

## BOD Measurement System OxiDirect

### Applications

- Waste Water
- Determination of Biological Activity
- Waste Water Treatment Plants
- Analytical Laboratories
- Scientific & Research

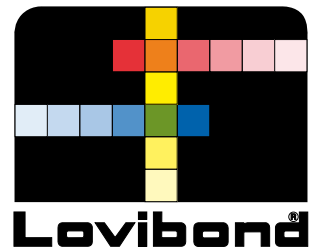
### References

- APHA, AWWA, WEF Standard Methods 5210 D
- H55 as a supplement to EN 1899-2



### Highlights

- Direct sample selection
- Accurate and direct display of BOD values in mg/l
- User-friendly handling
- User-selectable measuring period from 1 to 28 days (BOD<sub>5</sub>, BOD<sub>7</sub>, OECD...)
- Automatic storage of all values
- Measuring ranges from 0-40 mg/l to 0-4000 mg/l BOD, sample volume related
- Auto start function after temperature equalisation
- Mercury-free, environmentally-friendly
- Inductive stirring system with automatic re-centering of stirring rods
- Interface RS 232



## Biochemical Oxygen Demand (BOD)

BOD – biochemical oxygen demand – is an expression for the quantity of oxygen required for biological degradation of organic matter in a waste water sample. BOD measurement is therefore used as a basis for the detection of biologically degradable organic matter in water. The difference between BOD and chemical oxygen demand (COD) is that COD additionally registers biologically non-degradable organic matter.

BOD measurement is therefore an important measurement of the effects of domestic and industrial waste water on sewage plants and outflow points.

### Manometric, respirometric BOD measurement using the Lovibond® OxiDirect

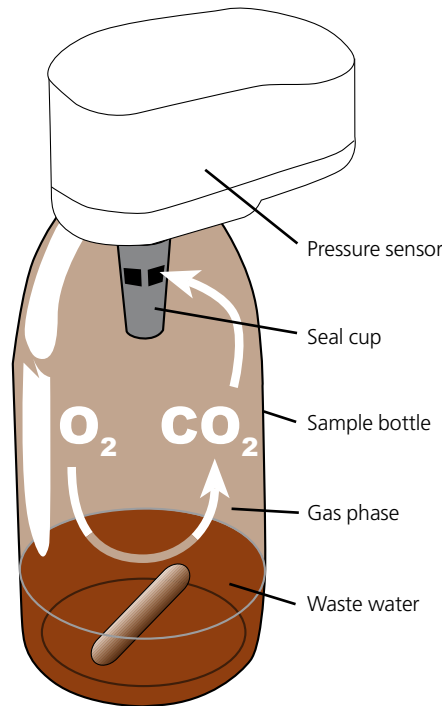
The Lovibond® sensor system OxiDirect is a 6 sample system that allows precise measurements of BOD based on the manometric principle. Manometric respirometers relate oxygen uptake to the change in pressure caused by oxygen consumption while maintaining a constant volume. Thanks to the modern integral pressure sensors, it is no longer necessary to use mercury for pressure measurements.

### Measuring ranges and sample volumes

The BOD level of a sample depends on the quantity of organic matter present, which can vary considerably. The Lovibond® BOD measuring system OxiDirect is therefore calibrated for the various sample volumes and the corresponding measuring ranges listed in the table below. The overall measuring range of the system is 0 – 4000 mg/l.

For all measuring ranges, BOD is shown directly in mg/l.

Range mg / l BOD	Sample Volume ml
0– 40	428
0– 80	360
0– 200	244
0– 400	157
0– 800	94
0– 2000	56
0– 4000	21.7



### OxiDirect Principle

Respirometric methods provide direct measurements of the oxygen consumed by microorganisms from an air or oxygen-enriched environment in a closed vessel under conditions of constant temperature and agitation. Carbon dioxide produced metabolically by the bacteria is chemically bound by the potassium hydroxide solution contained in the seal cup in the bottle.

The result is a pressure drop in the system, which is directly proportional to the BOD value and is measured by the Lovibond® BOD sensor. The BOD level is then displayed directly in mg/l.

