DOC022.53.90072

BODTrak™ II

USER MANUAL

02/2010,
Edition 2

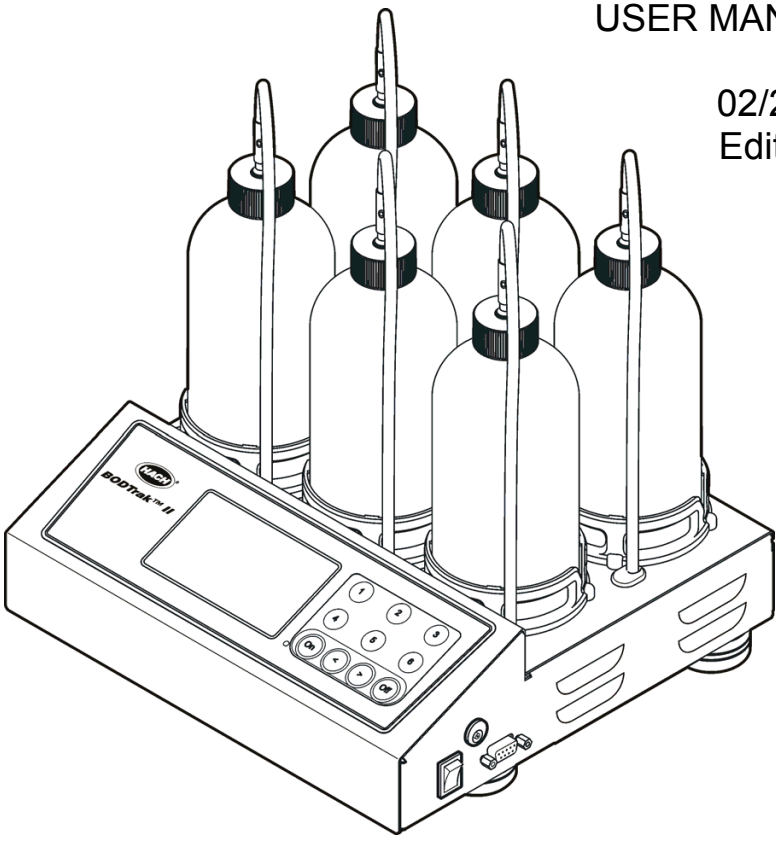


Table of contents

Section 1 Specifications

Specifications are subject to change without notice.

Table 1 Specifications

General	
Range	Selectable, 0 to 35, 0 to 70, 0 to 350, 0 to 700 mg/L
Dimensions	28.9 x 26 x 9.8 cm (11 3/8 x 10 ¼ x 3 7/8 inches)
External power supply	Input: 110 to 240 V, 50/60 Hz, Output: 24 V, UL CSA, and TUV approved
Capacity	Six 492 mL bottles
Shipping weight	4 kg (8.8 lb)
Operating temperature	20 ºC (68 ºF)
Storage temperature	0 to 40 ºC (104 ºF)
Method performance specifications	
Precision	On a standard containing 150 mg/L each of glucose and glutamic acid, a single analyst using 6 BODTrak™ II instruments and testing 44 samples obtained a mean of 235 mg/L BOD with a 95% confidence limit of distribution of 11 mg/L or a range of 224 to 246 mg/L BOD.
Drift	Less than 3 mg/L BOD in 5 days
Resolution	1 mg/L BOD

Table 2 Certification

Certification
Hach Company certifies this instrument was tested thoroughly, inspected and found to meet its published specifications when it was shipped from the factory. The BODTrak II has been tested and is certified as indicated to the following instrumentation standards: **FCC Part 15, Sub-Part B, Class A Limits:** Supporting test records by Intellistor, certified compliance by Hach Company **Canadian Interference-Causing Equipment Regulation, ICES-003, Class A:** Supporting test records by Intellistor, certified compliance by Hach Company **EN 55011/CISPR 11(EMI) "B" Limits per 89/336/EEC EMC:** Supporting test records by Intellistor, certified compliance by Hach Company **EN 50082-1 (Immunity) per 89/336/EEC EMC:** Supporting test records by Hach Company, certified compliance by Hach Company. Standards include: • IEC 801-2 and EN 61000-4-2 (ESD) • IEC 801-3 and EN V50140 (RF & EM Field) • IEC 801-4 and EN 61000-4-4 (Fast Transient) • EN 61000-4-5 (Surge) **Warranty:** US 1 year; EU 2 year

Table 2 Certification (continued)

Radio frequency interference
This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. ***Warning*** ***Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.*** This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at their own expense. Shielded cables must be used with this unit to ensure compliance with the Class A FCC limits. Because this instrument operates on and generates radio frequency energy, interference to radio and television reception may occur. If such interference does occur, the operator should take the necessary steps to correct the interference. The following techniques of reducing the interference problems are easily applied: • Disconnect power from the BODTrak II instrument to verify the instrument is the source of the interference. • If the BODTrak II is plugged into the same outlet as the device with which it is interfering, try another outlet. • Move the BODTrak II away from the device receiving the interference. • Reposition the receiving antenna for the device receiving the interference. • Try combinations of the above.

Section 2 General information

2.1 Safety information

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that specified in this manual.

2.1.1 Use of hazard information

DANGER
Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING
Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION
Indicates a potentially hazardous situation that may result in minor or moderate injury.

Important Note: *Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.*

Note: *Information that supplements points in the main text.*

2.1.2 Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol, if noted on the instrument, will be included with a danger or caution statement in the manual.

	This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.
	Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of life equipment to the Producer for disposal at no charge to the user. ***Note:*** *For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.*

2.2 Theory of operation

Respirometric Biochemical Oxygen Demand (BOD) is a test done at 20 °C (68 °F) in a controlled environment. The test period can be 5, 7 or 10 days, contingent on the analysis or protocol. The BOD test measures the quantity of oxygen consumed by bacteria that oxidize organic matter in a water sample. The test is used to measure waste loadings at wastewater treatment plants and to examine the efficiency of wastewater treatment.

BOD test results help find general oxygen uptake patterns. This lets operators estimate plant operating efficiency and find correct treatment procedures.

Advantages to the BODTrak™ II as an alternative to the dilution method are:

- Minimal time to prepare a sample.
- Decreased total test time.
- The BODTrak II method gives results comparable to the diluton method (BOD5) in 2 to 3 days.
- Calibration and dissolved oxygen measurement are not necessary.
- The BODTrak II test is easy to monitor.
- The sample is stirred constantly and kept in natural conditions. This makes the BODTrak II results similar to occurrences found in a natural environment. The dilution method supplies no additional oxygen to the sample. This causes a higher percentage of oxygen depletion and possible retardation of biochemical reactions.
- The BOD can be monitored at any time because the instrument continuously shows the BOD result. Pressure changes in the closed BODTrak II system are shown graphically in milligrams per liter (mg/L) on an LCD. The system supplies 360 uniform data points over the selected time period.
- The BODTrak II system continuously removes carbon dioxide from the system so that the pressure difference monitored is proportional to the quantity of oxygen used.
- Degassing can cause negative errors when heat is applied to a sample to achieve experimental temperature. The BODTrak II adjusts for this occurrence. The BODTrak II does not start the test until the temperature gets to equilibrium.

