STANDARD

OPERATING PROCEDURE

Plant Area: General

Procedure: Instrument Calibration Procedures

Doc. Ref. STD-OP02 Rev 2

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1.0 REVISIONS

Revision	Date	Description	Reviewed	Approved
0	12/08/2021	First issue	GC	DB
1	?	?	?	?
2	23/02/2023	Updated formatting	AM	DB

2.0 SAFETY

The checking or calibration of instruments involves the following safety issues:-

CAUTION: CONTACT WITH EFFLUENT / BIOLOGICAL HAZARDS

The checking or calibrating of instruments involves the likely contact with the effluent or biomass liquors. Due to the possible presence of bacteria in the effluent or biomass, there is a biological hazard associated with the instrument calibration.

During any instrument checking/calibration activity the following PPE is recommended as a minimum:-

- **Rubber Gloves**
- **Eye protection glasses**

Following this activity, operators must wash their hands before consuming food or drink or entering any food/drink manufacturing areas.

CAUTION: HIGH PRESSURE OPERATION OF SYSTEMS

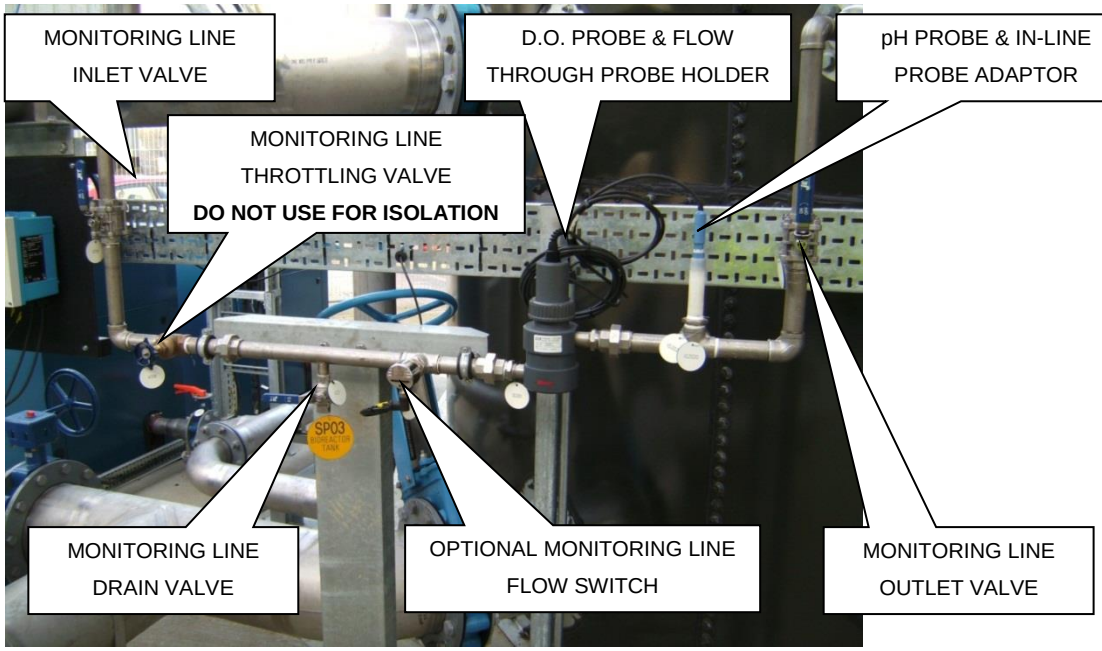
The instruments to be calibrated may be installed within systems which operate at high pressure. No instrument calibration activity must be carried out until the associated system is shutdown and the pressure is alleviated, except where retractable probe assemblies (with isolation ball valves) are provided which allow the probe to be removed from a 'live' process.

REFER TO SECTION OM03 HEALTH & SAFETY, FOR FURTHER SAFETY INFORMATION.

