Data Sheet
SS/9435_7

Low and High Level Dissolved Oxygen Monitor

9435

- **Monitors both high and low dissolved oxygen concentrations**
  – making it suitable for measurement during two shift and base load operation on power stations
- **Fast response**
  – reacts to rapid changes in plant operation
- **Microprocessor system**
  – provides automatic calibration and range changing
- **Disposable sensor and no routine maintenance**
  – give low running costs

Introduction

The high costs involved in replacing damaged equipment coupled with the need to extend the periods between plant overhauls has resulted in increased importance being placed on preventative maintenance. To reduce corrosion damage to boilers and related equipment, this principle has been extended to maintaining the quality of feed water running through the process system.

One of the major forms of boiler damage is oxidative corrosion. This occurs when oxygen dissolved in the process water comes into contact with the metal surfaces inside the boiler. During these conditions, electrolytic action establishes a potential difference between the oxygen and metal which, if allowed to continue, causes severe pitting and the eventual failure of the metal components.

This type of damage can be prevented if close attention is paid to oxygen levels and remedial action is taken in the event of these levels rising. Because oxygen levels tend to vary considerably during the load cycle of a plant, an analyzer is required that can cope with both high and low levels of dissolved oxygen and which is able to respond rapidly enough to enable the efficiency of deaerator and dosing systems to be checked.

General Information

The ABB 9435 Dissolved Oxygen Monitor is a microprocessor-based instrument which uses a Mackereth type sensor to measure accurately the levels of dissolved oxygen in process feed water. It has been designed specifically for in-line use on power generation and related process plant.

The Model 9435 is an accurate, reliable instrument which requires practically no maintenance and measures oxygen concentrations over the ranges 0 to 19.9µgkg^{-1}, 0 to 199µgkg^{-1}, 0 to 1.99mgkg^{-1} and 0 to 19.9mgkg^{-1}. The ranges being selected manually, or if required, switched automatically by the monitor's microprocessor-based electronics package. Two isolated current outputs are provided as are two high concentration alarms. The complete monitor is housed in two lockable steel cases consisting of a liquid handling section and an electronics section. The electronics case is protected to IP55 (NEMA 3) and can be separated from the liquid handling section by up to 100m (32.5 ft) if required.

Liquid Handling Section

The liquid handling section contains the following components: a constant head unit; a flow cell; a solenoid valve; a 'drain-run' switch; and the dissolved oxygen sensor.

Constant Head Unit – provided after the sample input to the monitor to stabilize flow conditions during sample pressure changes. It also incorporates the flow cell sample drain pot.

Dissolved Oxygen Sensor – the sensor is a disposable galvanic cell comprising a lead anode and a silver cathode in an alkaline electrolyte. The cell reactions are:

at the anode;	at the cathode;
$Pb \rightarrow Pb^{2+} + 2e^-$	$O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$

Flow Cell – this houses the dissolved oxygen sensor and sample temperature thermistor. The thermistor provides temperature information for air calibration and for automatic compensation of sample temperature variations.

Solenoid Valve – activated when the air calibration sequence is initiated, the valve diverts the sample to drain and in so doing exposes the sensor to air. It is also activated to protect the oxygen sensor should the sample temperature rise above 55°C (131°F).

Drain-run Switch – used to manually activate the solenoid valve to divert the sample to drain when replacing the dissolved oxygen sensor.

Model 9435-500 Main Components

The 9435-300 Disposable Sensor

Electronics Section

The current from the oxygen sensor and sample temperature information from the thermistor in the flow cell are fed to the microprocessor transmitter section. The electronics converts these signals into a digital display of oxygen concentration and also provides current, alarm and remote indication of range outputs.

The digital display is a seven-segment LED type which indicates the following information:

a)	Oxygen Concentration	0 to 19.9µgkg^{-1} 0 to 199µgkg^{-1} 0 to 1.99mgkg^{-1} 0 to 19.9mgkg^{-1}
b)	Running Mode	Normal – indicates oxygen concentration During calibration – indicates CAL
c)	Atmospheric Pressure	Displays atmospheric pressure settings in mmHg
d)	Alarm Settings	Displays alarm settings in µg-mgkg^{-1}
e)	Temperature above 55°C (131°F)	Displays 'hot'
f)	Near Calibration Fail	Displays CF

The information displayed depends upon the operating conditions and which push buttons on the monitor facia are depressed at the time.