2.2.1 Oxygen transfer to sample

Bacteria in the sample use oxygen while consuming organic matter in the sample bottles. The air in the bottle above the sample contains 21% oxygen and replenishes the dissolved oxygen used by the bacteria. During the test period, stir bars continually mix the sample in each bottle. This moves oxygen from the air to the sample and helps simulate natural conditions.

2.2.2 Pressure sensor function

The BODTrak II is sealed to prevent external atmospheric pressure changes in the test bottle. Pressure sensors monitor air pressure in the sample bottles. When oxygen is consumed, the pressure in the bottle head space drops. The pressure drop correlates directly to BOD.

2.2.3 Removing carbon dioxide

Carbon dioxide is made when microorganisms oxidize organic matter in the sample. The carbon dioxide must be removed from the system so it does not interfere with the measurement. Potassium hydroxide pellets put in the seal cup of each sample bottle before the test remove the carbon dioxide.

Section 3 Installation

3.1 Component list

Compare each item below to the items in the shipment. If an item is missing or damaged, refer to the manufacturer.

- BODTrak™ II instrument
- A UL/CSA approved 115 VAC power cord with a NEMA 5-15P style plug
- A 230 VAC harmonized power cord with a continental European plug
- Power supply, auto–switching between 115 V and 230 V
- 6 seal cups
- 6 BODTrak II amber sample bottles
- 6 BODTrak II magnetic stir bars
- Spatula scoop
- One package nutrient buffer solution pillows
- One container potassium hydroxide pellets

3.2 Electrical installation

The power adaptor supplies AC power to the IEC universal connector (Figure 1). The power switch powers the instrument on and off.

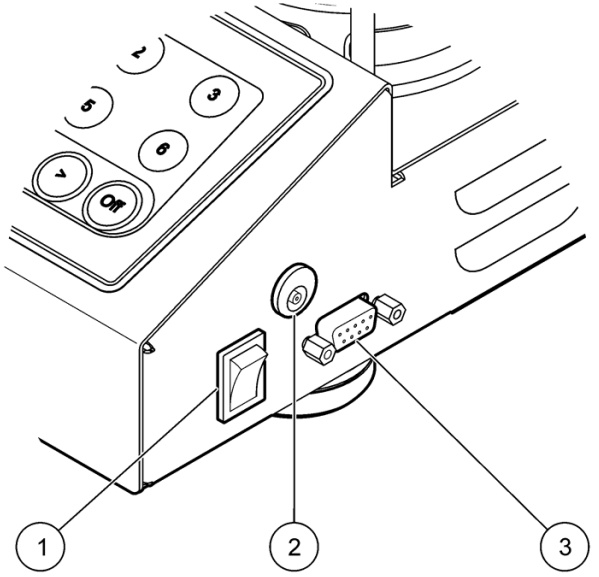


Figure 1 External connections

1 Power switch	**3** RS232 connector
2 IEC universal connector	

Section 4 Operation

4.1 Operational controls

The BODTrak™ II operator controls are shown in Figure 2.

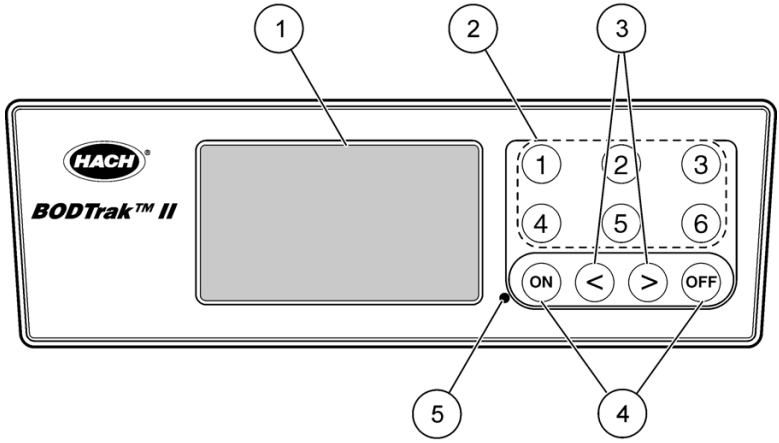


Figure 2 Operational controls

1 Display	**4** **ON/OFF** keys[1]
2 Channel selection keys	**5** Power indicator
3 Arrow keys	

[1] The ON/OFF keys start and stop a test. They do not power the instrument on and off.

4.1.1 Channel selection keys

Push the related channel selection key to show data for one of the 6 bottles.

The channel selection keys are also used in the instrument setup menu to choose a parameter to be edited (Table 3).

Table 3 Channel key setup parameters

Channel	Parameter
1	Year (0-99)
2	Month (1-12)
3	Day (1-31)
4	Hour (0-24)
5	Minute (0-59)
6	Test Length (5, 7, or 10 days)

4.1.2 The arrow keys

The display shows a graph of BOD values on the vertical axis and time in days on the horizontal axis. Push the left and right arrow keys to move the cursor along the BOD curve to show the approximate coordinates (time, BOD) of the selected data point.

The time interval and BOD value of the data point are shown in the lower right of the display. The cursor is automatically placed at the most recently collected data point in a channel display.

Push and hold the two arrow keys at the same time to go into the instrument setup menu. The arrow keys are also used to change the time, date, test length and range.

4.1.3 The ON key

To access the range selection menu, push the **ON** key from a channel display screen. Then push and hold the **ON** key to start the test for the selected channel.

4.1.4 The OFF key

When a test is in **DELAY** or **RUN** modes, pushing and holding the **OFF** key manually ends the test. The instrument will display **END**. The **OFF** key is also used to exit the instrument setup menu or range selection menu. Any changes made prior to exit will be saved.

4.2 Bottle connections

Each bottle position/channel has the applicable tube numbered with a plastic sleeve. The bottle positions are numbered 1 though 6 with number 1 in the back left corner of the chassis. Use the channel selection keys as a guide.

4.3 Setting the clock

All channels must show **END** or **CLEAR** before the clock can be set. Push and hold the two arrow keys at the same time until the instrument setup menu is shown. Select the clock parameter to be adjusted by pushing the applicable channel key (Table 3 on page 14). Use the arrow keys to edit the chosen parameter. Adjust each parameter in the same manner. When all time adjustments are complete, push the **OFF** key to save and go back to the data display screen.

4.4 RS232 Interface

All RS232 connections are made through the Serial I/O port (Figure 1 on page 12). Connect the 9-pin D connector of a computer interface cable to the Serial I/O port on the instrument. Connect the opposite end of the cable to the computer Serial I/O port (Com 1 or Com 2).

The BODTrak II instrument is equipped as Data Communication Equipment (DCE). The BODTrak II operates at 9600 baud with 8 data bits, no parity and one stop bit. The computer or printer will not receive complete transmissions if the device cannot continuously receive at 9600 baud.

