For T30 sensors, which have a bigger body than the S series sensors, the pipe clamps could be mounted directly on to the sensor. Care must be taken to avoid over-tightening the clamps and possibly damaging the sensor.



Vertical Mount Installation

For S series sensors, if the flow in the channel is not deep enough, a longitudinal hole can be created to ensure that the sensor fingers are continuously immersed, with the recommended clear zone.



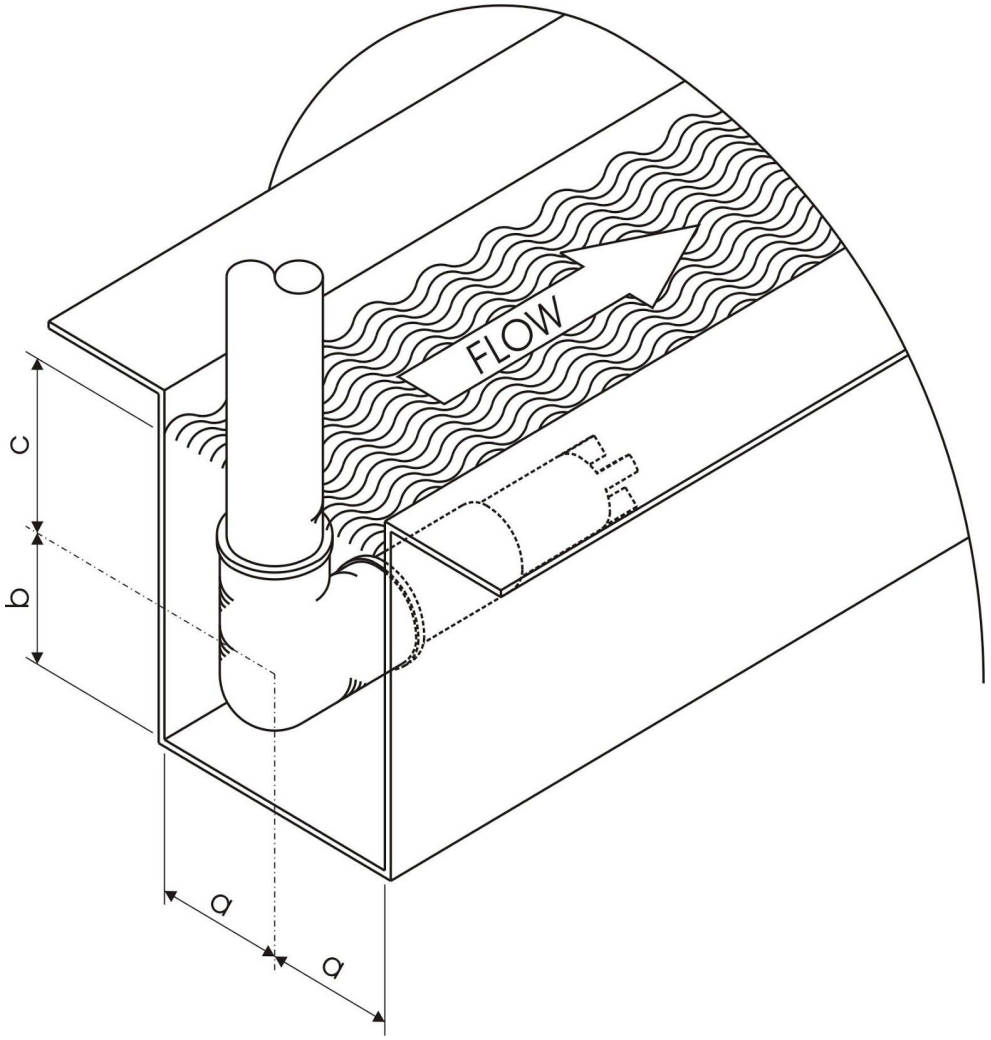
HORIZONTAL MOUNT

In some cases, it is not possible to do a vertical mount, for example in covered drains. In these situations the sensor can be mounted horizontally along the flow. It should be mounted using the 1¼ Inch thread with a short pipe that connects to an elbow typically having a 90° angle. The other end of the elbow connects to a longer pipe which is mounted with pipe clamps.

