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Operator's Manual

PC-BOD for Single Rack Systems

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Table of Contents

1.0 Introduction

1.1 General information

PC-BOD Version 3.0 software has been designed and optimized for the determination of Biochemical Oxygen Demand (BOD) and Carbonaceous Biochemical Oxygen Demand (CBOD).

The software has been set up to follow Standard Method 5210B – 23rd Edition - 5 Day BOD Test as well as the European Standard for Determination of BOD – EN 1899-1. The operation of the system and the calculations can be altered to meet other requirements as well. For more information, please contact MANTECH or your local distributor for technical assistance.

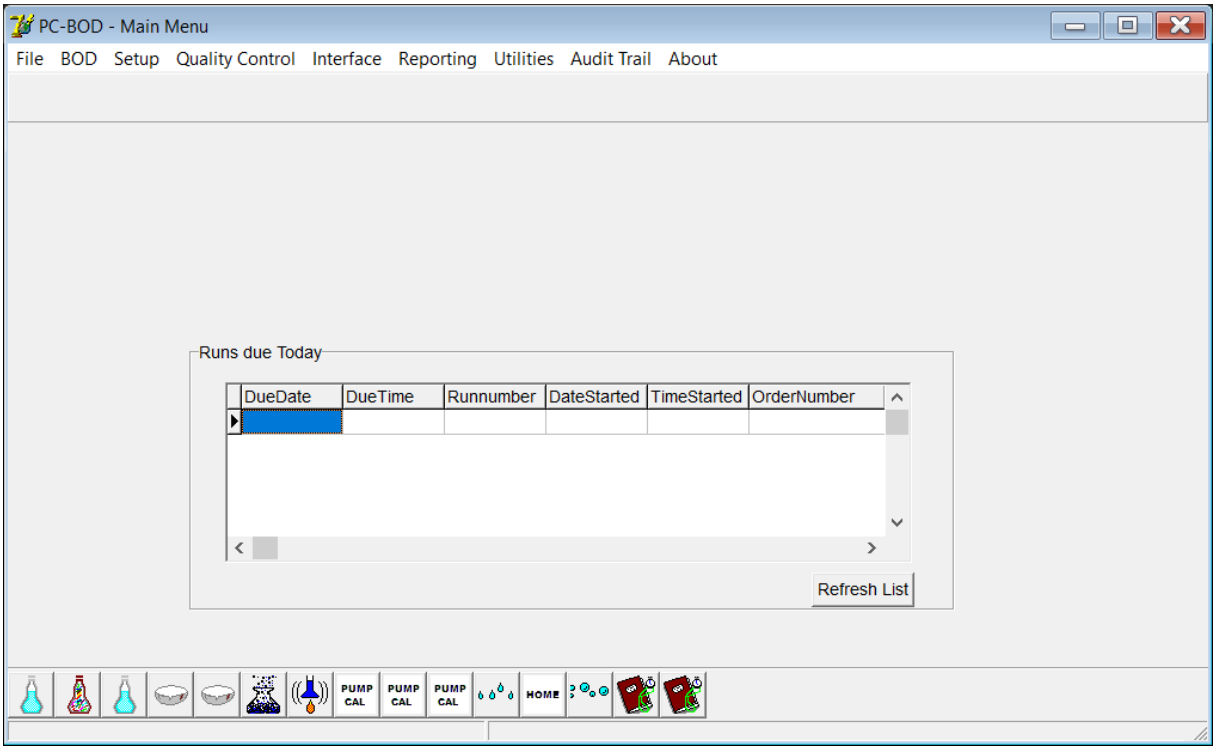
PC-BOD has two categories of software: one for single rack systems and one for multi rack systems. PC-BOD single rack systems use one rack on the autosampler bed at one time. These systems may use one of the following autosampler models: AM73, AM122, AM197, or Standalone (no autosampler). PC-BOD multi-rack systems use multiple racks on the autosampler bed at one time. These systems may use one of the following autosampler models: AM354, AM372, or AM390. Multi rack systems also have the capability to run dual probe BOD analysis.

While the functionality of the single and multi-rack software is very similar, differences do exist. This manual provides instructions on using the single rack software.

1.2 Opening the PC-BOD software

On the computer desktop, locate the software icon, as shown below.

Double click on the icon and the software will open to the home screen as shown in the following image. If the icon (shortcut) is not present, open the software from its file location at: *C:\Program Files\Hinterland\PC-BOD\PCBOD (application)*.



1.3 Home Screen

The home screen of PC-BOD shows the **Main Menu Options** along the top bar, BOD **'Runs due Today'** across the middle of the window, and the **AutoRun Buttons** along the bottom of the window.

The main menu options include information on BOD methods, templates, schedules, hardware setup, etc. and will be discussed further in the manual.

The **'Runs due Today'** section shows which batches of samples are due for final DO analysis that day (day 5).

Autorun buttons provide a quick-start option to run BOD analysis and other common operations. See the following table for a summary of Standard Database autorun button operations. Please note, these buttons may be customized and therefore, may not match a customer database exactly.

Standard Database AutoRun Buttons

Icon	Name	Description
	ANALYSIS – BOD	Loads template for running BOD analysis.
	ANALYSIS – BOD CBOD	Loads template for running BOD and CBOD analysis.
	ANALYSIS – CBOD	Loads template for running CBOD analysis.
	CHANGE MEMBRANE	Loads template for changing DO probe membrane; applicable to systems utilizing a membrane DO probe.
	CHANGE SENSOR CAP	Loads template for changing DO probe sensor cap and inputting cap coefficients; applicable to systems utilizing an optical DO probe.
	SAMPLER – HOME	Loads template for moving the autosampler (and probe) to the Home position.
	SAMPLER – RINSE	Loads template for moving the autosampler (and probe) to the rinse station.
	PROBE CALIBRATION	Loads template for performing a DO probe calibration
	PROBE PARK	Loads template for parking the DO probe in its proper storage position when not in use.
	PUMP CALIBRATION – DILUTION	Loads template for performing a flow rate check on the dilution pump.
	PUMP CALIBRAITON – INHIBITOR	Loads template for performing a flow rate check on the inhibitor pump.
	PUMP CALIBRATION – SEED	Loads template for performing a flow rate check on the seed pump.
	PUMP PRIME	Loads template for priming the lines of each pump.
	SUPPORTING DOCS – MANUAL	Loads template to display the Operation Manual.
	SUPPORTING DOCS – PARTS LIST	Loads teamplate to display the parts list.

2.0 Making Templates/Sample Sets

This section of the manual will describe Templates and Samples Sets, which can be used to prepare and save frequently used batch information. Templates and sample sets can be re-loaded to streamline the BOD analysis setup and makes the PC-BOD system more time efficient.

- Template: A pre-saved list of samples that is used as is, or is modified to create daily runs (as shown in the following image). Most commonly, the blank, seed (if applicable) and QC bottles are saved to a template. This is then used as the start of a run and daily samples are added on, as required.

Seq... #	Rack Num	Bottle Pos	Sample Name	Sample ID	Pre-Dilution	Is CBOD?	Inhib. Vol (mL)	Sample Vol (mL)	Seed Vol (mL)	Initial DO	Initial Temp	Final DO	Final Temp
1			Blank	Blank	1	No	0	0	0				
2			Seed	BOD Seed-1	1	No	0	0	10				
3			Seed	BOD Seed-2	1	No	0	0	15				
4			Seed	BOD Seed-3	1	No	0	0	20				
5			Seed	BOD Seed-4	1	No	0	0	25				
6			GGA_BOD	BOD QC-1	1	No	0	6	4				
7			GGA_BOD	BOD QC-2	1	No	0	6	4				
8			GGA_BOD	BOD QC-3	1	No	0	6	4				

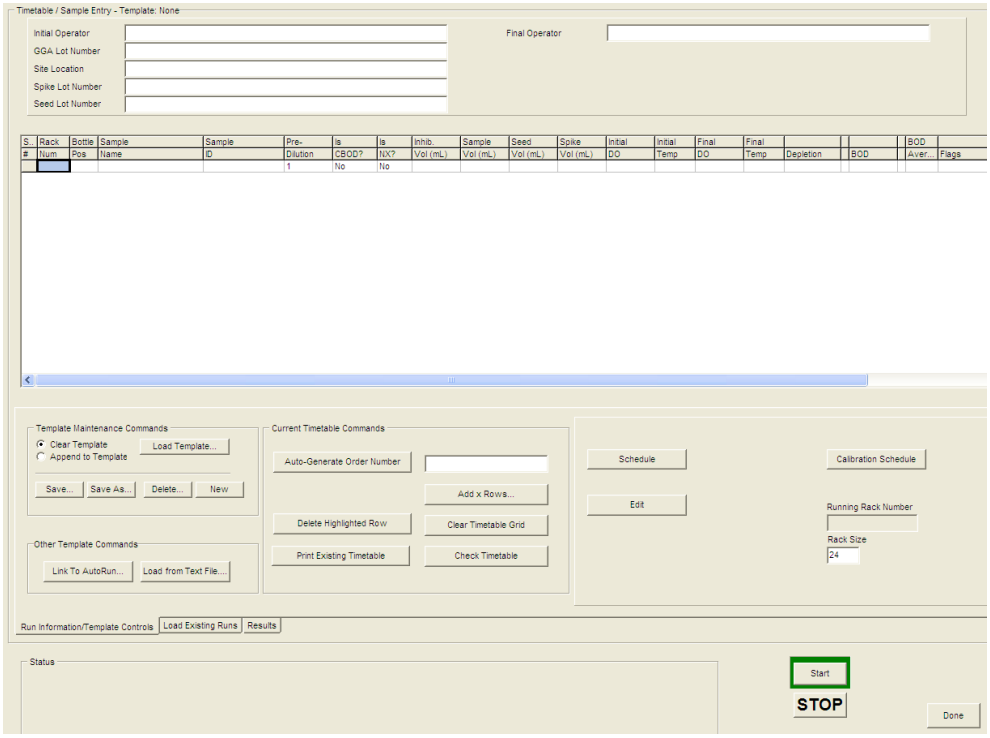
- Sample Set: A short template containing dilutions for only one sample type. These are appended to a template and/or other sample sets to create a daily run, as shown below.

