Oxygen Demand, Biochemical

DOC316.53.01242

Dilution Method[1, 2]

Method 10360

LBOD probe

Scope and application: For water and wastewater.

[1] Adapted from *Standard Methods for the Examination of Water and Wastewater* and from Klein, R.L.; Gibbs, C. *Journal of Water Pollution Control Federation*, 1979, 51(9), 2257. USEPA recommended for compliance monitoring. Meets ASTM 888-05 (C).

[2] Luminescent dissolved oxygen is USEPA approved for BOD5 and cBOD5. Refer to USEPA 40CFR Part 136.3.

Test preparation

Instrument-specific information

This procedure is applicable to the meters and probes that are shown in Table 1. Procedures for other meters and probes can be different.

Table 1 Instrument-specific information

Meter	Probe
HQ1130 portable one input, dissolved oxygen HQ4100, HQ2100 and HQ30d portable one input, multi-parameter HQ4200, HQ2200 and HQ40d portable two input, multi-parameter HQ4300 portable three input, multi-parameter HQ430d benchtop one input, multi-parameter HQ440d benchtop two input, multi-parameter	Intellical LBOD101 LDO for BOD

Before starting

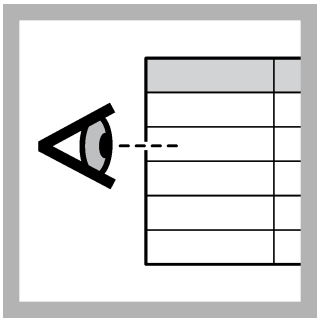
Refer to the meter documentation for meter settings and operation. Refer to probe documentation for probe preparation, maintenance and storage information.
Prepare the probe before initial use. Refer to probe documentation.
When an Intellical probe is connected to an HQ meter or an HQd meter, the meter automatically identifies the measurement parameter and is prepared for use.
High concentrations (more than 1 molar) of bases or acids decrease the service life of the probe cap.
Calibrate the probe before initial use. Refer to Calibration on page 8.
Prepare the dilution water before the test. Refer to Prepare the dilution water on page 3.
This test is a 5-day test. Complete all the steps carefully to make sure that the test does not have to be done again.
Salinity has an effect on the concentration of dissolved oxygen in the sample. To correct for salinity effects, refer to the probe documentation.
To analyze disinfected samples or industrial effluents, refer to Interferences on page 10.
Carbonaceous BOD (CBOD) can be determined by the addition of nitrification inhibitor. A test for CBOD is recommended for biologically-treated effluents, samples with bacterial seed, samples with biologically treated effluents and river water.
Air bubbles under the sensor tip can cause slow response or measurement errors. To remove the bubbles, carefully shake the probe.
Review the Safety Data Sheets (MSDS/SDS) for the chemicals that are used. Use the recommended personal protective equipment.
Dispose of reacted solutions according to local, state and federal regulations. Refer to the Safety Data Sheets for disposal information for unused reagents. Refer to the environmental, health and safety staff for your facility and/or local regulatory agencies for further disposal information.

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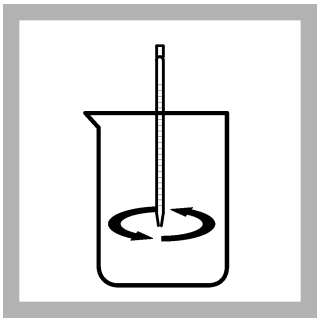
Items to collect

Description	Quantity
BOD bottle, 300 mL, glass, with glass stoppers and plastic caps	6
BOD bottle cap, plastic	6
Dilution water (refer to Prepare the dilution water on page 3)	varies
Pipet, seriological, 1 mL, 5 mL and 10 mL	1
Incubator	1
Nitrification Inhibitor (for the CBOD test only)	1 bottle

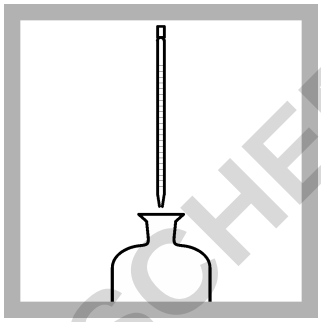
Test procedure



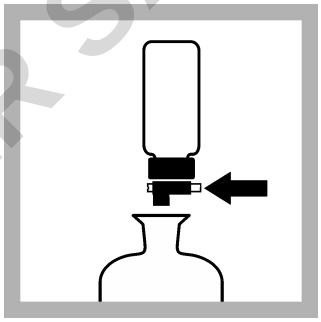
1. Identify five sample volumes to use for this test. Refer to Select the sample volumes on page 4.



2. Prepare the samples: Gently stir the sample.



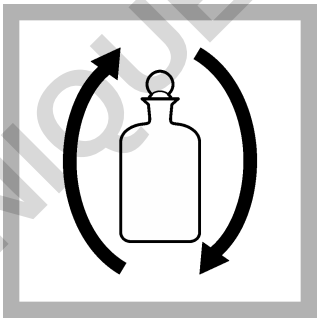
3. Use a pipet to add the sample volumes to five 300-mL BOD bottles.



