Hydro-Probe
Orbiter
User Guide
For model ORB1 – rotating mounting

This guide is for model ORB1 with rotating connector

FOR ROTATING SENSOR IN STATIC PAN MIXERS

Typical applications:

      All turbo pan mixers such as Liebherr, Pemat, Rapid, Teka

      Planetary type pan mixers with a hollow central shaft to the gearbox

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ACKNOWLEDGEMENTS

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225mm

156mm

Two lengths of arm are available – Overall length 560mm or 700mm

Rapid response temperature sensor

Figure 1 - The Hydro-Probe Orbiter with rotating connector

1 Introduction

1.1   Applications

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

1.   For **static** mounting of the Hydro-Probe Orbiter sensor (ORB1) in **rotating** mixers or for conveyor belts or material in free fall applications

2.   For a **rotating** mounting in **static** pan mixers, using a rotating connector for connecting the cable to the Hydro-Probe Orbiter

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 2:**

FOR A ROTATING SENSOR IN STATIC PAN MIXERS THAT CAN BE CONNECTED TO A CABLE USING A ROTATING CONNECTOR

A ROTATING CONNECTOR CAN BE USED WHERE THE MIXER HAS CABLE ACCESS TO AND FROM A CENTRAL POINT IN THE MIXER. IF THIS IS NOT POSSIBLE, A BATTERY MODEM IS RECOMMENDED

1.2   Typical Mixers

- Turbo pan mixers such as Liebherr, Pemat, Rapid or Teka

- Planetary mixers with hollow central shaft to the gearbox, such as some OMG and Skako 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 the 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 output with rotating connector

The standard 4 pole rotating connector will provide power to the sensor and a RS485 output only. This is suitable for connecting directly to the Hydro-Control V or direct to the control system using a RS232 converter.

Alternatively, the RS485 capability may be sacrificed to provide an analogue output.

A 6 pole rotating connector can be used instead of the 4 pole to provide both the RS485 and analogue outputs.

1.6   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.

1.7   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 reinforcement 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)

- Mounting rotating connector (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.


Two 'O' rings have to be installed to the end of the barrel

Clamp block – 4 bolts

Locking bolt 'A' to be removed

Strengthening collar
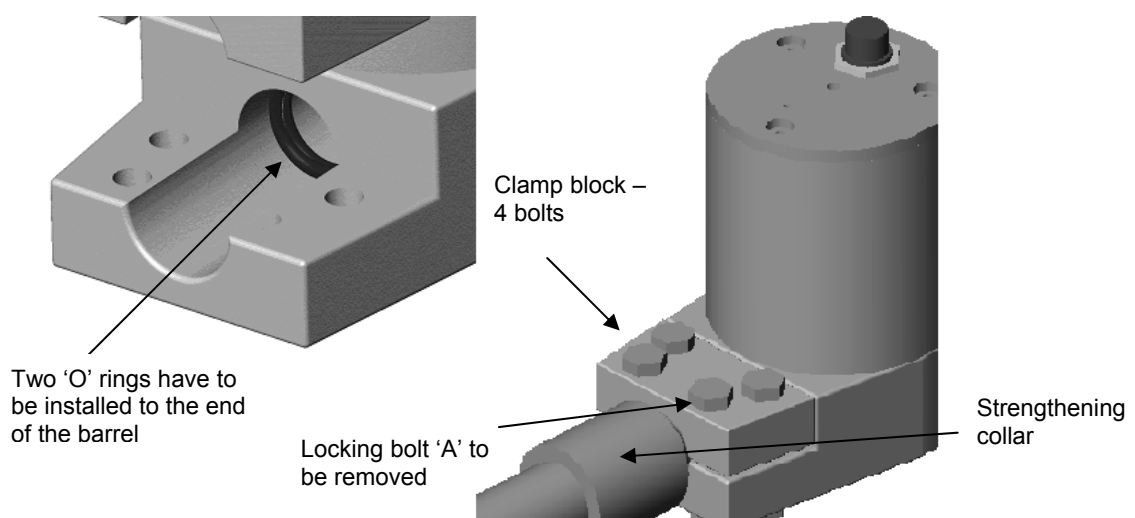
Figure 2 - Installation of sensing arm into sensor body

- 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 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 7.2 - Calibrating the new arm to the sensor electronics.

2.2 Selecting the best position for mounting the sensor

The small, stream-lined sensing head needs to be positioned such that it cuts cleanly and smoothly through the material, without build-up, thereby providing a smooth and clean signal.

In selecting the optimum position, the following considerations need to be taken into account:

- The cabling arrangement from the sensor to the rotating connector

- The sensing head should be positioned along the scraper blade arm where the flow of material is smoothest, and as far as possible free from the turbulence created by the mixer blades.

- As a general rule, the sensor should be attached along the scraper blade arm approximately 1/4 to 1/3 of the distance in from the wall of the mixer (see Figure 10). The faceplate of the sensing head should be angled at 55º to the centre of the mixer, which must be set using the aligner provided (see Figure 11 for further information).

- The sensor body may be mounted underneath the scraper blade arm (Figure 3) or above the scraper blade arm (Figure 4). In both cases the body should be as far out of the mix as possible in order to keep it reasonably clean and minimise wear.

- The sensing arms are available in 2 lengths (Figure 1) and the sensor should be mounted such that there is a 50mm gap between the underside of the sensing head and the mixer floor (Figure 8).

- 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)
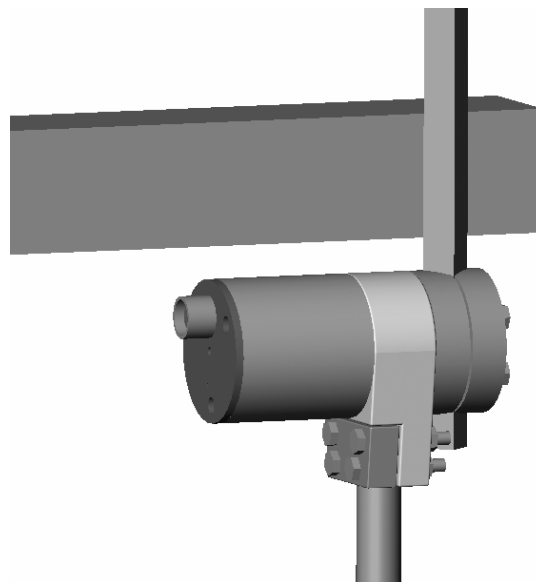

**Figure 3 - Fixing the sensor under the scraper blade arm**
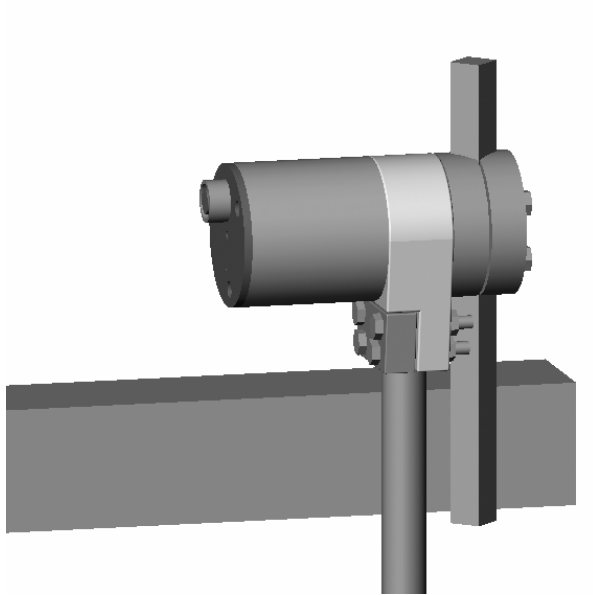
Figure 4 - Fixing the sensor above the scraper blade arm

Protective
'roof'

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 scraper blade arm, or alternative mixer arm, depending on the mixer configuration. It should be suitably reinforced to provide a rigid fixing that will withstand the thrust generated on the sensing head and arm whilst moving though the material. Ensure that the bar is perpendicular to the floor in both planes.

It may be preferable, such as in turbo mixers where each arm is sprung loaded, to construct a separate arm fixed to the central part of the mixer.

