

Hydro-Probe Orbiter User Guide

For model ORB1 – static mounting

This guide is for model ORB1 with standard sensor cable

FOR STATIC MOUNTING IN ROTATING PAN MIXERS OR ON CONVEYOR BELT
APPLICATIONS

Typical applications:

D type Eirich, Croker or Turmac mixers

Conveyor belts and material in free flow

To re-order quote part number: HD0215

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ERRORS IN DOCUMENTATION

The product described in this documentation is subject to continuous development and improvement. All information of a technical nature and particulars of the product and its use including the information and particulars contained in this documentation are given by Hydronix in good faith.

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ACKNOWLEDGEMENTS

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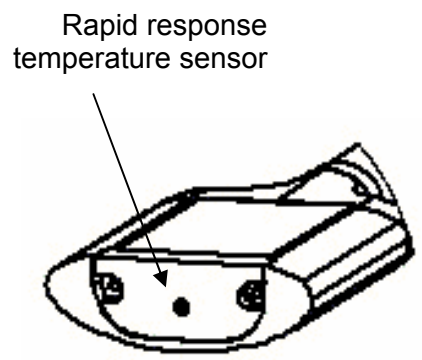
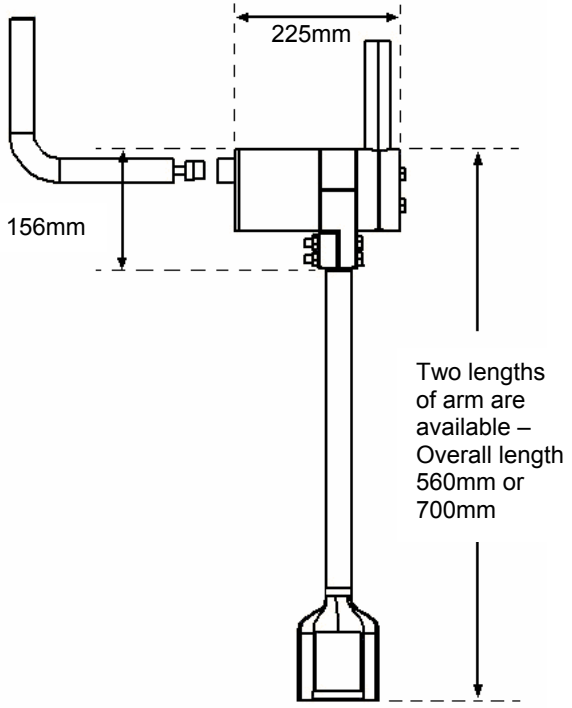
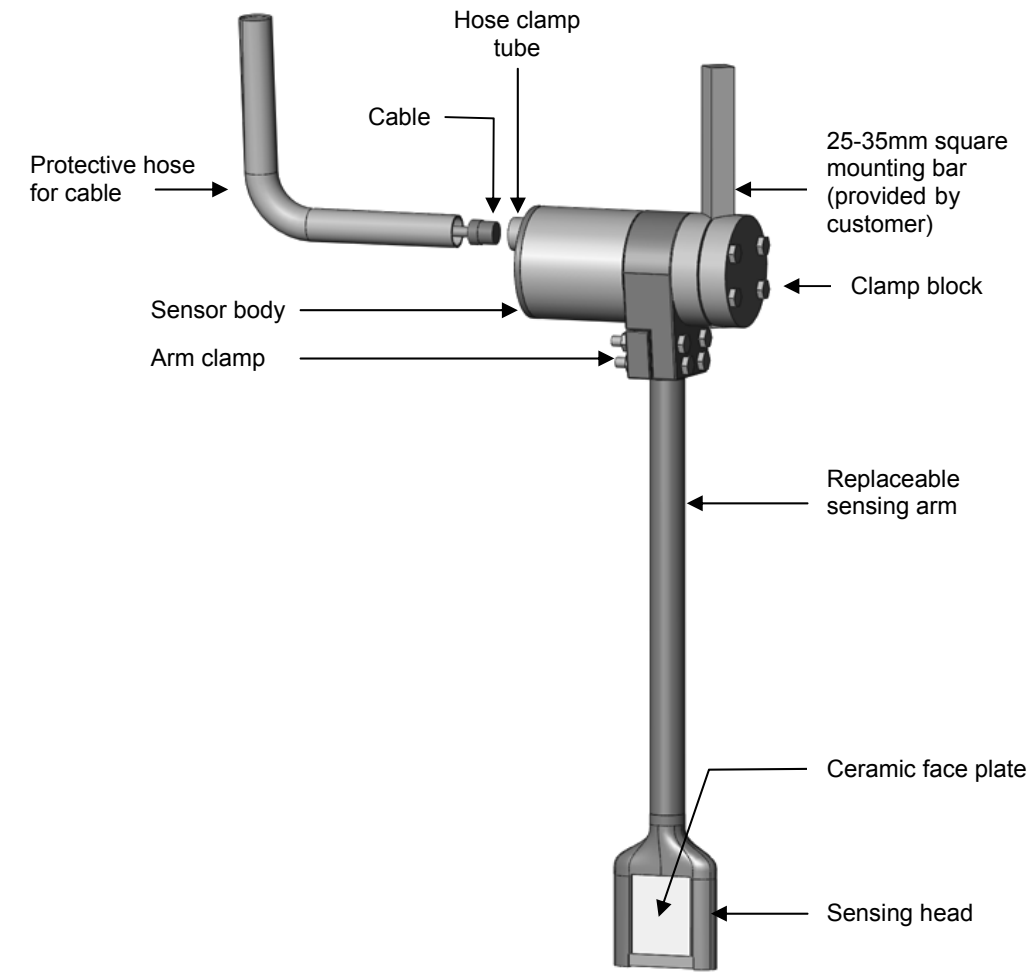


Figure 1 - The Hydro-Probe Orbiter

1 Introduction

1.1 Applications

The Hydro-Probe Orbiter may be used for three different types of application:

- Type 1:** For **static** mounting of the Hydro-Probe Orbiter sensor (ORB1) in **rotating** mixers or for conveyor belts or material in free fall applications
- Type 2:** For a **rotating** mounting in **static** pan mixers, using a rotating connector for connecting the cable to the Hydro-Probe Orbiter
- Type 3:** Also, for a rotating mounting using a battery-powered sensor (ORB1MB) with radio modem communication. This is for applications where it is not possible to electrically connect the sensor to the outside of the mixer via a rotating connector.

This manual is written for **Application Type 1**:

FOR THE STATIC MOUNTING OF THE HYDRO-PROBE ORBITER IN ROTATING PAN MIXER OR CONVEYOR BELT APPLICATIONS USING THE STANDARD SENSOR CABLE (PART NO 0090A)

1.2 Typical Mixers

D type Eirich, Croker and Turmac mixers

1.3 Description

The Hydro-Probe Orbiter is the most innovative sensor ever to reach the market. With an easily replaceable sensing head that slices through the mix, the Hydro-Probe Orbiter provides a rapid and representative measurement of both moisture content and temperature of the material. Utilising the latest digital technology, the Hydro-Probe Orbiter combines accuracy and speed to provide a meaningful reading that is unachievable with static mounted sensors.

The main sensor electronics are housed in the sensor body, separate from the hard wearing replaceable sensing arm and head. This provides many distinct advantages with the following key features and benefits:

- Small streamlined sensing head cuts cleanly and smoothly through the material without a build-up, providing a smooth and clean signal.
- Rapid response temperature measurement provided from a thermally 'insulated' temperature sensor in sensing head end plate.
- Easily replaceable sensing arm and hardened wear head, with easy calibration procedure for matching new microwave sensing head and arm to main electronics.

1.4 Measuring techniques

The Hydro-Probe Orbiter uses the very latest digital microwave techniques that provide a more sensitive measurement compared with other analogue techniques. The frequency has been selected to provide the optimum compromise between penetration of measurement and accuracy. The penetration of measurement is approximately 100mm in dry materials such as sand.

The output is linear for most materials with the ability to measure up to the point of saturation for the material concerned.

1.5 Sensor configuration

As with other Hydronix digital microwave sensors, the Hydro-Probe Orbiter may be remotely configured using the Hydro-Link or Hydro-Com diagnostics software.

1.6 Sensing arms

The Hydro-Probe Orbiter is available in various lengths. Standard lengths are 560mm or 700mm, note that this length refers to the overall height of the Hydro-Probe Orbiter, as shown in Figure 1. **Other lengths can be made to order.**

An additional feature with the longer (700mm) sensing arm is a reinforcing collar that fits over the top of the arm, see Figure 2. This is included to increase the strength of the arm.