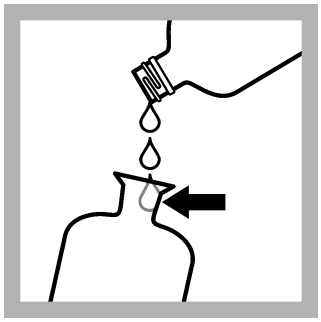
4. If the test is for CBOD, add two portions of Nitrification Inhibitor (approximately 0.16 g) to each bottle to prevent the oxidation of nitrogen compounds. Record the results as CBOD.



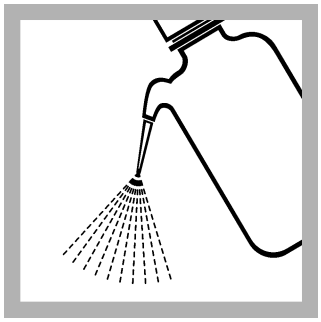
5. Fill each bottle with prepared dilution water. Refer to Prepare the dilution water on page 3. To prevent air bubbles, pour the water down the inner surface of the bottle.



6. Carefully insert a stopper in each bottle to prevent trapped air bubbles. Push down on the stopper. Invert the bottles several times to mix.

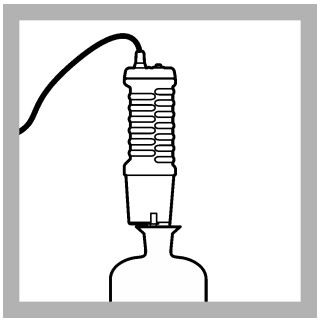


7. Prepare the blank: Fill another 300-mL BOD bottle with the prepared dilution water. To prevent air bubbles, pour the water down the inner surface of the bottle.

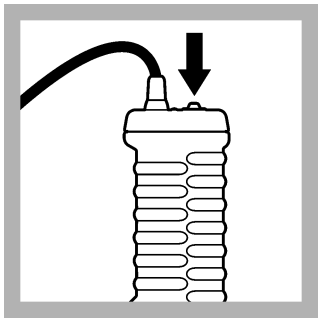


8. Rinse the probe with deionized water. Dry the probe with a lint-free cloth.

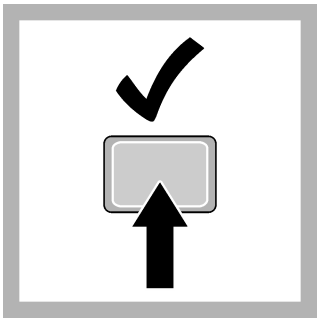
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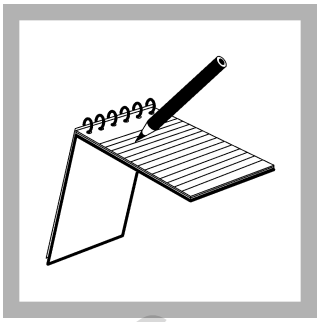
9. Put the probe in the blank. Make sure that there are no air bubbles under the probe.



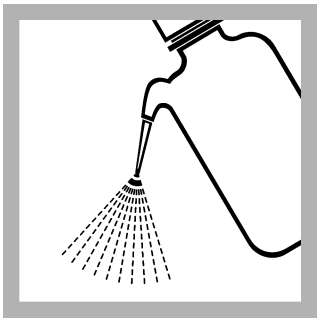
10. Push the button on the top of the probe to start the stir paddle. The green light is on.



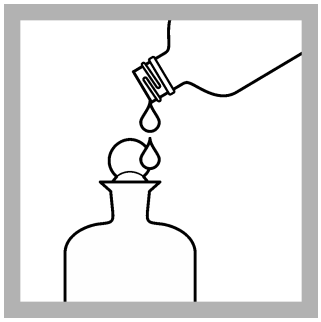
11. Push **Read**. A progress bar is shown. When the measurement is stable, the lock icon is shown.



12. When the value is stable, record the value.



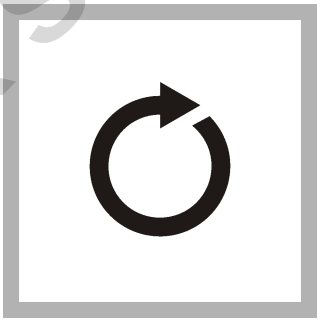
13. Rinse the probe with deionized water. Dry the probe with a lint-free cloth.



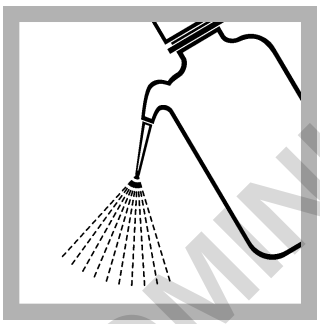
14. Carefully insert a stopper in each of the prepared sample bottles to prevent trapped air bubbles. Add dilution water above the stopper of the BOD bottles to make a water seal.



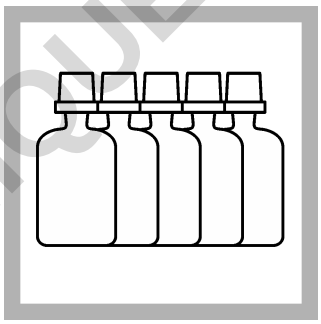
15. Add a cap to each bottle to prevent evaporation.