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.
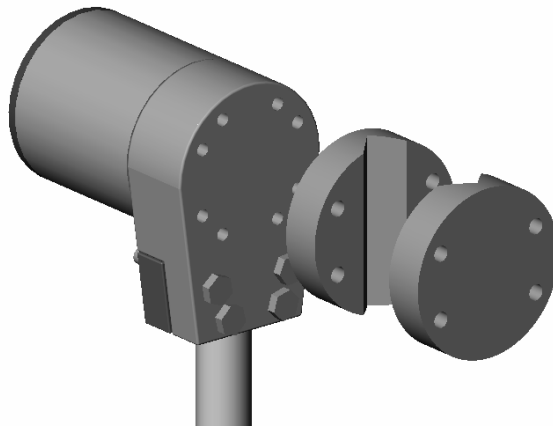

Figure 6 - Removing the mounting bar clamp blocks ready for fitting to the mixer

Figure 7 indicates how the square mounting bar may be welded to the scraper blade arm or an alternative arm.


Extra support bar welded

Top view
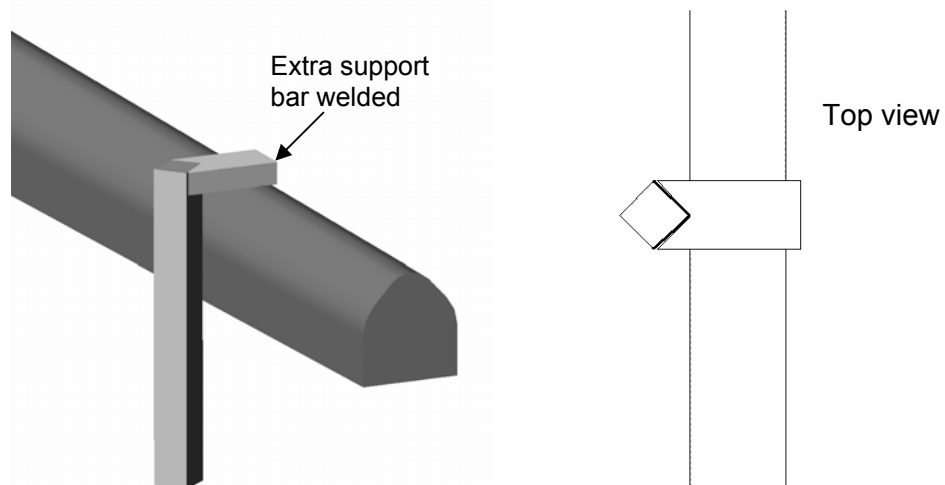
Figure 7 - Square mounting bar welded to scraper blade arm

2.4   Mounting the 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 8). 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.

Sensing head

Minimum level of material

Ceramic faceplate

50mm

Mixer floor
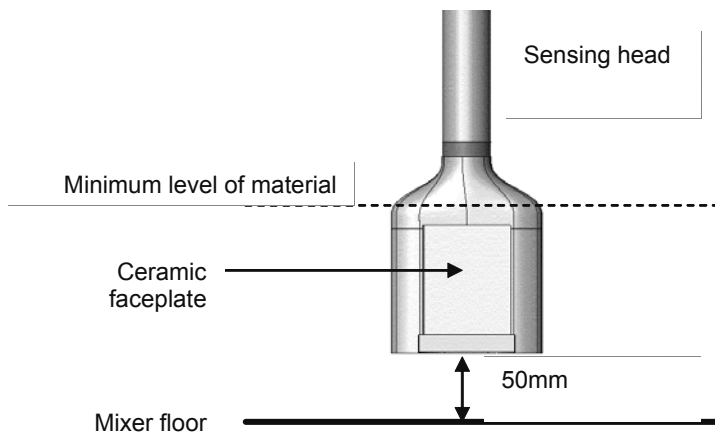
Figure 8 - Height setting of the sensing arm

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 300º (Figure 9). 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.
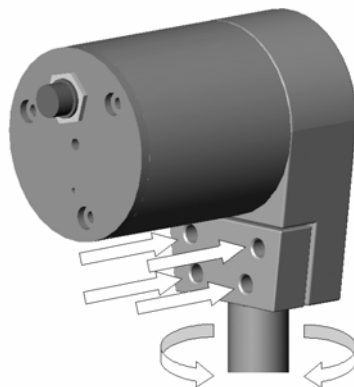
Figure 9 - Adjusting the sensing head angle

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.
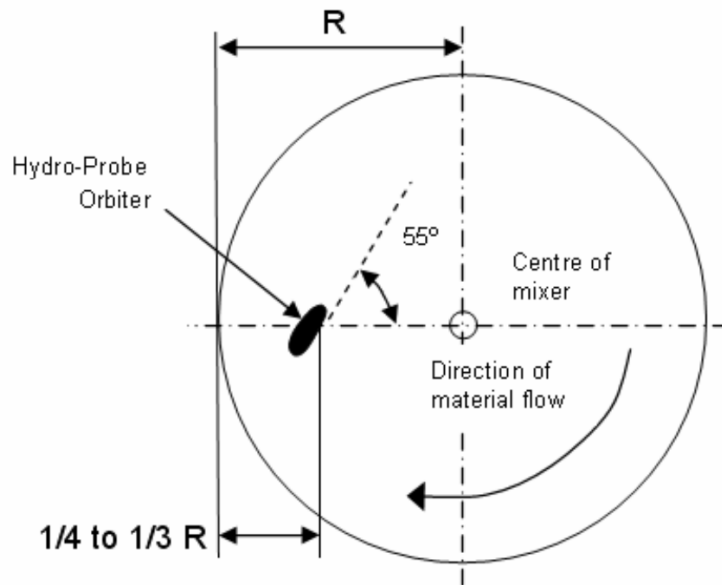

Figure 10 - Setting the sensor angle for optimum performance

- An angle of 55° generally provides good results. Use the angle aligner provided to set the angle (Figure 11).
- Ensure all clamp bolts are tightened to a torque of 28Nm (21 lb/ft) after adjustment.
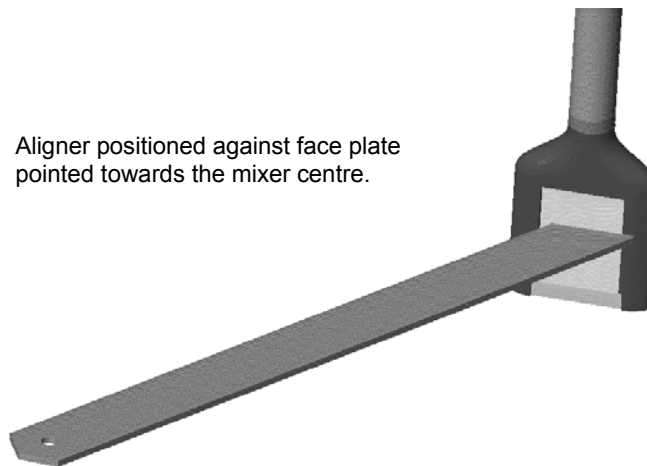

Aligner positioned against face plate pointed towards the mixer centre.

Figure 11 - The Hydronix angle aligner for sensor 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 static plant cabling is connected to the **rotating** Hydro-Probe Orbiter by means of a rotating connector assembly.

Electrical connectivity is achieved with the use of a high quality connector called a Mercotac. Two versions of Mercotac are available:

- The standard 4 pole, suitable for providing RS485 output only, for example when interfaced to Hydro-Control V.

- The 6 pole for providing both the RS485 and analogue outputs.

The cabling arrangements will be different for each type of mixer. Therefore, the intention of this manual is to conceptually cover the three different types of mixer applications.

The routing and fixing of the cable in the mixer, together with the fixing of the rotating connector, might require a certain amount of improvisation.
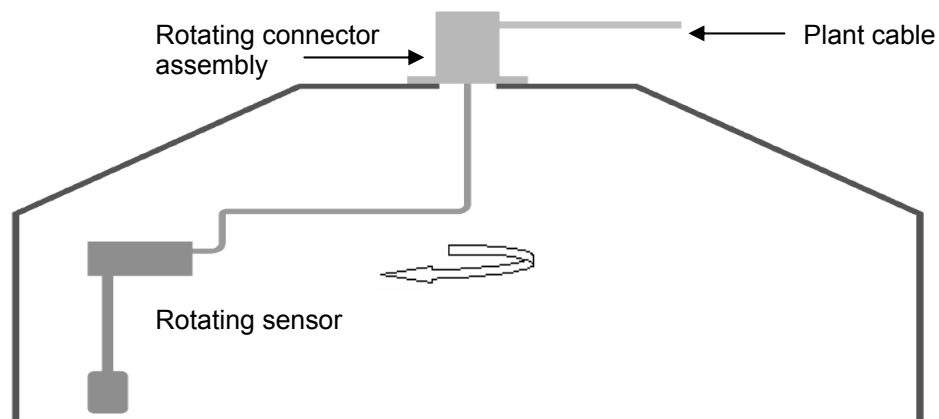

Figure 12 - Connecting the Hydro-Probe Orbiter to the rotating connector

Three different types of rotating connector assemblies, referred to as types 'A', 'B' or 'C', are available to suit different types of mixer.