CAUTION – NEVER HIT THE SENSING ARM

2 Installation process for mixers

The Hydro-Probe Orbiter may be clamped to a vertically or horizontally mounted 25-35mm square bar. The bar should be supplied and suitably mounted by the customer or agent installing the sensor.

The installation involves the following processes:

- Assembly of sensing arm and body (Section: 2.1)
- Selecting the best position for mounting the sensor (Section: 2.2)
- Fitting of the square mounting bar (Section: 2.3)
- Mounting the sensor and final adjustments when running (Section: 2.4)
- Cabling to the sensor (Chapter 3)

2.1 Assembly of sensing arm and body

The sensing arm and electronics body are shipped unattached. They need to be connected before installation into the mixer.

- Lay the main electronics body on a clean, flat surface
- Loosen the 4 arm clamp bolts on the electronics body and remove the locking bolt (A).
- Fit the two 'O' rings. These need to be located inside the clamp blocks up against the step as shown in Figure 2
- Ensure that the red mark on the electrical connector at the top of the sensing arm is on the same side of the arm as the ceramic faceplate. The connector can easily be rotated by hand if required.

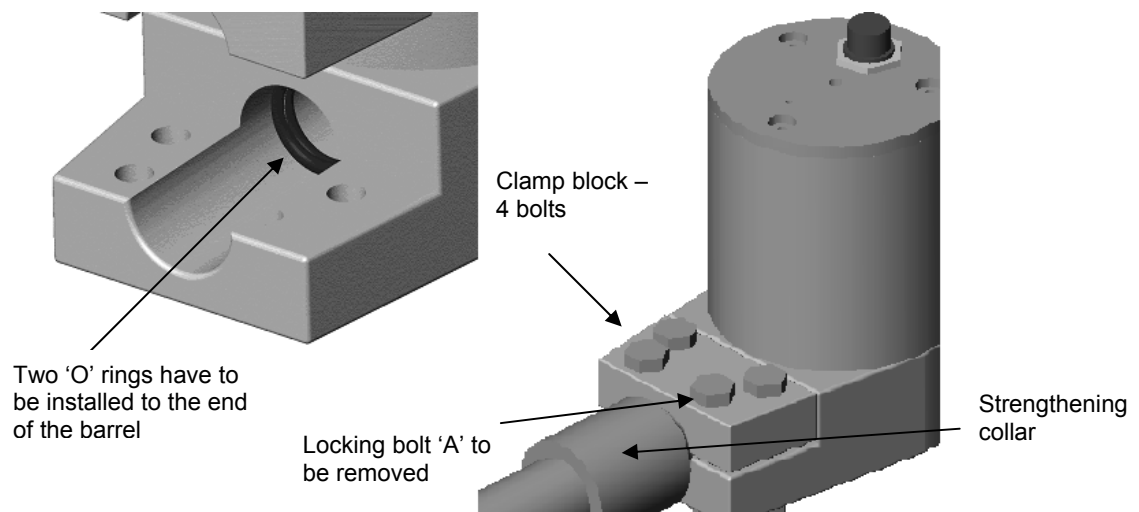


Figure 2 - Installation of sensing arm into sensor body

- Lay the sensing arm on the same clean, flat surface with the ceramic faceplate facing upwards, aligned with the hole in the head unit.
- For ease of fitting, apply a small amount of silicone grease to the connector end of the arm or around the two 'O' rings.
- Gently locate the connector at the top of the sensing arm in the hole in the head unit, such that the connector lines up with its socket in the head unit. Push the sensing head home into the main body unit.
- Tighten the arm clamp nuts up to a point where it is still possible to rotate the arm by hand – these are not fully tightened until the sensing head has been aligned at the correct angle after the Hydro-Probe Orbiter has been installed in the mixer.
- If the arm is a replacement then a recalibration procedure will need to be carried out. See section 8.2 - Calibrating the new arm to the sensor electronics

2.2 Selecting the best position for mounting sensor

Depending on the mixer type, the sensor may need to be fitted either inside (Figure 4), or above the mixer (Figure 3).

A square support bar needs to be fitted securely and rigidly to a cross member or the static side wall of the mixer to provide solid support for the Hydro-Probe Orbiter.

A protective 'roof' may be provided over the sensor body to protect the sensor from falling materials and prevent unnecessary build up of materials on the sensor body (Figure 5).

The sensing head is to be positioned in an area where the flow of material is the smoothest. Normally this is a quarter or a third of the distance in from the outer edge of the mixer wall. (Figure 9).

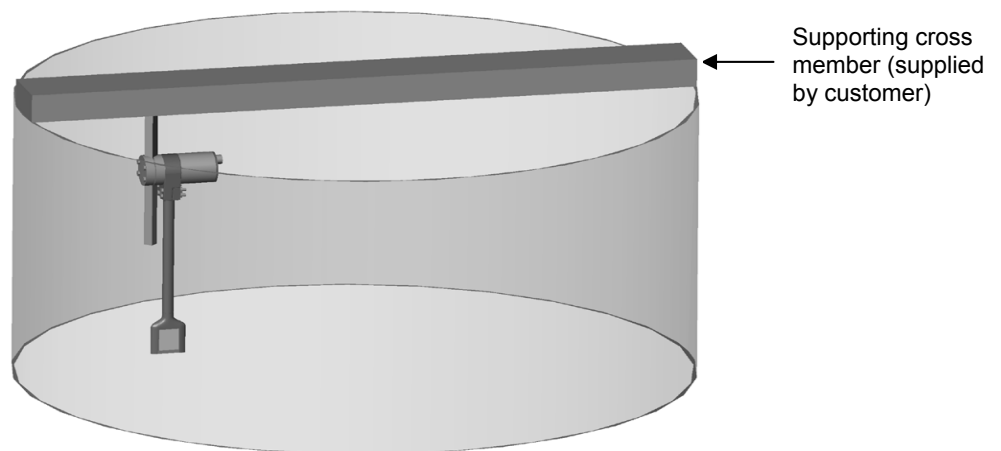


Figure 3 - Sensor mounted above the mixer on cross-beam

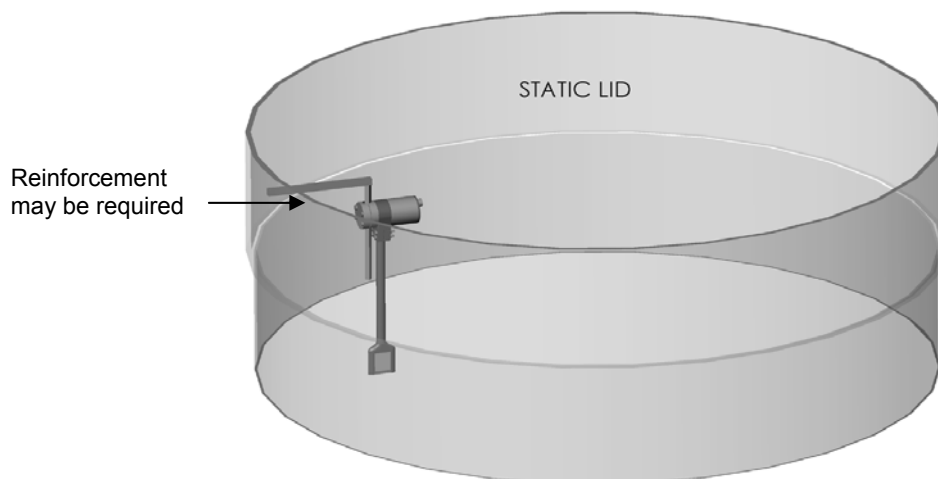


Figure 4 - Sensor mounted inside the mixer



Figure 5 - Protective 'roof' placed over the sensor body

2.3 Fitting the square mounting bar

A 25-35mm square bar should be very firmly welded to the appropriate cross member, or static side wall of the mixer. It should be suitably reinforced to provide a rigid fixing that will withstand the thrust generated on the sensor head and body from the moving material. Ensure that the bar is perpendicular to the floor in both planes.

Undo and remove the 4 bolts securing the pair of clamp blocks to the head unit (for clamping the unit to the square bar), and remove the pair of clamp blocks as shown in Figure 6. Depending on the configuration, the clamp blocks may need to be rotated for either vertical or horizontal fixing to the square bar.