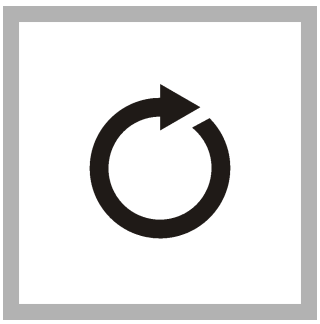
16. Measure each of the prepared samples. Do steps 8–12 for each prepared sample.
Note: *Skip this step if the graphic method (not for reporting) is used for calculation.*



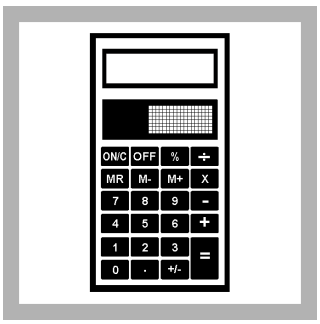
17. Rinse the probe with deionized water. Dry the probe with a lint-free cloth.



18. Keep the prepared sample bottles in an incubator at 20 °C (68°F). Do not move the prepared sample bottles for 5 days.



19. After 5 days, measure the remaining dissolved oxygen in each of the prepared samples. Do steps 8–12 for each prepared sample.
For accurate results, there must be at least 1.0 mg/L DO in the prepared samples after incubation.



20. Calculate the BOD value. Refer to BOD calculation—Standard Methods on page 6 or BOD calculation-Graphical Method on page 6.

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Prepare the dilution water

Make sure that no source of oxygen demand or toxins are added when the dilution water is prepared.

Items to collect:

- Dilution water (refer to the dilution water guidelines)
- BOD Nutrient Buffer Pillow[1]
- Raw sewage[2] for the bacterial seed, 3 mL (if the sample is low in bacteria)

Dilution water guidelines

- For the best results, use distilled water from an alkaline permanganate distillation.
- Use high-quality water that does not contain organic compounds or toxic compounds (e.g., chlorine, copper and mercury).
- Do not use deionized water from ion exchange columns. The resins in the cartridges (mostly new cartridges) occasionally release organic materials that have an oxygen demand. In addition, bacteria can grow on the columns, which adds contamination to the dilution water.
- The dissolved oxygen concentration of the dilution water must not change by more than 0.2 mg/L when incubated for 5 days at 20 °C (68 °F).

Prepare the dilution water as follows:

1. Keep the dilution water in clean jugs in an incubator at 20 °C (68°F). Shake the jugs to saturate the water with air. As an alternative, loosely put the cap on the jugs and wait a minimum of 24 hours before use.
2. (Optional) Use a small aquarium pump or an air compressor to saturate the water with air. Make sure to use filtered air. Make sure that the filter does not grow bacteria.
3. Shake the BOD Nutrient Buffer Pillow to mix the contents.
4. Add the contents of the BOD Nutrient Buffer Pillow to the distilled water.
5. Put the cap on the jug. Shake the jug vigorously for 1 minute to dissolve the nutrients and to saturate the water with air.
6. If the sample is known to be low in bacteria (e.g., industrial waste or sewage that has been disinfected), immediately before the test, add 3 mL of raw sewage to each liter of the dilution water.

   Measure the BOD of the raw sewage collected. The BOD of the raw sewage will be subtracted from the BOD of the sample.

Conventional method (optional)

As an alternative, prepare the dilution water with the conventional method as follows:

1. Pipet 1 mL of each of the solutions that follow per liter of distilled water at 20 °C:
   Note: *Be careful to prevent contamination of the solutions.*
   - Calcium Chloride Solution
   - Ferric Chloride Solution
   - Magnesium Sulfate Solution
   - Phosphate Buffer Solution[3]
2. Put the cap on the bottle. Shake the bottle vigorously for 1 minute.

Select the sample volumes

Select the five sample volumes to use for this test. The sample volumes change based on the sample BOD and the altitude of the laboratory.

- High BOD samples (e.g., raw sewage)—Use small sample volumes so that all the oxygen is not consumed.

[1] Different sizes are available for different quantities of water (e.g., 3 L and 6 L).
[2] Keep the raw sewage at 20 °C (68°F) and do not move for 24–36 hours before use. Pipet from the upper portion of the sewage.
[3] Keep the phosphate buffer solution in a refrigerator to decrease the rate of biological growth.

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- Low BOD samples—Use large sample volumes so that sufficient oxygen is consumed to give an accurate result.

At higher altitudes, the amount of oxygen that dissolves in water decreases, so less oxygen is available to microorganisms. Refer to Table 2.

Note: *At least 2.0 mg/L of dissolved oxygen (DO) must be consumed during the test and at least 1.0 mg/L DO must be in the BOD bottle after the test.*

1. Identify the minimum sample volume. Refer to Table 3.

   For example, if a sewage sample contains approximately 300 mg/L BOD, the minimum sample volume is 2 mL. If the sewage effluent contains approximately 40 mg/L BOD, the minimum sample volume is 15 mL.
2. Identify the maximum sample volume. Refer to Table 4.

   For example, if the sample contains approximately 300 mg/L BOD and the laboratory altitude is 305 m (1000 ft), the maximum sample volume is 8 mL. If the sample contains approximately 40 mg/L BOD and the laboratory altitude is 305 m (1000 ft), the maximum sample volume is 60 mL.
3. Select three other sample volumes between the minimum and maximum volumes so that there are five sample volumes total.