The connection details for the plant cabling to the terminal blocks inside the rotating connector assembly are the same in all cases, but are dependant on whether a 4 pole or 6 pole rotating connector is used.

3.1 Type 'A' rotating connector assembly

3.1.1 Suitable applications

Suitable for mixers with a hollow central shaft through the gearbox where the motor is not positioned centrally, i.e. planetary mixers such as OMG.

Rotating connector
assembly

Connection
through the
hollow shaft
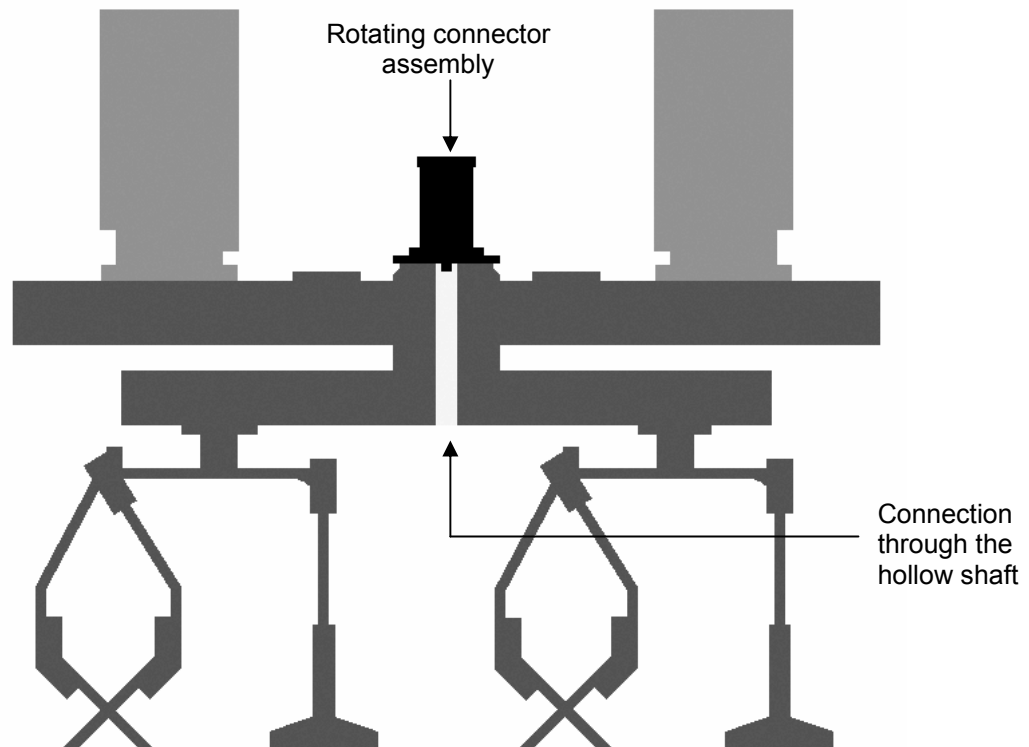
Figure 13 - Connection to the rotating connector using a hollow shaft through the gearbox

3.1.2 Mounting

Mounts directly on the top of the mixer using a nylon mounting flange

3.1.3 Connections

Connects directly to the mixer central hollow shaft by means of threaded adapters supplied

3.1.4 Threaded Adapters

On some mixers threaded adapters enable the Mercotac holder to be directly attached to the gearbox shaft. Two brass reducers are available depending on the type of mixer.   One is a 1" BSP male to ½" BSP male adapter and the other is a 1" BSP male to 3/4" male adapter. The construction using either adapter is shown in Figure 14

Cover screw

Earth connection

Rotating connector body

Mercotac connector (4 pole [shown] or 6 pole)

Nylon mounting flange

Brass Mercotac holder

Terminal block

Connection to plant cable through cable gland

Mercotac retaining 'O'-ring (used only for 6-pole Mercotac)

Mercotac retaining 'O'-ring (used only for 4-pole Mercotac)

1" BSP male to ½" BSP male brass adapter (reducer)

- or -

1" BSP male to ¾" BSP male brass adapter (reducer)

Connects directly to mixer threaded rotating shaft

Figure 14 - Type 'A' rotating connector assembly

3.1.5 Cabling arrangements

The routing of the cable and method of fixing it will be largely determined by the clearance between the underside of the gearbox and the highest point of the mixer blade arms, as depicted below in Figure 15. The cable should be protected by feeding it through a length of 32mm ID rubber hose.
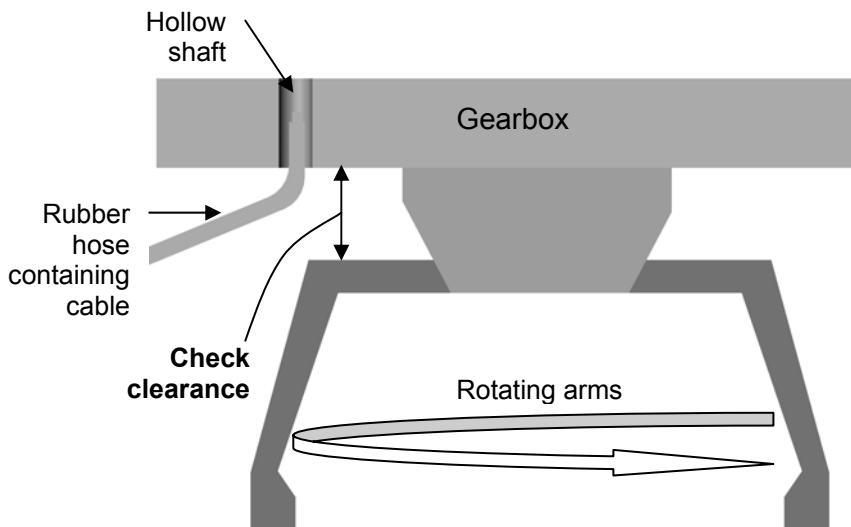
Figure 15 - Checking the clearance between the revolving arm and the ceiling of the mixer

3.1.6 Fitting with good clearance

The clearance should be sufficient to ensure the rotating arms do not snag the protective hose.
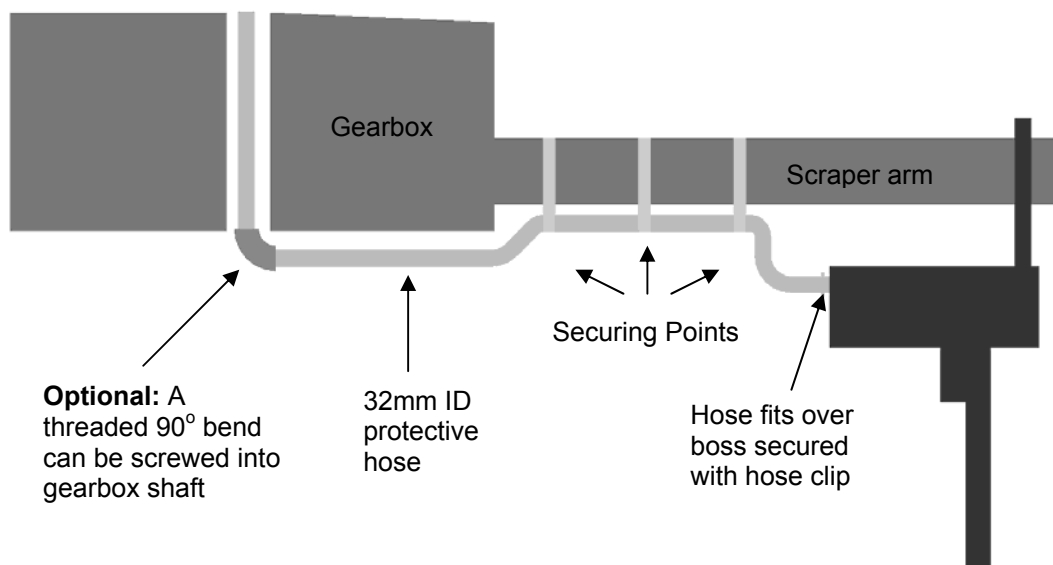
Figure 16 – Fitting the cable with good clearance

- The cable is sheathed with 32mm internal diameter rubber hose

- Rubber hose fits over the boss covering the connector on the Hydro-Probe Orbiter electronics body and is secured by a hose clip

- Metal straps to be welded or bolted as appropriate to provide securing points for the rubber hose and cable. Suggested details in Figure 16.