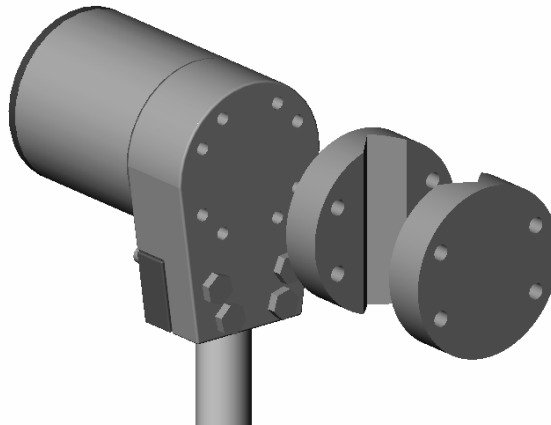


Figure 6 - Removing the mounting bar clamp blocks ready for fitting to the mixer

2.4 Mounting sensor and final adjustments when running

2.4.1 Height adjustment

The height may be adjusted by slackening the clamp blocks and sliding the body up and down the square support bar.

The recommended height for typical applications is 50mm above the floor of the mixer (Figure 7). This height can be set using the angle aligner, which has a width of 50mm.

The correct length of arm should be selected to allow the sensing head to sit a minimum of 50mm above the floor of the mixer and to ensure that the ceramic faceplate is in the full flow of the mix

When adjusted to the desired height, securely tighten the clamp block bolts to a torque of 60Nm (44lb/ft). It is essential to ensure the Nordlock washers are fitted to the clamp bolts so that the sensor is securely retained on the square bar.

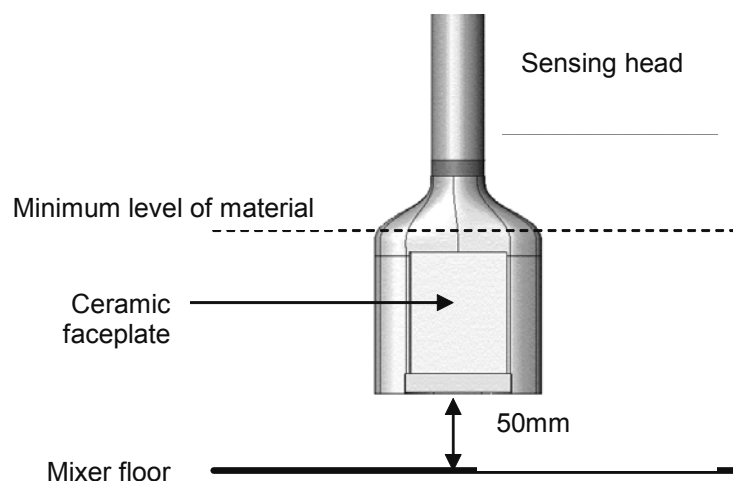


Figure 7 - Height setting of the sensing arm

2.4.2 Sensing head angle adjustment for optimum performance

With the 4 arm clamp nuts loose, the sensing arm can be rotated through an angle of approximately 300° (Figure 8). The sensing arm is fitted with a mechanical stop to protect the internal cables from being over-rotated. If this stop prevents the faceplate from being adjusted properly, then remount the Hydro-Probe Orbiter main body on the square bar at a different angle. This will then allow the arm to be adjusted correctly.

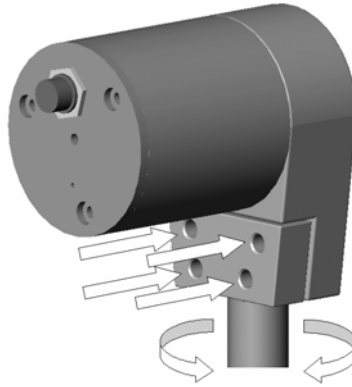


Figure 8 - Adjusting the sensing head angle

The angle of the sensing head face should be adjusted to provide consistent compaction of material against the ceramic measuring face and at an angle that avoids build up of material on the sensing head.

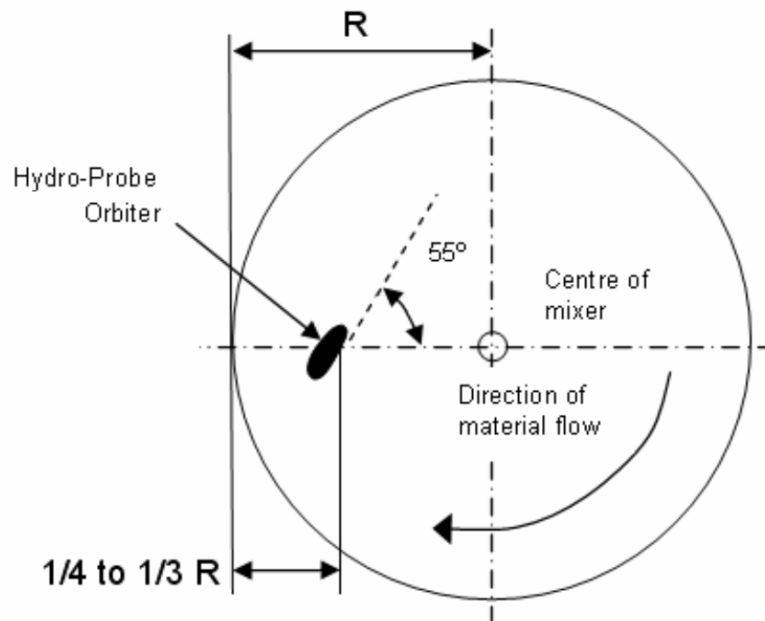


Figure 9 - Setting the sensor angle for optimum performance

- An angle of 55° generally provides good results. Use the angle aligner provided to set the angle (Figure 10).
- It has been found in some rotating pan mixers an angle of approximately 65° to the mixer centre is more appropriate to prevent too much build up of material.
- Ensure all clamp bolts are tightened to a torque of 28Nm (21lb/ft) after adjustment.

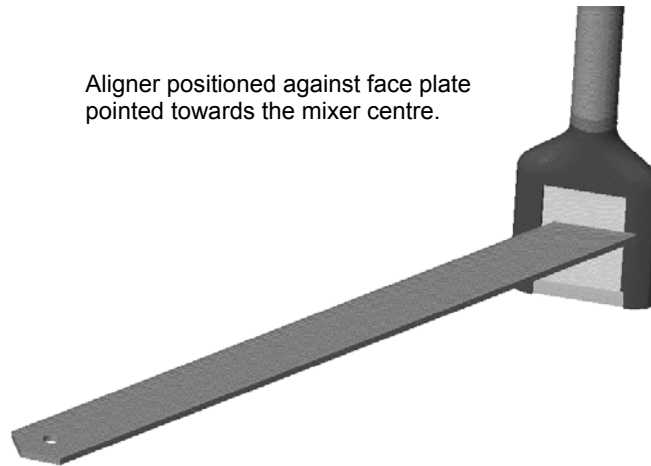


Figure 10 - The Hydronix angle aligner for sensing face alignment

IMPORTANT:

Once the alignment of the sensing arm is changed inside a mixer, the resultant density change of material passing the sensing head will have an effect on the measurement. It is therefore advisable to recalibrate the recipes before continuing batching.

Notes:

3 Cabling to the sensor

The cable to the sensor must be protected from the actions of the mixer and from damage that may be caused by the loading of aggregates into the mixer. It is recommended that the cable be sheathed in a heavy-duty rubber hose that is firmly secured at either end using hose clamps. Securing along the underside of the mixer arm, as shown in Figure 11, will also protect the cable from the incoming load.

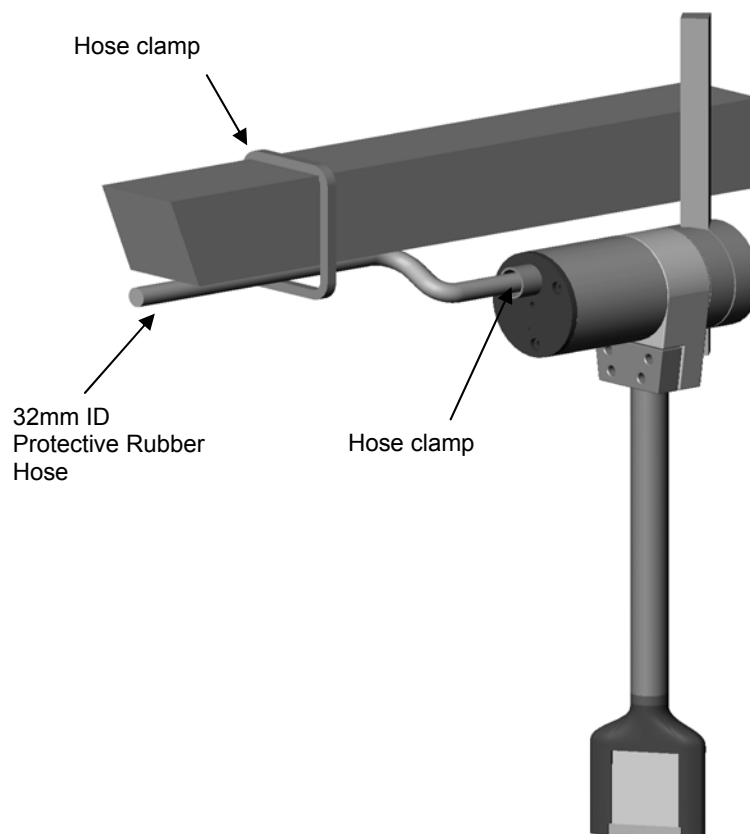


Figure 11 - Cabling to the sensor

Notes:

4 Conveyor belt or free-fall applications

THE HYDRO-PROBE II IS VERY POPULAR IN FREE-FALL AND CONVEYOR BELT APPLICATIONS. IF THE MATERIAL IS VERY ABRASIVE, THEN THE HYDRO-PROBE ORBITER PROVIDES A GOOD ALTERNATIVE.