Note: *Use of the specified cable or an equivalent shielded cable is mandatory to meet Radio Frequency Emissions requirements.*

4.5 Downloading test results

To transfer test results to a PC:

1. Choose **PROGRAMS**, **ACCESSORIES**, **COMMUNICATIONS**, **HYPERTERMINAL**.
2. In the Connection Description window, type in a name for the connection and choose an icon to represent it. Click **OK**.
3. In the Connect To window, use the drop-down menu to choose the COM port connected to the BODTrak II instrument. Click **OK**.
4. Configure the COM port properties:
   BPS = 9600, Data Bits = 8, Parity = None, Stop Bits = 1,
   Flow Control = None.
5. Click **OK**. The connect indicator will be shown.
6. Choose **TRANSFER**, **CAPTURE TEXT**.
7. In the Capture Text window, click **BROWSE** to choose a specific save location. Name the file and click **SAVE**.
8. In the Capture Text window click **START**.
9. Power on the BODTrak II. Push the applicable channel key for the data to be downloaded.
10. Type GA in the HyperTerminal window, then push **ENTER**. The transfer is complete when the screen stops adding new data.
11. Choose **TRANSFER**, **CAPTURE TEXT**, **STOP**.
12. Choose **CALL**, **DISCONNECT.** The disconnected indicator will be shown.
13. To end the HyperTerminal session, choose **FILE**, **EXIT**.
14. Click **YES** to save the session and all instrument/port configuration settings.

4.5.1 Import data

To import the data from the captured text file:

1. Open a new or existing spreadsheet. Choose **DATA**, **IMPORT EXTERNAL DATA**, **IMPORT DATA**.
2. Select the text file captured in HyperTerminal. Click **IMPORT**.
3. In the Text Import Wizard, choose **Delimited** as the file type, the start row in the spreadsheet, and **Windows (ANSI)** as the file origin. Click **NEXT**.
4. Check the **Space** delimiter and **Treat consecutive delimiters as one** check boxes. Click **NEXT**.
5. Choose General as the Column data format then click **FINISH**.
6. In the Import Data window, choose Existing worksheet. Choose the starting cell then click **OK**. The data will appear in your spreadsheet.
7. Choose File, Save As to save the spreadsheet.

The spreadsheet data cannot be edited or formatted in HyperTerminal or with the BODTrak II.

4.5.2 Data format

When a result array is downloaded to HyperTerminal, all data from the test are sent without pause. The data flow cannot be stopped or paused.

Figure 3 shows channel number, start date, start time, and the format of the downloaded data. BOD values in mg/L follow. Only the first data points, of a maximum of 360 equal distance points, are shown in this example. Each line ends with a carriage return and a line feed. The end of the data stream is shown by a message such as “Test Run to Completion” and a dollar symbol ($).

If small negative BOD values are seen at the start of a test, refer to Troubleshooting on page 37.

```
BOD Log for Ch 1
Status: END
Full Scale: 700 mg/L
Tst length: 7 days
Start Date: 3/3/08
Time: 13:04

Days, Reading (mg/L)

0.00, 0
0.05, 10
0.11, 12
0.16, 12
0.22, 14
0.27, 14
0.33, 12
0.38, 8
0.44, 10
0.50, 12
0.55, 12
0.61, 14
-
-
-
Test Run to Completion
$
```

Figure 3 Downloaded test data

4.5.3 Printing test results

The BODTrak II is compatible with the Citizen PD-24 printer, which is available as an optional accessory (Section 8 on page 41). Connect the printer cable to the serial port on the BODTrak II using the gender adapter provided with the printer. Make sure the printer interface settings are correct (section 4.4 on page 15).

Power on the BODTrak II instrument. Push and hold the applicable channel number for approximately 5 seconds at any time during a test. This moves the test results from the BODTrak II to the printer. The instrument will send a copy of the graphical display and a truncated data stream (127 data points).

Section 5 BODTrak™ II procedures

5.1 General Information

There are three BODTrak II procedure variations. Choose the procedure that meets the application requirements.

The **Simplified procedure** (section 5.2 on page 20) is recommended when sample seeding, extra nutrients or buffers are not necessary. It is also recommended when accuracy requirements are not stringent.

The **Hach GGA (glucose/glutamic acid) procedure** (section 5.3 on page 22) is recommended for all accuracy and performance checks using seeded GGA. It is also recommended when test accuracy is important.

The **Hach Standard Method procedure** (section 5.4 on page 24) is recommended when samples are seeded or extra nutrients or reagents are added. Use this procedure when following Standard Methods for the Examination of Water and Wastewater, 21st Edition, Method 5210 D Respirometric Method.

All procedure variations are followed by completion steps for all procedures (section 5.5 on page 27). It is possible to use a combination of these procedures with one instrument, but in different bottles. Only one test length can be chosen.

Before starting the test:

Use the applicable sample volume tables for each procedure.
If power is interrupted when the instrument is in **DELAY** status, the test will stop and the status will change to **CLEAR** when power returns. Start the test again. If power is interrupted when the instrument is in **RUN** status, the test will resume when power returns.
Keep deionized water overnight in an incubator at 20 ºC. Shake the deionized water to saturate with air.
Settle the seed overnight in the BOD incubator at a temperature of 20 ºC. Be careful not to disturb the settled solution. Pipet seed solution from the top.
Dilution is necessary if samples have BOD values more than 700 mg/L (5.7 on page 33).
At elevations higher than 5000 feet above sea level the 0 to 35 mg/L BOD range is decreased to 0 to 25 mg/L BOD. Adjustment is not necessary for other test ranges.
Refer to section 5.7 on page 33 for special considerations including sample seeding and pretreatment.
Use only BODTrak II stir bars and bottles. They are designed specifically for use with the BODTrak II.

5.2 Simplified procedure

Required apparatus:

BODTrak II bottle
Thermometer
Blender (optional)
Graduated cylinder

Required reagents:

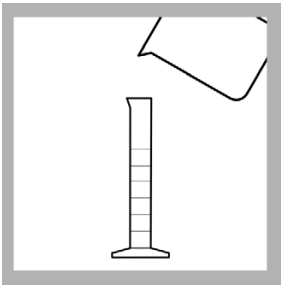
1 nutrient buffer pillow

Table 4 Simplified sample volumes

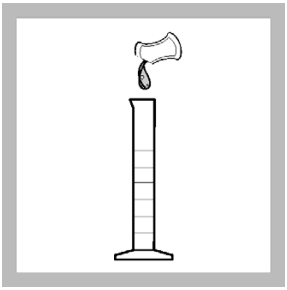
BOD range mg/L	Sample volume mL
0 to 35	420
0 to 70	355
0 to 350	160
0 to 700	95

1. Heat or cool the sample to 19 to 21 ºC (66 F to 70 ºF).

2. Homogenize the sample in a blender if it contains large settleable or floatable solids.



3. Choose the correct sample size for the sample range (Table 4). Measure the sample into a graduated cylinder.



4. Add the contents of 1 nutrient buffer pillow to the graduated cylinder.

5. Transfer the contents of the graduated cylinder to a BODTrak II bottle. Repeat steps 1 to 5 for additional samples.

6. Continue to the completion steps for all procedures (section 5.5 on page 27).

5.3 Hach GGA (glucose/glutamic acid) procedure

Required apparatus:

BODTrak II bottle
Graduated cylinder
Volumetric pipet and pipet filler
Tensette® pipet and pipet tips
Wash water bottle
Ampule breaker

Required reagents:

Deionized water
Hach GGA solution
1 nutrient buffer pillow

Before starting the test:

Use Hach BOD Standard Solution Ampules for Manometric Method (3000 mg/L Glucose, 3000 mg/L Glutamic acid).
On a standard containing 150 mg/L each of glucose and glutamic acid, a single analyst using 6 BODTrak II instruments and testing 44 samples obtained a mean of 235 mg/L BOD with a 95% Confidence Limit of Distribution of 11 mg/L or a range of 224 to 246 mg/L BOD after 5 days.
Always prepare the seed blank before the GGA samples. Use the same amount of seed for all GGA samples and seed blank.
Refer to section 5.7 on page 33 for special considerations.