Dimensions “a” and “b” should be 50mm (2”) for S-Series sensors, and 75mm (3”) for T-Series sensors to conform to the “Keep Clear” zone. Dimension “c” should be at least 50mm (4”) for both series.

In this setup, the minimum channel depth is 150mm (6”) for S-Series sensors and 175mm (7”) for T-Series sensors.

The sensor should be installed such that the two IR transmitters (black looking) are at the bottom facing upwards and the two IR receivers at the top facing downwards. This minimizes the effect from ambient light changes. The front of the sensor should be facing downstream.

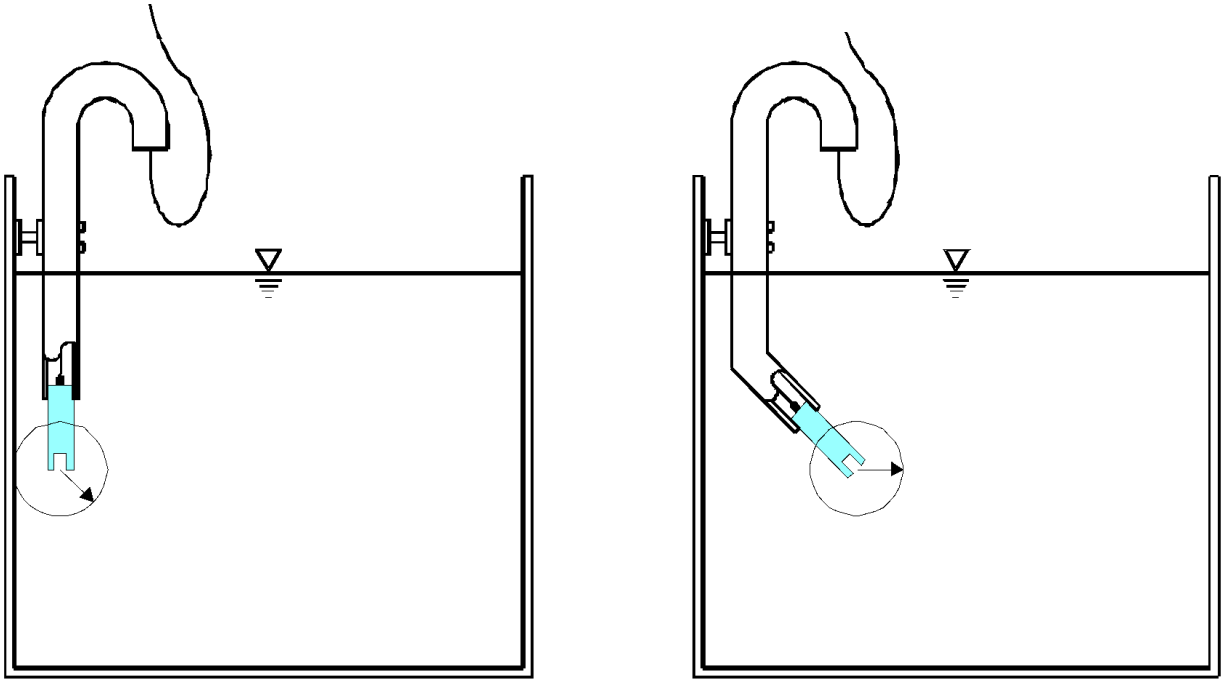


TANK INSTALLATION

This installation is done with an immersion style sensor. The thread at the back of the sensor is used to mount the sensor at the end of a pipe. This pipe is fixed to the side of the tank wall as shown. The Clear Zone must be maintained by ensuring that the clamps at the wall push the sensor far enough away from the wall. It is recommended that the sensor is installed approximately half way down the tank. If the tank is shallow, it is preferable that the sensor is closer to the bottom rather than the top, to avoid the effect of ambient light changes.

It is also recommended to install an elbow in the pipe as shown, to push the sensor away from the wall and closer to the centre of the tank.

If the tank or sump is open to the atmosphere, protection from sunlight will reduce the chance of abnormal readings produced by scattered or direct sunlight.