3.1.7 Fitting where minimal clearance exists

One suggested method of fitting the cable when there is very small clearance is by using a small thin plate that can be fixed in place using the existing blanking bolt in the ceiling of the mixer. If the head of the bolt is drilled, the cable can be passed through and up the gearbox shaft. The plate is used to protect the cable near to the centre of the mixer where planetary blades run a risk of hitting the cable.
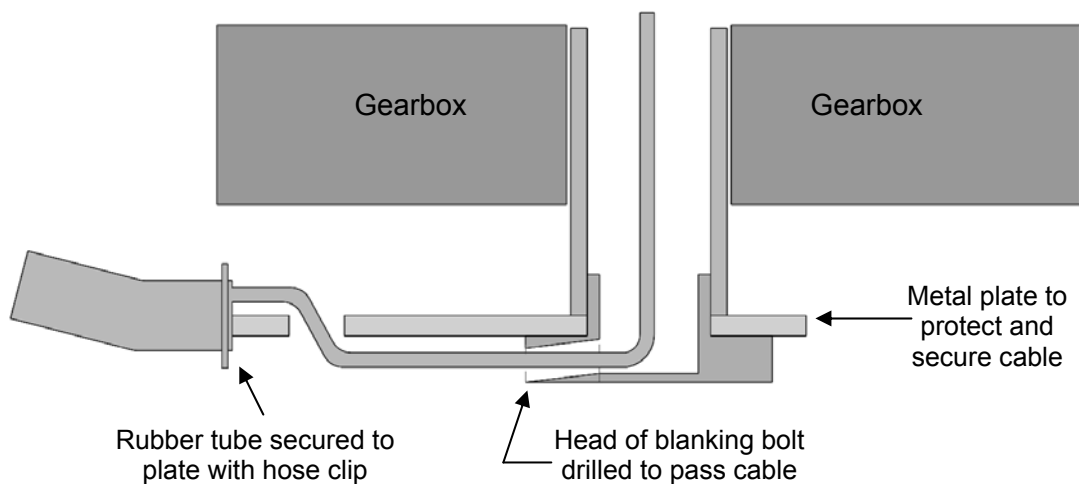
Figure 17 - Fitting the cable where minimal clearance exists

3.1.8 Fitting rotating connector type 'A' and connecting sensor cable to Mercotac

- Remove blanking bolts from both ends of the gearbox shaft.

- Remove the Mercotac holder from the rotating connector and, using the correct brass thread adapter, screw into the end of the shaft.

- Remove the wide mounting flange from the rotating connector.

- Remove the bolts only securing the cover plate to the gearbox – Generally there are a number of bolts around the cover plate but two would be sufficient to fix the rotating connector nylon mounting flange.

- Drill holes in the nylon mounting flange to match the cover plate bolt holes.

- If there is a grease nipple in the top of the gearbox that will obstruct the nylon flange, drill a large hole in the nylon mounting flange.

- Mount the flange on top of the cover plate replacing the removed cover bolts with longer studs. Ensure the captive bolts for securing the rotating connector are in place. See figure 18.
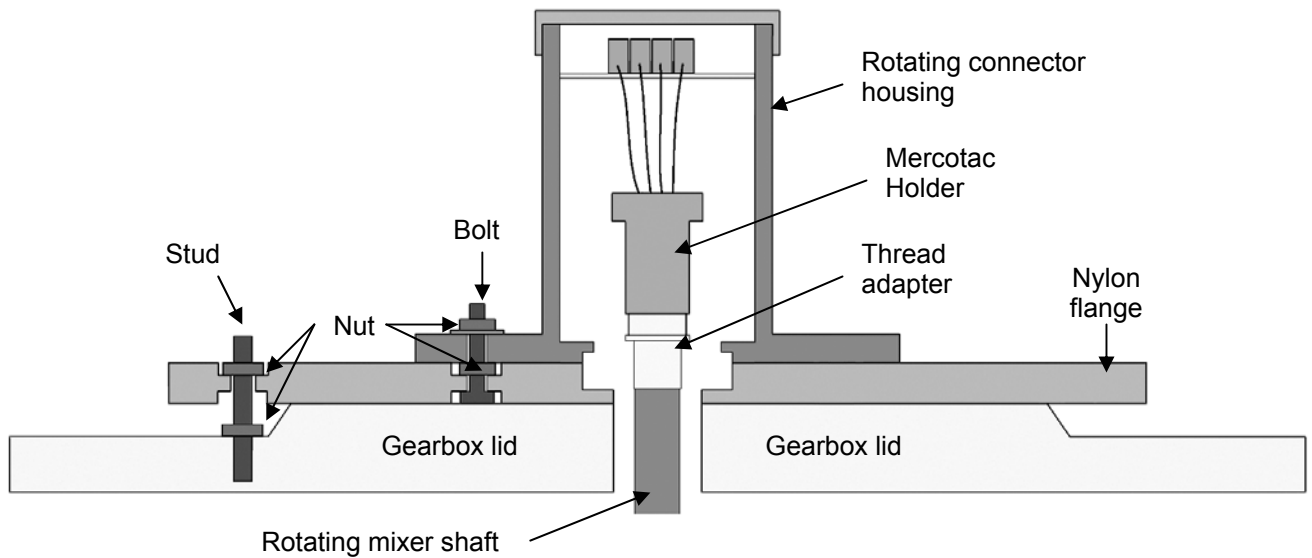
Figure 18 – Mounting the type 'A' rotating connector

- Position the rotating connector over the hole, easing spare cable back though the rubber hose, and secure by tightening nuts of the three bolts

- With the cable connected to the Hydro-Probe Orbiter, feed up through the rotating shaft and the Mercotac holder and cut to the correct length. Ensure the cable and its protective hose do not interfere with the mixer arms.

- Cut back the cable sheath and crimp on spade terminals.
  At most, 6 conductors are being used, so unused conductors can be cut back.

- Connect to the Mercotac terminals (See 3.4 Mercotac wiring connections).
  The static end of the Mercotac should already be connected to the terminal blocks.

- Ease the Mercotac back into the holder, gently pulling back any cable slack through the rotating shaft. The retaining 'O' ring may make this difficult, so a small application of grease/oil would make this easier.

- Fix the rotating connector body to the mounting flange.

- Wire plant cable to terminal block in the rotating connector

- Provide earth continuity wiring for the rotating connector.

3.2   Type 'B' rotating connector assembly

In this assembly, the Mercotac holder is mounted in a bearing protected by a seal, as shown in Figure 19.
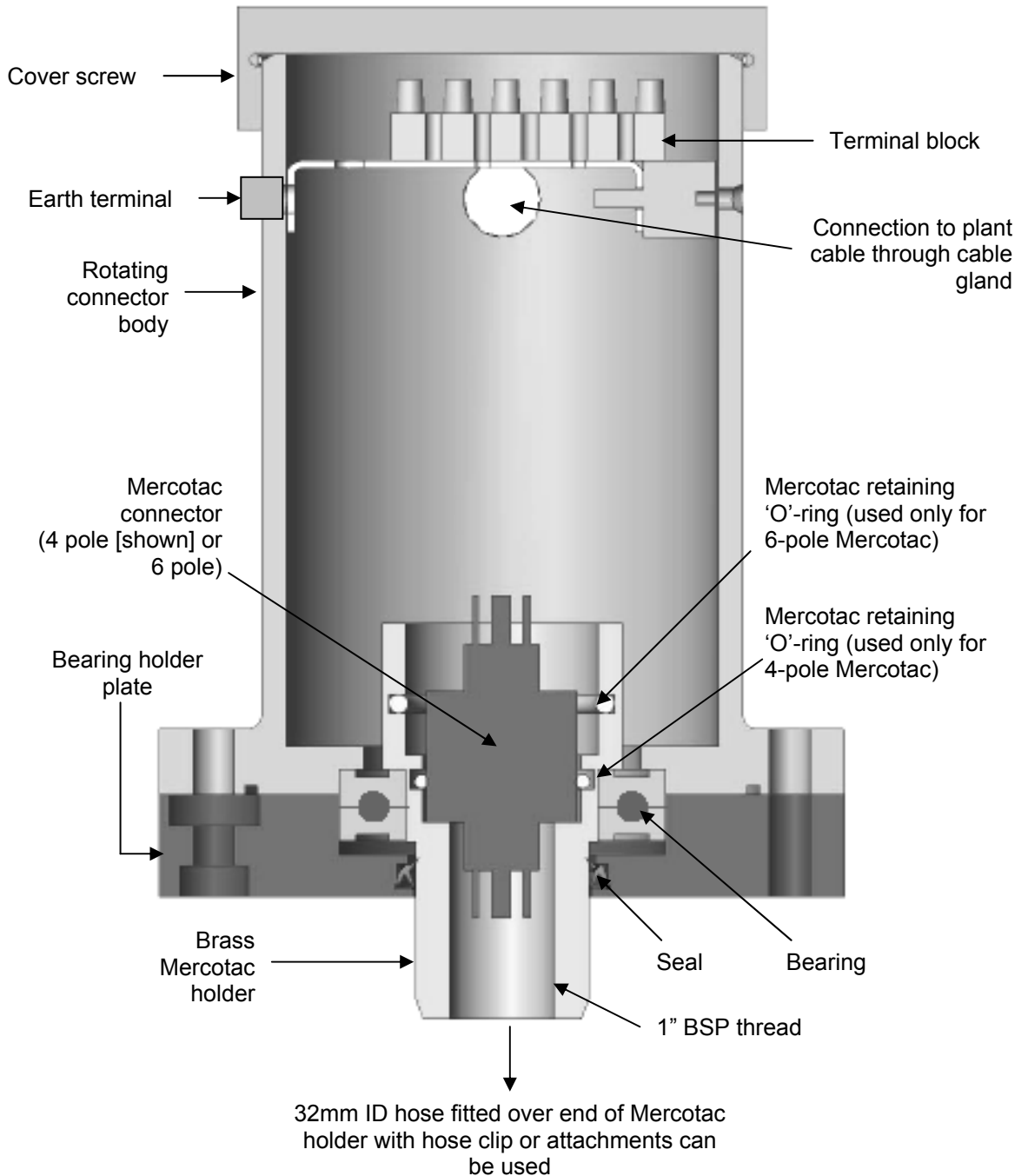
Figure 19 - Type 'B' rotating connector assembly