3.0 INSTRUMENT PROBE MOUNTING ARRANGEMENTS

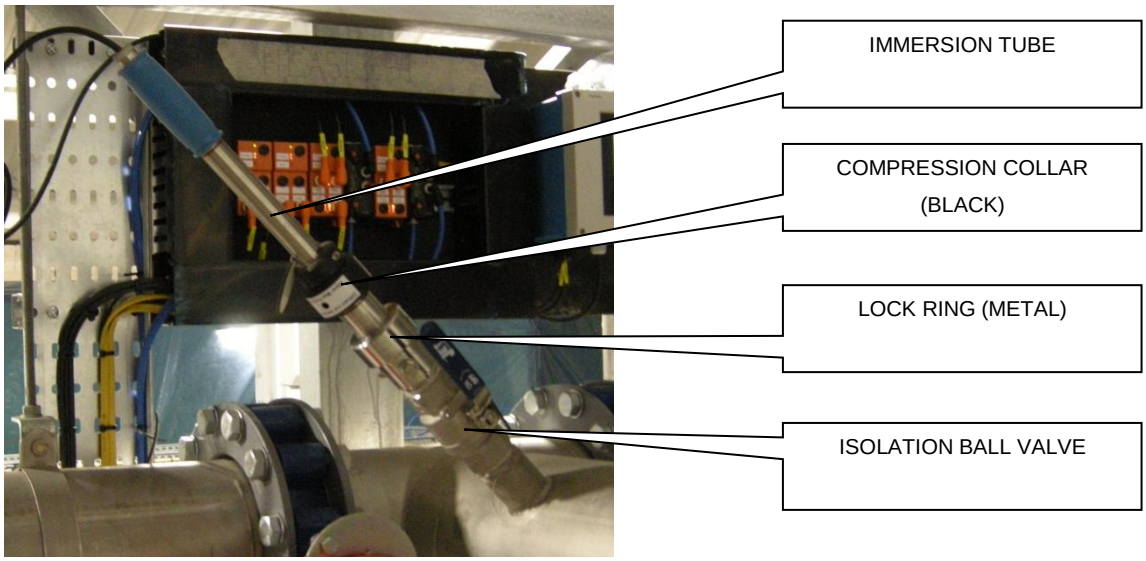
The instrument probes are normally mounted in one of two standard arrangements:-