MANIFOLD INSTALLATION

In Dairy Loss Monitoring installations where there are multiple points of measure, for example Conductivity, pH and Temperature as well as Suspended Solids or Turbidity it can be advantageous to run the monitored fluid through an instrument manifold.

CALIBRATION

Relative measurement

Because of the use of the four beam ratio-metric principle Quadbeam sensors have a very repeatable output. With this self compensating technology, quite simply, the more care taken in setting the sensors up the more accurate the output will be.

In the Linearisation process, the raw data PS (probe signal) value is related to concentrations of suspended solids in the solution being used for calibration.

MXD70 Manuals

For comprehensive instructions of the MXD73 and MXD75 transmitters see MXD70 Manuals available on the USB card supplied with the transmitters or in the Downloads section of the Quadbeam Technologies website.

Relative Measurement - Probe Signal (PS)

PS Number - a binary number generated by the Input card that has an "Engineering" Value applied to it in the Transmitter "lineariser"

The sensors are analogue or have an analogue component which means each sensor/input card combination will be a little different.
The PS is the result of the four beam ratio-metric output therefore is the repeatable part of the process
The output is only as good as the quality of the standard of calibration and installation.

- The "Calibration" process is to tie the PS value to an "Engineering" Value.
- The Engineering Value can be one of %, mg/l, g/l, ppm, ppt, NTU, FTU and PS.
- Once the relationship between the PS and "Engineering" value is established, setting up of front screen information, analogue output, relay alarms and fine tuning can be done.

Calibration Standards.

The sensors measure the intensity of NIR light emitted across the sensor light paths. Different materials absorb or scatter NIR light in different ways. For best results, where possible, use the actual process fluid and solids being measured as standards to setup the linearisation of the sensors.

It is not uncommon for pre-prepared solutions to be used, for example NTU solutions or varying concentrations of SiO2 in water. These work very well as repeatable standards, but the questions need to be asked - are they directly relevant to what is being measured and are they understood by operators?

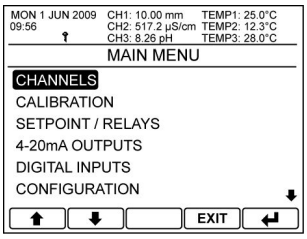
It is possible to have up to 10 points in a calibration curve. Some materials have a linear response to 880 NIR for example NTU Solutions and SiO2. Some materials have a non-linear response, for example Milk Fat. In applications like milk fat we recommend at least 5 points on the curve.

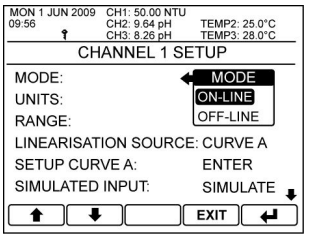
Where relatively tight control is required we recommend clustering the calibration points around the control range.

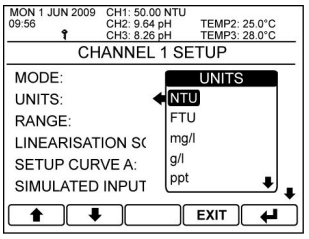
Simple Calibration

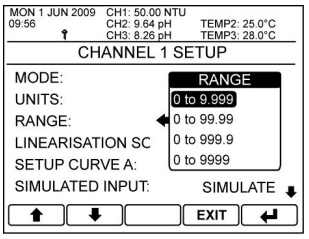
Prepare samples

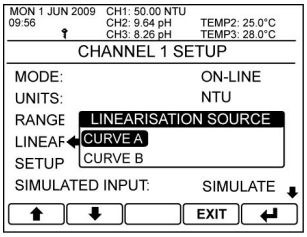
Work through the following menu steps;