3.2.1 Suitable applications

Suitable for turbo pan mixers where the motor is fitted to the underside of the mixer. The cable is taken through a central hole in the top lid of the mixer.

Several options exist for routing the cable, but the important requirement is the ability to remove the cover lid to the gearbox for maintenance and blade adjustment.

3.2.2 Routing of cable

These are suggested options only and fitting must be customized to suit each installation. The cable should be routed through the protective 32mm internal diameter rubber hose and should connect directly onto the Mercotac holder. As mentioned above, it is important to be able to remove the cover lid to the gearbox, so a longer length of cable is advised which can be wrapped with enough length to still remove the cover whilst connected. A suggested method may be to secure the hose along the top inside edges of the blades as shown in Figure 20.
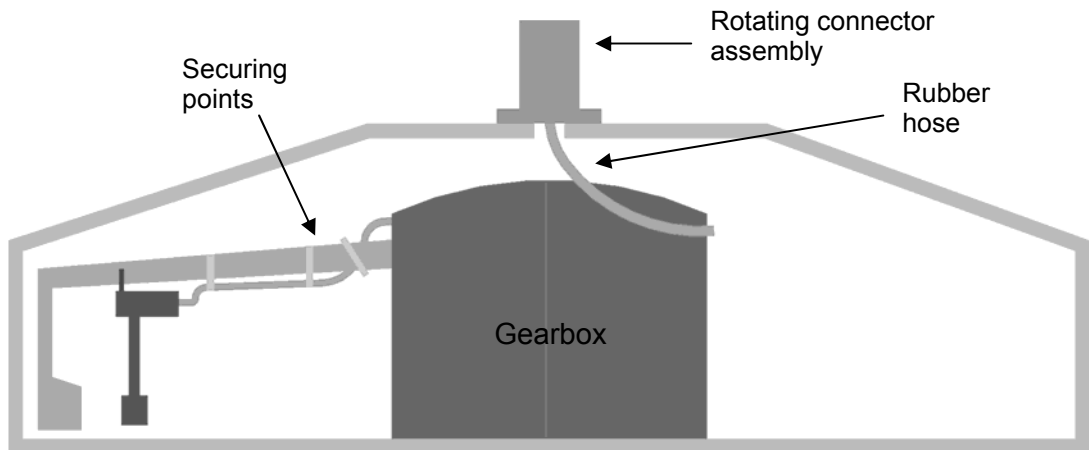
Figure 20 - Routing the cable to the rotating connector for turbo type pan mixers

Alternatively, the hose can be wrapped around the edge of the gearbox lid using a series of hooks as shown in Figure 21. This would provide a simpler way of both detaching and attaching the hose and cable during times of maintenance. **The hose can be squeezed into and out of the hook.**
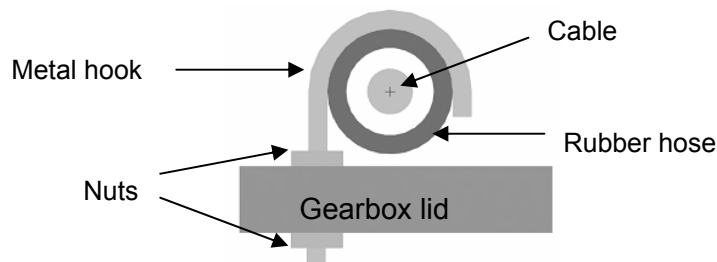
Figure 21 - Securing the cable

3.2.3 Fitting rotating connector type 'B' and connecting the sensor cable to the Mercotac

The procedure described below will be broadly similar in principle irrespective of the routing option selected.

- Drill or cut a central hole in top cover lid, approximately 50mm diameter.

- Using the bearing holder plate as a template, mark and drill the three fixing bolt holes.

- Fix flange bolts into place as indicated.

- Position the rotating connector over the hole, easing spare cable back through the rubber hose and secure by tightening nuts on the three bolts.

- With the cable connected to the Hydro-Probe Orbiter, feed up through the Mercotac holder and cut to the correct length.

- Cut back the cable sheath and crimp on spade terminals.
  At most, 6 conductors are used so any unused conductors can be cut back

- Connect to the Mercotac terminals (See section 3.4 Mercotac wiring connections).
  The static end of the Mercotac should be already connected to the terminal blocks.

- Ease the Mercotac back into the holder. The retaining 'O' ring may make this difficult so a small application of grease/oil would make this easier.

- Fix the rotating connector body to the bearing holder plate.

- Wire plant cable to terminal block in rotating connector.

- Provide earth continuity wiring for rotating connector.

3.3 Type 'C' rotating connector assembly

This is almost identical to the type 'B' rotating connector and will also provide a direct replacement for the HydroStop rotating connector.

3.3.1   Suitable applications

Suitable for some Skako-Couvrot mixers with an 80mm metal tube mounting.

3.3.2   Features

The type 'C' rotating connector is provided with a bottom spigot flange over which an 80mm rubber tube may be fitted, thereby providing a sealed connection.