Table 2 Oxygen values at different altitudes—20 °C (68 °F)

Altitude	Oxygen value in water saturated with air	Altitude	Oxygen value in water saturated with air
Sea level	9.2 mg/L	1219 m (4000 ft)	7.9 mg/L
305 m (1000 ft)	8.9 mg/L	1524 m (5000 ft)	7.6 mg/L
610 m (2000 ft)	8.6 mg/L	1829 m (6000 ft)	7.4 mg/L
914 m (3000 ft)	8.2 mg/L		

Table 3 Minimum sample volume

Sample type	BOD (mg/L)	Volume (mL)	Sample type	BOD (mg/L)	Volume (mL)
Strong trade waste	600	1	Oxidized effluents	50	12
Raw and settled sewage	300	2		40	15
	200	3		30	20
	150	4		20	30
	120	5		10	60
	100	6	Polluted river waters	6	100
	75	8		4	200
	60	10		2	300

Table 4 Maximum sample volume

mg/L BOD—Sea level	mg/L BOD—305 m (1000 ft)	BOD—1524 m (5000 ft)	Volume (mL)
2460	2380	2032	1
1230	1189	1016	2
820	793	677	3
615	595	508	4
492	476	406	5
410	397	339	6
304	294	251	8
246	238	203	10

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Table 4 Maximum sample volume (continued)

mg/L BOD—Sea level	mg/L BOD—305 m (1000 ft)	BOD—1524 m (5000 ft)	Volume (mL)
205	198	169	12
164	158	135	15
123	119	101	20
82	79	68	30
41	40	34	60
25	24	21	100
12	12	10	200
8	8	7	300

BOD calculation—Standard Methods

Use the Standard Methods calculation when the results will be given to a regulatory agency. Give the results as $CBOD_5$ if nitrification inhibitor was added in the test.

When a bacterial seed is not added to the dilution water, calculate the BOD as follows:

BOD_5 mg/L = $(D_1 – D_2) \div P$

When a bacterial seed is added to the dilution water, calculate the BOD as follows:

BOD_5 mg/L = $((D_1 – D_2) – (B_1 – B_2) \times f) \div P$

Where:

BOD_5 = BOD value from the 5-day test (mg/L)

D_1 = DO of the prepared sample immediately after preparation (mg/L)

D_2 = DO of the prepared sample after incubation in mg/L

P = Decimal volumetric fraction of sample used

B_1 = DO of the bacterial seed control immediately after preparation (mg/L)

B_2 = DO of bacterial seed control after 5-days at 20 °C (68 °F) in mg/L

f = ratio of the bacterial seed in the diluted sample to the bacterial seed in the bacterial seed control. f = (% seed in diluted sample) ÷ (% seed in seed control)

OR

If the bacterial seed material is added directly to sample or to the bacterial seed control bottles:

f = (volume of the bacterial seed in the diluted sample) ÷ (volume of the bacterial seed in the bacterial seed control)

Averaged results are satisfactory if all the criteria that follows is true for more than one of the sample dilutions:

- The remaining DO is at least 1 mg/L.
- The final DO value is at least 2 mg/L less than the initial DO value.
- Toxicity at higher sample concentrations is not seen.
- There are no obvious anomalies.

BOD calculation-Graphical Method

NOTICE

Do not use the Graphical Method when the results must be given to a regulatory agency.

1. On a graph, record on the y-axis the remaining dissolved oxygen (DO) (mg/L) in each of the prepared samples after 5 days. Record the sample volume (mL) on the x-axis. Draw the best straight line through the plotted points. Refer to Figure 1.

   Note: *At least three points should be on the graph line or very near to the graph line. Ignore an error point if seen at this time. For unseeded dilution water, the graph line should cross the*

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mg/L oxygen remaining scale near or at less than the oxygen saturation value for the altitude of the laboratory as shown in Prepare the dilution water *on page 3.*

2. To calculate the BOD, use the equation that follows, which is mathematically the same as the BOD equation. Refer to BOD calculation—Standard Methods on page 6.

   mg/L BOD = (A × 300) – B + C

   Where:

   A = the slope of the graph line. The slope of the graph line is equal to the mg/L DO consumed for each mL of sample. Select a point on the line and subtract the mg/L DO remaining at that point from the mg/L DO where the line crosses with the DO scale (Y-intercept, mg/L DO remaining). Divide the difference by the mL of sample at the point selected.

   300 = the volume of the BOD bottle (300 mL)

   B = the Y-intercept. The Y-intercept is the DO value where the line crosses the "DO remaining" scale. (The Y-intercept should be very near to the actual dilution water blank value.)

   C = the sample DO. The sample DO is the DO of the undiluted sample.

   A different way to write this equation is:

   mg/L BOD = (slope × 300) – Y-intercept + sample DO

   Note: *If the best straight line is supplied by linear regression through the use of a calculator, change the sign (–) of the slope (+ slope) before the slope is multiplied by 300.*

   For example:

   The mg/L DO remaining was determined for a series of four dilutions of domestic sewage after 5 days of incubation. The results are given in Table 5.

   If a set of BOD dilutions is done correctly with a homogeneous sample, a graph of the mg/L DO remaining versus the sample volume results in a straight line. The Y-intercept value is equal to the DO content of the dilution water after the 5-day incubation. But the Y-intercept value is not actually measured.