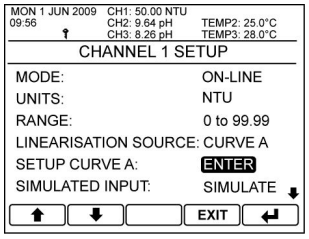


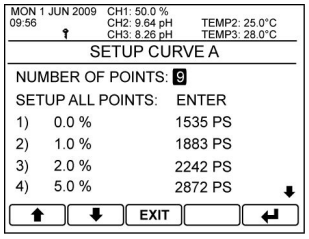


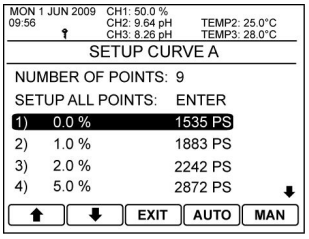


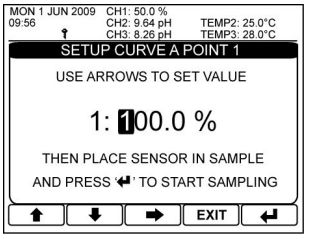
For comprehensive setup details see QB MXD70 Suspended Solids Input Manual

When ready for actual curve setup place in opaque cups ensuring the bottom of the sensor fingers are at least 20mm from the bottom of the cup and the sensor is centralised. Complete the following steps.









Repeat for each point.

Refining

Because of the variance between inline and calibration cups it is possible to do a fine adjustment once installed.

Once installed, take a grab sample at the same time as reading the sensor output.

Analyse the sample in the lab.

If required to bring into line with the lab, move the zero point of offset by working through the Calibration menu accessed from the main menu.

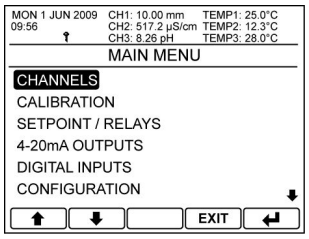
Better Calibration Method

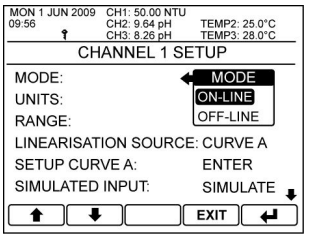
To help eliminate variability in the setup build a set of calibration vessels as close as practical to the actual pipe work.

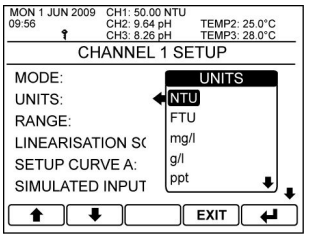
Work through the same steps as above.

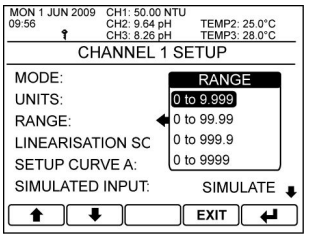
Best Calibration Method for tight control applications

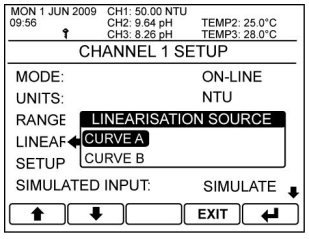
For applications involving tight control, for example fat standardising or yogurt concentration control, install the sensor with a sample port as soon after the sensor as practical.











For comprehensive setup details see QB MXD70 Suspended Solids Input Manual

During operation take a sample, at the same time note down the PS value showing on the MXD transmitter.

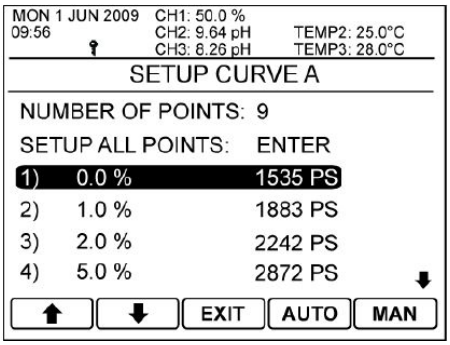
Vary the operation to change the solids concentration, again take a sample and record the PS value.

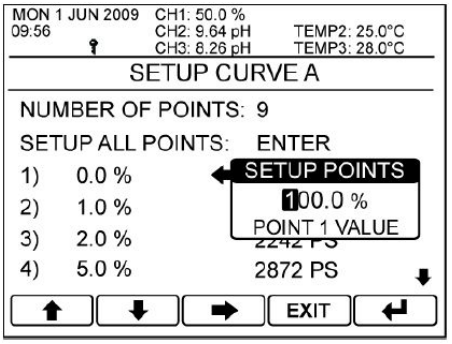
Repeat at least 5 times with varying solids concentrations.