3.1. pH/D.O. Monitoring Line Arrangement



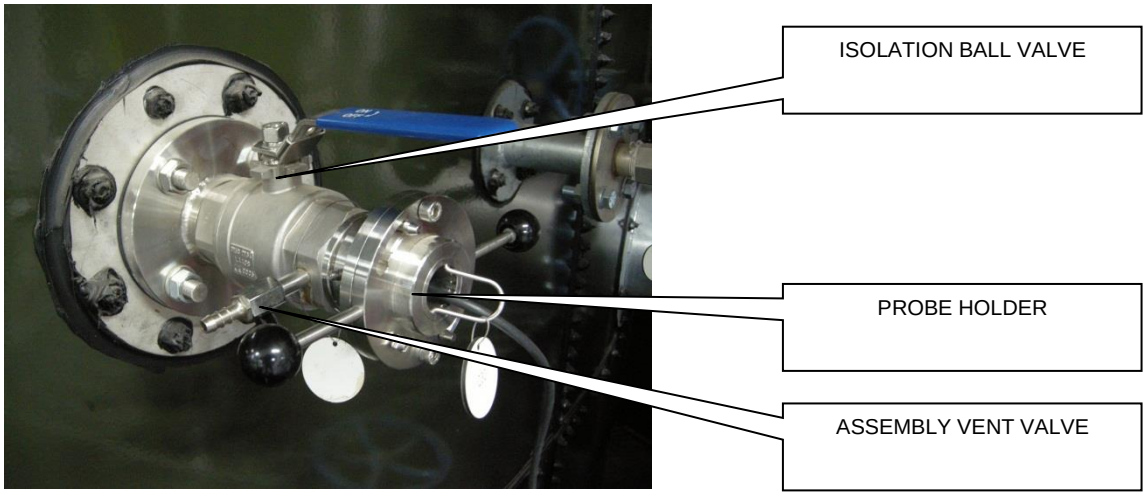
Typical monitoring line arrangement

3.2. pH Retractable Probe Assembly



Typical retractable probe assembly

3.3. D.O. Retractable Probe Assembly



Typical retractable probe assembly

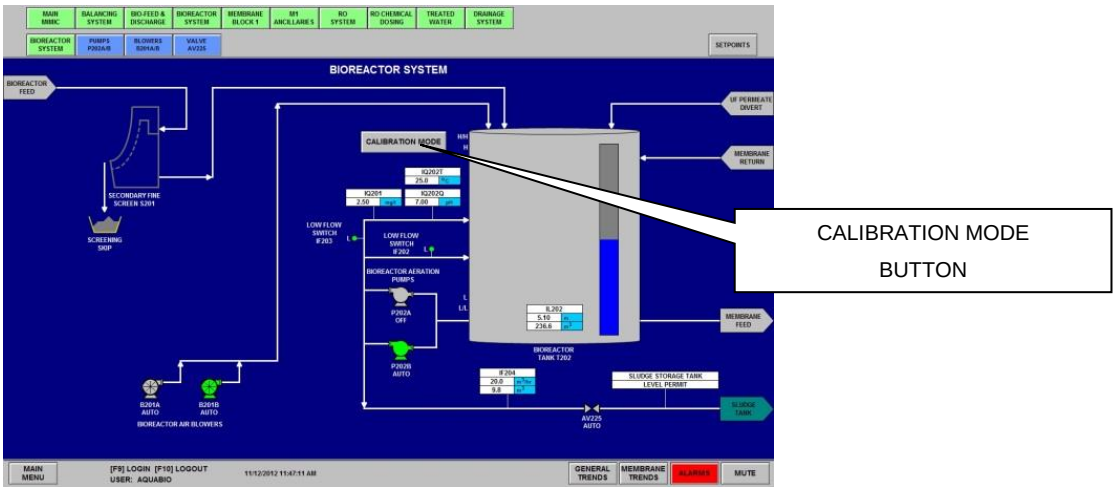
4.0 INITIATING CALIBRATION MODE

Where multiple instruments are mounted in the same monitoring line, particularly at a Bioreactor Tank where a D.O. probe is included which controls Air Blowers, the control system may include a Calibration Mode function. When activated this function holds the values of all the instruments associated with the monitoring line and ignores the low flow signal from any associated flow switch (where fitted).

1. If Calibration Mode is included, it is recommended to wait until the associated D.O. reading is high before pressing the CALIBRATION button as the D.O. reading will be held during the process and this ensures that the aeration control is not ramped up to the maximum number of blowers operating during the calibration.

NOTE:
If the CALIBRATION button is pressed when the D.O. value is low (i.e. less than 1 mg/l) the Aeration Control will ramp up to the maximum number of Air Blowers running continuously during the calibration process. Running all blowers continuously for long periods can lead to excessive foaming at the Bioreactor Tank.

2. If required, activate the Calibration Mode by pressing the CALIBRATION button at the associated Process Mimic Page. The button goes to flashing green to indicate the calibration mode is active. This holds the last values of the associated instruments e.g. D.O. and pH and prevents a low flow alarm from any associated flow switch for 30 minutes at which point a warning alarm will be raised. After a further 10 minutes a critical alarm is raised.



Typical Process Mimic Page with CALIBRATION button

5.0 CALIBRATION OF PH PROBE

The following instructions should be read in conjunction with the manufacturer's literature. To carry out a calibration of a pH probe, the following procedures apply:-

5.1. Initial Considerations

1. Suitable pH buffer solutions (pH 4.0 and pH 7.0) must be available before starting the calibration procedure.

2. Due to the possible contact with effluent/biomass the appropriate Personnel Protective Equipment must be worn prior to starting the calibration.

3. If required, activate the associated Calibration Mode function prior to starting the instrument checking/calibration as described in Section 3.0.

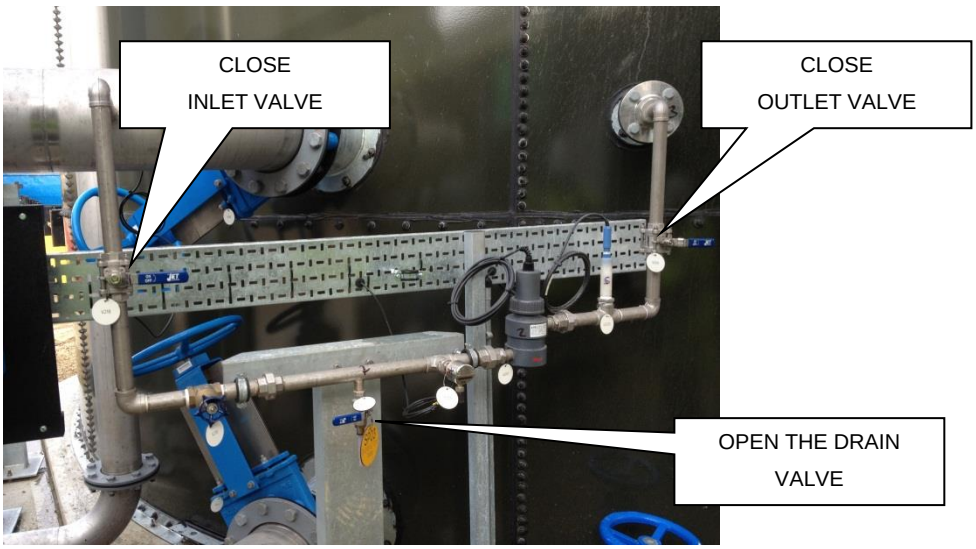
5.2. Isolating and Removing Instrument Probe

5.2.1. Monitoring Line Arrangement

Where the instrument is installed in a monitoring line arrangement the following steps must be taken to isolate and remove the probe:-

1. Isolate the line by closing the inlet and outlet valves.
   Note: Do not use the gate valve to isolate the line; this is a throttling valve for setting the flowrate through the monitoring line.