Prepare seed blank

Use steps 1, 3 to 7.

Prepare sample

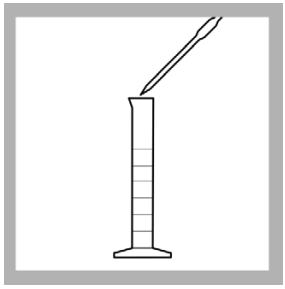
Use steps 1 to 7.

Table 5 GGA sample volumes

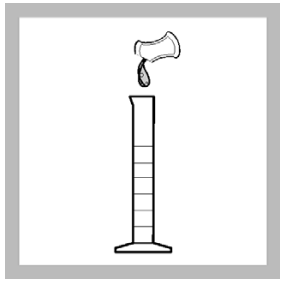
BOD range (mg/L)	GGA volume (mL)	Seed volume (mL)	Final Volume (mL)
0 to 350	8.0	10 to 35	160

Note: *If seed strength is unknown, use 20 mL. Adjust seed volume as necessary to achieve optimum GGA results. Use the same amount of seed for all GGA samples and seed blank.*

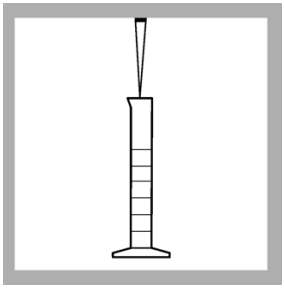
1. Add approximately 30 mL of deionized water to a 200 mL graduated cylinder.



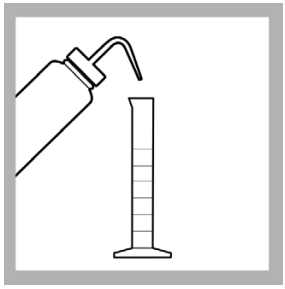
2. Use a volumetric pipet to transfer 8.0 mL of Hach GGA solution to the graduated cylinder.
Note: *Skip this step when preparing the seed blank.*



3. Add the contents of 1 nutrient buffer pillow to the graduated cylinder.



4. Use a tensette pipet to add the correct quantity of seed to the graduated cylinder (Table 5).



5. Dilute to the sample to 160 mL using a deionized water wash bottle.

6. Transfer the prepared sample from the graduated cylinder to a BODTrak II bottle.
Note: *For additional GGA samples, repeat steps 1 to 6.*

7. Continue to the completion steps for all procedures (section 5.5 on page 27).

5.4 Hach Standard Method procedure

Required apparatus:

Thermometer
BODTrak II bottle
Blender (optional)
Graduated cylinder
Tensette pipet and pipet tips
Wash water bottle

Required reagents:

1 nutrient buffer pillow
Additional nutrient or buffer (optional)
Deionized water

Before starting the test:

Use the sample volume table to choose the correct sample size (Table 6).
If seeding samples, prepare a seed blank before preparing a sample. Treat the seed blank the same as any other sample and omit step 5.
Refer to section 5.7 on page 33 for special considerations.

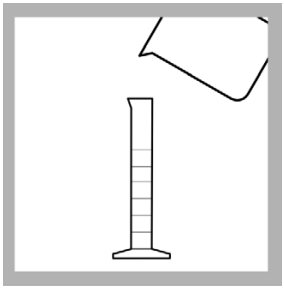
Table 6 Hach Standard Method sample volumes

BOD range (mg/L)	Sample volume (mL)	Seed volume (mL)	Final volume (mL)	Dilution factor
0 to 35	370	10 to 35	420	1.14
0 to 70	305	10 to 35	355	1.16
0 to 350	110	10 to 35	160	1.45
0 to 700	45	10 to 35	95	2.11

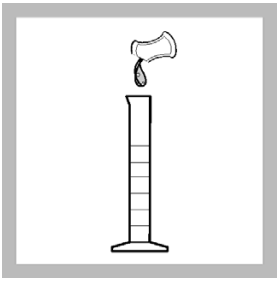
Note: *If seed strength is unknown, use 20 mL. Adjust seed volume as necessary to achieve optimum results.*

1. Heat or cool the sample to 19 to 21 ºC (66 to 70 ºF).

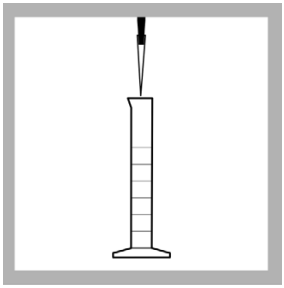
2. Homogenize the sample in a blender if it contains large settleable or floatable solids.



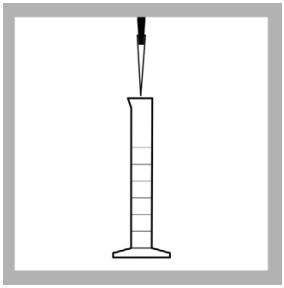
3. Choose the correct sample size for the sample range (Table 6 on page 24). Measure the sample into a graduated cylinder.



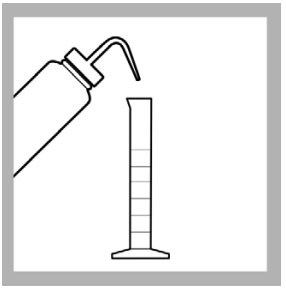
4. Add the contents of 1 nutrient buffer pillow to the graduated cylinder.



5. If seeding the sample, use a tensette pipet to add the correct quantity of seed to the graduated cylinder (Table 6 on page 24).



6. If necessary, add more nutrient or buffer. Do not add more than a total volume of 50 mL (seed, nutrient, buffer).



7. Fill to the final test range volume, if necessary, with a deionized wash water bottle (Table 6 on page 24).

8. Transfer the prepared sample from the graduated cylinder to a BODTrak II bottle.
Note: *Repeat steps 1 to 8 for additional samples.*

9. Continue to the completion steps for all procedures (section 5.5 on page 27).

5.5 Completion steps for all procedures

Required apparatus:

BODTrak II
Spatula scoop
BOD incubator
Seal cup
Stir bar

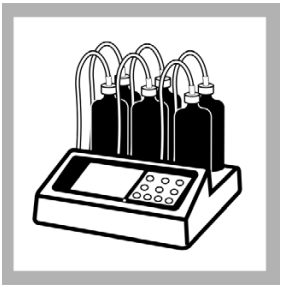
Required reagents:

2 potassium hydroxide pellets

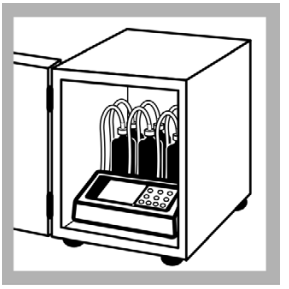
1. Put a BODTrak II stir bar into the bottle.

2. Put a seal cup into the neck of the bottle.

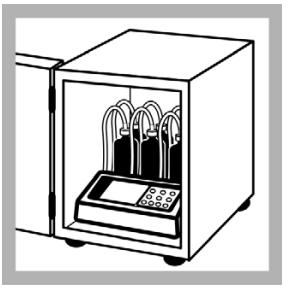
3. Use a spatula scoop to add 2 potassium hydroxide pellets to the seal cup. Repeat steps 1 to 3 for each sample bottle.