   In this example, the Y-intercept is equal to 9.0 mg/L and the DO of the domestic sewage sample is thought to be zero. Refer to Table 5. If another type of sample is used, measure the DO of an undiluted sample by the Winkler titration or potentiometrically. The slope in the example is calculated as follows:

   (DO value at Y-intercept – DO value at Point A) ÷ (sample volume at Point A – sample volume at Y-intercept)

   (9.0 mg/L –3.0 mg/L) ÷ 8 mL – 0 mL = 0.75 mg/L per mL = slope

   American Public Health Association formula—The calculation for BOD can be written as follows (not approved for reporting purposes):

   Slope = (mg/L DO remaining with a smaller sample volume – mg/L DO remaining with a larger sample volume) ÷

   (mL of a larger sample volume – mL of a smaller sample volume)

   slope × 300 – DO_D + S = mg/L BOD

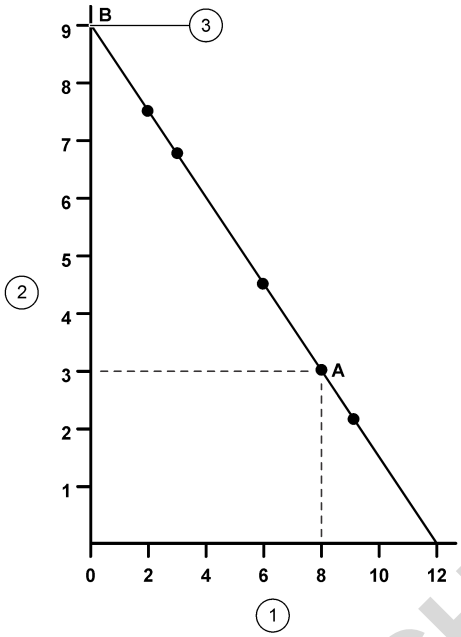
   Where:

   DO_D = mg/L DO of dilution water

   S = mg/L DO of sample

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Figure 1 DO per mL of sample

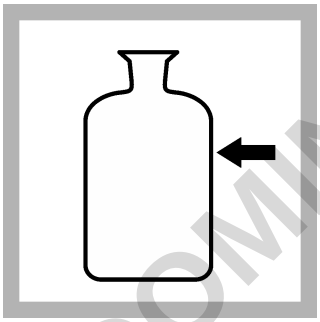


1 mL of sample	**2** mg/L DO remaining	**3** Y-intercept

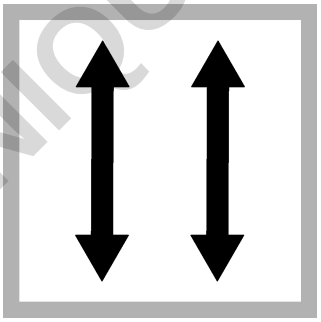
Table 5 Sample volume versus DO remaining

Sample volume	DO remaining
2.0 mL	7.50 mg/L
3.0 mL	6.75 mg/L
6.0 mL	4.50 mg/L
9.0 mL	2.25 mg/L

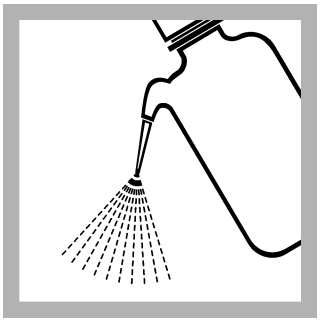
Calibration



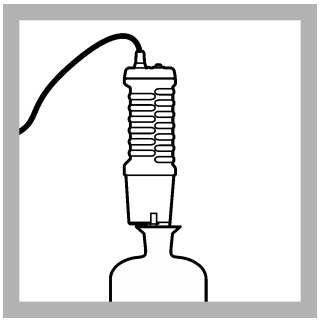
1. Fill a 300-mL BOD bottle ¾ full with deionized water. Refer to Add sulfite on page 9 if a 0% calibration point is necessary.



2. Insert a stopper and shake the bottle vigorously for 1 minute.

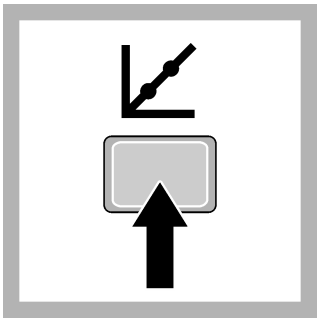


3. Rinse the probe with deionized water. Dry the probe with a lint-free cloth.

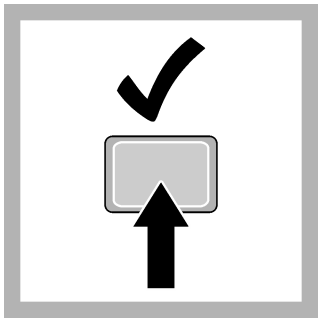


4. Remove the stopper. Put the probe in the bottle for several minutes.

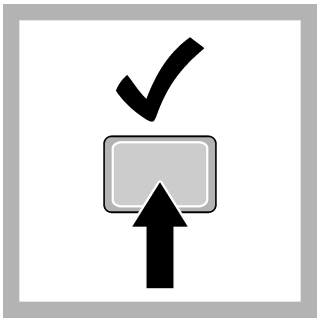
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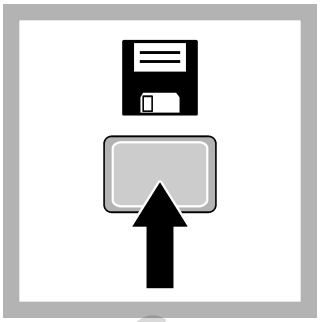
5. Push **Calibrate**.
Note: *If the meter has more than one probe attached, make sure that the display is in the single screen LBOD101 mode.*