2. Drain the monitoring line by opening the drain valve.



3. Carefully unscrew the pH probe from the white probe holder. It should not be necessary to unplug the electrical connection as the probe connection thread can be rotated without rotating the probe.

4. Clean the pH probe if necessary with a damp cloth.



5.2.2. Retractable Probe Assembly

Where the instrument is installed in a retractable probe assembly the following steps must be taken to isolate and remove the probe:-

1. Securely hold the immersion tube to prevent movement if the system is under pressure.

2. Using the supplied hook wrench, carefully loosen the compression fitting (black collar) by ¼ to ½ revolution.



3. Pull the immersion tube out of the process until it stops at the "service" position.



4. Carefully close the ball valve to isolate the probe from the process.
   Take care that the probe is fully withdrawn otherwise the probe could be damaged by closing the ball valve.



5. Using the supplied hook wrench, loosen the lock ring (metal collar).



6. Unscrew the lock ring such that the immersion tube and probe can be removed from the isolation ball valve.

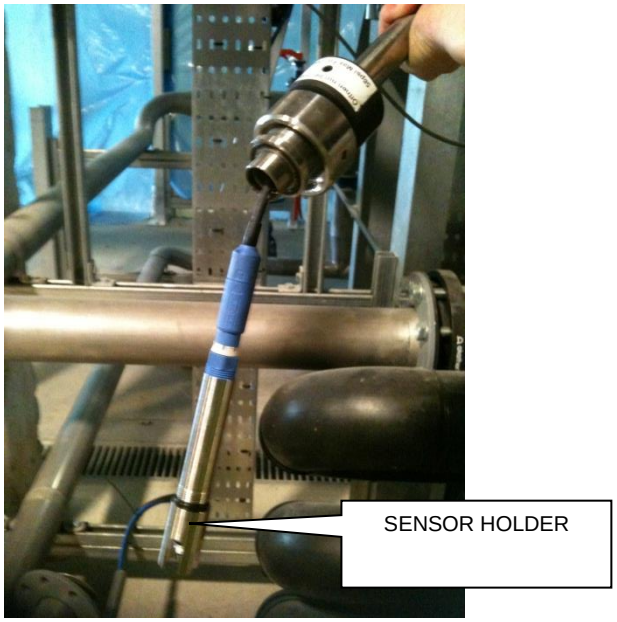




7. Loosen the cable gland at the top of the assembly and then unscrew the sensor holder from the immersion tube.

8. Carefully unscrew the pH probe from the sensor holder. It should not be necessary to unplug the electrical connection as the probe connection thread can be rotated without rotating the probe.

9. Clean the pH probe if necessary with a damp cloth.



5.3. Calibration Sequence

Once the instrument probe is isolated and removed from the process arrangement, the calibration sequence can be carried out as follows:-

1. At the transmitter, press the **CAL** button.



2. On next screen, select **CH2 1:2 pH Glass**. Turn wheel to highlight then press centre of wheel to confirm.



3. On next screen, select **2-Point Calibration**.



4. Transmitter will show "**Do you want to start calibration?**". Press **OK** to confirm.



5. Transmitter will show "**Buffer 1 – 7.00 pH. Please clean sensor before immersing in buffer 1.**"



6. Rinse the pH probe with de-ionised water. **Do not dry the sensor.**



7. Place the probe in pH 7 buffer solution. **Ensure that the probe and buffer solution are suitably supported and secure to prevent any possible upset which may lead to damage of the glass probe**.



8. At transmitter, press **OK** to start calibration.



9. Transmitter will show "**Waiting for stable meas. value**".



10. When stable reading has been achieved, transmitter will show "**Buffer 2 – 4.00 pH. Please clean sensor before immersing in buffer 2.**"

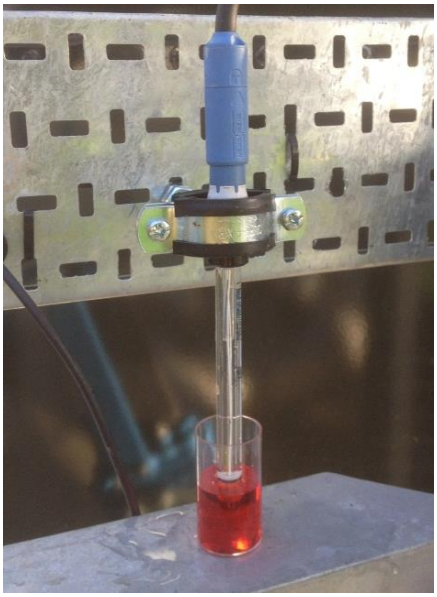


11. Rinse the pH probe with de-ionised water. **Do not dry the sensor.**

12. Place sensor in pH 4 buffer solution.

13. At transmitter, press **OK** to start calibration.

14. Transmitter will show "**Waiting for stable meas. value**".



15. When stable reading has been achieved, transmitter will show "**Do you want to take over the calibration data for adjustment?**".