Seq... #	Rack Num	Bottle Pos	Sample Name	Sample ID	Pre-Dilution	Is CBOD?	Inhib. Vol (mL)	Sample Vol (mL)	Seed Vol (mL)	Initial DO	Initial Temp	Final DO	Final Temp
1			Effluent		1	Yes	3	5	3				
2			Effluent		1	Yes	3	10	3				
3			Effluent		1	Yes	3	20	3				
4			Effluent		1	Yes	3	40	3				

1. From the main menu, click on **'Setup'** then **'Edit Timetable Templates'**. This can also be done by clicking on '**BOD**', '**Run BOD'**. Note that in order to select the latter, the interface must be connected and communicating with the computer.
2. For single rack systems, click on the '**Add X Rows**' button. Enter the number of rows needed in addition to the one already on the grid, to have one line per bottle. Click '**OK**' and the rows will be added.
3. Fill in the appropriate columns on the template. See Appendix A for column definitions and required template fields. Also refer to Appendix G for tips and hints on making BOD templates.
4. Select the method to use by clicking on the **'Schedule'** button. i.e. 'BOD-DILUTION-SEED'
5. If a software calibration will be part of the template, select the appropriate calibration method by clicking on the **'Calibration Schedule'** button. A calibration is denoted by writing 'calib' in the Sample Name column of the bottle which is to be used for the calibration.
6. Click the **'Auto-Generate Order Number'** button; this produces a unique number used by the software to track each run. It will be automatically updated each time this template is used.
7. If any extra lines are present, use the **'Delete Highlighted Row'** button to remove them. Do not leave any blank lines in the template.
8. Click on '**Save As**' and enter a unique template name and press **'OK'**.
9. To create another template/sample set, click on '**Clear Timetable Grid**' and then repeat steps 2-5 described above. Alternatively, the samples currently on the screen can be altered and the **'Save As'** button used to give the template a different name.

3.0 Setting up an Initial Run

Samples can be added manually, loaded from a template or an AutoRun button, or imported onto the run screen from a text file. These options will be discussed below in Section 3.1, 3.2 and 3.3. Note: any or all these options may be used when creating a run up to a maximum of **512 lines/bottles per run**. An example of the run screen is shown below.



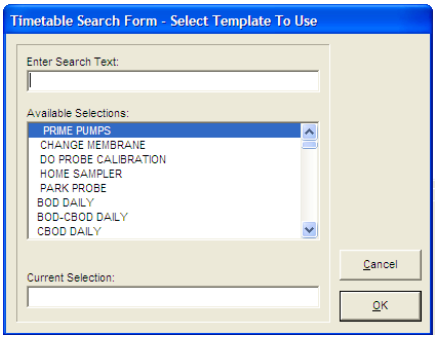
3.1 Manually

1. Launch the run screen by selecting the 'BOD' tab at the top of the screen, and select 'Run BOD…'
2. Click on the '**Add X Rows**' button. Enter the number of rows that need to be added to the one already on the grid to give one row per bottle for the run. Click '**OK**' and the rows will be added.
3. Fill in each column of the template. See Appendix A for column definitions and required template fields. Also see Appendix G for tips on quickly making BOD runs.
4. To remove extra lines, click the **'Delete Highlighted Row'** button. Do not leave blank lines in the template.
5. When in '**Edit**' mode, lines may be inserted into the template by selecting the template row to insert above and clicking on the **'Insert X Rows'** button. Rows cannot be inserted above rows which have been partially or fully analyzed. If this is attempted the '**Insert X Rows'** button will remain greyed out.
6. Select the method to use to analyze samples by clicking on the **'Schedule'** button.
7. If a calibration will be performed as part of the run, select this method by clicking the **'Calibration Schedule'** button. Note: a calibration is denoted by writing 'calib' in the Sample Name column of the bottle which is to be used for the calibration.
8. Click the **'Auto-Generate Order Number'** button if the order number is not already populated; this produces a unique number used by the software to track each run.
9. Fill the bottles with the appropriate samples, and put them into the Autosampler racks in the order they appear on the run screen, starting with position 1.

10. Place the rack containing the first samples onto the Autosampler.
11. Press the **'Start'** button to begin sample analysis. When prompted, enter or scan the rack number currently on the Autosampler and press **'OK'**.
12. When the rack is complete, remove it and replace it with the rack containing the next set of samples on the run screen. Press 'Start' and enter or scan the new rack number. The run will continue with the new rack. Repeat until all racks have been analyzed.

3.2 Using Templates

1. Launch the run screen by selecting the 'BOD' tab at the top of the screen, and select 'Run BOD…'
2. From the run screen, click on the '**Load Template**' button.
3. Search through the list and select the desired template, then press '**OK**'. The template will now be loaded onto the run screen grid. To learn how to make templates see Section 2.

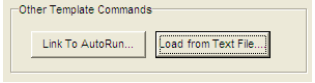


4. To add additional templates to the run, select the '**Append to Template**' option located beside the **'Load Template'** button and repeat steps 1 and 2. Each template added will be appended to the bottom of the run.
5. To make changes to templates that have been loaded, click on the **'Edit'** button located on the '**Run Information/Template Controls'** tab. For tips on populating BOD templates refer to Appendix G.
6. While in **'Edit'** mode, check that the correct schedule and calibration schedule methods have been selected. If applicable, select these by clicking on their respective buttons and choosing the method to use.
7. Once all changes have been made, click **'Done Edit'**.
8. Fill the bottles with the appropriate sample and put them into the Autosampler racks in the order they appear on the run screen, starting with position 1.
9. Place the rack containing the first samples onto the Autosampler.
10. Click on the **'Start'** button to begin the run. When prompted, enter or scan the rack number currently on the Autosampler and press **'OK'**.
11. When the rack is complete, remove it and replace it with the rack containing the next set of samples. Press 'Start' and enter or scan the new rack number. The run will continue with the new rack. Repeat until all racks have been analyzed.

3.3 Importing Run Data

Importing data requires a text file with a specific format. See Appendix E for this information.

1. Launch the run screen by selecting the 'BOD' tab at the top of the screen, and select 'Run BOD…'
2. From the run screen, select the **'Load from text file'** button.

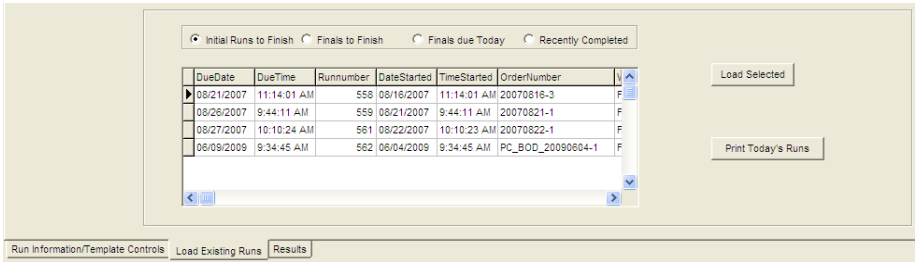


3. Select the file location and then the text file and press **'Open'**. The data will be populated into the appropriate columns.
4. To change any data, click on the **'Edit'** button on the '**Run Information/Template Controls**' tab. For tips on making/changing BOD templates refer to Appendix G.
5. While in **'Edit'** mode, check that the correct schedule and calibration schedule methods have been selected. If applicable, select these by clicking on their respective buttons and choosing the method to use.
6. Once all changes have been made, click **'Done Edit'**
7. Fill the bottles with the appropriate sample and put them into the Autosampler racks, starting with position 1.
8. Place the rack containing the first set of samples onto the Autosampler.
9. To begin the run, click on the **'Start'** button. When prompted, enter or scan the rack number currently on the Autosampler and press **'OK'**.
10. When the rack is complete, remove it and replace it with the rack containing the next set of samples. Press '**Start**' and enter or scan the new rack number. The run will continue with the new rack. Repeat until all racks have been analyzed

4.0 Loading an Existing Run

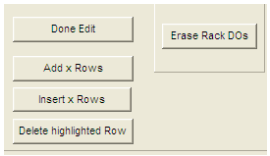
Once a run has been started, the data will always be saved to the database. This section will describe how to locate and re-start a run that has not yet been completed. If the run has already been finished and does not require editing, see Section 10.3 to view data and/or print a report.

1. From the main screen click on '**BOD**' and then select '**Run BOD…**'
2. Choose the '**Load Existing Runs**' tab, as shown below.



3. On this screen there are four radio buttons which contain runs in various stages of completion. They are described below:
   - Initial Runs to Finish: contains runs which have not had any/all initial DO measurements taken.
   - Finals to Finish: contains runs which have not had any/all final DO measurements taken and/or calculations completed. Runs that are over or under the incubation period specified in the BOD Method are only located here.
   - Runs Due Today: only contains runs that have completed the incubation period and require final DO measurements to be taken that day. This section also contains runs which are due today which have been started but not completed.
   - Recently Completed: contains runs that have been finished on the system and are still within the specified time frame. These runs can have final DO measurements reset and re-analyzed and select sample information modified. If a run is located in this menu and it is loaded it will be moved to the finals to finish section. The run must then be started again to transfer it back to recently completed. If the run is found only in post run analysis, it is outside the specified time frame and data in the run can no longer be modified.