The push buttons on the monitor facia are used to set/display the alarm values, the atmospheric pressure settings and to manually trigger a calibration sequence. A five-position switch mounted directly below the buttons selects the range: 0 to 19.9mgkg^{-1} (range 1), 0 to 1.99mgkg^{-1} (range 2), 0 to 199.9µgkg^{-1} (range 3), 0 to 19.9µgkg^{-1} (range 4) or automatic range change.

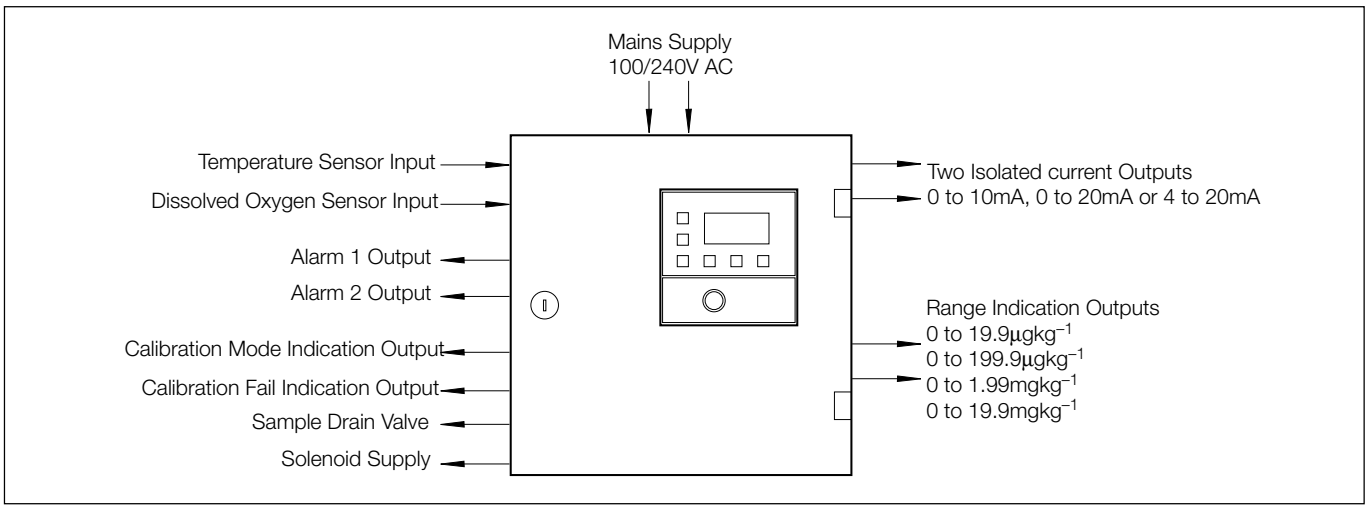
Model 9435-100 Transmitter Unit

Two isolated current outputs provide remote indication of reading and four sets of contacts give a remote indication of range, further sets of contacts energize in the event of calibration fail and alarm conditions.

An internal switch programs the monitor to fully automatically calibrate every seven days or to calibrate only when the facia button is depressed. Inputs for remotely triggering and remotely inhibiting the calibration sequence are also provided.

Atmospheric compensation – the oxygen partial pressure, and hence the sensor current, in air is a function of the atmospheric pressure. Before a calibration routine is initiated the relevant atmospheric pressure can be programmed into the monitor facia. This introduces a correction factor into the final calculation of dissolved oxygen levels.