The BOD values are stored in the sensor memory and can be called up on the large-format display at any time without the need for time-consuming conversion using factors. This means that test series that end on a Sunday can be evaluated during the following week without any problem.

The measurement period is user-selectable between 1 and 28 days to suit the application. While short measurement periods are useful for scientific applications, standard BOD measurements typically extend over a period of 5 days – and manometric determination of OECD, for example, generally takes place over a period of 28 days.



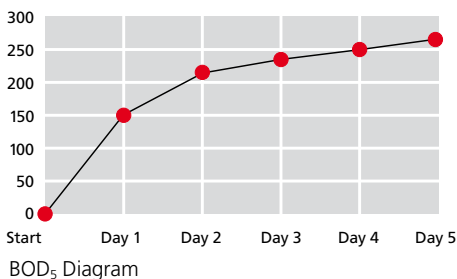
BOD-Measurement

## Evaluation of measurements

If the measuring period is set at 24 hours, the Lovibond® OxiDirect BOD measuring system records a measurement once every hour. With a measuring period of 48 hours, the unit measures and stores a BOD value once every 2 hours. If the measuring period is between 3 and 28 days, one value is measured and stored each day.

Current values and stored values may be called up at any time. The table/graph below illustrates an example of BOD<sub>5</sub> evaluation. The development of BOD over a period of 5 days is easily seen.

Day	Display
1. Day	150 mg/l
2. Day	220 mg/l
3. Day	240 mg/l
4. Day	250 mg/l
5. Day	260 mg/l



## Automatic start function

Variations in sample temperature prior to testing result in pressure variations within the measuring system during the temperature equalisation period in the thermostatically controlled cabinet (if BOD measurement is to take place at 20°C, for example). Such variations would normally cause errors during manometric measurement. In order to prevent such errors, the Lovibond® OxiDirect BOD meter is equipped with an automatic start feature: measurement does not commence until the temperature in the samples is the same as that in the thermostatically controlled cabinet. This rules out the possibility of temperature (and hence pressure) fluctuations that are not related to the manometric measurement.

## The complete OxiDirect measuring system

In addition to the BOD unit for measurement and storage of BOD levels, the Lovibond® OxiDirect BOD measuring system includes sample bottles, measuring sensors, non-wearing inductive stirring system, overflow measuring flasks for metering of sample volumes, nitrification inhibitor and potassium hydroxide as an absorbent.

## Delivery Content

- Lovibond® OxiDirect, complete unit with 6 sensor heads and control unit with batteries
  - Inductive stirring unit with power supply
  - 6 sample bottles
  - 6 rubber gaskets
  - 6 magnetic stirring rods
  - 1 overflow flask, 157 ml
  - 1 overflow flask, 428 ml
  - 1 bottle, 50 ml potassium hydroxide solution
  - 1 bottle, 50 ml nitrification inhibitor solution
  - 1 instruction
- Order code: 2 44 44 06**
- Lovibond® OxiDirect, as above but with 12 sensor heads
- Order code: 2 44 44 10**

## Technical data

<b>Meas. principle</b>	Manometric; mercury-free; electronic pressure sensor
<b>Ranges [mg/l O<sub>2</sub>]</b>	0 - 40, 0 - 80, 0 - 200, 0 - 400, 0 - 800, 0 - 2000, 0 - 4000 mg/l
<b>Accuracy*</b>	0.5 % full scale at 20°C
<b>Applications</b>	BOD <sub>5</sub> , BOD <sub>7</sub> , OECD 301 F ...
<b>Result display</b>	BOD [mg/l]; 4 - digits; 7 - segment LED
<b>Measurement parameter display</b>	BOD-range, volume, duration, time of measurement
<b>Measurement period</b>	User-selectable, between 1 and 28 days
<b>Auto result storage</b>	Up to 28 results, depending on measurement period
<b>Storage interval</b>	- hourly (1 day); - every 2 hours (2 days); - daily (3-28 days)
<b>Automatic start function</b>	- After temperature equalisation of samples; - Can be switched off
<b>Power supply</b>	3 alkaline-manganese batteries ("Baby" cells/size "C")
<b>Battery life</b>	1 year (normal use as BOD <sub>5</sub> meter - max. one reading a day); early warning before battery fails
<b>Interface</b>	RS 232 for printer or PC connection
<b>Clock</b>	Real-time clock
<b>Protection class</b>	IP 54 (sensor head)
<b>Dimensions: (L x W x H)</b>	375 x 195 x 230 mm including stirring unit
<b>Weight</b>	3850 g, unit with bottles 5750 g, complete with stirring unit
<b>Housing</b>	ABS
<b>Approval</b>	CE