4. Click the appropriate radio button for the run being located and find it in the list shown. The most recent runs are at the bottom of the list.
5. Click on the '**Load Selected**' button.
6. If any information such as sample name needs to be modified, select the **'Run Information/Template Controls'** tab and click the **'Edit'** button to gain access to the template. See Section 6 if DO values need to be reset and Appendix G for tips on editing BOD templates. Once the desired changes have been made click **'Done Edit'**.



7. Place the rack containing the first samples onto the Autosampler.
8. To begin the run, click on the **'Start'** button. When prompted, enter or scan the rack number currently on the Autosampler and press **'OK'**.
9. When the rack is complete, remove it and replace it with the rack containing the next set of samples. Press 'Start' and enter or scan the new rack number. The run will continue with the new rack. Repeat until all racks have been analyzed

5.0 Adding Samples to a Run

This can ONLY be done during the initial DO readings.

5.1 During the run:

1. Click on the 'STOP' button.
2. Select the **'Edit'** button on the **'Run Information/Template Controls'** tab of the run screen.
3. Add samples manually or from templates using the instructions found in Section 3.1 or 3.2 respectively.
4. Once all required information has been populated, click the **'Done Edit'** button.
5. Press **'Start'**, enter the rack number and press **'OK'** to continue where the run left off. The new samples will automatically be added to the last rack if it is incomplete, and a new rack will be added to the end of the run, if necessary. Ensure these bottles are placed in the correct rack locations.
6. When the rack is complete, remove it and replace it with the rack containing the next set of samples. Press 'Start' and enter or scan the new rack number. The run will continue with the new rack. Repeat until all racks have been analyzed

5.2 After the initial run is complete:

1. From the main screen of PC-BOD, load the run from the '**finals to finish**' section of the software as described in steps 1-5 of Section 4.
2. Once loaded, click the **'Convert Finals Run to Initials Run'** button.
3. On the '**Run Information/Template Controls'** tab, click on the **'Edit'** button.
4. Add samples manually or from templates using the instructions found in Section 3.1 or 3.2 respectively.
5. Once all required information has been entered, click the **'Done Edit'** button.
6. Press **'Start'**, enter the rack number, and press **'OK'**. The run will start at the beginning of the new bottles. The new samples will automatically be added to the last rack if it is incomplete, and a new rack will be added to the end of the run if necessary. Ensure these bottles are placed in the correct rack locations.
7. When the rack is complete, remove it and replace it with the rack containing the next set of samples. Press 'Start' and enter or scan the new rack number. The run will continue with the new rack. Repeat until all racks have been analyzed

6.0 Resetting DO Measurements and Correcting Run Information

6.1 If not leaving the run screen:

1. Click on the '**STOP**' button.
2. On the '**Run Information/Template Controls**' tab, click on the '**Edit**' button.
3. Reset desired DO readings by removing the DO value using the delete key on the keyboard. If all DO values in a rack need to be reset, click the '**Erase Rack DOs'***** button, enter the rack number of the rack to be reset and press '**OK**'.
4. To edit run data, click on the desired cell and use the delete key on the keyboard to remove the current information. Type the new information into the cell. **Important:** When manipulating volumes of samples that have been run, be careful that volumes which were added via pumps are not changed, or calculated results will be inaccurate.
5. When finished, click on '**Done Edit**'.
6. Click on the '**Start**' button, enter the rack number and then click '**OK'**. The sampler will go back and re-read any reset DO values in the rack entered prior to continuing the run. If DO readings were reset in a previous rack, be sure that the rack number on the Autosampler corresponds with the rack number entered into the software.

6.2 If leaving the run screen or the exiting software:

1. If the software has been closed, double click the shortcut icon to open it.
2. Load the incomplete run as described in Step 1-5 of Section 4.
3. On the '**Run Information/Template Controls**' tab, click on the '**Edit**' button.
4. Reset desired DO readings by removing the DO value using the delete key on the keyboard. If all DO values in a rack need to be reset, click the '**Erase Rack DOs'***** button, enter the rack number of the rack to be reset and press '**OK**'.
5. To edit run data, click on the desired cell and use the delete key on the keyboard to remove the current information. Type the new information into the template cell. **Important**: When manipulating volumes of samples that have been run be careful that volumes which were added via pumps are not changed or calculation results will be inaccurate.
6. When finished, click on '**Done Edit**'.
7. Click on the '**Start**' button, enter the rack number and then click '**OK'**. The sampler will go back and re-read any reset DO values in the rack prior to continuing the run. If DO readings were reset in a previous rack, be sure that the rack number on the Autosampler corresponds with the rack number entered into the software.

6.3 After a run is complete*

1. On the main screen click on '**BOD**' drop-down menu and then select '**Run BOD…**'
2. Select the '**Load Existing Runs**' tab.
3. Locate and select the run in either the **'Finals to Finish'** or the '**Recently Completed'** section of the software, depending on whether the run completed was initials or finals. See Section 4 step 3 for information on locating a specific run.
4. Click on the '**Load Selected**' button.
5. If the run was loaded from the '**Recently Completed'****** section of the software, the run will automatically be converted back to 'Finals to Finish' ***

6. If loaded from '**Finals to Finish**', press the '**Convert Finals Run to Initials Run**' button. **NOTE**: nothing will change on the screen to indicate that the conversion has been done.

7. Follow steps 2-6 of Section 6.1 to reset DO readings or edit other fields.

***** If resetting multiple rack DO's in one run, the correct procedure is to erase the first rack, then exit the 'Edit Function' by clicking 'Done Edit', then click the 'Edit' button again, click the 'Erase Rack DO' button again, select the rack number and click OK, then click the 'Done Edit' button again. Repeat as necessary. The main purpose of closing the Edit function after each reset is to ensure the Skip Rinse feature remains active when the run is restarted.

****** The software has been se tup to keep a run in the recently completed section for 6 hours. After this, the run will only be available for viewing from the Post Run BOD menu and changes can no longer be made. If you wish to change the number of hours a run can be modified, do this by going into '**Utilities**', '**Options**' and changing the value in the '**Allow finals to be modified for'** section.

******* After the run, if converted back to 'Finals to Finish', if it is just closed, it will remain there. To get it to be transferred back to 'Recently Completed', simply click Start. The run will complete, and be transferred automatically.

7.0 Dissolved Oxygen (DO) Probe Calibration

It is highly recommended that the DO probe/meter be calibrated at the beginning of each run. There are several calibration schedule options specific to the meter and probe configuration on the system. Regardless of the calibration schedule chosen, it is very important to have a consistent calibration procedure to ensure passing blank and QC results and accurate sample results. The PC-BOD calibration schedules are outlined below. For YSI 52 and 5100 meters, there is also the option for manual calibration, which does not use a schedule.

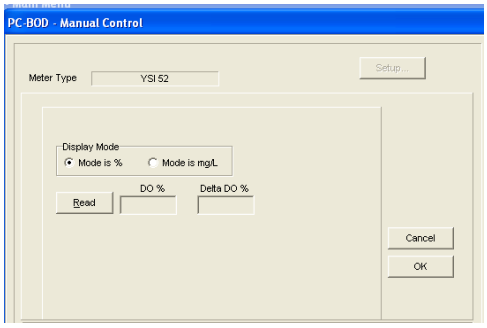
List of PC-BOD Calibration Schedules

Schedule Name	Description
YSI 4010 METER CALIBRATION	Step-by-step schedule instructing the user on how to calibrate the DO probe using the YSI 4010 MultiLab meter.
YSI5100 BAROMETER CALIBRATION	Step-by-step schedule instructing the user on how to calibrate the DO probe using the YSI 5100 meter using its internal barometer.
YSI5100 CALIBRATION	Step-by-step schedule instructing the user on how to calibrate the DO probe to a specified standard using the YSI 5100 meter.
YSI5100 CALIBRATION - PERCENT	Step-by-step schedule instructing the user on how to calibrate the DO probe to a specified standard in units of % using the YSI 5100 meter.
YSI5100 CALIBRATION - AUTOCAL	Schedule for automated calibration of the DO probe to a specified standard using the YSI 5100 meter.
YSI5100 CAL - PERCENT AUTOCAL	Schedule for automated calibration of the DO probe to a specified standard in units of % using the YSI 5100 meter.
YSI PROOBOD METER CALIBRATION	Step-by-step schedule instructing the user on how to calibrate the DO probe using the YSI ProODO meter using its internal barometer.

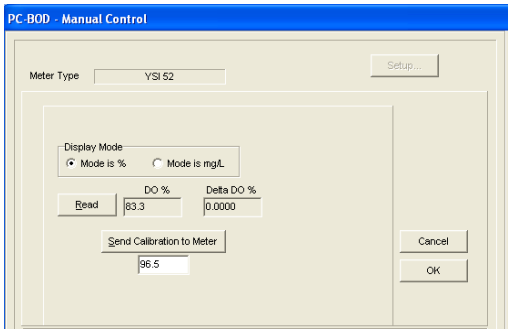
7.1 Manual Calibration

The following applies to both the YSI 52 and YSI 5100 meters **only**. This calibration is a direct meter calibration and therefore does not provide a calibration report and the values will not be recorded in the software.

1. Before calibrating, rinse the DO probe with deionized water to wet the membrane. Dab off the excess water with a Kim Wipe.
2. For an air saturated calibration, place the DO probe in a BOD bottle containing ~1 inch of water and ensure there is a tight seal. To do this, hold the probe and twist the bottle onto the probe until it is held in place. This can also be done by moving the DO probe into the bottle using manual control (see Section 8.4).
3. For a Winkler calibration, place the probe into the Winkler bottle and turn on the stirrer as discussed in Manual Control.
4. Let the probe stabilize (~5-15 minutes).
5. Once the reading is stable, from the main menu, click on '**BOD**' and select '**Manual Control**'.
6. Select the '**Serial Devices**' tab at the bottom of the screen, then select the tab for the DO meter.
7. Click on the '**Setup**' button. The screen to the below will appear.