9435-100 Inputs/Outputs



Calibration Method

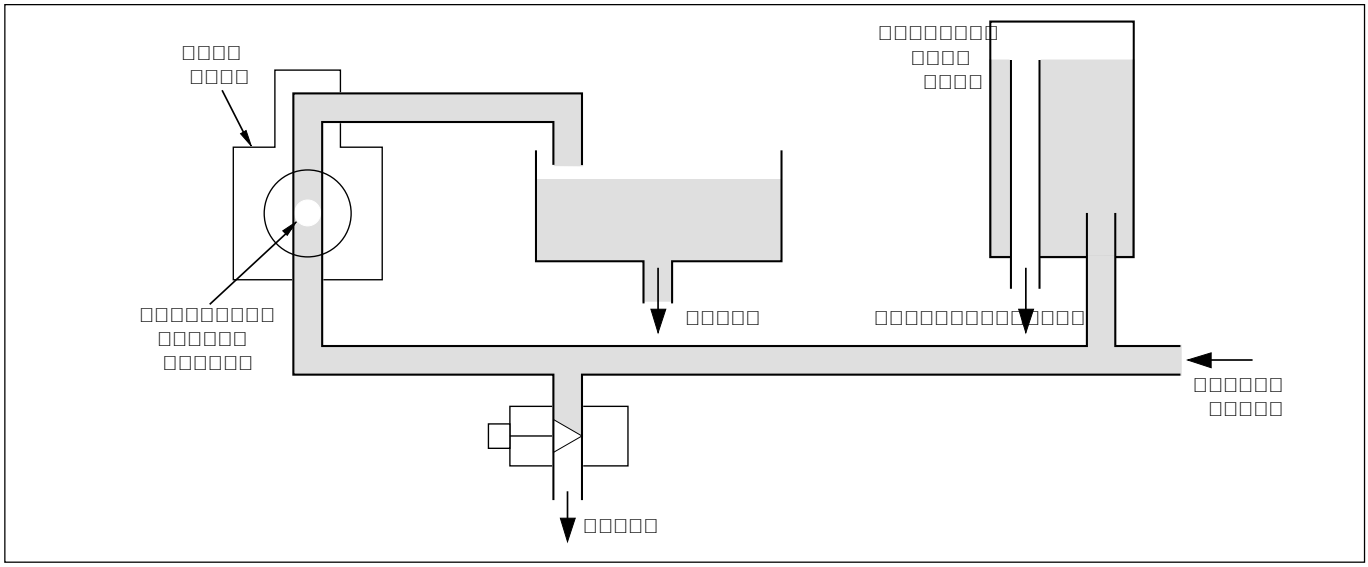
The current output from a Mackereth type sensor decreases with age, so every 1 to 4 weeks, dependent on operating conditions, the monitor may require to be recalibrated. This is achieved by the opening of a solenoid valve which drains the sample and exposes the sensor to air.

Because air contains a known proportion of oxygen, it is possible to compute the sensitivity of the sensor to oxygen and to adjust the final amplification accordingly. The calculation and adjustments are carried out by the microprocessor, which takes into account atmospheric pressure and air temperature variations.