6. Push **Read**. A progress bar is shown. When the measurement is stable, the lock icon is shown.

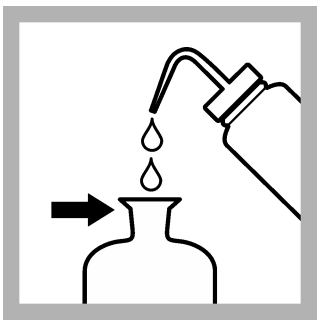


7. Push **Done**. The calibration summary shows. The slope value is the comparison between the latest calibration and the factory calibration shown as a percentage.

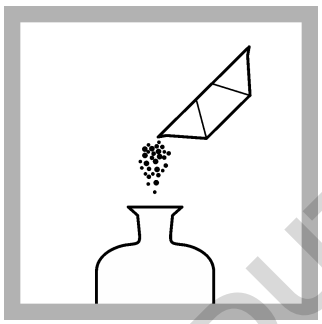


8. Push **Store** to accept the calibration.

Add sulfite



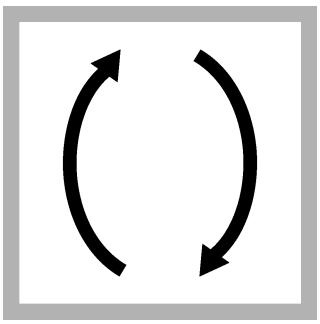
1. Fill a BOD bottle with deionized water.



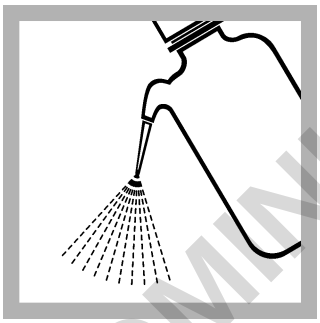
2. Add 300 mg of sodium sulfite to the bottle.



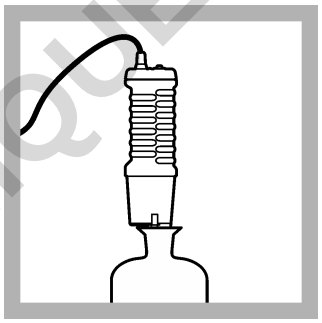
3. Add a small crystal of cobalt chloride to the bottle.



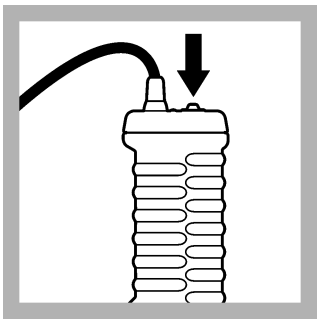
4. Insert a stopper. Invert several times to mix.



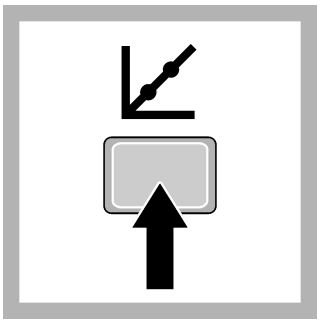
5. Rinse the probe with deionized water. Dry the probe with a lint-free cloth.



6. Put the probe in the bottle. Make sure that there are no air bubbles under the probe.

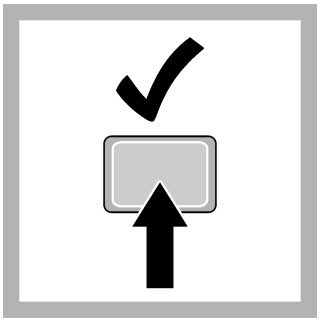


7. Push the button on the top of the probe to start the stir paddle. The green light is on.

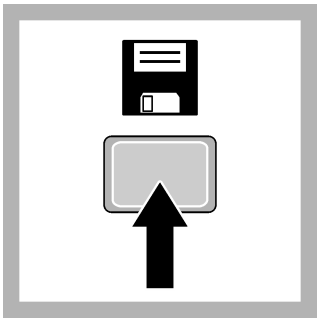


8. When the reading is stable, push **Calibrate**.
Note: *If the meter has more than one probe attached, make sure that the display is in the single screen LBOD101 mode.*

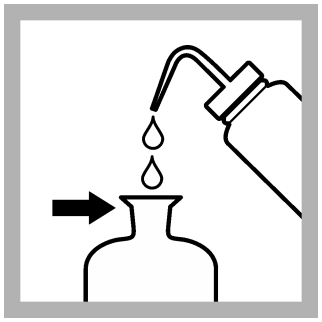
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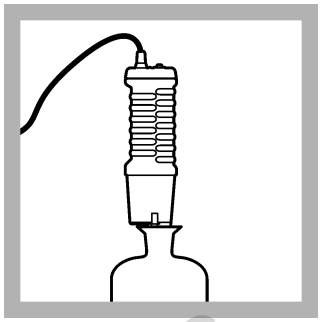
9. Push **Read**. A progress bar is shown.