8. Select the display mode for the calibration (% or mg/L).
9. Click on the '**Read**' button and when a reading appears, press the '**Stop**' button.
10. Enter the calibration value, in the appropriate units, in the window below the '**Send Calibration to Meter**' button.



11. Click on the '**Send Calibration to Meter**' button. When the calibration is complete the meter will beep once and display the calibration value.
12. Check to see that the reading remains stable before beginning a run. If necessary, repeat steps 9 to 11.
13. When an acceptable calibration has been performed, click on the **'OK'** buttons to exit back to the main screen.

7.2 Automated Calibration

As outlined in the table above, there are several PC-BOD schedules available for automated meter calibration. It is important to select the calibration schedule applicable to the meter and probe, and to site-specific procedures.

For an automated calibration, the Sample Name column for the calibration bottle must read 'calib' and a calibration schedule must be selected.

The next section will explain the automated calibration schedule options.

7.2.1 YSI 4010 METER CALIBRATION

This calibration is a direct meter calibration and therefore does not provide a calibration report and the values will not be recorded in the software.

Important: Do not put a calibration on the last line of a template.

1. Click on the PROBE CALIBRATION AutoRun button. The icon will look like the one shown,  unless customized.
2. Add samples to the run, if desired, using the instructions found in Section 3.
3. For performing a water vapour air saturated calibration, place a bottle with approximately 1 inch of water in position 1 of the first rack on the Autosampler.
4. Click on the '**Start**' button in the software.
5. After the probe is rinsed, the software will prompt for the probe end to be cleaned of any excess water. Remove this water using a Kim Wipe.
6. When prompted, make a seal between the bottle and probe by holding the probe and twisting the bottle onto the probe until it is held in place.
7. The software will count down from 10 minutes, while the DO reading stabilizes.
8. Follow the OK messages, to press CAL and START on the meter, to take the calibration reading.
9. The meter will beep once the reading has stabilized.
10. Press F1 on the meter to return to the measure value display.
11. **Important:** Break the seal between the probe and the bottle.
12. The probe will move to the rinse station to rinse, prior to proceeding with samples, if applicable.

7.2.2 YSI5100 BAROMETER CALIBRATION and YSI PROOBOD METER CALIBRATION

This calibration uses the internal barometer in the YSI 5100 or ProODO to calibrate the meter and is the preferred calibration for these meters due to its accuracy. It is a direct meter calibration and as a result the software does not provide a report of calibration results.

Important: Do not put a calibration on the last line of a template.

1. Click on the PROBE CALIBRATION AutoRun button. The icon will look like the one shown,  unless customized.
2. Place a bottle with approximately 1 inch of water in position 1 of the rack on the Autosampler.
3. If performing this calibration as part of a run, fill out the rest of the template using the instructions found in Section 3.
4. Click on the '**Start**' button.

5. Enter the rack number on the Autosampler and press '**OK'**.
6. After the probe is rinsed, the software will prompt for the membrane/sensor to be cleaned of any excess water. Remove this water using a Kim Wipe.
7. When prompted, make a seal between the bottle and probe by holding the probe and twisting the bottle onto the probe until it is held in place.

*If you are using a **YSI 5100 meter follow steps 7 – 12**. If using a **YSI ProODO meter follow steps 14 - 18***

8. Once the reading is stable, (typically, stabilization takes 10-15 minutes), the software will direct you via several 'OK' messages to go to the main screen of the meter by pressing the '**Mode'** button on the meter twice.
9. Once on the main screen, press the '**Calibrate'** button on the meter, followed by the '**Autocal'** button.
10. The meter will use its internal barometer to calibrate to the correct value.
11. Once the calibration is complete, remove the bottle from the probe.
12. Press the **'Mode'** button on the meter twice, and then press the **'Remote'** key to allow the software to read the meter.
13. If the calibration is being performed as part of the run, the system will continue with the next bottle, otherwise the sampler will return to the home position and complete the run.

For YSI ProODO meter:

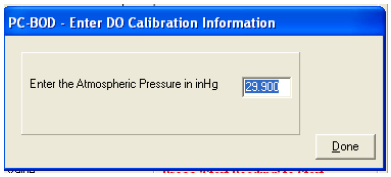
14. Once the reading is stable, the software will direct you via several 'OK' messages, beginning with pressing the '**Cal**' button on the meter.
15. From the list on the meter screen, select '**DO'**.
16. Select '**DO%**' from list on the meter screen.
17. Select '**Accept Calibration**'. The meter will proceed with the calibration.
18. Once the calibration is complete, remove the bottle from the probe.
19. If the calibration is being performed as part of the run, the system will continue with the next bottle, otherwise the sampler will return to the home position and complete the run

7.2.3 YSI5100 CALIBRATION and YSI5100 CALIBRATION - PERCENT

Important: Do not put a calibration on the last line of a template.

1. Click on the PROBE CALIBRATION AutoRun button. The icon will look like the one shown,  unless customized.
2. Add samples onto the run, if desired, using the instructions found in Section 3.
3. If performing an air saturated calibration, place a bottle with approximately 1 inch of water in position 1 of the rack on the Autosampler. If performing a Winkler calibration, place the Winkler bottle in this position instead.
4. Click the '**Mode**' button on the meter twice to go to the main menu. Press the button below **'Calibrate'** to note the atmospheric pressure displayed, for use later in the calibration process. Then, click on the '**Mode**' button followed by the **'Remote'** button before continuing with the calibration.
5. Click on the **'Start'** button in the software.
6. Enter the rack number that is currently on the Autosampler and press '**OK'**.
7. After the probe is rinsed, the software will prompt for the membrane to be cleaned of any excess water. Remove this water using a Kim Wipe.
8. When prompted, make a seal between the bottle and probe by holding the probe and twisting the bottle onto the probe until it is held in place. **Note**: A seal does not need to be made if performing a Winkler calibration.

9. Once the reading is stable, the software will request the calibration value. Enter one of the following numbers depending on the calibration type:
    a. Atmospheric pressure in mmHg (if measuring in percent DO)
    b. Atmospheric pressure in inHg (if measuring in percent DO)
    c. Atmospheric pressure in kPa (if measuring in percent DO)
    d. DO value in mg/L (if measuring in mg/L DO)



For example, in the calibration shown, the pressure in inches of mercury is required. For Winkler calibrations, this value will be in mg/L.

10. **Important:** once the calibration is complete, break the seal between the bottle and the probe.
11. If the calibration is being performed as part of the run, the system will continue with the next bottle, otherwise the sampler will return to the home position and complete the run.

7.2.4 YSI5100 CALIBRATION – AUTOCAL and YSI5100 CAL - PERCENT AUTOCAL

This calibration does not require the user to be present to respond to the OK messages that are in the other calibration procedures.

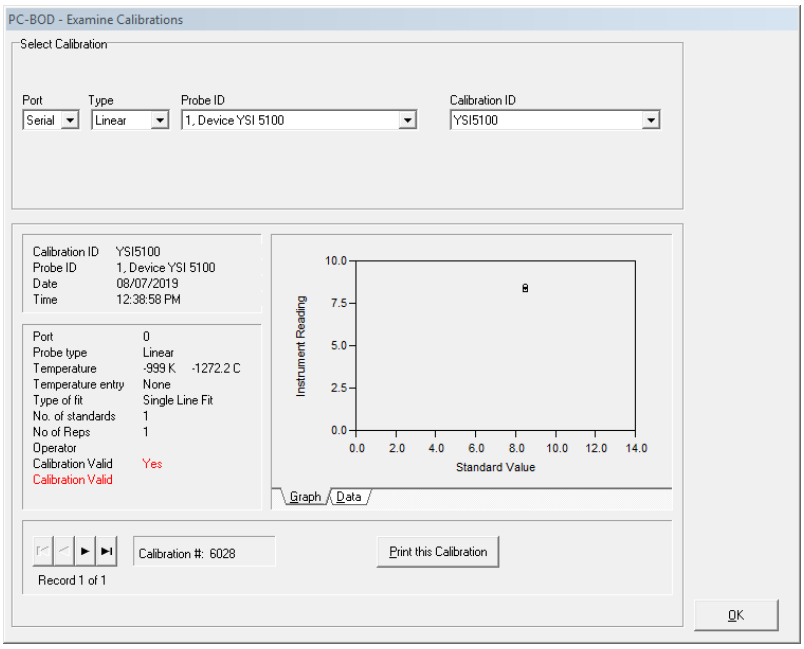
Important: Do not put a calibration on the last line of a template.

1. From the main menu, select '**Setup**', then '**Calibration Template**'.
2. Click the '**Load**' button and select the calibration template used. This will likely be named 'YSI 52 AutoCal' or 'YSI 5100 AutoCal'. Click '**OK**'.
3. Enter the atmospheric pressure in the specified units or the calibration value in mg/L and ensure that the '**Autocal without user intervention**' box is checked.
4. Click the '**Save**' button. Press '**OK**' to exit back to the main screen.
5. Create the run using the instructions found in Section 3. For the calibration position(s), ensure 'calib' is written in the sample name column for that bottle. Also be sure to load the appropriate calibration schedule by clicking the '**Calibration**' button on the run screen.
6. When the run is prepared, place the bottles with the appropriate sample in them into the Autosampler racks. If performing an air saturated calibration, place a bottle with approximately 1 inch of water in the calibration positions(s) of the rack on the Autosampler. If performing a Winkler calibration, place the Winkler bottle in these positions instead.
7. Place the rack containing the first samples onto the Autosampler.
8. To begin the run, click on the **'Start'** button. When prompted, enter the rack number currently on the Autosampler and press **'OK'**.
9. When a 'calib' bottle is reached, the software will automatically calibate the meter to the value specified in step 3.