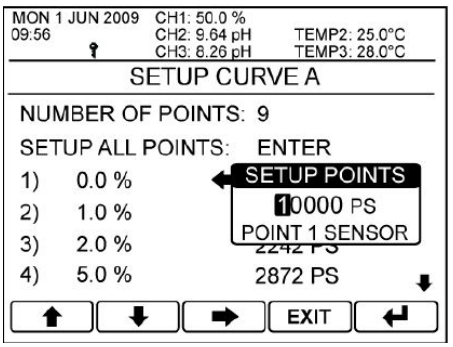
Have the lab analyse the samples and provide the solids concentration. It is often useful to have the lab run “same sample” tests to ensure lab repeatable testing.

When the solids concentration is established from the lab, go back to the MXD transmitter and manually input the Concentration values against the PS values recorded at time of sample extraction.

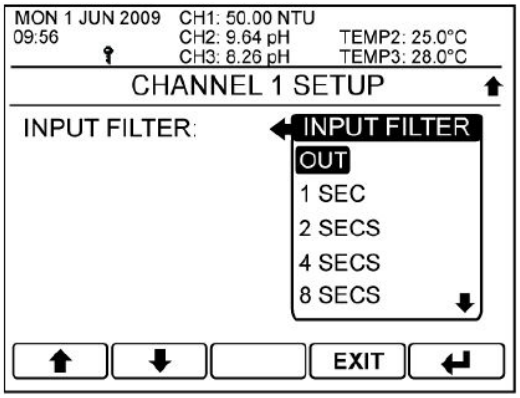
Please note that higher concentration samples should have a higher PS value than lower concentration samples.



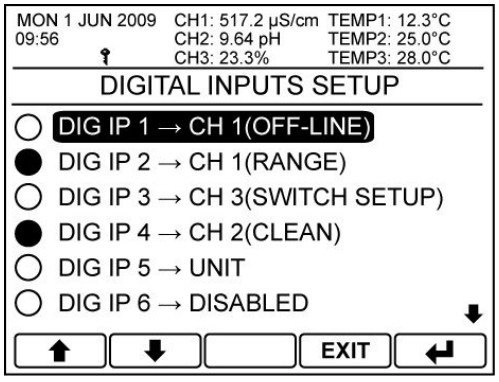


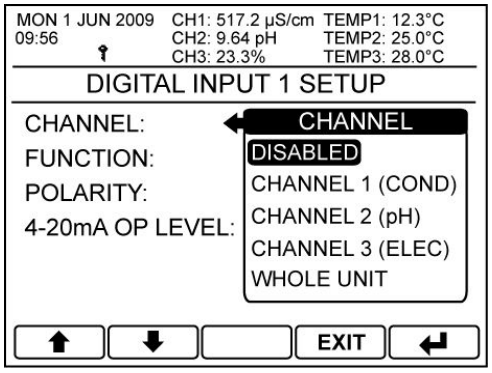


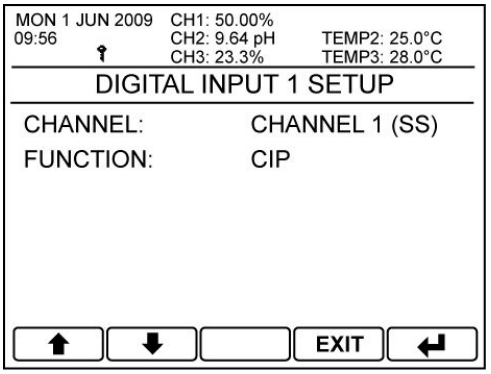
Input Filter
With installations where the data is changing rapidly it can help to add an input filter.



CIP
If not using the sensor for measuring the hot processes during CIP, the life of the sensor can be extended by activating CIP mode. This will turn off the sensor head.