16. Press **OK** to accept new calibration.



17. Transmitter will show "**Calibration is finished**".

18. Press **OK**.

19. Press **ESC** repeatedly to return to User Defined Screen 1 (normal view).



5.4. Refitting the Probe

Once the calibration procedure has been completed the probe can be refitted into the process.

5.4.1. Monitoring Line Arrangement

1. Re-fit the pH probe into the probe holder and tighten (hand tight is sufficient).

2. Ensure that the drain valve for the monitoring line is closed, then open the inlet and outlet valves to allow flow back through the monitoring line.

3. If fitted, check that flow is re-established in the monitoring line by checking the LED display at the flow switch.

5.4.2. Retractable Probe Assembly

1. Screw the sensor holder into the immersion tube until it stops and hand tighten it.

2. Insert the assembly in the isolation ball valve.

3. Tighten the lock ring using the supplied hook wrench.

4. Open the ball valve.

5. Push the immersion tube into the process until stopped by the setting collar.

6. Tighten the compression fitting hand-tight. Then use the supplied hook wrench to further tighten the compression fitting by 1/8 revolution (45°).

5.5. Final Steps

1. If previously activated, switch off the Calibration Mode by pressing the CALIBRATION MODE button at the associated Process Mimic Page – button goes back to grey.

2. Wait for the reading to stabilise and compare with previous results.

3. Record date and time of instrument checking / calibration.

6.0 CHECKING / CALIBRATION OF D.O. PROBE

The following instructions should be read in conjunction with the manufacturer's literature. To carry out the checking / calibration of a D.O. probe, the following procedures apply:-

6.1. Initial Considerations

1. Due to the possible contact with effluent/biomass the appropriate Personnel Protective Equipment must be worn prior to starting the calibration.

2. If required, activate the associated Calibration Mode function prior to starting the instrument checking/calibration as described in Section 3.0.

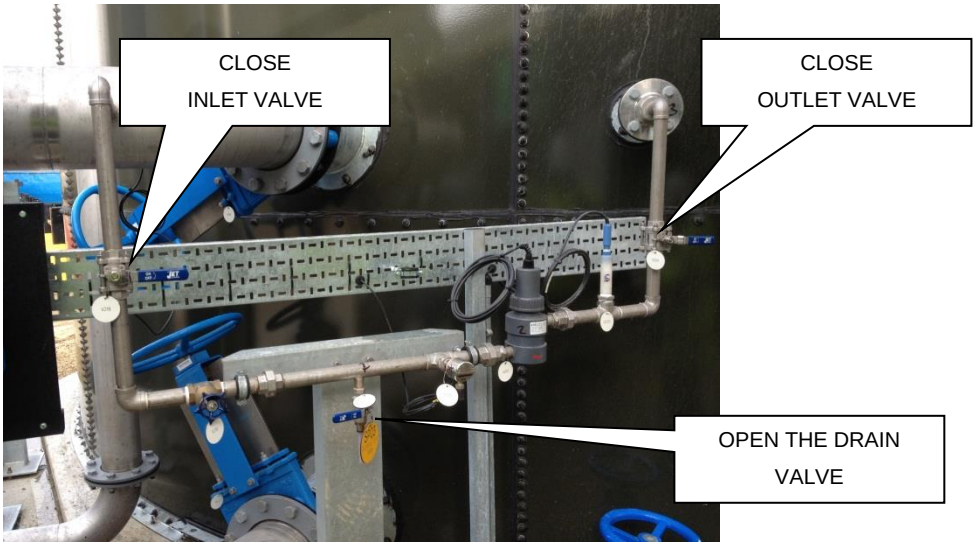
6.2. Isolating and Removing Instrument Probe

6.2.1. Monitoring Line Arrangement

Where the instrument is installed in a monitoring line arrangement the following steps must be taken to isolate and remove the probe:-

1. Isolate the line by closing the inlet and outlet valves.
   Note: Do not use the gate valve to isolate the line; this is a throttling valve for setting the flowrate through the monitoring line.