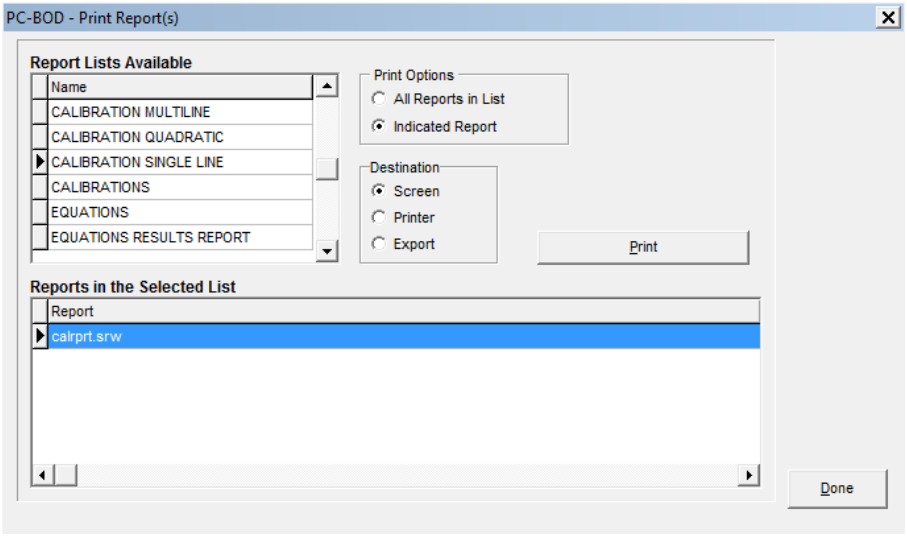
7.6 Examining Historical Calibration Data

Calibration data is only stored when using the following templates: YSI5100 CALIBRATION, YSI5100 CALIBRATION – PERCENT, YSI5100 CALIBRATION – AUTOCAL, and YSI5100 CAL - PERCENT AUTOCAL.

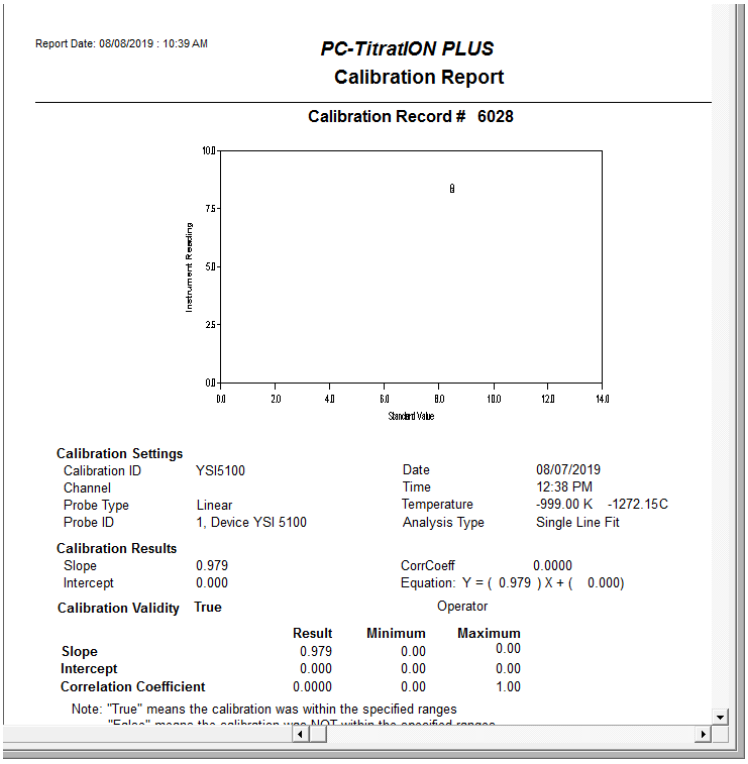
1. From the main menu, go to **'BOD'**, **'Examine Calibrations'**.
2. Under **'Port'**, select **'Serial'**, and under **'Type'**, select **'Linear'**. Under **'Probe ID'** should be the meter type.
3. At the bottom of the window, use the left and right arrows to scroll through the calibrations. The calibration details will show in the middle of the window.



4. The calibration report can be printed to screen, printed to a printer, or exported to another location by selecting **'Print this Calibration'**.
5. In the next window, ensure the report selected is '**calrpt.srw'**. Choose whether to print to screen, printer, or export.



6. An example of a calibration report is shown below:



Report Date: 08/08/2019 : 10:39 AM

PC-TitratION PLUS
Calibration Report

Calibration Record # 6028

Calibration Settings

Calibration ID	YSI5100	Date	08/07/2019
Channel		Time	12:38 PM
Probe Type	Linear	Temperature	-999.00 K -1272.15C
Probe ID	1, Device YSI 5100	Analysis Type	Single Line Fit

Calibration Results

Slope	0.979	CorrCoeff	0.0000
Intercept	0.000	Equation: Y = (0.979) X + (0.000)	

Calibration Validity **True** Operator

	Result	Minimum	Maximum
Slope	0.979	0.00	0.00
Intercept	0.000	0.00	0.00
Correlation Coefficient	0.0000	0.00	1.00

Note: "True" means the calibration was within the specified ranges

7.7 Calibration Data from the YSI 4010 MultiLab meter

The calibration value on the YSI 4010 MultiLab meter is automatically evaluated after each calibration. For evaluation, the slope of the sensor is compared to the slope of an ideal sensor, using the following equation: $S = S_{semsor}/S_{ideal}$. An ideal sensor has a slope of 1.

There are four different classifications of the calibration evaluation, summarized in the table below:

Calibration Evaluation

Calibration Record	Relative Slope
+++	0.94 < S < 1.06
++	0.92 < S < 0.94 or 1.06 < S < 1.08
+	0.90 < S < 0.92 or 1.08 < S < 1.10
Error	S < 0.90 or S > 1.10

(Xylem Inc. (2018). *MutliLab 4010-3W Operating Manual ba76194e 03 07/2018*. OH.)

Ideally, the calibration record will display +++, which indicates that the sensor is measuring closest to an ideal sensor. If the calibration record is displaying less than +++, recalibrate, or compare the displayed result to an altitude chart. If the displayed value matches the chart's value, then the calibration is valid, however, the sensor may need replacement soon (i.e. new sensor cap or membrane). It is good practice to always compare the measured value against the attitude chart, even if the calibration record displays +++.

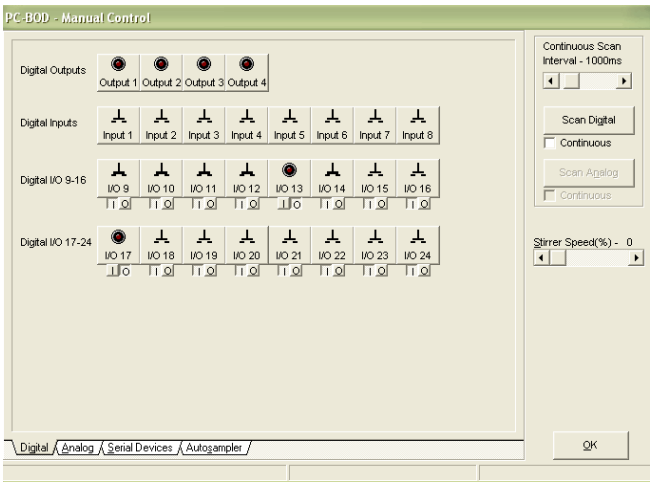
8.0 Manual Control

Manual control allows the testing and control of hardware without the use of the schedules and run screen. This section is very useful for troubleshooting. Access to the different areas of manual control can be selected by clicking one of the tabs at the bottom of the screen. To enter this section of the software click on '**BOD**' drop-down menu and select '**Manual Control…**'.

8.1 Digital Tab

This tab allows the pumps and stirrer to be turned on or off. Click on the buttons listed below to turn a specific device on or off. Please note, there are several cable configuration iterations. This manual lists the current cable configuration; therefore, the customer cable configuration may vary.

Hardware Component	Current Digital
Level Sensor	(Input) 1
Stirrer	1
Rinse Pump	4
Dilution Pump	9
Fan for Dilution Pump	13
Seed Pump	17
Inhibitor Pump	21
Spike Pump	Not on standard cable, available upon request



This section of the software can be used to prime pumps or for troubleshooting.

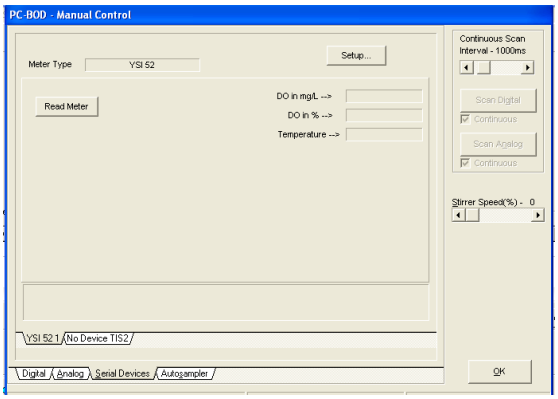
8.2 Analog Tab

This section is currently not used in the PC-BOD software.

8.3 Serial Devices Tab

This tab allows access to the DO meter.

It can be used to do a manual calibration (YSI 52 or 5100 only) or to check that the meter is communicating with the system correctly.



Read the meter:

1. Select the tab for the DO meter.
2. Click on the '**Read Meter**' button. The temperature and DO value in mg/L and % will be displayed in the boxes on the right of the screen. If there is a connection issue, '**Meter not Found'** will be displayed here. See the Troubleshooting Guide for possible solutions.