4.1 *Hydro-Probe Orbiter for conveyor belt applications*

In concept, the sensor may be fitted in a similar manner, with the sensing face angled at approximately 35° to the flow of material or 55° to line perpendicular to the direction of the flow.

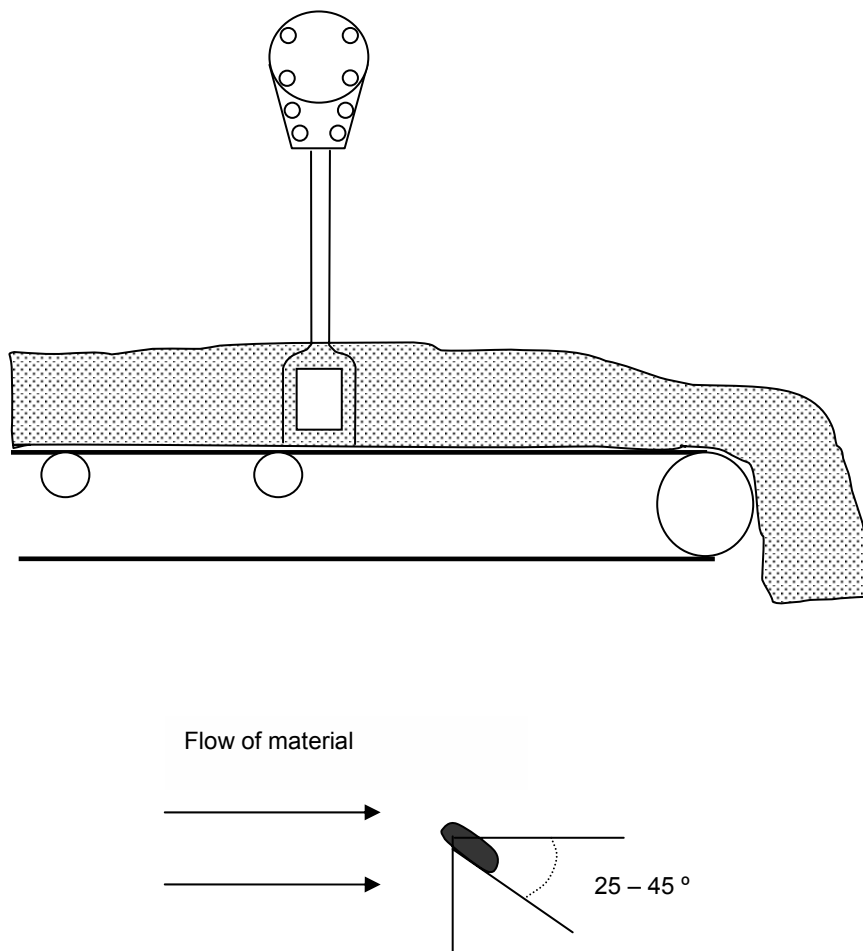


Figure 12 - Mounting the Hydro-Probe Orbiter for conveyor belt applications

4.2 Hydro-Probe Orbiter for free-fall applications

Fitting should be as indicated in the drawings below

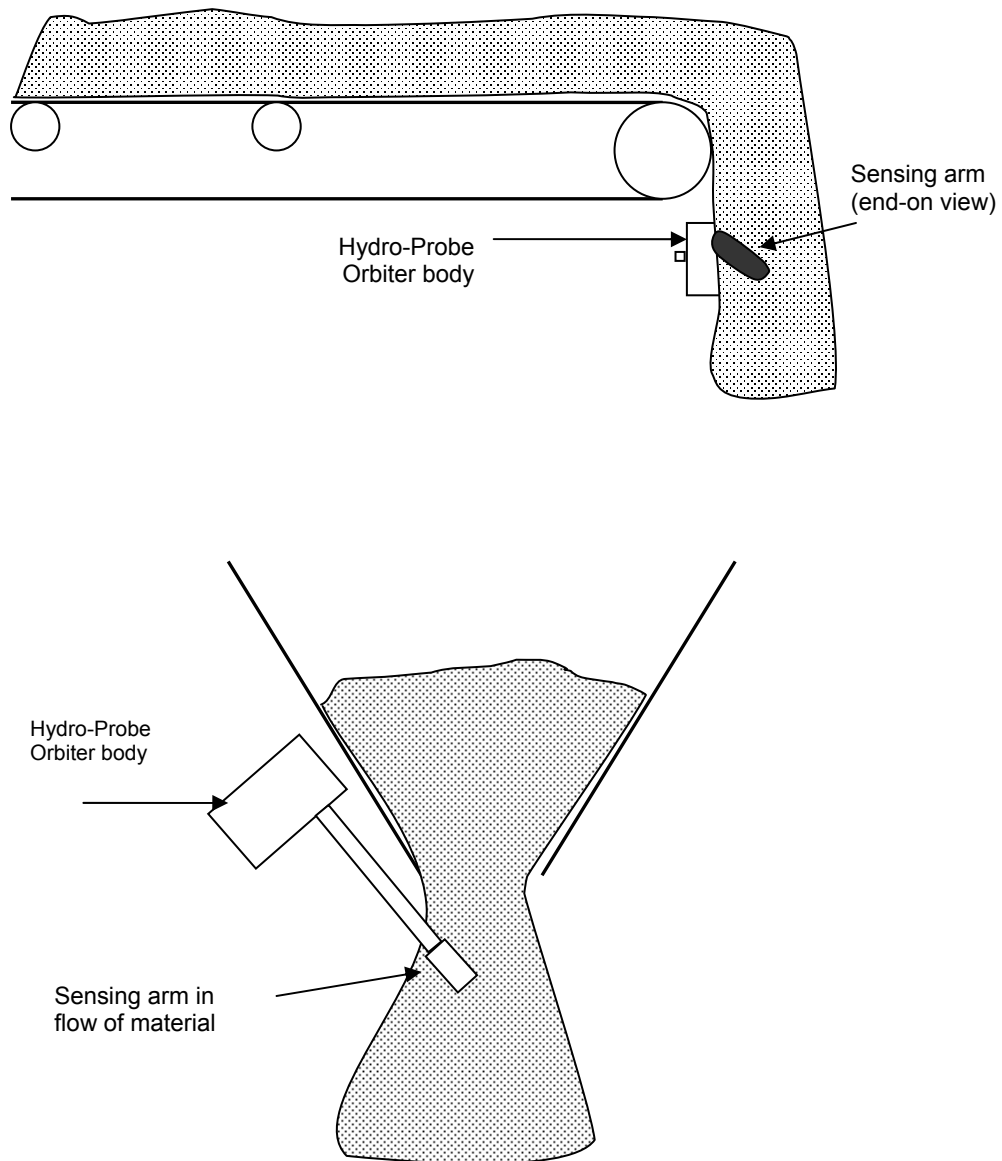


Figure 13 - Mounting the Hydro-Probe Orbiter for free-fall applications (conveyor and silo)

5 Wiring connections

The Hydro-Probe Orbiter is connected using a 4 metre cable (part no 0090A). An extension cable (twisted pairs) from the plant control room should be provided by the customer or agent installing the sensor. Up to 6 twisted pairs may be required dependent on installation requirements. It is recommended that a high quality cable with a good braid and foil screen is used to minimise electrical interference, containing 22 AWG, 0.35mm² conductors. Recommended cable types are Belden 8306 or Alpha 6377. The cable screen must be connected at the sensor end only, and therefore it is essential that the sensor body has a good connection to an electrical earth.