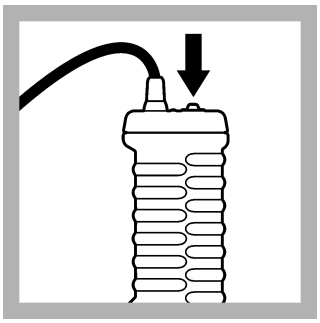
10. After "0% saturated" shows, push **STORE** to accept the calibration.



11. Fill a second BOD bottle with deionized water.



12. Put the probe in the second bottle.



13. Push the button on the top of the probe to start the stir paddle. The green light is on.



14. Keep the probe in the bottle for 10 minutes. The sulfite residue on the probe is removed.

Interferences

To get good BOD results, special handling is necessary to analyze chlorinated and industrial effluents. Usually, careful experimentation with the sample shows the changes that should be made to the test procedure. Toxins in the sample have an adverse effect on any microorganisms in the sample, which results in lower BODs.

The substances in Table 6 interfere in the determination of oxygen demand at the given concentrations.

Table 6 Interfering substances

Interfering substance	Interference level
Chlorine	Small quantities of residual chlorine—Let the sample sit for 1 to 2 hours at room temperature. Larger quantities of chlorine—Refer to Remove chlorine from the sample on page 10.
Phenols	Dilute the sample with high quality distilled water. As an alternative, acclimatize the bacterial seed used in the dilution water to tolerate such materials. Refer to Acclimatize the bacterial seed on page 11.
Heavy metals	
Cyanide	
Highly buffered samples or extreme sample pH	Less than pH 6.5 or more than pH 7.5 interfere. Adjust to pH 7.2 with acid (Sulfuric Acid, 1 N or Phosphate Buffer Solution) or base (Sodium Hydroxide, 1 N).
Cold temperature	Cold samples can be supersaturated with oxygen and will have low BOD results. Fill a 1-liter (1-quart) bottle ½ full with cold sample. Shake the bottle vigorously for 2 minutes. Let the sample temperature increase to 20 °C (68 °F).

Remove chlorine from the sample

Items to collect:

- 250-mL Erlenmeyer flask

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- 10-mL serological pipet and a pipet filler
- 25-mL buret
- 0.020 N Sulfuric Acid Standard Solution, 10 mL
- 100-g/L Potassium Iodide Solution, 10 mL
- 0.025 N Sodium Thiosulfate Standard Solution, 25 mL
- Starch Indicator Solution, 3 full droppers

1. Add 100 mL of sample to a 250-mL Erlenmeyer flask.
2. Use a 10-mL serological pipet and a pipet filler to add 10 mL of 0.020 N Sulfuric Acid Standard Solution to the flask.
3. Use a 10-mL serological pipet and a pipet filler to add 10 mL of 100-g/L Potassium Iodide Solution to the flask.
4. Add 3 full droppers of Starch Indicator Solution. Swirl to mix.
5. Fill a 25-mL buret with 0.025 N Sodium Thiosulfate Standard Solution.
6. Titrate the sample from dark blue to colorless.
7. Calculate the amount of 0.025 N Sodium Thiosulfate Standard Solution to add to the sample.

   mL 0.025 N Sodium Thiosulfate Standard Solution = (mL titrant used × volume of remaining sample) ÷ 100
8. Add the calculated quantity of 0.025 N Sodium Thiosulfate Standard Solution to the sample.
9. Mix fully. Wait 10–20 minutes before the test is done.

Acclimatize the bacterial seed

1. Fill a 4-liter (1-gallon) stainless steel or plastic container with domestic sewage.
2. Aerate the sewage for 24 hours.
3. Let the heavier material collect on the bottom for 1 hour.
4. Use a siphon to remove 3 liters (3 quarts) of the material from the top and discard.
5. Fill the container with a mixture of 90% sewage and 10% wastes that contain the toxic material.
6. Aerate for 24 hours.
7. Do steps 3–5 again with more and more quantities of waste until the container holds 100% toxic waste material.

Accuracy check

Standard solution method

Use the standard solution method to validate the test procedure and the instrument.

Items to collect:

- 300-mg/L BOD Standard Solution[4], Voluette Ampule, 10 mL
- Seeded dilution water
- Four 300-mL BOD bottles
- Pipet, volumetric, Class A, 1.0–4.0 mL
- TenSette Pipet

1. Use the TenSette pipet to add 1.00, 2.00, 3.00 and 4.00 mL of the standard solution to four 300-mL BOD bottles.
2. Fill each bottle with the seeded dilution water. Refer to Prepare the dilution water on page 3. To prevent air bubbles, let the water flow over and down the outer surface of the bottle.

[4] 300-mg/L of glucose and 300-mg/L of glutamic acid

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3. Use the test procedure to measure the DO concentration of the diluted standard solutions and then again after 5 days. Do not add Nitrification Inhibitor. Record the values.
4. Calculate the BOD value.
5. Divide the calculated BOD value by 2. The expected result when compared to Standard Methods is 198 (± 30.5) mg/L.