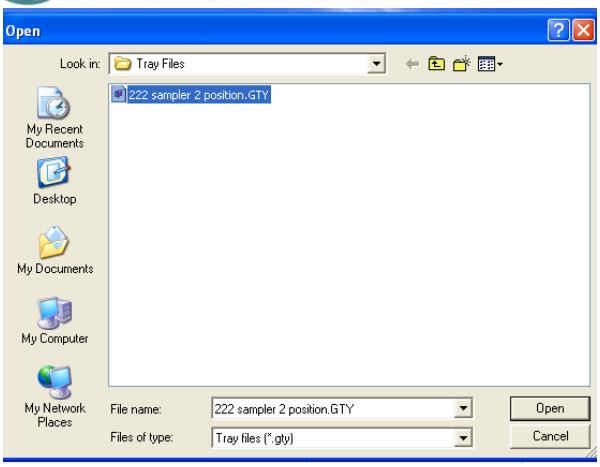
Manual Calibration:

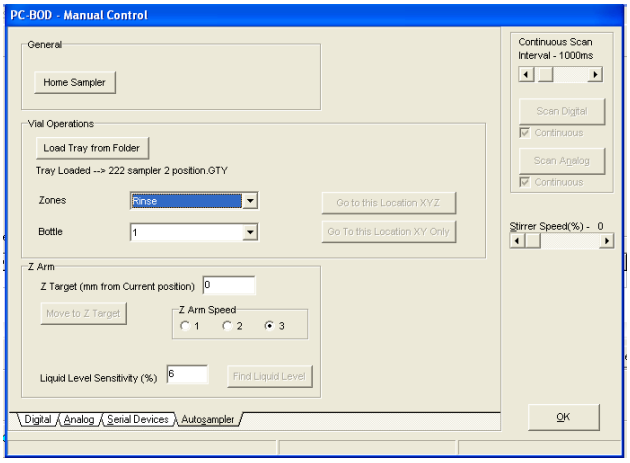
See Section 7.1 for detailed instructions.

8.4 Autosampler Tab

This section of Manual Control allows the Autosampler to be moved around the BOD rack. It is often used for manually parking the DO probe for overnight storage and troubleshooting any sampler issues that arise.

1. Click on the '**Load Tray from Folder**' button. The window shown on the right will appear. Click on the tray file name and then click the '**Open**' button. There may be more than one tray file located here. Make sure the correct file is selected to prevent possible damage to the DO probe. If unsure, please contact MANTECH or your local distributor for technical assistance.
2. Click on the '**Home Sampler**' button. The sampler will move to the home position (back left of the sampler bed), and the Z-arm will become active. If the sampler is already in the home position, it may appear that nothing is happening but within a few seconds the two buttons will become active.
3. To move the Autosampler to a specific location first select one of the three zones:
    a. Rinse: moves the DO probe and dispensing tubes into the rinse station
    b. Tube: moves the dispensing tubes into the bottle
    c. Bottle: moves the DO probe into the bottle
4. Select the bottle location to move to using the drop down menu. For example, selecting 'Bottle' and '9' will move the DO probe into the 9th bottle position.
5. To move the Autosampler to the specified location click on **'Go to this location XY only'** to move above the zone. Do not use the **'Go to this location XYZ'** button as it may move the probes too far into the bottle, causing an Autosampler error.
6. To move the Autosampler in the Z direction (up and down), enter the number of millimeters to move in the box next to '**Z Target (mm from current position)**'. A positive number will move the probes up from the current position and a negative value will move them down. Click '**Move to Z Target'** to move the sampler. For example, entering -20 will move the Z arm down 20 mm.





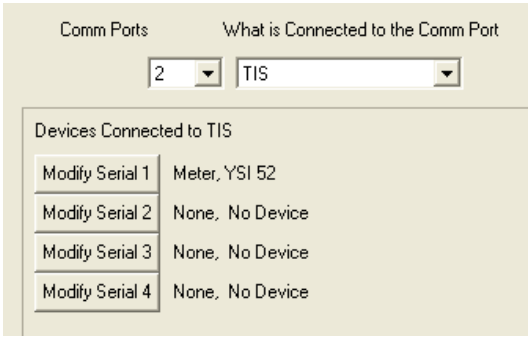
9.0 Hardware Setup

This section of the software details how the various components are connected to the system for correct communication and operation. For the most part, changes to this section of the software will not need to be made. The primary reason to enter into this area would be to update the pump flow rates as determined in Section 12.4. To view this section of the software, from the main screen, click on '**Interface**' followed by '**Hardware Setup**'.

9.1 Serial Devices

On this tab the DO meter model is specified as well as where it is connected to the interface. In the example below, a YSI 52 meter is connected to the system on the first serial port of the interface. To change the meter connected to a YSI 5100, click on the 'Modify Serial 1' button and select 'YSI 5100' from the list.

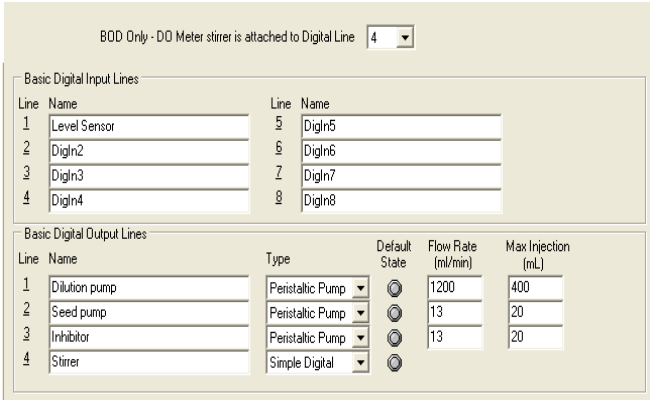
Also on this screen is the computer Comm Port location for the Interface module (TIS). In the example on the right, the interface is connected to Comm Port 2 on the computer. Depending on the computer used, the interface may also be connected to Comm 3 or 4. Unless the system does not use an Autosampler, the Comm Port for the interface should not be Comm 1, as this port is reserved for the Autosampler connection.



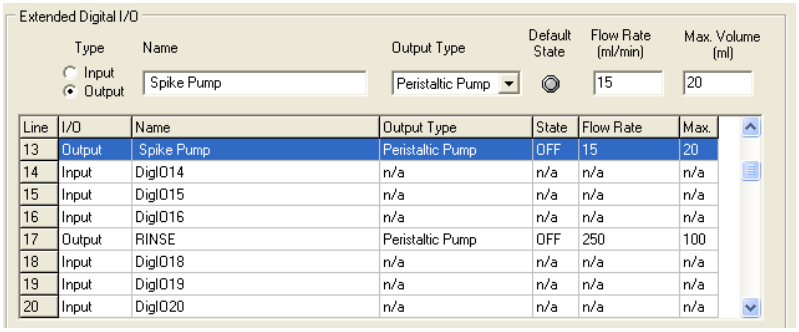
9.2 Digital/Amplifiers

This tab is where the pumps connected to the system are specified as well as where information such as flow rate and maximum volume to inject are entered.

The '**Basic Digital Output Lines'** section shown to the right is where information for the dilution, seed, and inhibitor pumps as well as the stirrer is located (customer configuration may vary). The flow rate of each pump allows the software to deliver the correct amount of reagent. The maximum volume to inject is also established here. This volume prevents bottles from overflowing in the event of level sensor failure, as well as protects from volume input errors. To modify these numbers, simply delete the current information and type in the new number. Refer to Section 12.4 for instructions on how to determine a pump flow rate.



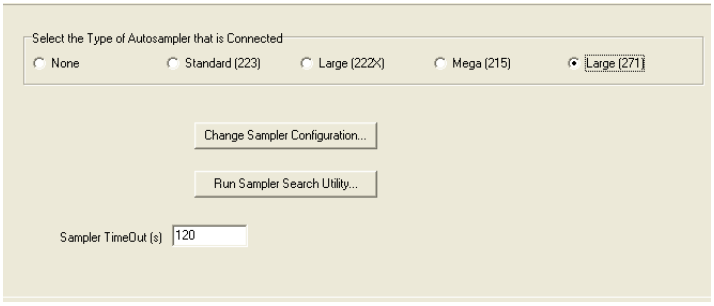
There are additional pumps located on the '**Extended digital I/0**' tab as shown to the right (customer configuration may vary). To make changes to the flow rate and maximum volume to inject, click on the pump and edit the value in area above the grid.



Note: The 'name' for the rinse pump must be 'RINSE' in order for the skip rinse function to work correctly, so do not modify this information.

9.3 Sampler

This tab contains information about the type of Autosampler connected to the system.



It is also where the amount of time that the software will try to establish communication with the Autosampler is set. The standard setting is 120 seconds; if after this amount of time communication cannot be achieved, an 'Autosampler timeout exceeded' error with be displayed.

10.0 Reports

This section of the manual will describe how to manually view, print and export a PC-BOD report.

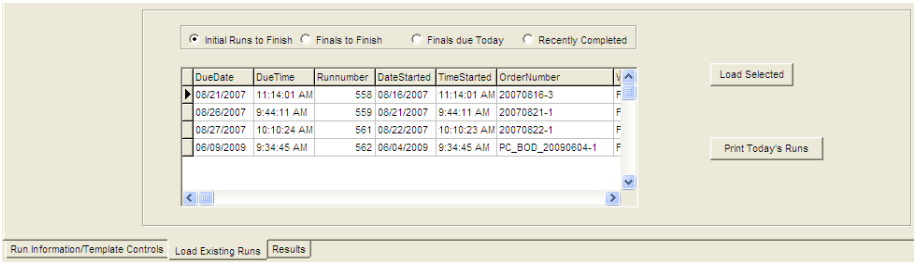
All reports can be automatically set up to do any/all of these functions at the end of a run. This is usually set up at the time of installation but can also be done by contacting MANTECH or your local distributor.