The extension cable run from the sensor to the control unit must be separate from any heavy equipment power cables, particularly the power cable for the mixer. Failure to separate the cable runs can lead to signal interference.

5.1 Analogue output

A DC current source generates an analogue signal proportional to any of a number of selectable parameters (e.g. filtered unscaled, filtered moisture, average moisture, etc. See section 6, or Hydro-Link manual for details). Using Hydro-Link, Hydro-Com or direct computer control the output may be selected to be:

- 4 – 20 mA
- 0 – 20 mA This may be configured as a 0 – 10 V DC voltage output if a 500 ohm resistor is connected across the analogue output and return wires (see Figure 14)

NOTE: If a 0-10V signal is required, connect the resistor at the control room end.

Twisted Pair Number	MIL spec pins	Sensor connections	Cable colour
1	A	+15-30V DC	Red
1	B	0V	Black
2	C	1 st Digital input	Yellow
2	--	-	Black (Cut back)
3	D	1 st Analogue Positive (+)	Blue
3	E	1 st Analogue Return (-)	Black
4	F	RS485 A	White
4	G	RS485 B	Black
5	J	2 nd Digital input	Green
5	--	-	Black (Cut back)
6	D	2 nd Analogue Positive (+)	Brown
6	K	2 nd Analogue Return (-)	Black
	H	Screen	Screen

Table 1 – Sensor cable (0090A) connection
Applies to analogue and multi-drop connections

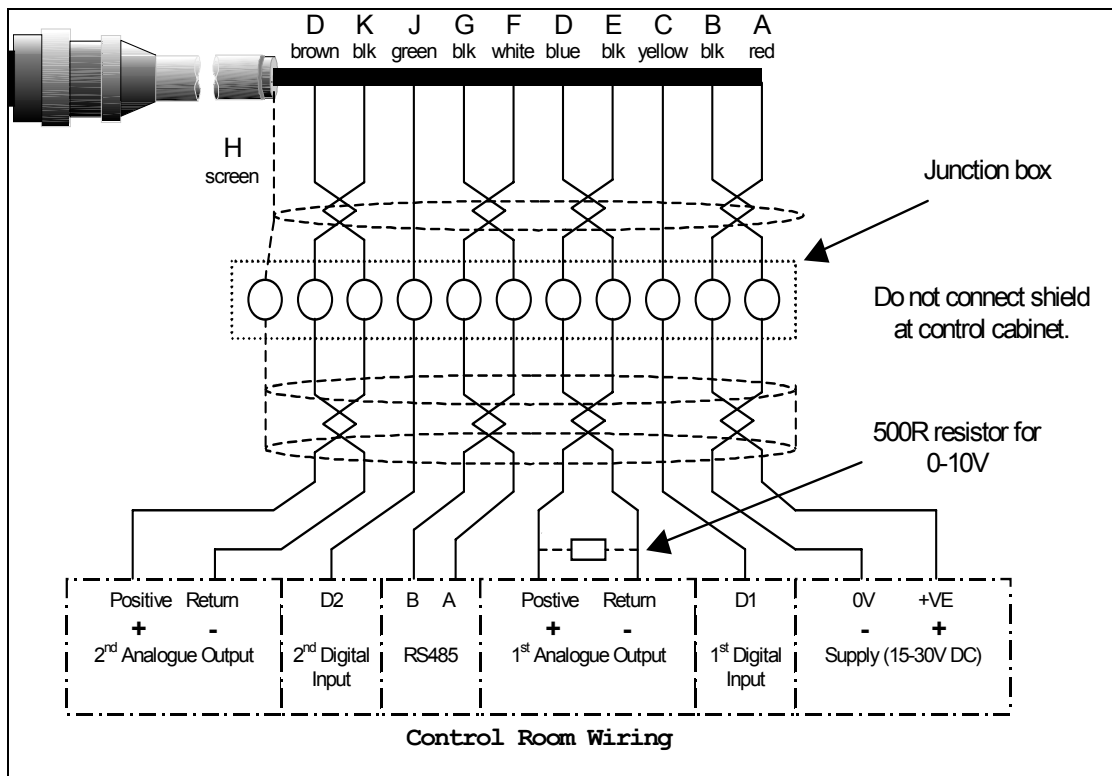


Figure 14 - Sensor cable (0090A) connection

NOTE: The cable screen is grounded at the sensor and therefore should not be connected at the control system end. It is important to ensure that the plant where the sensor is installed is properly grounded. If there is any doubt, a connection from the cable screen to ground should be provided at the junction box.

5.2 RS485 multi-drop connection

The RS485 serial interface allows up to 16 sensors to be connected together via a multi-drop network. Each sensor is connected using a waterproof junction box.

The control system is generally connected to the nearest junction box

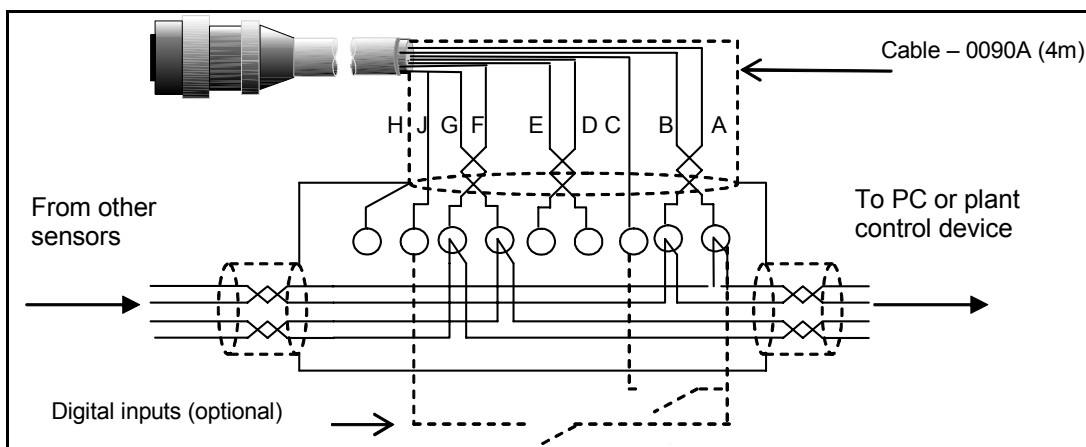


Figure 15 - Multi-drop connection

5.3 Compatibility mode

Compatibility mode allows a Hydro-Probe Orbiter to connect to a Hydro-Control IV or Hydro-View. To operate in this mode the 'output type' needs to be set to compatibility using Hydro-Link or Hydro-Com, see section 6. The 500 ohm resistor is required to convert the analogue current output to a voltage signal. This should be fitted as shown at the Hydro-Control IV/ Hydro-View. The required connections are shown below in Figure 16.

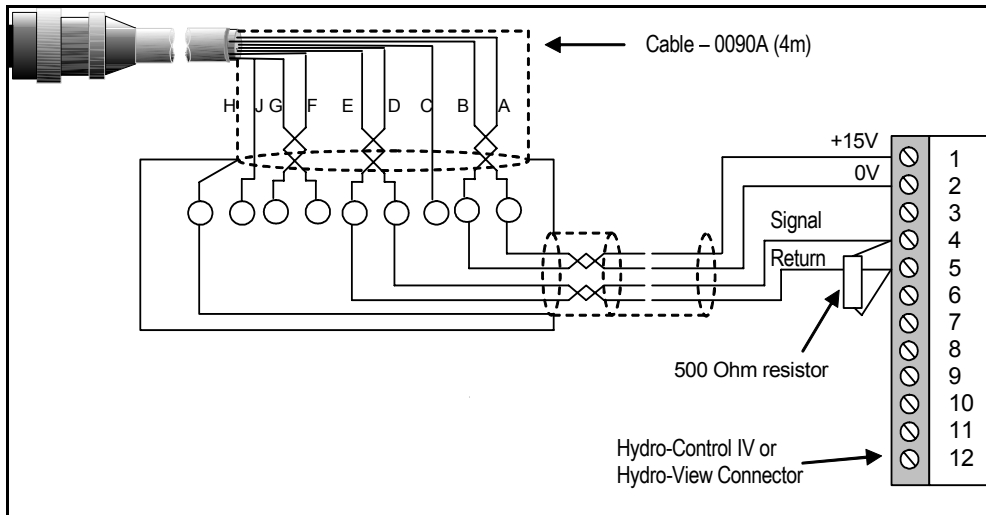


Figure 16 - Compatibility mode

5.4 Connecting to a PC

An RS232-485 converter is required to connect one or more sensors to a PC. There are three types of converter supplied by Hydronix. All operate identically, but come in a different package to suit a variety of connection types and applications.