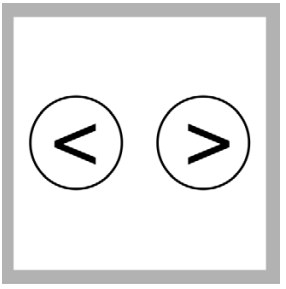
4. Put the bottles on the BODTrak II chassis. Connect the applicable tube to the sample bottle and tighten the cap.



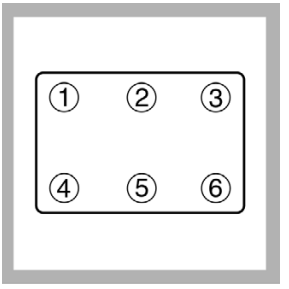
5. Put the instrument in the incubator. The incubator temperature must be 20 ± 1 ºC (68 ± 1 ºF).
Note: *Instrument performance has not been tested at other temperatures.*



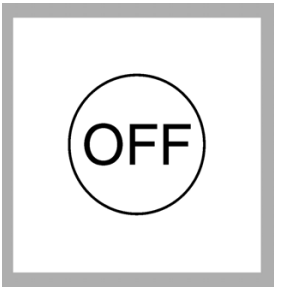
6. Plug in and power on the instrument. Make sure all stir bars are rotating. If not, lift the bottle up and set down again.



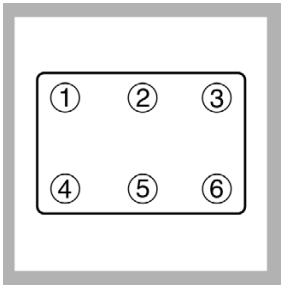
7. Push and hold the left and right arrow keys at the same time to access the instrument setup menu.
Note: *Set the time and date, if necessary (**section 4.3 on page 15**).*



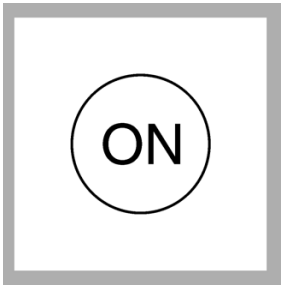
8. Push the Channel **6** key to access the test length parameter. Use the arrow keys to choose a 5, 7 or 10 day test.
Note: *The selected test length is for all 6 channels.*



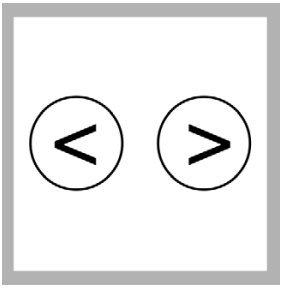
9. Push **OFF** to save selections and exit the menu.



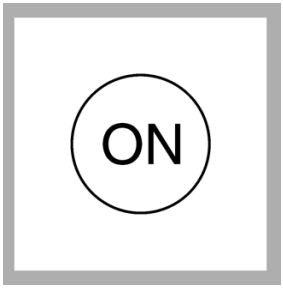
10. To start the test, push the channel number applicable to the bottle.



11. Push the **ON** key. The range selection menu is shown.

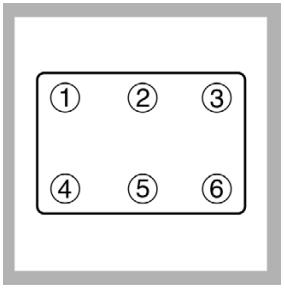


12. Use the arrow keys to choose the test range.
Note: *Use the left arrow key for the 0 to 35 and 0 to 70 mg/L ranges. Use the right arrow key for the 0 to 350 and 0 to 700 mg/L ranges.*



13. Push and hold the **ON** key to start a test. A graph will be displayed.
Note: *To cancel a test push and hold the **OFF** key.*

Note: *There is a built-in 1 hour instrument/sample equilibration period before data collection. The display will show **DELAY** during this period.*



14. Do steps 10 through 13 again to set the test range and start each of the 6 channels. It is not necessary to operate all 6 channels if less than 6 samples are available.

5.5.1 Determination of results

After the end of the chosen test period (5, 7 or 10 days), **END** is shown on the display. The procedure that is done dictates the determination of the results. The results are determined based on the selected procedure: Simplified, Hach GGA or Hach Standard Method.

5.5.1.1 Simplified sample results

The Simplified Procedure results are shown on the BODTrak II display. Push the applicable channel selection key to show the results.

Note: *If the sample was pre-diluted, apply a dilution factor to the instrument reading (section 5.7.1 on page 33).*

5.5.1.2 Hach GGA (glucose/glutamic acid) results

The seed blank and seeded GGA sample results are necessary for the Hach GGA procedure results.

1. Push the channel selection key for the seed blank bottle. The results are shown.
2. Push the channel selection key for the seeded GGA sample bottle. The results are shown.
3. Calculate the results:

   BOD mg/L = seeded GGA sample result - seed blank result

5.5.1.3 Hach Standard Method results

1. Push the channel selection key for the Hach Standard Method sample bottle. The results are shown.

Note: *Treat the seed blank the same as all other samples.*

Note: *If the sample was pre-diluted, apply a dilution factor to the instrument reading (section 5.7.1 on page 33).*

2. Find the dilution factor based on the selected range (Table 6 on page 24).

   Example: If the sample range selected was 0 to 350 mg/L BOD, the dilution factor is 1.45.

3. Calculate the corrected results:

   BOD mg/L = BOD mg/L (instrument reading) x dilution factor

   Example:
   Instrument Reading = 200 mg/L, BOD dilution factor = 1.45
   200 mg/L x 1.45 = 290 mg/L BOD (Corrected Result)

4. When samples are seeded, calculate the results using this equation and the corrected results:

$$BOD(mg/L) = A - \left[B \times \left(\frac{SA}{SB} \right) \right]$$

Where:

A = corrected BOD of the seeded sample
B = corrected BOD of the seed blank
SA = volume of seed in sample (sample can also be GGA)
SB = volume of seed in seed blank

Example:
A= 290 mg/L BOD
B= 120 mg/L BOD
SA= 20 mL
SB= 110 mL

$$BOD(mg/L) = 290mg/L - \left[120mg/L \times \left(\frac{20mL}{110mL} \right) \right]$$

BOD mg/L = 268 mg/L

5.6 Typical curves

Typical curves through a 10 day test period are shown in Figure 4. For incorrect curves refer to Figure 5 on page 37.