\*No standard is available to check the accuracy of respirometric oxygen uptake measurement. Tests with a glucose-glutamic acid solution having a known theoretical BOD have shown that the variation is approximately 5% in the range of 50...100 mg/l BOD, and 3% for higher range. Minimum Response or sensitivity of respirometric systems is about 0.05 ... 1 mg/l.



BOD accessories

## Accessories

Item	Order code
<b>Sensor head</b>	2 44 44 30
<b>BOD sample bottle</b> Brown glass, 500 ml	41 86 44
<b>BOD sample bottles</b> , Brown glass, 500 ml, set of 6 bottles	41 86 45
<b>Cable for connection to a PC</b> serial 9-pins	2 44 44 40
<b>Inductive stirring system</b> for 6 samples, 110-240 V / 50-60 Hz	2 44 44 51
<b>Stirring rod</b>	41 86 37
<b>Stirring rod remover</b>	41 86 38
<b>Rubber gasket</b>	41 86 36
<b>Chemicals:</b>	
<b>Potassium hydroxide solution</b> 45 %, 50 ml	2 41 86 34
<b>Nitrification inhibitor (N-ATH)</b> 50 ml	2 41 86 42
<b>Overflow flask</b> , 21.7 ml	41 86 64
<b>Overflow flask</b> , 56 ml	41 86 55
<b>Overflow flask</b> , 94 ml	41 86 56
<b>Overflow flask</b> , 157 ml	41 86 57
<b>Overflow flask</b> , 244 ml	41 86 58
<b>Overflow flask</b> , 360 ml	41 86 59
<b>Overflow flask</b> , 428 ml	41 86 60
<b>Complete set</b> <b>Overflow flasks</b>	41 86 54
<b>Test set</b> , BOD CM test tablets, box with 8 tablets	41 83 28

## Inductive stirring system



Inductive stirring system ET 606

The microprocessor-controlled Lovibond® inductive stirring system is non-wearing and maintenance-free. In other words, there are no moving parts in the system.

At regular intervals, the magnetic stirring rods are accelerated and slowed down again, taking them up to maximum speed and back down again. This ensures the centralization of the stirring rods.

Stirring rods that move away from the centre of the bottle are re-centered quickly and reliably.

The inductive actuation system guarantees maintenance-free operation (no need to replace drive belts or burnt-out drive motors) for many years.

### Advantages

- Maintenance-free and non-wearing
- Regular change in stirring speed
- Automatic centering of stirring rods
- No mechanical components in the stirring system

## Test set for OxiDirect

We also supply a test set to check for correct operation of the Lovibond® OxiDirect® BOD meter. The set contains 8 BOD CM1 test tablets that cause a defined oxygen consumption.

The tablets are easy to use. Simply place a tablet in the BOD bottle, start the measurement process, read off the BOD value after 5 days, and then compare with the defined value. If this value is within the quoted tolerance, this means that the BOD measuring system is functioning correctly.



BOD CM test tablets, order code: 41 83 28

## Temperature equalisation during BOD measurement

Temperature equalisation is essential prior to biological testing, as temperature has a major effect on biological activity. BOD measurements, for example, are always performed in a thermostatically controlled cabinet at a temperature of 20°C.

For temperature equalisation, we recommend Lovibond® thermostatically controlled cabinets with a user-selectable temperature from 2°C to 40°C.