10.1 Initial Report

This report will automatically be printed to the computer screen at the end of an initial run. From here it can be manually sent to the printer by clicking on the print icon in the tool bar at the top of the screen or by going to **'File'**, **'Print'**.

If an initial report needs to be printed at a later date, follow the directions below:

1. On the main screen click on '**BOD**' and then select '**Run BOD…**'.
2. Choose the '**Load Existing Runs**' tab.



3. Click on the '**Finals to Finish'** selection and locate the run in the list shown. The most recent runs are located at the bottom of the list.
4. Click on the '**Load Selected**' button.
5. Click on the '**Convert Finals Run to Initials Run'** button. The run will be converted to an initial run.
6. Press the '**Start**' button and enter the **last** rack number present in the run.
7. The software will check that all data is present in the template and then reprint the report to the screen. If an Autocal is being performed in the rack specified, the calibration will be performed again before the report is displayed. This can then be printed as described at the top of this section.
8. Once finished, press '**Done**' and software will exit to the main screen. The run will once again be located in the '**Finals to Finish'** section of the software.

10.2 Final Report

This report will automatically be printed to the computer screen at the end of finals. From there it can be manually sent to the printer by clicking on the print icon in the tool bar at the top of the screen or by going to **'File'**, **'Print'**.

If the final run has been completed recently, follow the instructions below. If the report to be printed is older, follow the directions in Section 10.3 below.

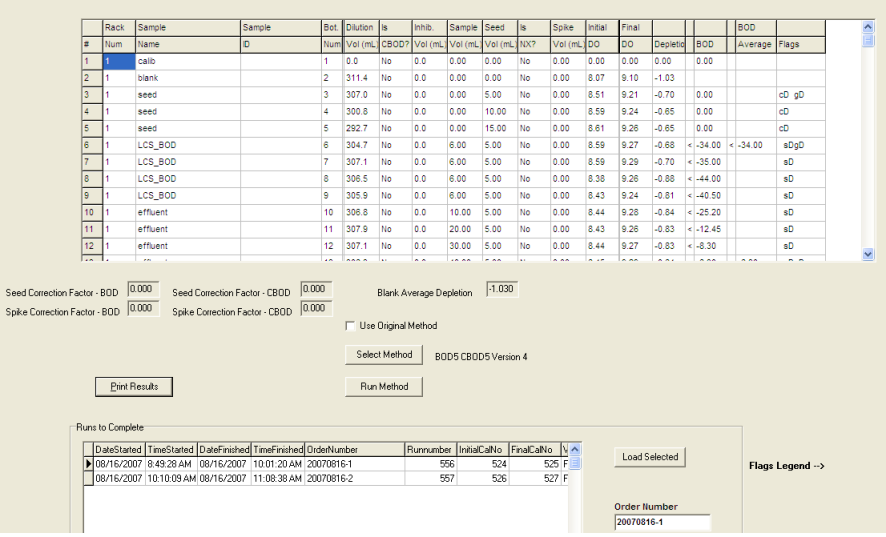
1. On the main screen click on '**BOD**' and then select '**Run BOD…**'
2. Choose the '**Load Existing Runs**' tab.
3. Click on the '**Recently Completed**' selection and locate the run in the list shown. The most recent runs are located at the bottom of the list. If the run is not present here, follow the instructions in Section 10.3 below.
4. Click on the '**Load Selected**' button. The run will be transferred into the '**Finals to Finish**' section.
5. Press the '**Start**' button and enter the **last** rack number present in the run.
6. The software will check that all data is present in the template and then reprint the report to the screen. If an Autocal (no user intervention) is being performed in the specified rack, the calibration will be performed again before the report is displayed. Once on the screen, the report can be printed as described at the top of this section.
7. To export the data, click on the **File** menu on the report, and select **Export**.

8. For the '**File Type'** select either **ASCII Delimited File (*.txt)** or **Fixed Field ASCII File (*.txt)**. Click on the '**…**' button and choose a file location and name the file. Click **OK** and the file will be created. This file can then be imported into another software package, such as LIMS software.
9. Once finished, press '**Done**' and exit to the main screen. The run will once again be located in the '**Recently Completed'** section of the software.

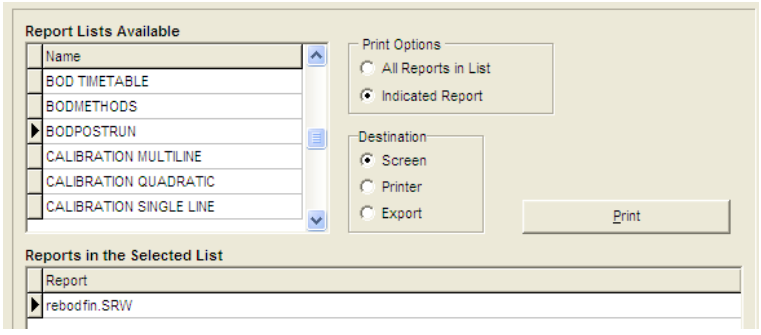
10.3 Post Run Report

This section of the software contains data from all runs that have been completed to date.

1. From the main menu, go to **'BOD'** and select **'Post Run BOD Analysis'**.
2. In the **'Runs to Complete'** section at the bottom of the screen, select the desired run; the most recent runs will be at the bottom of the list. Once selected, click on the **'Load Selected'** button and the run will be shown on the screen.



3. To calculate the results using the original method, click on the **'Run Method'** button. If a different version of the calculations or rules is to be used see Appendix D.
4. To print the data, click on the **'Print Results'** button which has now become available. The screen below will appear.



5. Select **'Print'**, leaving the default settings as is. The report will be displayed on the screen.
6. From there it can be manually sent to the printer by clicking on the print icon in the tool bar at the top of the screen or by going to **'File'**, **'Print'**.

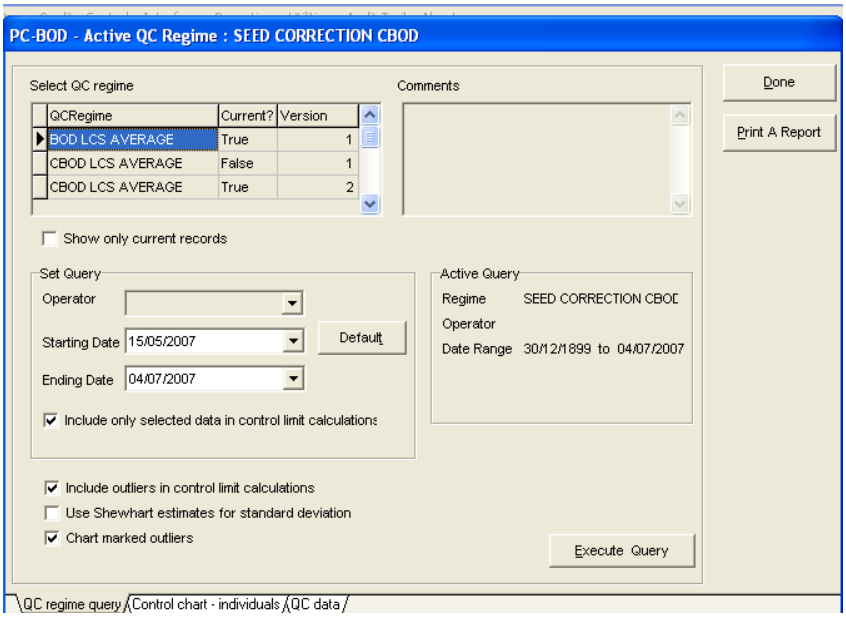
7. For **File Type** select either **ASCII Delimited File (*.txt)** or **Fixed Field ASCII File (*.txt)**. Click on the '**…**' button and choose a file location and name the file. Click **OK** and the file will be created. This file can then be imported into another software package, such as LIMS software.

11.0 Quality Control Data

This section of the software allows data in the QC regimes to be viewed. There are four QC regimes that have been setup in the system:

1. BOD LCS Average: plots the average of all GGA standards analyzed for BOD within a run
2. CBOD LCS Average: plots the average of all GGA standards analyzed for CBOD within a run
3. Seed Correction BOD: plots the BOD seed correction factor per ml of seed.
4. Seed Correction CBOD: plots of the CBOD seed correction factor per ml of seed.

Note: '-9999' will appear in QC plots if all standards in the run fail the depletion, fail residual DO rules, or if that sample type was not in the run. If any or all standards pass the rules, the average will be used in the QC plot.



1. To view a quality control plot, click on the **'Quality Control'** menu on the main screen and then on **'View a QC plot'**.
2. Select a QC regime by clicking on the desired chart from the grid on the top left of the screen.
3. To access the data in the QC plot, select the check box '**Show only current records**'.
4. Click on the '**Execute Query**' button, then choose the **'Control Charts – individual'** tab to see the graph, or the **'QC data'** tab to see the detailed data.
5. To tag a data point as an outlier, select the **'QC Data'** tab and double click on the **'No'** beside the data point to change it to '**Yes**'.
6. To remove this point from the graph, go to the **'QC regime query'** tab and press the **'Execute Query'** button. The graph in the '**Quality Control Charts – Individual**' tab will now have the outliers removed.

12.0 System Maintenance

12.1.1 Priming Reagent Lines – Beginning of the day

At the beginning of a day the system will be used, the lines will need to be filled with fresh reagent. Often, the database will have an AutoRun button on the main screen designed to guide you through this procedure. If this is not found, follow the instructions below to prime the lines.