The arrangement for a type 'C' connector also requires threaded adapters that enable the Mercotac holder to be directly attached to the mixer rotating tube that carries the cable from the sensor.
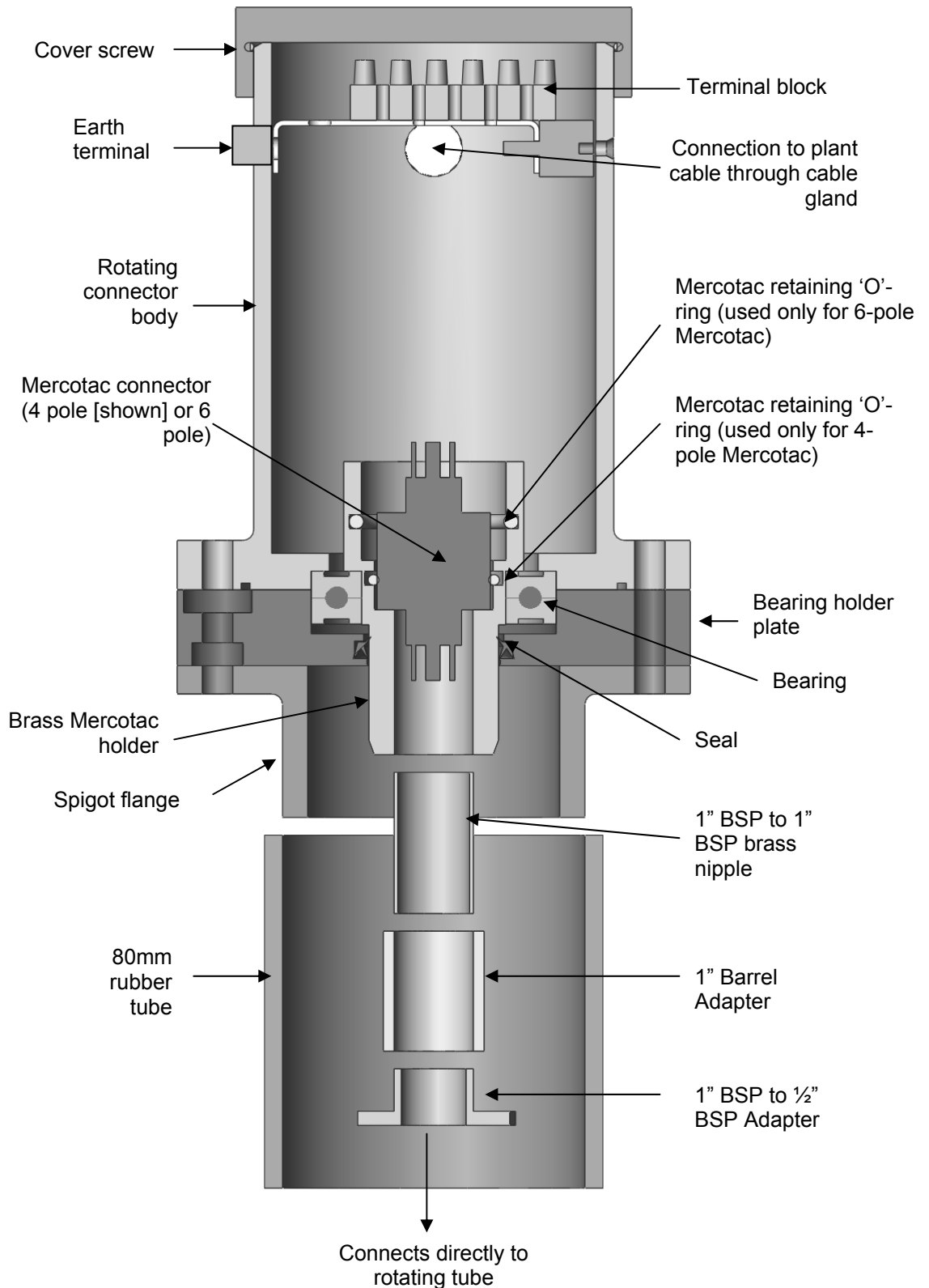
Figure 22 - Type 'C' rotating connector assembly

3.3.3 Fitting rotating connector type 'C' and connecting sensor cable to Mercotac

The procedure for fitting the type 'C' will be similar in principle to the type 'B' except for connecting the threaded adapters and the 80mm rubber tube.

- Over the mixer rotating tube fit the 80mm rubber tube, the spigot flange then the bearing holder plate.

- Screw on the brass adapters to the mixer rotating tube.

- With the Mercotac removed from the holder, screw the Mercotac holder on top of the brass adapters.

- With the cable connected to the Hydro-Probe Orbiter, feed the cable up through the rotating tube and the Mercotac holder and cut to the correct length.

- Cut back the cable sheath and crimp on spade terminals.
  At most 6 conductors are used, so unused conductors can be cut back.

- Connect to Mercotac terminals (See section 3.4 Mercotac wiring connections).
  The static end of the Mercotac should be already connected to the terminal blocks.

- Ease the Mercotac back into the holder. The retaining 'O' ring may make this difficult, so a small application of grease/oil would make this easier.

- Fix the rotating connector body to the bearing holder plate and spigot flange.

- Tighten the thread adapters, and slide over the 80mm rubber tube securing both ends with hose clips.

- Wire plant cable to terminal block in rotating connector.

- Provide earth continuity wiring for rotating connector.

3.4   Mercotac wiring connections

When connecting the Hydro-Probe Orbiter to the rotating connector, it is important to maintain the correct wiring to avoid possible damage to the sensor electronics. The orientation of the terminals on the Mercotac for both the 4-pole and the 6-pole is illustrated in Figure 23. The top end (marked on the side of the Mercotac with an arrow pointing upwards), remains static and this should be already connected to a terminal block. **It is essential the Mercotac is mounted the correct way up.** The terminal block has pins that allow it to directly connect into a second terminal block mounted on the bracket in the rotating connector body. Table 1 below shows the connections from the Mercotac to the terminal block using the pin-referenced numbers in Figure 23.

Terminal block		4-pole Mercotac	6-pole Mercotac
+24V	Red	3	3
0V	Black	4	4
RS485 A	White	1	1
RS485 B	Violet	2	2
Analogue output (+)	Blue	--	5
Analogue output (-)	Green	--	6

Table 1 – Rotating connector terminal block to Mercotac connections

** Note that these terminals are located nearer to the edge compared with their opposite terminals
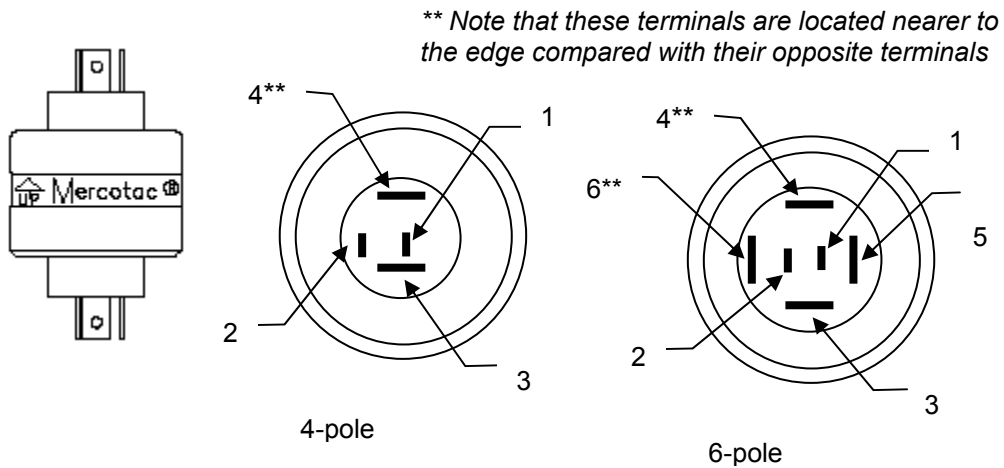
Figure 23 - Terminal configuration of the Mercotac connectors

3.4.1   Wiring sensor cable to Mercotac

The wiring instructions for the sensor cable are shown in table 2 below. Please refer to Engineering Note EN0035, enclosed with the cable, for full information. The twisted pair numbers are referenced to the table in EN0035 and the Mercotac terminal numbers are as shown in Figure 23.

If there is any doubt as to the terminal connections on the Mercotac, check continuity using an electrical meter between the terminals at the bottom of the Mercotac (rotating section) and the screw terminal block in the rotating connector body.

Sensor Cable 0090A twisted pair			4-pole Mercotac	6-pole Mercotac
Number	Signal	Colour		
1	+24V	Red	3	3
1	0V	Black	4	4
4	RS485 A	White	1	1
4	RS485 B	Black	2	2
3	Loop +	Blue	--	5
3	Loop -	Black	--	6

Table 2 – Rotating connector sensor cable to Mercotac connections

4 Wiring connections

The Hydro-Probe Orbiter is connected using a 4 metre cable (part no 0090A). An extension cable (twisted pairs) from the rotating connector to the plant control room should be provided by the customer or agent installing the sensor. Up to 3 twisted pairs may be required dependent on installation requirements. It is recommended that a high quality cable with a good braid <u>and</u> foil screen is used to minimise electrical interference, containing 22 AWG, 0.35mm^2 conductors. Recommended cable types are Belden 8303 or Alpha 6374. 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 rotating connector 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.