APPENDIX A

Setting up Multiple Curves that can be switched remotely

Operation overview

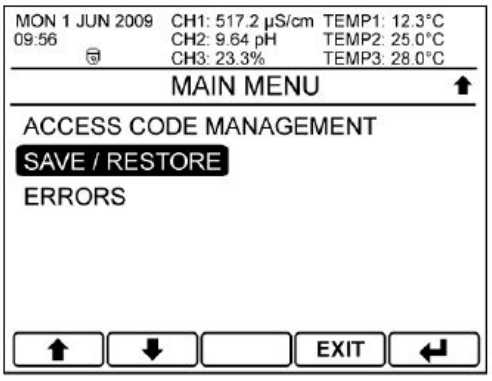
After setting up the three curves, saving two of them to separate stores and assigning two digital inputs to those stores you will be able to switch between them.
With no digital inputs you will be in a neutral position so the active curve will operate.
Activate Digital input assigned to store A will switch setup to store A
Activate Digital input assigned to store B will switch setup to store B
You always have to go back to neutral before switching from A to B.

Setting Up Curves

Curve Set Up A

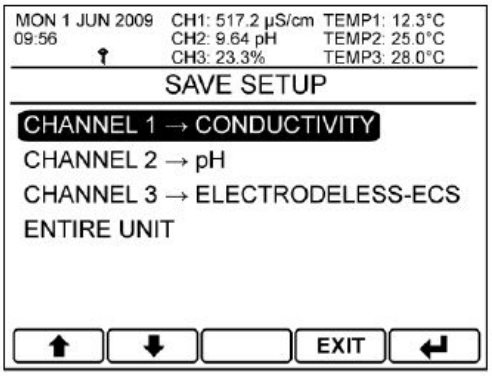
Setup the Channel, Curve and Outputs in the normal way.

From the main menu go to SAVE/RESTORE

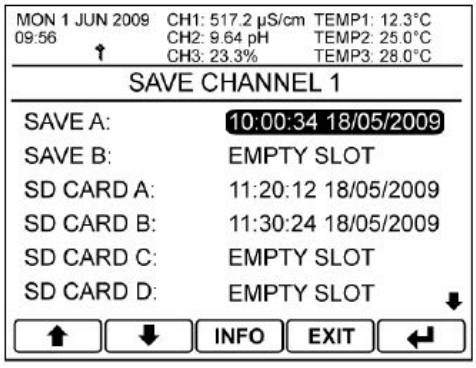


SAVE SETUP

Select the channel you have just set the curve for.



SAVE A



Curve Set Up B

Repeat the process for Channel, Curve and Output Set Up B
This time saving in SAVE B

Curve Set Up Neutral

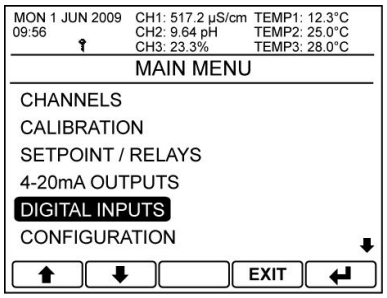
For your third curve, setup the curve and Output in the normal way. Do not save.

For security you can backup the whole unit to an SD Card.

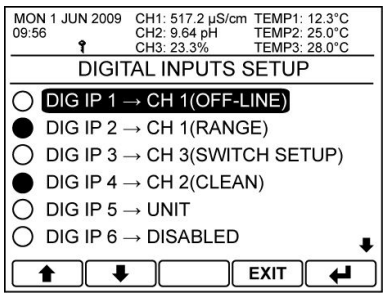
Setting up Digital Inputs

For Curve A

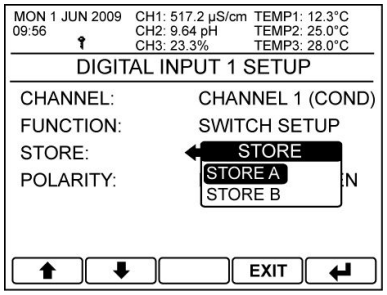
From the main menu go to digital inputs



Select the input



Select the channel
Set function to Switch Channel
Set Store to Store A



For Curve B
Repeat process this time for Digital input 2 and Store B.

For Curve Neutral - no digital input activated

Setup the curve in the normal way, do not save.

Activation
Connect Digital Inputs

To select Curve A, activate Digital Input 1
To select Curve B, activate Digital Input 2
To select Curve Neutral - do not activate Digital Input 1 or 2.