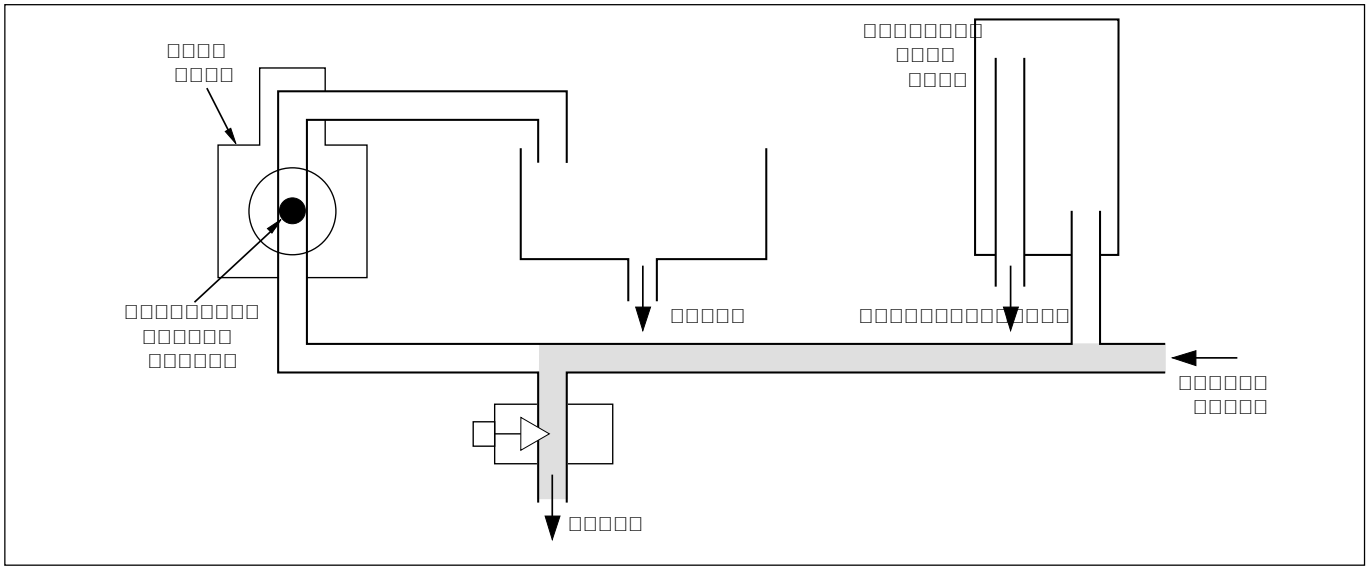
The calibration sequence itself occurs completely automatically and can be initiated manually at any time; alternatively, the monitor can be programmed so that a calibration is performed every seven days without the need for manual intervention.

During normal operating conditions the sample passes through the inlet into both the flow cell and constant head unit. The constant head unit ensures that any variation in sample pressure does not affect the sample flow rate through the cell.

When the calibration sequence is in operation or when the sample temperature exceeds 55°C (131°F) the sample is diverted to waste via the solenoid valve. The sample then drains from the constant head unit and flow cell so exposing the sensor to air.



Sample Flow During Normal Operating Conditions



Sample Flow During Calibration or Thermal Overload Mode.

Sensor Replacement

After 6 to 12 months (dependent on operating conditions) the current output of the sensor in air drops below a preset level causing the readings on the monitor to flash on and off. This gives a warning that the sensor soon needs replacing. Eventually, after a further drop in current, the monitor fails to calibrate and the calibrate fail relay is energized.

Replacement of the sensor takes less than two minutes and involves removing it from the flowcell, unscrewing it from the sensor mounting handle and replacing it with a new one.

Maintenance

No routine maintenance is required. Change the sensor every 6 to 12 months (depending on operating conditions). The instrument automatically indicates when the sensor is in need of replacement.

Electronic Servicing

In the event of an electronic fault, a fixed price exchange circuit board scheme is operated.

Ordering Information

Supplied with monitor:

a) Instruction manual

b) Dissolved oxygen sensor 9435-300

c) 2m (6.5 ft) of interconnecting cable

Additional options:

Interconnecting cable 0233-835 specify length up to 100m (325 ft).

Sample inlet valve 9390-632 (supplied loose) 30 bar max. input pressure. $^{1}/_{4}$ in. compression fittings.

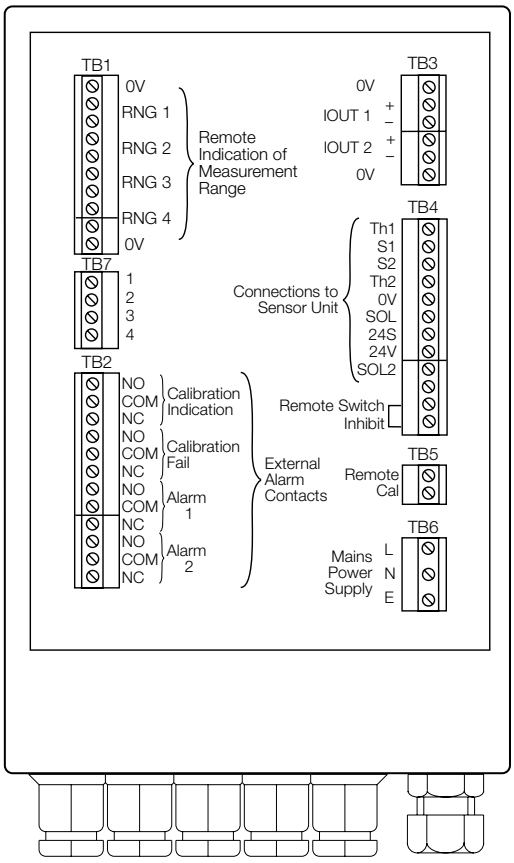
Spare sensor 9435-300.
NB. It is recommended that sensors should be stored no longer than 6 months before being used.