For single sensor applications, the twisted pair RS485 wires from the sensor can be either terminated in a 9-pin male D-type converter (part no 0049) or a terminal block connected converter (part no 0049B). These two converters are shown in Figure 17.

For multi-sensor applications, it is recommended that a converter that has an external power supply is used, such as the converter show in Figure 18, which is designed for industrial applications and is DIN-rail mounted. Note that this unit has an additional RJ-11 type RS232 port if the customer wishes to connect to a PC using a suitable cable.

RS485 line termination will not normally be required in applications with up to 300m of cable. For longer lengths, connect a resistor (approximately 100 ohm) in a series with a 1000 pF capacitor across each end of the cable.

It is recommended that the RS485 signals be run to the control room even if they are unlikely to be used. This is because it will facilitate the use of diagnostic software should the need arise.

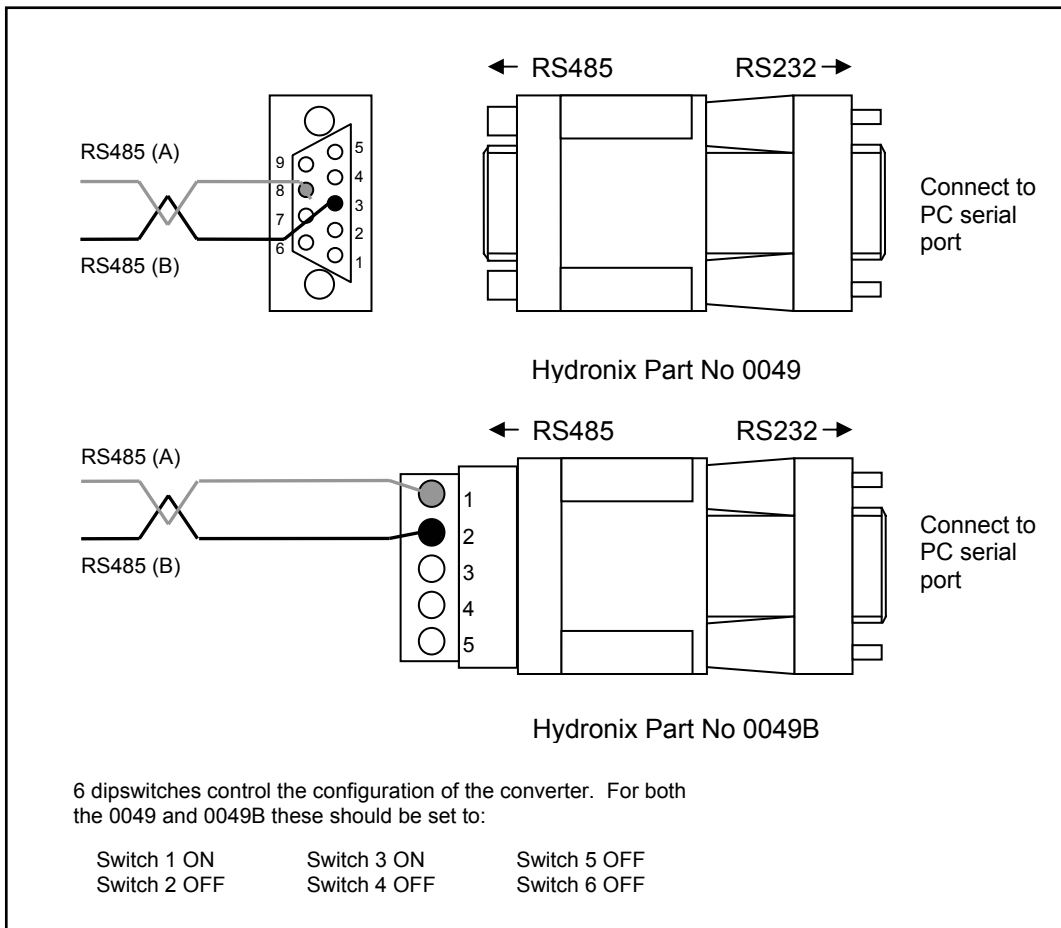


Figure 17 - RS232/485 converter connections

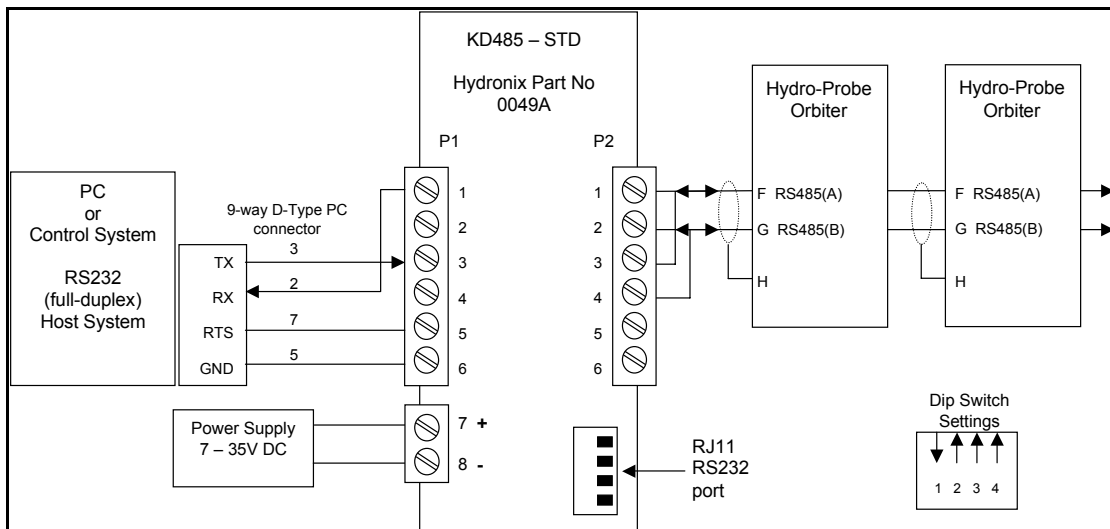


Figure 18 - Din rail mounting RS232/RS485 converter

6 Configuring the sensor

The Hydro-Probe Orbiter may be configured using the Hydro-Link or Hydro-Com software.

The complete set of default parameters is shown in the table below:

Parameter	Hydro-Probe Orbiter	Range/options
	Standard Default	
<i>Moisture calibration</i>		
A	0.0000	
B	0.2857	
C	-4.0000	
SSD	0.00	
<i>Signal processing configuration</i>		
Smoothing time	7.5 sec	1.0, 2.5, 5.0, 7.5, 10
Slew rate +	Light	Light, Medium, Heavy, Unused
Slew rate -	Light	Light, Medium, Heavy, Unused
<i>Averaging configuration</i>		
Average hold delay	0 sec	0.0, 0.5, 1.0, 1.5, 2.0, 5.0
High limit (m%)	30.00	0 – 100
Low limit (m%)	0.00	0 – 100
High limit (us)	100.00	0 – 100
Low limit (us)	0.00	0 – 100
<i>Input/output configuration</i>		
Output type	0 – 20 mA (0 – 10V)	0-20mA, 4-20mA, Compatibility
Output variable 1	Filtered unscaled	Filtered moisture %, Average moisture %, Raw moisture %, Raw unscaled, filtered unscaled, Average unscaled, Material temperature
Output variable 2	Material temperature	Filtered moisture %, Average moisture %, Raw moisture %, Raw unscaled, filtered unscaled, Average unscaled, Material temperature
High %	20.00	0 – 100
Low %	0.00	0 – 100
Input Use 1	Average/hold	Average/hold, Average/filtered, Moisture/temp, Unused
Input/output Use 2	Unused	Unused, Moisture/temp, Bin empty, Data invalid, Probe OK
<i>Temperature compensation</i>		
Electronics temp. coeff	0.002	
Resonator temp. coeff	0.0075	

Table 2 - Hydro-Probe Orbiter default parameters

Note: When connected to a Hydro-Control IV or Hydro-View the output type should be set to compatibility.

6.1 Calibration parameters

The default calibration parameters in Table 2 are Hydronix standard sand calibration set. These values will be used to convert the unscaled reading to a moisture reading according to the formula:

$$\text{Moisture (\%)} = A \times (\text{unscaled reading})^2 + B \times (\text{unscaled reading}) + C$$

The A, B and C coefficients are only active when either:

- The analogue output is set to give Raw, Filtered or Average moisture.
- Raw, Filtered or Average moistures are read from the RS485 link

The recommended analogue output type is 'Filtered Unscaled'. In this case the calibration parameters will have no effect.