4.1 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 5, 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 24)

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	1st Digital input	Yellow
2	--	-	Black (Cut back)
3	D	1st Analogue Positive (+)	Blue
3	E	1st Analogue Return (-)	Black
4	F	RS485 A	White
4	G	RS485 B	Black
5	J	2nd Digital input	Green
5	--	-	Black (Cut back)
6	D	2nd Analogue Positive (+)	Brown
6	K	2nd Analogue Return (-)	Black
	H	Screen	Screen

Table 3 – Sensor cable (0090A) connections

Applies to analogue and multi-drop connections
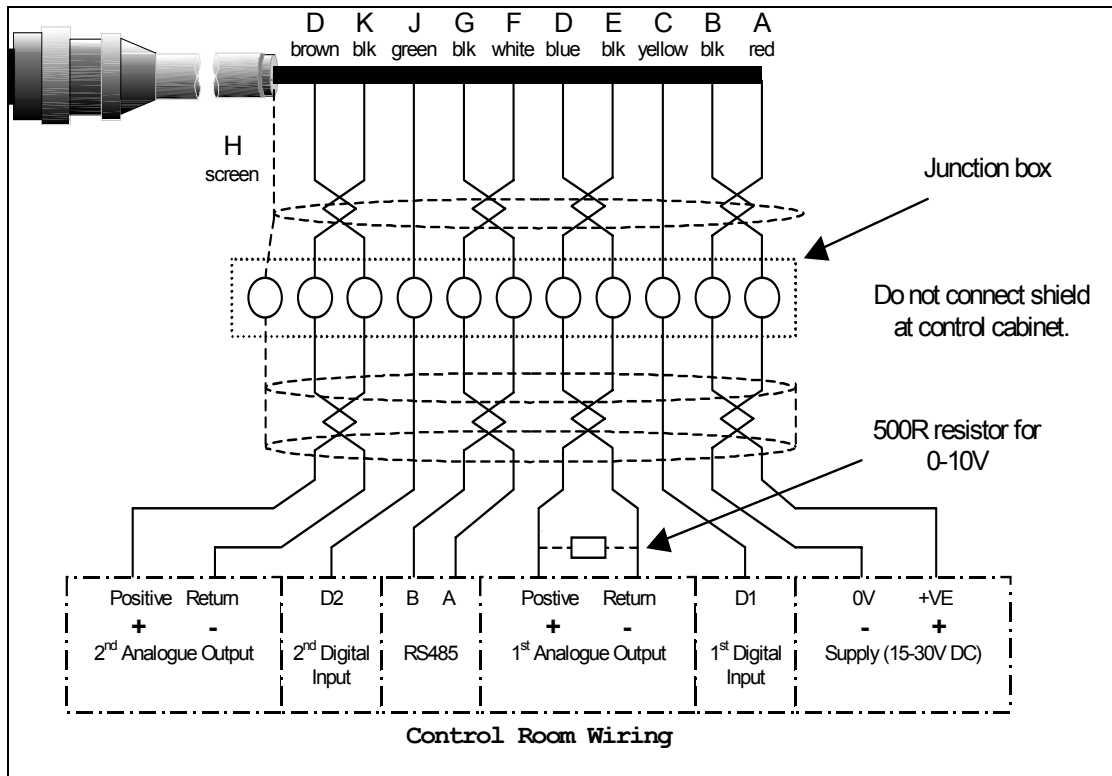
Figure 24 – Sensor cable (0090A) connection

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.

4.2   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
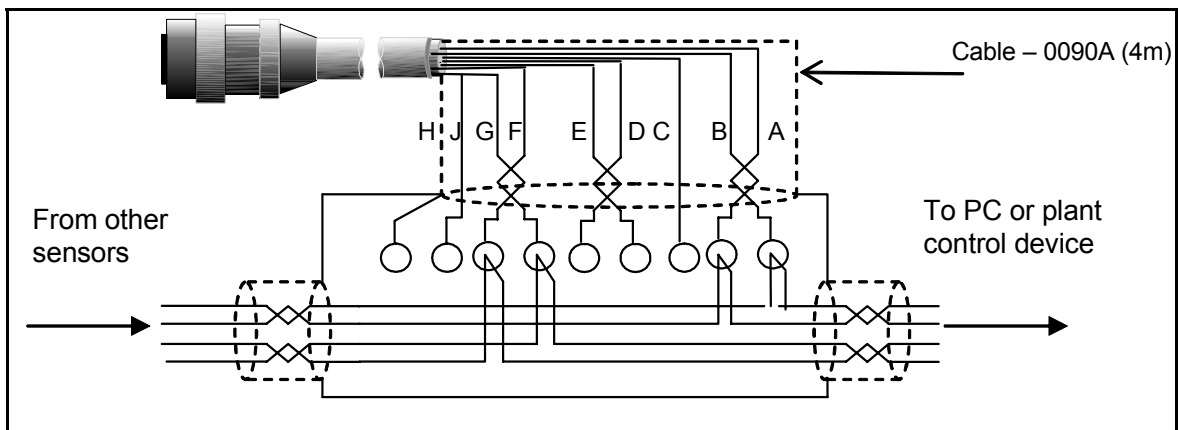
Figure 25 - Multi-drop connection

4.3   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 5. 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 26.
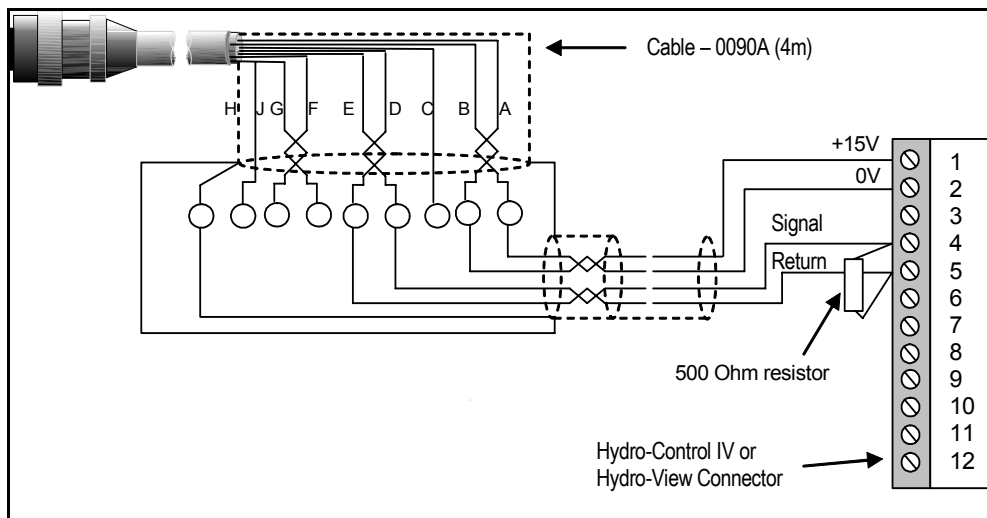
Figure 26 - Compatibility mode

4.4   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 27.