Oxygen sensor simulator unit.

A current source to test the functioning of the transmitter unit
9439-950.

Details on a range of sample cooling equipment are available on request.

Electrical Connections



Specification

Range

0 to 19.9µgkg^{-1}, 0 to 199µgkg^{-1}, 0 to 1.99mgkg^{-1},
0 to 19.9mgkg^{-1}

Accuracy

±5% of reading or ±1µgkg^{-1} whichever is the greater

Response time

90% or a step change in 1 minute

Stability

±5% of reading or ±1µgkg^{-1} per week whichever is the greater

Outputs

Two isolated current outputs in the range 0 to 10mA,
0 to 20mA or 4 to 20mA. Max. impedance 1kΩ

Remote range indication

Four voltage-free contacts rated at
125V, 0.4A non-inductive

External alarms

Two normal or fail-safe, high concentration alarms

Calibration mode indication

Calibration fail indication
All voltage-free contacts 250V, 2A non-inductive

Inputs

Remote initiation of calibration sequence
Remote inhibit of calibration sequence

Calibration

Automatic air calibration every 7 days or initiated manually when required

Installation Information

Sample temperature

5 to 55°C (35 to 131°F)

Sample flow

100 to 500ml/min

Sample pressure

Max. 30 bar with 0216-403 input valve
15 mbar without input valve

Ambient temperature

0 to 55°C (32 to 131°F)

Dimensions of sensor unit

300mm wide x 400mm high x 200mm deep
(11.8 in. wide x 15.7 in. high x 7.87 in. deep)

Mounting for sensor unit

Four holes 8.5mm (0.33 in.) diameter
230mm (9.05 in.) horizontal
330mm (13 in.) vertical

Weight of sensor unit

10kg (22lb)

Connections to sensor unit

Sample inlet – 1/4 in. OD compression fitting
Sample waste – 10mm (0.39 in.) flexible
Atmospheric drain
Sample line material – Stainless steel
Electrical – via gland, cable size 7 to 10.5mm

Max. core size

Mains 32/0.2mm
Signal 24/0.2mm

Dimensions of transmitter unit

356mm wide x 300mm high x 200 mm deep
(14 in. wide x 11.8 in. high x 7.87 in. deep)

Mounting for transmitter unit

Four holes 8.5mm (0.33 in.) diameter
230mm (9.05 in.) horizontal
330mm (13 in.) vertical

Weight of transmitter unit

12kg (26.4lb)

Electrical connection

Via glands in terminal box

Power supply requirements

100/110/120V, 200/220/240V, 50/60Hz, 100VA

Power supply tolerances

Voltage +10% –20%.
Frequency min. 47Hz max. 65Hz

Case protection of transmitter

IP55 (NEMA 3)

Maximum distance between sensor and transmitter unit

100m (325 ft)