2. Drain the monitoring line by opening the drain valve.



3. Unscrew the collar at the top of the D.O. probe holder and remove the D.O. probe.

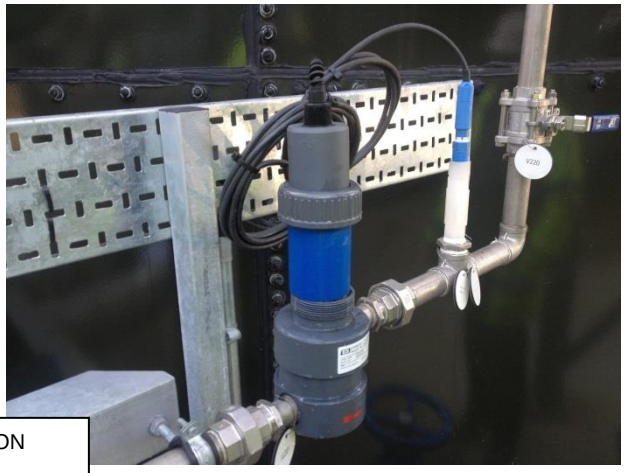


4. Inspect the surface of the D.O. probe. If necessary flush with water and clean probe with a damp cloth.

5. Wash the monitoring line through to drain valve with clean water.



6. Using the D.O. calibration spacer, mount the probe back into the probe holder. This allows the probe to measure the saturation of oxygen in air but protects the probe from sunlight and the wind which can prevent stable readings.



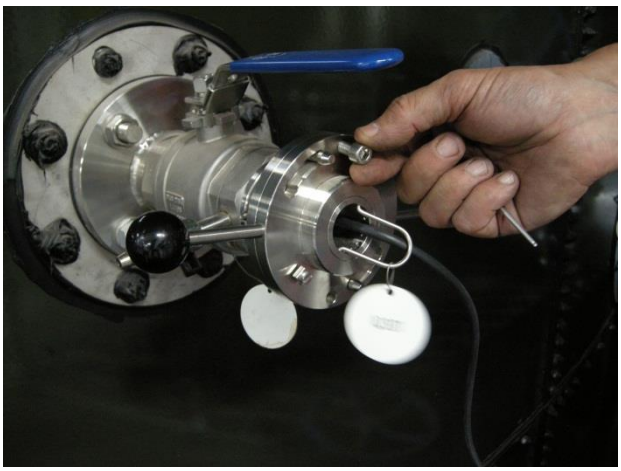


CALIBRATION SPACER

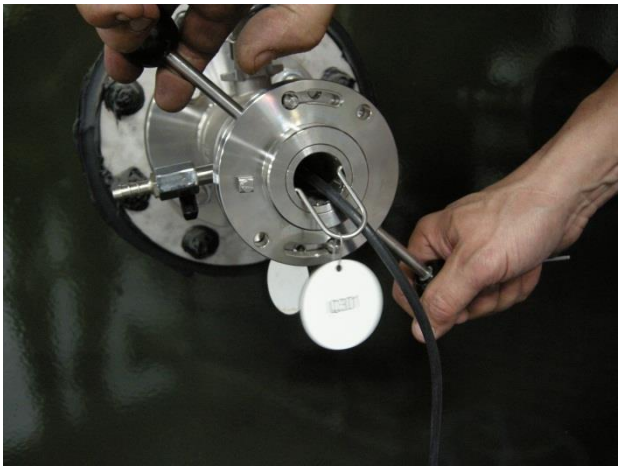
6.2.2. Retractable Probe Assembly

Where the instrument is installed in a retractable probe assembly the following steps must be taken to isolate and remove the probe:-

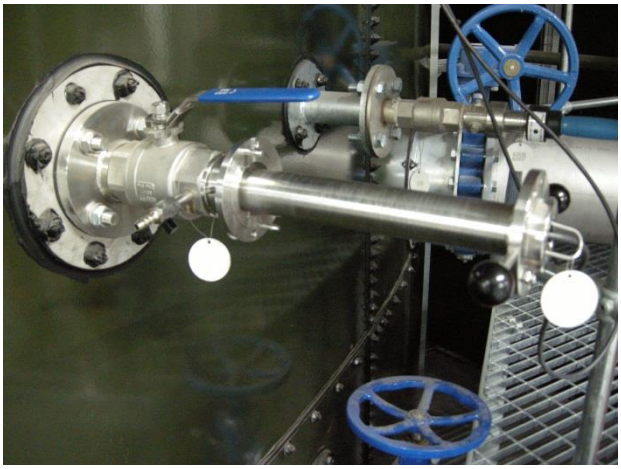
1. Firstly loosen and remove the fastening screws using an Allen key. Place screws in safe place for later re-installation.