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 28, 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.
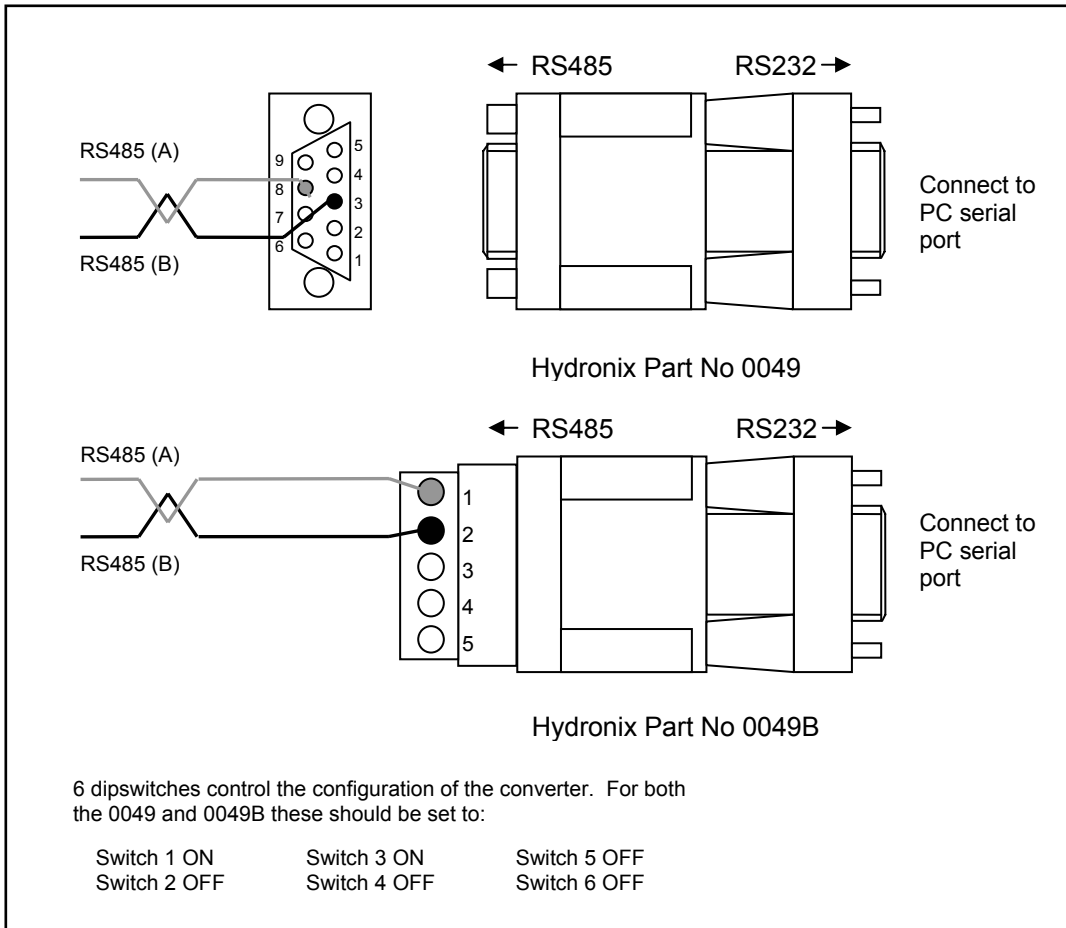
Figure 27 - RS232/485 converter connections
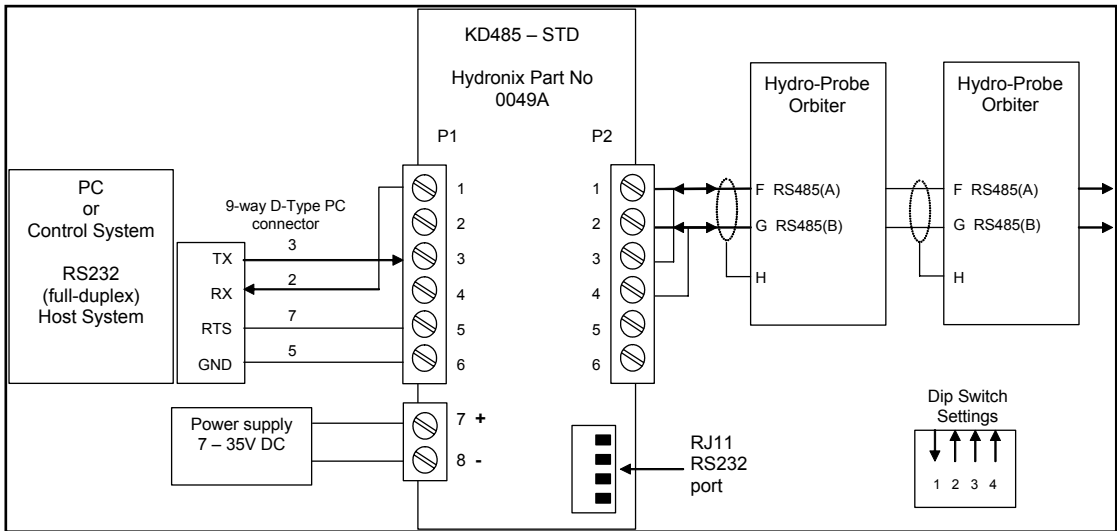
Figure 28 - Din rail mounting RS232/RS485 converter

5 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 Standard Default	Range/options
Moisture calibration		
A	0.0000	
B	0.2857	
C	-4.0000	
SSD	0.00	
Signal processing configuration		
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
Averaging configuration		
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
Input/output configuration		
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
Temperature compensation		
Electronics temp. coeff	0.002	
Resonator temp. coeff	0.0075	

Table 4 - Hydro-Probe Orbiter default parameters

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

5.1 Calibration parameters

The default calibration parameters in Table 4 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.

5.2 Average/Hold Delay

This parameter would only be used for applications where the Hydro-Probe Orbiter is replacing the Hydro-Probe II in high wear environments (see HD0215 Hydro-Probe Orbiter Manual – Static Mounting). Therefore in mixer applications this should be set to zero (0) for the Hydro-Probe Orbiter.

5.3 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

5.4 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, which correspond to 5, 2.5 and 1.25 unscaled units per second respectively.

5.5 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.

5.6   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.

<u>Input Use 1</u>

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.

<u>Input/Output Use 2</u>

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)

6 Sensor care

6.1 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 and rotating connector.**

CAUTION – NEVER HIT THE SENSING ARM

Notes:

7 Replaceable parts

7.1 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.

7.1.1 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).

7.1.2 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.

7.2 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.

7.2.1 Autocal

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 4.4) 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 29, 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 30.

Figure 29 - The Hydronix Autocal Dongle
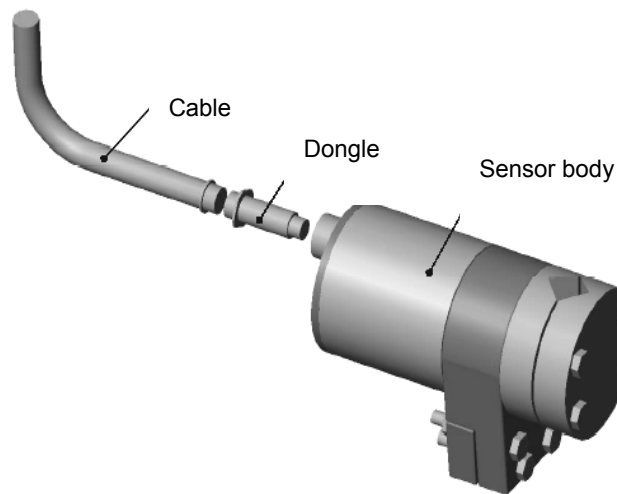
Figure 30 - Connecting the Hydronix Autocal Dongle for calibration

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 30. 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.

7.2.2 Air and water calibration

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 4.4), 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 31), 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.

200mm min.

Sensor in the water bath

Sensor

Minimum water depth 200mm
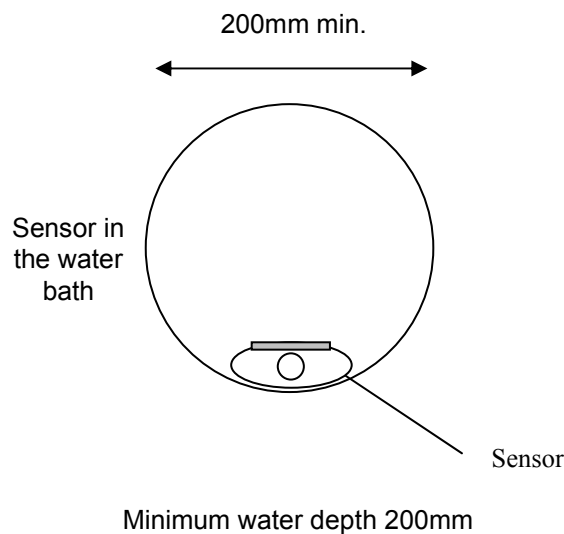
Figure 31 - Air-water calibration

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:

8 Troubleshooting tips

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

8.1 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.

8.2 Electrical

- Ensure that the cable is of suitable quality – the minimum specification is twisted pairs of 22 AWG ($0.35mm^2$) conductors, screened with aluminium/polyester foil and 65% minimum coverage braid – Belden 8303 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.

8.3 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.

8.4   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.

8.5   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.

8.6   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.

8.7 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 $2.5m^3 + 2.5m^3 + 1.0m^3$ 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:

    o Load aggregates (including steel or rigid plastic fibres if used).
    o Load microsilica slurry, if used.
    o Load cement just after aggregates start (and after micro silica slurry, if used).
    o Run cement and aggregates together (and silica fume powder, if used).
    o Finish cement before aggregates.
    o Allow sufficient dry mix time to obtain a good stable signal.
    o Measure moisture content.
    o Load water and admixtures.
    o Wet mix until the signal is stable.

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

Notes:

9 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

9.1   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

9.2   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.

9.3   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:

10　Technical specification

10.1　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)

10.2　Construction

- Body: stainless steel (AISI 304)

- Sensing head: Hardened stainless steel (wear resistant surface coating also available)

- Faceplate: Alumina ceramic

10.3　Penetration of field

- Approximately 75 – 100 mm dependent on the material

10.4　Operating temperature range

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

10.5　Supply Voltage

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

10.6　Connections

10.6.1　Sensor cable

- 3 pairs twisted (6 cores total) screened (shielded) cable with 22 AWG, 0.35mm^2 conductors

- Screen (shield): Braid with 65% minimum coverage plus aluminium/polyester foil

- Recommended cable types: Belden 8303, Alpha 6374

- Maximum cable run: 100 m separate to any heavy equipment power cables

10.6.2　Digital (serial) communications

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

10.7　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

10.8　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'

10.9　Grounding

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