## Thermostatically controlled incubators



### Highlights

- CFC free
- Backlit Display
- 2 °C to 40 °C
- Adjustable in steps of 0.1 °C
- 20 °C BOD determination
- 4 °C Storage of waste water samples
- 25 °C Enzyme activity (TTC test)
- 37 °C Colony count

Incubators with  
glass / standard door

### Applications

- BOD-Measurement
- Microbiological Research
- Food Industry
- Dairies
- Laboratories
- Research Centres
- Universities



## Technical Data

<b>Design:</b>	Fully insulated cabinet with universal temperature control unit
<b>Models with glass door:</b>	Insulating glass door in an aluminium frame
<b>Operation:</b>	Splash-proofed keypad, 2 buttons with tactile feedback
<b>Control range:</b>	+ 2 °C to + 40 °C, steps of 0.1 °C
<b>Climate class:</b>	+ 10 °C to + 32 °C,
<b>Temperature tolerance:</b>	± 1 °C, specified for a stirred 500 ml water sample in the centre of the cabinets. For BOD (T=20 °C ±0,5 °C)
<b>Display:</b>	Backlit LED display Resolution 0.1 °C
<b>Fan:</b>	Radial, output 320 m <sup>3</sup> /h
<b>Cooling/Heating:</b>	Integrated powerful cooling and heating
<b>Power supply:</b>	230 V / 50 Hz
<b>Approval:</b>	CE

## Temperature control unit

The temperature control unit fulfills the EMC requirements according IEC 61326 : Electrical equipment for measurement, control and laboratory use.



## Models with standard door

### ET 618-4 type 180

3 metal racks + 1 bottom grid
I. D. (approx.): 515 D x 430 W x 700 H mm
Net capacity: approx. 135 l
O. D. (approx.): 600 D x 600 W x 850 H mm with work top 600 D x 600 W x 820 H mm without work top
Suitable for built under applications
Weight: approx. 39.0 kg
Order code: 2 42 82 00

### ET 626-5 type 260

4 metal racks + 1 bottom grid
I. D. (approx.): 515 D x 415 W x 1045 H mm
Net capacity: approx. 195 l
O. D. (approx.): 600 D x 600 W x 1216 H mm
Weight : approx. 49.0 kg
Order code: 2 42 82 20

### ET 636-6 type 360

5 metal racks + 1 bottom grid
I. D. (approx.): 515 D x 415 W x 1450 H mm
Net capacity: approx. 280 l
O. D. (approx.): 600 D x 600 W x 1590 H mm
Weight : approx. 64.5 kg
Order code: 2 42 82 30

### ET 650-8 type 500

5 metal racks + 1 bottom grid
I. D. (approx.): 652 D x 515 W x 1300 H mm
Net capacity: approx. 395 l
O. D. (approx.): 752 D x 710 W x 1516 H mm
Weight : approx. 79.5 kg
Order code: 2 42 82 40

## Models with glass door

### ET 619-4 type 180

3 metal racks + 1 bottom grid
I. D. (approx.): 515 D x 443 W x 700 H mm
Net capacity: approx. 140 l
O. D. (approx.): 600 D x 600 W x 885 H mm
Weight: approx. 50.0 kg
Order code: 2 42 82 10

### ET 627-5 type 260

4 metal racks + 1 bottom grid
I. D. (approx.): 515 D x 415 W x 1045 H mm
Net capacity: approx. 195 l
O. D. (approx.): 600 D x 600 W x 1216 H mm
Weight : approx. 66.5 kg
Order code: 2 42 82 25

### ET 637-6 type 360

5 metal racks + 1 bottom grid
I. D. (approx.): 515 D x 415 W x 1450 H mm
Net capacity: approx. 280 l
O. D. (approx.): 600 D x 600 W x 1590 H mm
Weight : approx. 82.0 kg
Order code: 2 42 82 35

### ET 651-8 type 500

5 metal racks + 1 bottom grid
I. D. (approx.): 652 D x 515 W x 1300 H mm
Net capacity: approx. 395 l
O. D. (approx.): 752 D x 710 W x 1516 H mm
Weight : approx. 98.5 kg
Order code: 2 42 82 45

## Space for BOD-OxiDirect®-systems in thermostatically controlled incubators

Model	Systems, standard <sup>1)</sup>	Systems, comfort <sup>2)</sup>
ET 618-4/619-4	3	2
ET 626-5/627-5	5	2
ET 636-6/637-6	9	4
ET 650-8/651-8	12	8

1) Change of bottles **by** removing racks.

2) Change of bottles **without** removing racks.