NOTE: The analogue and RS485 output work independently of each other. Therefore if Raw, Filtered or Average moisture levels are requested via the RS485 link, the analogue output can still be set to give an unscaled output (which will not use the A, B and C values) and visa versa.

6.2 Average/Hold Delay

This parameter would only be used for applications where the Hydro-Probe Orbiter is replacing the Hydro-Probe II, for example in high wear environments. In mixer applications this should be set to zero (0) for the Hydro-Probe Orbiter.

6.3 Smoothing time

This defines the amount of filtering on the output signal. The smoothing time defines the time taken to get 50% of the final value in response to a step input. A value of 7.5 seconds is normal for most mixer situations

6.4 Slew rate + and slew rate -

These slew rates are used to limit the effect of rapid transient signals due to mixing action. There are three settings available: Light, Medium and Heavy, these correspond to 5, 2.5 and 1.25 unscaled units per second.

6.5 Temperature coefficient

This parameter is used to correct for thermal drifts in the electronics when used in hot environments or with hot materials. It should not normally be altered.

6.6 *Digital input/output*

The Hydro-Probe Orbiter has two digital lines. One line can be configured as an input and the other can be either an input or output.

Input Use 1

1. **Unused** – the status of the line is ignored
2. **Average/hold** (default) – the readings are averaged and when switched the analogue output holds the average value.
3. **Average/filtered** – the readings are averaged and when switched the analogue output returns to the filtered output.
4. **Moisture/temperature** – switch the analogue output between a signal proportional to moisture and a signal proportional to external (material) temperature.

Input/output Use 2

1. **Unused** (default) – the status of the line is ignored
2. **Moisture/temperature** - Switch the analogue output between a signal proportional to moisture and a signal proportional to external (material) temperature.
3. **Bin empty** (output)
4. **Data invalid** (output)
5. **Probe OK** (output)

Notes:

7 Sensor care

7.1 *Keeping the sensing head clean*

Ensure there is no permanent build up of material over the sensing head and arm. If the angle of the face of the sensing head is correctly adjusted, then the continual movement of fresh material against it should normally keep it clean.

At the end of the shift, or if there is a significant gap in production, it is advisable to hose or wipe the arm and head to ensure no hard build-up occurs.

It is recommended that a high pressure water cleaning system is used to clean the sensor. However, although the Hydro-Probe Orbiter is waterproof, its seals will not prevent the ingress of water from high pressure equipment nozzles that are held in close proximity to the sensor. **Keep all high pressure water sprays at least 300mm away from the sensor.**

CAUTION – NEVER HIT THE SENSING ARM

Notes:

8 Replaceable parts

8.1 *Changing the sensing arm*

The sensing arm is a replaceable item. The wear life of the arm is dependent on the materials in which it is used, the mixer, and of course on the amount of use.

Wear life may be extended by taking precautions as set out in the previous chapter. However, periodically, either through accidental damage or excessive wear, it may be necessary to replace the head and arm.

8.1.1 Removing the sensing head and arm

- Undo the clamp bolts securing the sensor body to the square support bar.
- Remove the entire sensor body and arm and take to a clean environment.
- Lay the sensing arm on a clean flat surface.
- Undo the arm clamp nuts on the sensor body and pull out the worn sensing arm.
- Attach the new sensing arm by following the installation instructions in this guide (See section 2.1)

8.1.2 Fitting the Hydro-Probe Orbiter back into the mixer

Follow the instructions in Chapter 2, ensuring both the height from the mixer floor and the angle of the sensing head are set correctly.

8.2 *Calibrating a new arm to the sensor electronics*

Recalibration is necessary after fitting a new arm to the sensor electronics. For mixer applications, a calibration called AUTOCAL is sufficient, although there are other ways in case the customer has no facility for this. For conveyor belts or freefall applications, a separate AIR and WATER calibration is needed.

8.2.1 Autocal – Hydro-Probe Orbiter used in mixer applications

During any Autocal, the ceramic face must be clean, dry and free from obstruction.

This calibration can be performed in three ways

- **Using Hydro-Com PC utility**
The sensor should be connected to a computer (see section 5.4) running a suitable Hydronix PC utility such as Hydro-Com. The configuration section of these programs has an Autocal facility. Once selected, the Autocal will be completed in approximately 60 seconds and the sensor is ready for use in the mixer. Note that Hydro-Link does not have Autocal feature.
- **Using the Hydro-Control V**
The Hydro-Control V has the capability to perform an Autocal calibration in the sensor configuration page. From the main window this can be accessed by the following: MORE > SETUP > (enter pass-code 3737) > DIAG > CONF > CALIB. Note this feature is only available on Hydro-Control V firmware versions 4.1 and later, and Autocal will only work for the Hydro-Probe Orbiter, no other Hydronix sensors.

- **Using the Hydronix Autocal Dongle**

The Autocal Dongle as shown in Figure 19, has been designed for applications where there is no RS485 serial link and the customer is using the analogue output from the sensor. This calibration is completed by connecting the dongle in-line between the cable and the sensor body, as shown in Figure 20.



Figure 19 - The Hydronix Autocal Dongle

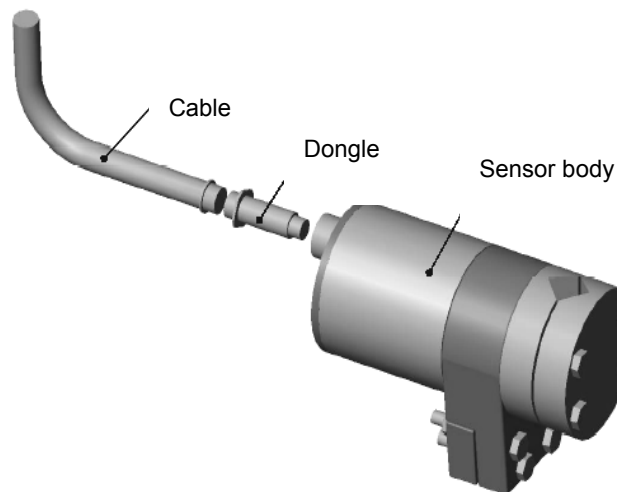


Figure 20 - Connecting the Hydronix Autocal Dongle for calibration

The simple procedure outlined below should take less than one minute to complete:

1. Ensure the ceramic face plate is facing upwards and is completely clean and dry
2. Connect the Autocal Dongle to the sensor body and cable as shown in Figure 20. The Autocal Dongle should begin flashing (red) *bright-dim-bright* for 30 seconds
3. After 30 seconds the Autocal Dongle should start flashing *on-off-on*
At this stage it is important to keep away from the ceramic faceplate
4. After approximately 20 seconds the Autocal Dongle should illuminate constantly. The calibration is finished and the Hydro-Probe Orbiter is ready to be fitted back into the mixer. Disconnect the Autocal Dongle and reattach the cable for normal use.

If the Autocal Dongle continues to flash *on-off-on* as in stage 3, then the calibration was unsuccessful due to variation during its measurement stage (stage 4). If this is the case, disconnect the Autocal Dongle from the sensor body and cable, and repeat steps 1 – 4.

8.2.2 Air and water calibration

Can be used for mixer applications; **required** when the Hydro-Probe Orbiter is used on conveyor belts and freefall applications

Using **any** of the available Hydronix configuration utilities (Hydro-Link, HydroNet-View, Hydro-Com).

The calibration is performed by making separate readings in air and water. With the sensor connected to a computer (see section 5.4), the Hydronix PC-based utility can be used to make the measurements and update the sensor in the configuration section.

The air reading should be made with the face-plate clean, dry and free from obstructions. On the appropriate tab of the application software press the New Air or High button. The software will make a new air measurement.

The water reading should be carried out in a bucket filled with a clean brine solution. This solution should be made up from water with 0.5% by weight of salt (e.g. 10 liters of water to be mixed with 50gm of salt). The level of water needs to cover the ceramic face-plate, and at least 200mm of water is needed in front of the ceramic. It is suggested that the sensor is held in the bucket offset to one side with the face towards the centre of the bucket (see Figure 21), hence the measurement is carried out with a full bucket of water in front. Press the New Water or Low button. The software will make a new water measurement.

Once both readings are made, the sensor can be updated by pressing the update button in the application software and it is then ready for use.