EMC

Emissions

Conforms to EMC Directive 89/336/EEC

Classifications

BS EN 500 81–2
BS EN 500 82–2

Design and manufacturing standards

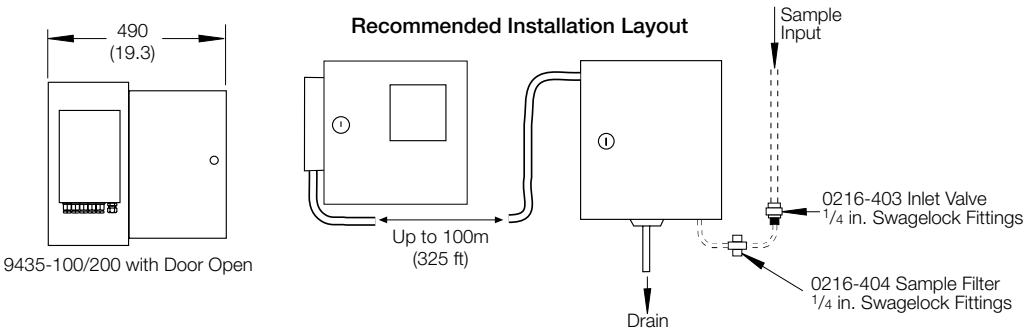
CE mark

Electrical safety

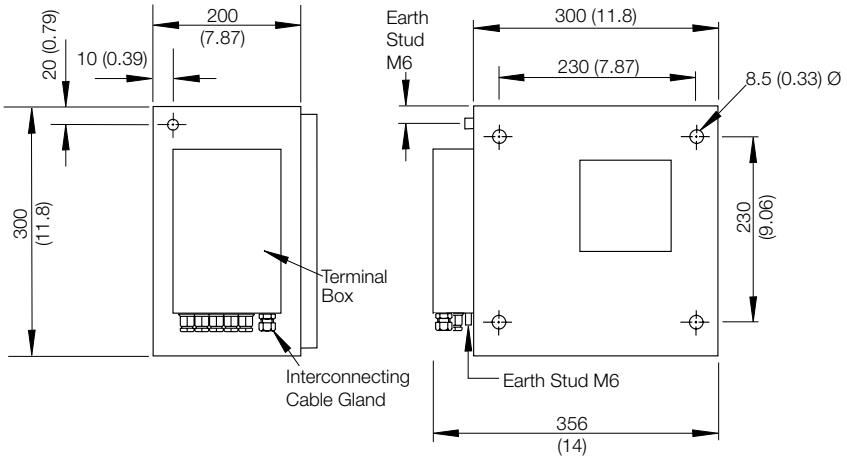
BS EN 61010–1

Overall Dimensions

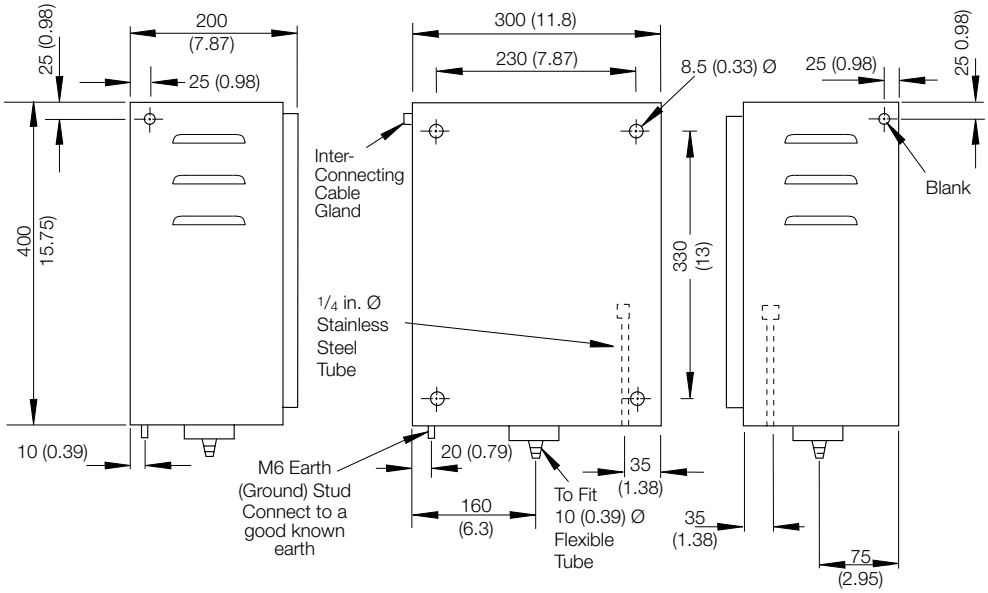
Dimensions in mm (in.)



9435-100
Transmitter Unit



9435-200
Sensor Unit



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