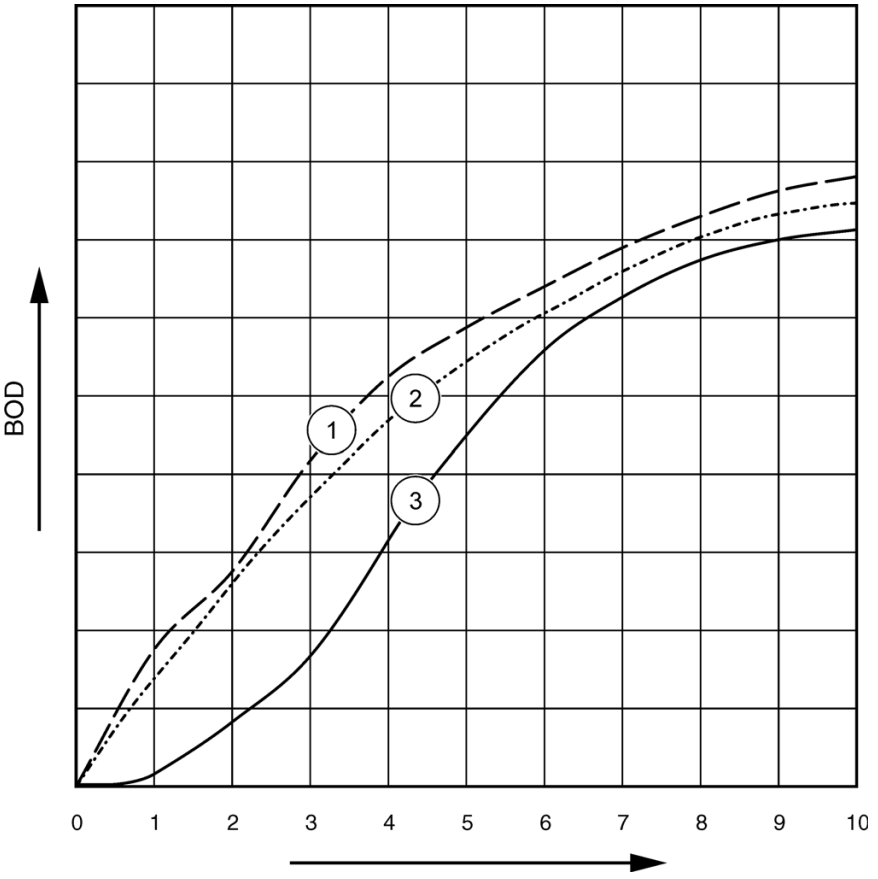


Figure 4 Typical curves

1 Typical with substrate variation	**3** Typical with time lag
2 Typical	

5.7 Special considerations

5.7.1 Sample dilution

Unknown sample BOD effluent is typically in the 0 to 70 mg/L range. Unknown sample BOD influent is typically in the 0 to 700 mg/L range. When the oxygen requirement of a sample is more than 700 mg/L, dilute the sample with high-quality distilled or deionized water.

Calculate the results to include the additional dilution factor. Example: If the BOD of the sample is 1000 mg/L, dilute the sample 1:1 with distilled or deionized water. The estimated BOD is now 500 mg/L. Use the sample volume specified in the table for the 0 to 700 mg/L range of the chosen procedure. Multiply the instrument reading result by 2. If using the Hach Standard Method procedure, continue with remaining calculations.

5.7.2 Sample seeding

Some types of BOD samples do not contain sufficient bacteria to oxidize the organic matter in the sample. Many industrial wastes are of this type. Some sewage treatment plant effluents are chlorinated and essentially sterile. A BOD test cannot be done in the absence of viable bacteria. To test such samples, seed each bottle from a source known to contain a viable bacterial population.

Settled domestic wastewater plant influent or primary clarifier effluent are the preferred sources of seed for most samples. Mixed liquor or undisinfected effluent can be used for seed, but it is recommended to include a nitrification inhibitor. Commercial seed sources are sometimes suitable. To prepare, see the instructions from the manufacturer.

5.7.3 Sample temperature

Standard Methods for the Examination of Water and Wastewater, 21st Ed., 2005, 5210 D recommends an incubation temperature of 20 ±1 °C (68 °F) for the BOD test. Put the BODTrak II instrument in an incubator that is adjusted to 20 ±1 °C. An applicable BOD incubator is available from Hach (section 8.1 on page 41). Warm or cool samples to 20 ± 1 °C.

Note: *Instrument performance has not been validated at temperatures other than 20 °C.*

5.7.4 Toxic materials

Industrial and chlorinated samples often contain toxic substances and require special considerations when running BOD tests. Toxic materials in the sample will cause decreased BOD values. Dilute the sample to minimize the toxic materials or their effects. Refer to Standard Methods for the Examination of Water and Wastewater, 21st edition, 5210 D.

5.7.5 Chlorine

Any chlorine in the sample must be removed prior to testing. Keep the sample at room temperature for 1 to 2 hours before a test to dissipate low chlorine concentrations. If any chlorine remains after sitting for 2 hours or if the chlorine concentration is high, add sodium thiosulfate to remove the chlorine:

1. In a 250 mL erlenmeyer flask add 100-mL of sample.
2. Add 10 mL of 100 g/L potassium iodide solution and 10 mL of 0.02 N sulfuric acid standard solution to the erlenmeyer flask.
3. Add 3 droppers of starch indicator solution and swirl to mix.
4. Titrate from dark blue to colorless with 0.025 N Sodium Thiosulfate standard solution.
5. Calculate the quantity of sodium thiosulfate standard solution necessary to dechlorinate the remaining sample:

$$\text{mL of Sodium Thiosulfate} = \frac{(\text{mL used})(\text{mL sample to be dechlorinated})}{100}$$

6. Add the necessary quantity of 0.025 N sodium thiosulfate standard solution to the sample and mix fully. After 10 to 20 minutes, do the BOD test.

5.7.6 pH effect

Low BOD test results occur when sample pH is outside the range of 6 to 8. Keep this pH to simulate source sample conditions or adjust the pH to neutrality (buffered at pH 7). Use 1.0 N (or weaker) sulfuric acid to neutralize caustic samples. Use 1.0 N (or weaker) sodium hydroxide to neutralize acidic samples. When samples are pH adjusted, they should also be seeded.

5.7.7 Supersaturation

Equilibrate supersaturated cold samples (containing more than 9 mg/L dissolved oxygen at 20 °C) to saturation:

1. Heat or cool the sample temperature to approximately 20 °C.
2. Half fill a sample bottle with sample.
3. Shake for 2 minutes or aerate with filtered compressed air for 2 hours.

Section 6 Maintenance

DANGER
Only qualified personnel should conduct the tasks described in this section of the manual.

6.1 Cleaning the instrument

Clean spills on the BODTrak™ II instrument with a soft cloth which has been dampened with deionized or distilled water.

6.1.1 Sample bottles

After each test, empty the sample bottles and flush them thoroughly with hot water. Use a brush, hot water and soap to remove residue. Residue creates a BOD. Flush the bottles thoroughly with tap water and finally with distilled or deionized water to remove all detergent.

6.1.2 Stir bars and seal cups

Clean the stir bars with hot water and soap. Use a brush to remove deposits. Flush with tap water and finally with distilled or deionized water to remove all detergent. Carefully empty and rinse the seal cups with water. Invert to dry.

6.1.3 Bottle fences

The bottle fences prevent tipping of the bottles and provide tubing management during storage. For storage, put the tubing into the opening in the bottle fence. Wind the tubing counter-clockwise and secure the bottle cap inside the fence.

Incorrect BOD curves through a 10 day test period are shown in Figure 5. For typical curves refer to Figure 4 on page 32.