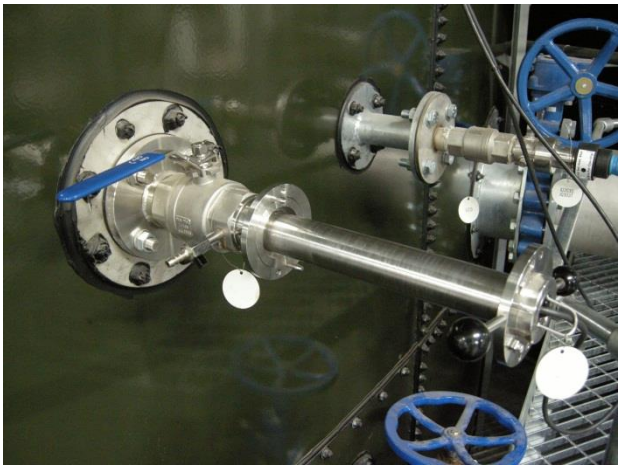
2. Open the bayonet joint by rotating the barrel of the probe holder in a clockwise direction.



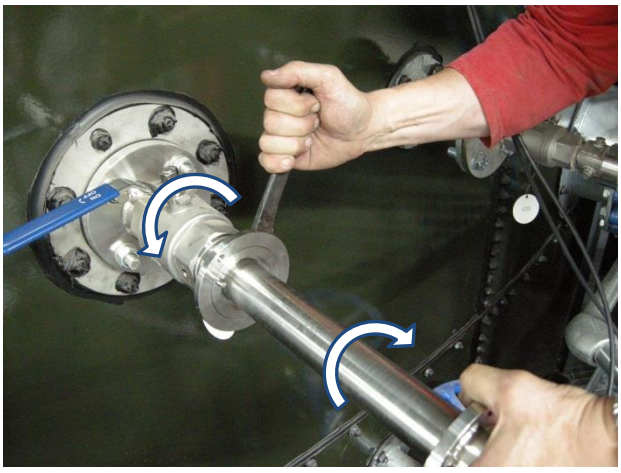
3. Using the handles carefully pull the immersion tube out of the process until it stops at the "service" position.
   The probe holder can sometimes get stuck in the isolation ball valve assembly. Ensure that the ball valve is correctly aligned to allow the probe to be removed.



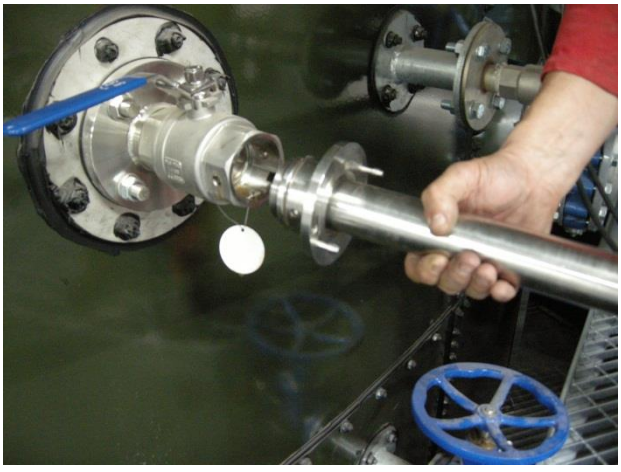
4. Once the probe is in the “service” position, carefully close the ball valve to isolate the probe from the process.
   Take care that the probe is fully withdrawn otherwise the probe could be damaged by closing the ball valve.



5. Using a C-spanner (supplied) un-thread the probe assembly from the ball valve.
   Probe holder can be rotated in the opposite direction to prevent cable becoming tangled.

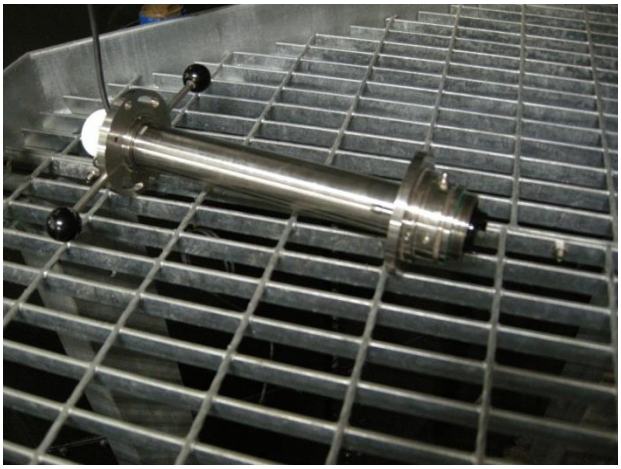


6. Once it is un-threaded, remove the probe assembly from the ball valve.



7. Inspect the surface of the D.O. probe. If necessary flush with water and clean probe with a damp cloth.

8. Position the D.O. probe and immersion tube assembly in a suitable secure location to allow the probe to measure the saturation of oxygen in air. Ideally the probe should be out of direct sunlight and protected from the wind which can prevent stable readings.