   Note: *The ampule includes 2 mL of 450 mg/L Glucose plus Glutamic Acid (GGA). Pour all the ampule is equivalent to add 6 mL of 150 mg/L solution with the Standard Methods. Calculate the BOD concentration as though there were 6 mL added to the bottle instead of 2 mL. The dilution factor for this standard is 50x.*

Clean the probe

Clean the probe when:

- Drifting/inaccurate readings occur as a result of contamination on the sensing element or incorrect storage conditions.
- Slow response time occurs as a result of contamination on the sensing element.

For general contamination, complete the steps that follow.

1. Rinse the probe with deionized water. Blot dry with a lint-free cloth.
2. If harsh contaminants are attached to the probe, polish the probe tip with a soft cloth or cotton swab to remove the contaminants.
3. Soak the probe in deionized water for 1 minute.

Summary of method

Biochemical oxygen demand (BOD) is a measurement of the oxygen requirements of municipal and industrial wastewaters and sewage. The test results are used to calculate the effect of waste discharges on the oxygen resources of the receiving waters. The BOD test is of limited value in the measurement of the actual oxygen demand because temperature change, biological population, water movement, sunlight, oxygen concentration and other environmental factors cannot be simulated accurately in the laboratory. The BOD test is of the most value after patterns of oxygen uptake for a specified effluent and receiving water are identified.

For this test, a sealed wastewater sample (or a prepared dilution) is incubated for the standard 5-day period. Then, the change in dissolved oxygen content is identified. The BOD value is calculated from the results of the dissolved oxygen tests.

Consumables and replacement items

HQ meters, HQd meters and probes

Description	Unit	Item no.
HQ1130 portable one input, dissolved oxygen meter	each	LEV015.53.1130A
HQ2100 portable one input, multi-parameter meter	each	LEV015.53.2100A
HQ2200 portable two input, multi-parameter meter	each	LEV015.53.2200A
HQ4100 portable one input, multi-parameter meter	each	LEV015.53.4100A
HQ4200 portable two input, multi-parameter meter	each	LEV015.53.4200A
HQ4300 portable three input, multi-parameter meter	each	LEV015.53.4300A
HQ430d benchtop one input, multi-parameter meter	each	HQ430D
HQ440d benchtop two input, multi-parameter meter	each	HQ440D
Intellical LBOD101 luminescent/optical dissolved oxygen (LDO) probe for BOD, 1 m cable	each	LBOD10101

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Consumables and replacement items

Required reagents

Description	Quantity/Test	Unit	Item no.
BOD Nutrient Buffer Pillow, 3 mL (for 3 L of dilution water)	1 pillow	50/pkg	1486166

Required apparatus

Description	Quantity/test	Unit	Item no.
BOD bottle with glass stopper, 300 mL	6	each	62100
BOD bottle cap, plastic	6	6/pkg	241906
Pipet, serological, 1 mL, glass	1	50/pkg	2093135
Pipet, serological, 5 mL	1	each	53237
Pipet, serological, graduated, 10 mL	1	each	53238
Pipet filler, safety bulb	1	each	1465100

Recommended standards

Description	Unit	Item no.
BOD Standard Solution, Voluette® Ampule, 300 mg/L, 10 mL	16/pkg	1486510

Optional reagents and apparatus

Description	Unit	Item no.
BOD bottle with glass stopper, 300 mL	6/pkg	62106
BOD bottle with glass stopper, 300 mL	24 pkg	62124
BOD Nutrient Buffer Pillow, 0.5 mL (for 300 mL of dilution water)	50/pkg	1416066
BOD Nutrient Buffer Pillow, 3 mL (for 3 L of dilution water)	50/pkg	1486166
BOD Nutrient Buffer Pillow, 4 mL (for 4 L of dilution water)	50/pkg	2436466
BOD Nutrient Buffer Pillow, 6 mL (for 6 L of dilution water)	50/pkg	1486266
BOD Nutrient Buffer Pillow, 19 mL (for 19 L of dilution water)	25/pkg	1486398
Calcium Chloride Solution, APHA, for BOD	500 mL	42849
Clippers	each	96800
Ferric Chloride Solution, APHA, for BOD	1 L	42953
Flask, Erlenmeyer, 250 mL	each	50546
Magnesium Sulfate Solution, APHA, for BOD	500 mL	43049
Nitrification Inhibitor	35 g	253335
Nitrification Inhibitor	500 g	253334
Nitrification Inhibitor, dispenser cap	each	45901
Phosphate Buffer Solution, APHA, for BOD, pH 7.2	500 mL	43149
Potassium Iodide Solution, 100 g/L	500 mL	1228949
Probe clips, color-coded, for IntelliCAL probes	50/pkg	5818400
Sodium Hydroxide, pellets, ACS	500 g	18734
Sodium Hydroxide Standard Solution, 1.00 N	100 mL MDB	104532
Sodium Thiosulfate Standard Solution, 0.025 N	1 L	35253

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Optional reagents and apparatus (continued)

Description	Unit	Item no.
Sodium Thiosulfate Standard Solution, 0.1 N	100 mL	32332
Starch Indicator Solution	100 mL MDB	34932
Sulfuric Acid Standard Solution, 0.020 N	1 L	20353
Sulfuric Acid Solution, 1.00 N	1000 mL	127053

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