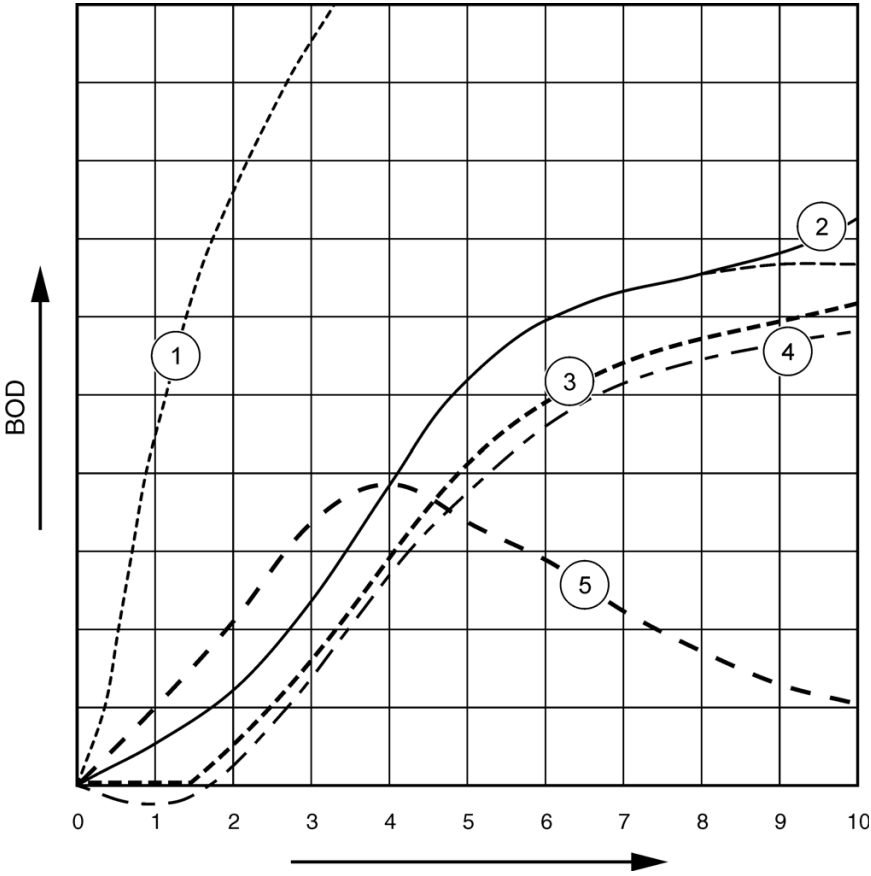


Figure 5 Incorrect BOD curves

1	High oxygen demand	**4**	Initial sample temperature below 20 °C or supersaturated with oxygen
2	Nitrification	**5**	Bottle leak
3	Excessive time lag		

7.1 High oxygen demand

Samples that are above range (for example, a BOD over 350 mg/L when a 160-mL sample is taken) will cause results as shown in Curve 1 (Figure 5 on page 37). Dilute the sample (section 5.7 on page 33) or use a higher BOD range and a different sample volume (Table 4 on page 20, Table 5 on page 23 or Table 6 on page 24).

When the BOD range of a sample is unknown:

- Use the results from the Chemical Oxygen Demand (COD) test. An estimated BOD value can be obtained by multiplying the COD by 0.68.
- Use the results from a series of BOD tests using the same sample but different volumes.
- Or use dilution ratios to choose an applicable BOD range.

Typically, effluent is in the 0-70 mg/L range while influent is in the 0-700 mg/L range. When the BOD of the sample is more than 700 mg/L, prepare a sample dilution (section 5.7 on page 33).

7.2 Nitrification

The condition shown by Curve 2 is an example of nitrification (Figure 5 on page 37). Deviation from the typical curve (shown as the dashed line) is apparent by the concave increase near the end of the test period.

Biological oxidation of organic nitrogen usually occurs after 5 days with typical domestic waste. Nitrifying bacteria develop more slowly than other types of bacteria.

However, some samples contain a high concentration of nitrifying bacteria and nitrification results can occur sooner. Control nitrification problems with Hach Nitrification Inhibitor. Dispense the inhibitor powder into an empty sample bottle and then add the sample. With the Hach Dispenser cap, dispense 6 shots (approximately 0.48 grams) into the empty bottle. Refer to replacement parts and accessories (Section 8 on page 41).

7.3 Excessive time lag

Curve 3 (Figure 5 on page 37) shows a test that did not start with sufficient bacteria during the incubation period. To do a test on a sample without sufficient bacteria, seed the sample (section 5.7.2 on page 33).

Bacteria acclimation also causes conditions that could cause Curve 3. This sometimes occurs with standards and added seed. Add more seed or choose a different seed source.

7.4 Sample temperature

The initial negative results of Curve 4 (Figure 5 on page 37) show that the initial sample temperature was below the specified range of 20 ± 1 ºC. A sample supersaturated with oxygen will also display this type of curve (section 5.7.3 on page 33 and section 5.7.7 on page 34).

7.5 Bottle leak

Curve 5 (Figure 5 on page 37) shows a bottle leak. A bottle leak can also cause no response from the system. If such a response occurs, check the seal cup and bottle cap for contamination or damage.

Section 8 Replacement parts and accessories

8.1 Replacement parts

Description	Quantity	Item Number
BODTrak™ II Instrument, 115/230 VAC	1	2952400
Bottle, BODTrak II, amber (6x)	1	714421
Power cord, 18/3 SVT 7.5', 10A-125 VAC for North American 115 VAC use	1	2959200
Power Cord, 8', with continental European plug for 230 VAC use	1	2959100
Power Supply	1	2952500
Computer cable for data transfer to PC	1	2959300
Seal Cup	1	2959500
Spatula scoop	1	1225700
Stir Bar, magnetic, BODTrak II	1	2959400

8.2 Reagents

Description	Quantity	Item Number
Respirometric BOD nutrient buffer pillows	1	2962266
Potassium hydroxide pellets	1	31425

8.3 Optional reagents

Description	Quantity	Item Number
Nitrification inhibitor, 35 g	1	253335
Dispenser cap for 35 g bottle (for use with nitrification inhibitor)	1	45901
Polyseed Inoculum (50x)	1	2918700
Potassium iodide solution, 100 g/L, 500 mL	1	1228949
Sodium Hydroxide standard solution, 1.0 N, 900 mL	1	104553
Sodium Thiosulfate standard solution, 0.025 N, 1000 mL	1	35253
Starch indicator solution, dropping bottle, 100 mL MDB	1	34932
Sulfuric acid, ACS, 500 mL	1	97949

8.3 Optional reagents (continued)

Description	Quantity	Item Number
Sulfuric acid, 0.02 N standard solution, 1000 mL	1	20353
Sulfuric acid, 1.0 N standard solution, 1000 mL	1	127053
Voluette ampule standard for BOD, 3000 mg/L for manometric, 10-mL/ampule, 16 ampules	1	1486610

8.4 Accessories

Description	Quantity	Item Number
Ampule breaker kit for voluette ampules	1	2196800
Bottle, wash, 500 mL	1	62011
Bottle, polyethylene, with spigot, 4 L	1	1486817
Brush, cylinder, size 2	1	68700
Buret, straight stopcock, Teflon plug, 25 mL	1	1405940
Clamp, buret, double	1	32800
Cylinder, graduated, 10 mL	1	50838
Cylinder, graduated, 25 mL	1	50840
Cylinder, graduated, 50 mL	1	50841
Cylinder, graduated, 100 mL	1	50842
Cylinder, graduated, 250 mL	1	50846
Cylinder, graduated, 500 mL	1	58049
Cylinder, graduated, 1000 mL	1	50853
Flask, erlenmeyer	1	50546
Incubator, BOD, Model 205, 110 V	1	2616200
Incubator, BOD, Model 205, 220/240 V	1	2616202
Pipet, Tensette®, 0.1 to 1.0 mL	1	1970001
Pipet, Tensette, 1 to 10 mL	1	1970010
Pipet tips, 0.1 to 1.0 mL (50x)	1	2185696
Pipet tips, 0.1 to 1.0 mL (1000x)	1	2185628
Pipet tips, 1 to 10 mL (50x)	1	2199796
Pipet tips, 1 to 10 mL (250x)	1	2199725
Pipet filler, 3 valve	1	1218900
Pipet, serological, glass, 10 mL	1	53238
Printer, Citizen PD-24 with cable	1	2960100
Standard Methods for the Examination of Water and Wastewater	1	2270800
Support stand, buret	1	32900