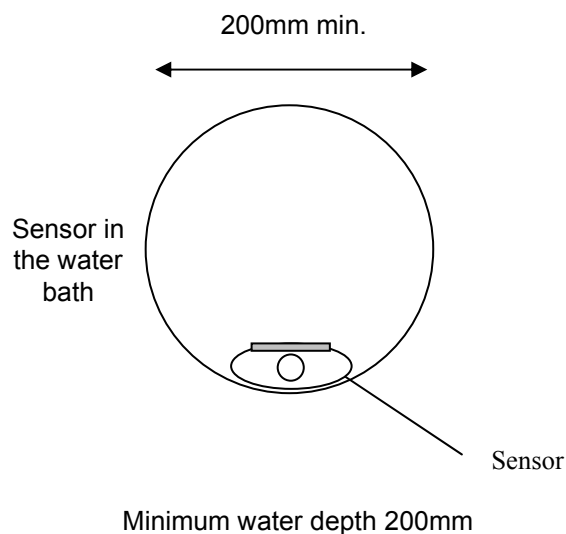


Figure 21 - Air-water calibration

IMPORTANT:

Once the alignment of the sensing arm is changed inside a mixer, the resultant density change of material passing the sensing head will have an effect on the recipe. This would apply when a new arm is fitted, despite pointing the faceplate in the same approximate direction as the previous installed arm. It is therefore advisable to recalibrate the recipes before continuing batching.

Notes:

9 Troubleshooting tips

These tips are intended as suggestions for troubleshooting when problems occur with the water control system.

9.1 *Installation*

- Fit the sensor with a 50 mm gap between the bottom of the Hydro-Probe Orbiter and the mixer floor.
- Fit away from the water, cement and aggregate inlets.
- If the Hydro-Probe Orbiter performance is suspect, if possible compare the signal from the sensor (using Hydro-Com or Hydro-Link) to the calculated moisture content. This will identify if the problem is with the Hydro-Probe Orbiter or the control system.

9.2 *Electrical*

- Ensure that the cable is of suitable quality – the minimum specification is twisted pairs of 22 AWG (0.35mm²) conductors, screened with aluminium/polyester foil and 65% minimum coverage braid – Belden 8306 or equivalent.
- When using the analogue output, it is advisable to take the RS485 cable back into the control cabin. This can be particularly useful over the life of the equipment for diagnostic purposes and takes the minimum of effort and cost at the time of installation.
- Route the signal cable away from power cables, in particular the mixer power supply.
- Check the mixer is properly grounded.
- The signal cable should only be grounded at the mixer end.
- Ensure the cable shield is not connected at the control cabin end.
- Ensure there is continuity of the shield through any junction boxes.
- Keep the number of joints in the cable to a minimum.
- Note that there is a M4 threaded hole provided on the back plate of the Hydro-Probe Orbiter body for a ground connection.

9.3 *Mixer*

- Look at the mixing process. Check how the water disperses. If water sits on top of the aggregates for a time before dispersing, then spray bars will be required to get it into the mixer quicker to shorten the mix time.
- Spray bars are far better than single water inlets. The greater the area of water inlet, the faster it mixes in.

9.4 **Ingredients**

- If the aggregate masses are not corrected for high moisture contents, the aggregate/cement ratio will change considerably, having a bad effect on workability and concrete performance.
- If the aggregates are very wet, then there may be more water in the aggregates than the mix requires. This could be the case at the beginning of the day due to water drainage in the storage bin.
- The moisture content of the aggregates must be above their saturated surface dry (SSD) moisture content before loading into the mixer. Microwave sensors measure moisture content accurately above the SSD value of a material because measurement loses linearity below SSD. Mixing performance is also increased when the aggregates are above their SSD value upon loading, as the cement can absorb free moisture prior to water addition.
- Beware of hot cement, it can affect water demand and hence moisture content.
- Changes in ambient temperature also affect water demand.

9.5 **Workability**

- The Hydro-Probe Orbiter measures moisture, it does not measure workability, or someone's perception of workability.
- Changes in many factors affect workability but these changes may not affect moisture content:
 - Aggregate grading.
 - Aggregate/cement ratio.
 - Admixture dosage and dispersion.
 - Ambient temperature.
 - Coarse/fine ratio.
 - Water/cement ratio.
 - Ingredient temperatures.

9.6 **Calibration**

- Leave out the admixtures when calibrating.
- If the wet mix time is shortened for production, ensure the full time is used during calibration.
- Different batch recipes may be required for large variations in batch volume.
- Calibrate when conditions/ingredients are typical e.g., not first thing in the morning when the aggregates are very wet, or when the cement is hot.
- When using a calibration-based water addition method, obtaining a correct dry reading is essential.
 - Signal must be stable.
 - Dry mix time must be long enough to obtain signal stability.
 - Good measurement requires time.

9.7 *Mixing*

- Minimum mix times are a function of the mix design (ingredients and mixer) not just the mixer.
- Different mixes need different mix times.
- Keep batch sizes as consistent as possible e.g. three batches of $2.5\text{m}^3 + 2.5\text{m}^3 + 1.0\text{m}^3$ is not as good as 3 batches of 2.0m^3 .
- Keep the premix time as long as possible, at the detriment of the wet mix time if necessary.
- The shortest mix time is generally obtained from this mix order:
 - Load aggregates (including steel or rigid plastic fibres if used).
 - Load microsilica slurry, if used.
 - Load cement just after aggregates start (and after micro silica slurry, if used).
 - Run cement and aggregates together (and silica fume powder, if used).
 - Finish cement before aggregates.
 - Allow sufficient dry mix time to obtain a good stable signal.
 - Measure moisture content.
 - Load water and admixtures.
 - Wet mix until the signal is stable.

REMEMBER – DO NOT HIT THE CERAMIC – IT IS EXTREMELY WEAR RESISTANT, BUT BRITTLE

Notes:

10 Sensor performance

The moisture reading from the sensor can only indicate what is happening in your mixer. The speed of reading or the time taken to reach a steady reading when the materials are homogenous reflects the effectiveness of the mixer. By taking some simple precautions, the overall performance can be considerably improved and the cycle time reduced with consequent financial savings

10.1 Adjustment of the blades

- Ensure the mixer blades are regularly adjusted to comply with the manufacturers recommendations (normally 2mm clear of the floor), with the consequent benefits:
 - All the residual mix is discharged when emptying the mix
 - Mixing action close to the floor of the mixer is improved, thereby improving the reading of the sensor
 - Reduced wear on mixer floor plates

10.2 Cement addition

- Mixing the fine cement particles in with the relatively coarse particle size of the sand and aggregates is a tough job. When possible cement addition should commence a few seconds after the loading of the sand and aggregates. Folding in the materials together in this way will greatly assist the mixing process.

10.3 Water addition

- To facilitate the mixing action, the water should be sprayed in over as wide an area as possible, rather than discharged at one point. Remember excessively rapid water addition will increase the wet mix time required to reach homogeneity. Therefore there is an optimum rate of water addition for achieving minimum mix cycle time.
- Commencement of water addition should only start after the cement has been substantially mixed in with the aggregates. **Cement powder lying on the surface of the aggregates will absorb the water turning into a wet paste which will be more difficult to disperse uniformly throughout the mix**

Notes:

11 Technical specification

11.1 Mechanical Dimensions

- ORB1 Housing: 156 x 225 mm
- Sensing arm: 104.5 x 34 mm (length of arm to suit mixer, usually 560 mm or 700mm)

11.2 Construction

- Body: stainless steel (AISI 304)
- Sensing head: Hardened stainless steel (wear resistant surface coating also available)
- Faceplate: Alumina ceramic

11.3 Penetration of field

- Approximately 75 – 100 mm dependent on the material

11.4 Operating temperature range

- 0 – 60° C. The sensor will not measure in frozen materials

11.5 Supply Voltage

- +15V to 30 V DC, 4 watt max.

11.6 Connections

11.6.1 Sensor cable

- 6 pairs twisted (12 cores total) screened (shielded) cable with 22 AWG, 0.35mm² conductors
- Screen (shield): Braid with 65% minimum coverage plus aluminium/polyester foil
- Recommended cable types: Belden 8306, Alpha 6373
- Maximum cable run: 100 m separate to any heavy equipment power cables

11.6.2 Digital (serial) communications

- Opto-isolated RS485 2 wire port – for communications including changing operating parameters and sensor diagnostics

11.7 Analogue output

- Two configurable outputs 0 - 20mA or 4 - 20mA current loop source available for moisture and temperature. Also may be converted to 0 – 10 V DC

11.8 Digital inputs/outputs

- Two lines available for batch averaging, start/stop, or temperature multiplexing. One line may also be used as an output status flags indicating 'out of range', 'bin empty' or 'probe ok'

11.9 Grounding

- Ensure equipotential bonding of all exposed metalwork. In areas of high lightning risk, correct and adequate protection should be used.