6.3. Checking Sequence

Regular calibration of a Dissolved Oxygen (D.O.) probe is not expected to be required. Instead the manufacturer recommends regular checking of the D.O. saturation measurement.

Once the instrument probe is isolated, removed from the process arrangement and set-up for checking/calibration, the checking sequence can be carried out as follows:-

1. To check the D.O. sensor accuracy it is necessary to view the measurement in % Saturation rather than mg/l. The following steps are required to view the measurement in % Sat.



2. At the transmitter, press the **Menu** button.



3. On next screen, select **Display / operation**. Turn wheel to highlight then press centre of wheel to confirm.

4. On next screen, select **User definable screens**.



5. On next screen, select **Screen 1 [On]**.



6. On next screen, select the **Line Number which has been set-up to show the Oxygen Reading**.



7. On next screen, select **Measured value**.



8. On next screen, select **Saturation**.



9. Press **ESC** repeatedly to return to display page. The value for D.O. will be displayed as **% SAT**.



10. Wait for stable reading to be achieved. This may take 10-20 minutes.

11. When a stable reading has been achieved, check that a saturation value of **100 ±2 % SAT** is achieved.



12. If the value is outside this range, calibration of the D.O. probe is recommended.

13. If the value is within the range then the D.O probe does not need calibration and can be returned to normal service.

14. To return the measured display to mg/l, repeat steps 3 – 8 to select **Measured value**.



15. On next screen, select **Concentration liquid**.

16. Press **ESC** repeatedly to return to display page. The value for D.O. will be displayed as **mg/l**.

6.4. Calibration Sequence

If the required Saturation value of **100 ±2 % SAT** is not achieved in the Checking Sequence, calibration of the D.O. probe is required.

Once the instrument probe is isolated, removed from the process arrangement and set-up for checking/calibration, the calibration sequence can be carried out as follows:-

1. At the transmitter, press the **CAL** button.



2. On next screen, **select the Channel used for the Oxygen probe**. Turn wheel to highlight then press centre of wheel to confirm.



3. On next screen, select **Oxygen (opt.)**.



4. On next screen, select **Slope**.



5. On next screen, select **Air 100% rh**.



6. Transmitter will show "**Do you want to start calibration?**". Press **OK** to confirm.



7. Next screen shows "**Please clean sensor before immersing in medium/air**". Press **OK** to start calibration.



8. Wait for stable reading to be achieved. This may take 10-20 minutes.



9. When stable reading has been achieved, transmitter will show "**Do you want to accept the calibration data for adjustment?**".

10. Press OK to accept new calibration.



11. Transmitter will show "**Calibration is finished**".

12. Press **OK**.

13. Press **ESC** repeatedly to return to User Defined Screen 1 (normal view).



6.5. Refitting the Probe

Once the calibration procedure has been completed the probe can be refitted into the process.

6.5.1. Monitoring Line Arrangement

1. Re-fit the D.O. probe into the probe holder and tighten (hand tight is sufficient).

2. Ensure that the drain valve for the monitoring line is closed, then open the inlet and outlet valves to allow flow back through the monitoring line.

3. If fitted, check that flow is re-established in the monitoring line by checking the LED display at the flow switch.

6.5.2. Retractable Probe Assembly

1. It is recommended to grease the outer sleeve of the probe holder to ensure the assembly moves in and out smoothly. See manufacturer's manual for recommended grease.

2. Insert the probe and immersion assembly in the isolation ball valve and thread into the ball valve using the C-spanner.
   Rotate the probe holder in opposite direction during this to prevent cable tangling.

3. Ensure the vent valve on the side of the assembly is closed.

4. Carefully open the ball valve and check for leaks on the assembly.

5. Push the immersion tube as far as possible into the process.
   The probe holder can sometimes get stuck in the isolation ball valve assembly. Ensure that the ball valve is correctly aligned to allow the probe to be removed.

6. Lock the sensor holder using the bayonet joint and refit fastening screws. This prevents the sensor holder from returning inadvertently into the "Service" position.

6.6. Final Steps

1. If previously activated, switch off the Calibration Mode by pressing the CALIBRATION MODE button at the associated Process Mimic Page – button goes back to grey.

2. Wait for the reading to stabilise and compare with previous results.

3. Record date and time of instrument checking / calibration.