8.4 Accessories (continued)

Description	Quantity	Item Number
Thermometer, Mercury, -20 to 110 °C	1	56601
Thermometer, non-Mercury, -20 to 110 °C	1	2635702
Water Still, 120 V	1	2615900
Water Still, 220 V	1	2615902
Water System, Ultrapure, Millipore Direct -Q 3	1	2512100
DQ3 purification pack	1	2512201

Section 9 Contact Information

HACH Company World Headquarters

P.O. Box 389
Loveland, Colorado
80539-0389 U.S.A.
Tel (800) 227-HACH
(800) 227-4224
(U.S.A. only)
Fax (970) 669-2932
orders@hach.com
www.hach.com

Repair Service in the United States:

HACH Company
Ames Service
100 Dayton Avenue
Ames, Iowa 50010
Tel (800) 227-4224
(U.S.A. only)
Fax (515) 232-3835

Repair Service in Canada:

Hach Sales & Service
Canada Ltd.
1313 Border Street, Unit 34
Winnipeg, Manitoba
R3H 0X4
Tel (800) 665-7635
(Canada only)
Tel (204) 632-5598
Fax (204) 694-5134
canada@hach.com

Repair Service in Latin America, the Caribbean, the Far East, Indian Subcontinent, Africa, Europe, or the Middle East:

Hach Company World
Headquarters,
P.O. Box 389
Loveland, Colorado,
80539-0389 U.S.A.
Tel +001 (970) 669-3050
Fax +001 (970) 669-2932
intl@hach.com

HACH LANGE GMBH

Willstätterstraße 11
D-40549 Düsseldorf
Tel. +49 (0)2 11 52 88-320
Fax +49 (0)2 11 52 88-210
info@hach-lange.de
www.hach-lange.de

HACH LANGE LTD

Pacific Way
Salford
GB-Manchester, M50 1DL
Tel. +44 (0)161 872 14 87
Fax +44 (0)161 848 73 24
info@hach-lange.co.uk
www.hach-lange.co.uk

HACH LANGE LTD

Unit 1, Chestnut Road
Western Industrial Estate
IRL-Dublin 12
Tel. +353(0)1 46 02 5 22
Fax +353(0)1 4 50 93 37
info@hach-lange.ie
www.hach-lange.ie

HACH LANGE GMBH

Hütteldorferstr. 299/Top 6
A-1140 Wien
Tel. +43 (0)1 9 12 16 92
Fax +43 (0)1 9 12 16 92-99
info@hach-lange.at
www.hach-lange.at

DR. BRUNO LANGE AG

Juchstrasse 1
CH-8604 Hegnau
Tel. +41(0)44 9 45 66 10
Fax +41(0)44 9 45 66 76
info@hach-lange.ch
www.hach-lange.ch

HACH LANGE FRANCE S.A.S.

33, Rue du Ballon
F-93165 Noisy Le Grand
Tél. +33 (0)1 48 15 68 70
Fax +33 (0)1 48 15 80 00
info@hach-lange.fr
www.hach-lange.fr

HACH LANGE SA

Motstraat 54
B-2800 Mechelen
Tél. +32 (0)15 42 35 00
Fax +32 (0)15 41 61 20
info@hach-lange.be
www.hach-lange.be

DR. LANGE NEDERLAND B.V.

Laan van Westroijen 2a
NL-4003 AZ Tiel
Tel. +31(0)344 63 11 30
Fax +31(0)344 63 11 50
info@hach-lange.nl
www.hach-lange.nl

HACH LANGE APS

Åkandevej 21
DK-2700 Brønshøj
Tel. +45 36 77 29 11
Fax +45 36 77 49 11
info@hach-lange.dk
www.hach-lange.dk

HACH LANGE AB

Vinthundsvägen 159A
SE-128 62 Sköndal
Tel. +46 (0)8 7 98 05 00
Fax +46 (0)8 7 98 05 30
info@hach-lange.se
www.hach-lange.se

HACH LANGE S.R.L.

Via Riccione, 14
I-20156 Milano
Tel. +39 02 39 23 14-1
Fax +39 02 39 23 14-39
info@hach-lange.it
www.hach-lange.it

Contact Information

HACH LANGE S.L.U.

Edif. Arteaga Centrum
C/Larrauri, 1C- 2ª Pl.
E-48160 Derio/Vizcaya
Tel. +34 94 657 33 88
Fax +34 94 657 33 97
info@hach-lange.es
www.hach-lange.es

HACH LANGE LDA

Av. do Forte nº8
Fracção M
P-2790-072 Carnaxide
Tel. +351 214 253 420
Fax +351 214 253 429
info@hach-lange.pt
www.hach-lange.pt

HACH LANGE SP.ZO.O.

ul. Opolska 143 a
PL-52-013 Wrocław
Tel. +48 (0)71 342 10-83
Fax +48 (0)71 342 10-79
info@hach-lange.pl
www.hach-lange.pl

HACH LANGE S.R.O.

Lešanská 2a/1176
CZ-141 00 Praha 4
Tel. +420 272 12 45 45
Fax +420 272 12 45 46
info@hach-lange.cz
www.hach-lange.cz

HACH LANGE KFT.

Hegyalja út 7-13.
H-1016 Budapest
Tel. +36 (06)1 225 7783
Fax +36 (06)1 225 7784
info@hach-lange.hu
www.hach-lange.hu

HACH LANGE S.R.L.

Str. Leonida, nr. 13
Sector 2
RO-020555 Bucuresti
Tel. +40 (0) 21 201 92 43
Fax +40 (0) 21 201 92 43
info@hach-lange.ro
www.hach-lange.ro

HACH LANGE

8, Kr. Sarafov str.
BG-1164 Sofia
Tel. +359 (0)2 963 44 54
Fax +359 (0)2 866 04 47
info@hach-lange.bg
www.hach-lange.bg

HACH LANGE SU ANALİZ SİSTEMLERİ LTD.ŞTİ.

Hilal Mah. 75. Sokak
Arman Plaza No: 9/A
TR-06550 Çankaya/ANKARA
Tel. +90 (0)312 440 98 98
Fax +90 (0)312 442 11 01
bilgi@hach-lange.com.tr
www.hach-lange.com.tr

HACH LANGE D.O.O.

Fajfarjeva 15
SI-1230 Domžale
Tel. +386 (0)59 051 000
Fax +386 (0)59 051 010
info@hach-lange.si
www.hach-lange.si

HACH LANGE Ε.Π.Ε.

Αυλίδος 27
GR-115 27 Αθήνα
Τηλ. +30 210 7777038
Fax +30 210 7777976
info@hach-lange.gr
www.hach-lange.gr

HACH LANGE E.P.E.

27, Avlidos str
GR-115 27 Athens
Tel. +30 210 7777038
Fax +30 210 7777976
info@hach-lange.gr
www.hach-lange.gr