1. Place the tubing into the reagent bottles below the liquid level.
2. Place an empty beaker under the tips on the Autosampler arm to catch the waste. When priming the dilution pump line, it is best if the tips are in the beaker as the water will eject with some pressure once it reaches the tip. This can be done by moving the Autosampler in manual control or by holding the beaker up around the tips.
3. Manually turn on the dilution pump(s) using the switch on the front of the module until the dilution water is ejecting from the tip and there are no bubbles in the lines. Turn the pump to the 'Auto' position to allow the software to control the pump during the run.
4. Manually turn on the remaining pumps using the switch on the front of each pump and let them run until the lines are full and no bubbles are present. This can also be done by turning on the pumps in manual control. Once complete, turn the pumps to the 'Auto' position to allow the software to control them during the run.

12.1.2 Rinsing out Reagent Lines – End of the day

At the end of each day, it is important to empty the lines of all reagents to prevent growth. This is especially important for dilution and seed solutions since growth can occur very rapidly if left in the lines.

1. Lift the tubing in the reagent bottles above the liquid level in the bottle.
2. Place a beaker under the tips on the Autosampler arm to catch the waste. When emptying the dilution pump line, it is best if the tips are in the beaker as the water will eject with some pressure. This can be done by moving the Autosampler in manual control or by holding the beaker up around the tips.
3. Manually turn on the pumps using the switch on the front of each pump and let them run until the lines are empty. Turn the pumps off. This can also be done by turning on the pumps on manual control.
4. Place the tubing from the reagent bottles into a beaker of DI water.
5. Manually turn on the pumps as above and let the lines fill with DI water.
6. Once sufficient water is present, remove the ends of the tubing from the DI water beaker and let the lines fill with air.
7. When complete, turn the pumps to the 'Auto' position.
8. Store the probe in a BOD bottle with 1 inch of water over night. This can be done manually or by using the 'Park Probe' Autorun button on the main screen.

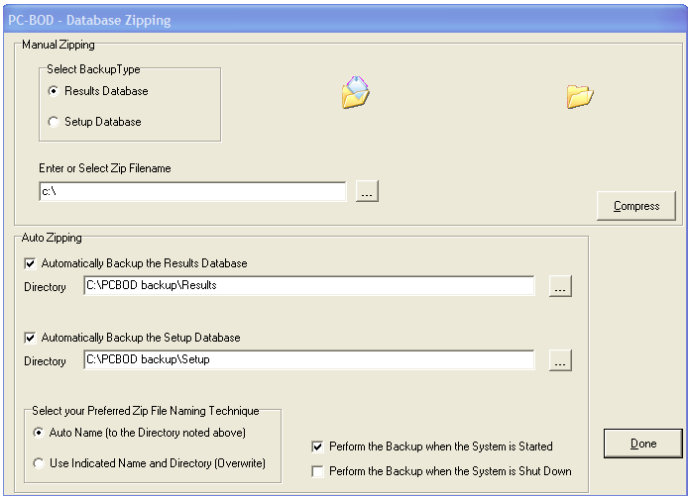
12.2 Database Management – Twice a month

An automated backup is performed at the end of each sample or each rack to ensure that no data is lost during a power failure or other unforeseen circumstance. As a result, the backup files will accumulate over time and must be periodically removed.

The instructions below will describe how to locate and remove the backup files for the system.

1. From the main menu of the PC-BOD software, select '**Utilities**' followed by '**Database Zipping'**.

2. In the Auto Zipping section, note down the file path(s) for the backups. In the screen shown on the next page, this is C:\PCBOD backup\Results and C:\PCBOD backup\Setup. Press '**Done**'.
3. From the Start menu on the computer, locate the backup folder(s) by following the path(s) noted above in Step 2.
4. The backup files will be named using a date stamp YYMMDD##. For example: the 11th results backup performed on March 2nd, 2010 would be named 'Results10030211'.
5. Highlight the files that need to be deleted by holding the left mouse button and dragging. Never delete all of the backup files at once; keep several of the most recent backups in case they are needed. If Setup and Results files are in the same folder make sure to leave several of the most recent backup for BOTH the Setup and Results tables.
6. Press the '**Delete**' key on the keyboard and select '**Yes**' to delete all highlighted files.



12.3 Changing the DO Probe Membrane – minimum once a month or as needed

For BOD systems that use a membrane probe, it will be necessary to change the DO probe membrane and add electrolyte solution to the probe. An Autorun button has been set up with a schedule that allows easy access to the probe without removing it from the system.

The membrane can last anywhere from a few hours to several weeks depending on the nature of the samples being analyzed and how the probe is cared for. Probe readings that are erratic or do not stabilize are the most common indicator that electrolyte needs to be added to the probe or that the membrane needs to be changed.

1. On the main screen, select the '**Change Membrane'** Autorun button.
2. When the '**Run BOD Analysis**' screen is open, click on the '**Start**' button, enter a valid rack number and press '**OK**'.
3. The Autosampler will move the probe to an easily accessible position, so that the membrane may be changed.
4. Unscrew the old membrane from the bottom of the DO probe. Fill the new membrane halfway with electrolyte, screw it back into place and press '**OK**'.
5. The probe will need to sit for at least 30 minutes in a BOD bottle containing 1 inch of water before calibrating or running samples.

12.4 Changing the DO Probe Sensor Cap – yearly or as needed

For BOD systems that use an optical probe, it will be necessary to change the DO probe sensor cap and input the sensor cap coefficients into the meter. An Autorun button has been set up with a schedule that allows easy access to the probe without removing it from the system, and step-by-step instructions for inputting the new sensor cap coefficients into the meter.

Sensor caps typically last one year, depending on the nature of the samples being analyzed and how the probe is cared for. Probe readings that are erratic or do not stabilize are the most common indicator that the sensor cap needs to be replaced.

1. On the main screen, select the '**Change Sensor Cap'** Autorun button.
2. When the '**Run BOD Analysis**' screen is open, click on the '**Start**' button, enter a valid rack number and press '**OK**'.
3. The Autosampler will move the probe to an easily accessible position, so that the sensor cap may be changed.
4. Follow the OK messages within the schedule to replace the sensor cap and input the coefficients into the meter.
5. The probe must be calibrated after replacing the sensor cap.

12.5 Checking the Flow Rate of a BOD Reagent Addition Pump – Once a Month

The flow rate of a pump should be checked once a month or if issues arise with BOD results. Also, if any of the tubing is changed on a pump, the flow rate will need to be verified.

12.5.1 Automated Pump Calibration

Use the following instructions if your database contains schedules already set up to assist in the pump calibrations. These schedules will have the following names:

- PUMP CALIBRATION – DILUTION
- PUMP CALIBRAITON – INHIBITOR
- PUMP CALIBRATION – SEED
- PUMP CALIBRATION – RINSE

If these schedules are not in the database refer to the instructions found in Section 12.4.2 below.

1. From the main screen, click on '**BOD**' and select '**Run BOD…**'.
2. On the BOD analysis screen, click the '**Schedule**' button and select the pump calibration schedule for the pump to be calibrated. Press '**OK**'.
3. Fill out the sample name column with the name of the pump to be calibrated.
4. Press '**Start**'.
5. Follow the instructions displayed on the screen. The pump will automatically be turned on/off after the specified amount of time (usually 60 seconds).
6. The pump calibration will be performed 5 times so that the results can be averaged.
7. Follow the instructions in Section 12.4.3 to enter the flow rate into the software.

12.5.2 Manual Pump Calibration

The following instructions can be used for any of the pumps present on the PC-BOD system but will be described using a seed pump.

The pump calibration can be done using deionized water or seed.

1. Place the end of the tubing in a bottle of seed or a beaker of DI water.
2. Using the switch on the front of the module, manually turn on the pump until the line is fully primed. Discard any liquid obtained.
3. Place an appropriately sized graduated cylinder (see per chart below) under the tips on the BOD sampler arm and manually turn on the pump for exactly 1 min (Use a stopwatch or the clock on your computer). Note: if

performing a calibration on a high flow rate pump, such as the dilution pump, a time of 15 or 30 seconds can be used and the result multiplied by four or two respectively to give the flow rate per minute.

Pump	Approximate Flow Rate (ml/min)
Dilution	400-600 for single headed and 1000-1200 for dual headed
Seed	10-20ml
Inhibitor	10-20ml
Spike	10-20ml
Rinse	200 - 250ml

4. Record the volume pumped.
5. Repeat at least 2 more times and average the results
6. Once this is complete the flow rate in the software will need to be changed – see section 12.4.3 below.

12.5.3 Changing the Flow Rate

1. From the main screen, go into '**Interface**', and select '**Hardware Setup**'.
2. Click on the '**Digital/Amplifiers**' tab and then '**Basic digital I/0**' or '**Extended digital I/0**' depending on the pump flow rate to be updated.
3. Look at the chart below for the list of current digitals, to modify, if a different flow rate was observed. Please note, customer pump and digital configurations may vary. If the customer setup is not identical to the chart, use the labels attached to each pump to determine the relevant digital.
4. Enter the average flow rate obtained above in Section 12.5.2 in the flow rate box and click on OK.

Pump	Digital to change in Hardware Setup
Dilution	Output 9
Seed	Output 17
Inhibitor	Output 21
Spike	NA
Rinse	Output 4

With an accurate flow rate, the software will be able to accurately deliver the volumes specified on the run screen.

12.6 Replacing Pump Tubing – Once every 3 months

To keep the system running optimally, Tygon pump tubing should be replaced regularly according to the length of time below, or when any growth is present in the lines. Amount of use will vary how often the tubing should be replaced. Note that bleach can be used to clean any clear tubing. Do NOT bleach anti-microbial silver tubing.

Tubing Type	Time to Replace
Dilution	Every 3 months for silver anti-microbial tubing and Every 1-2 months for normal tubing
Seed	Every 1-2 months
Inhibitor	Replace as needed
Rinse	Replace as needed

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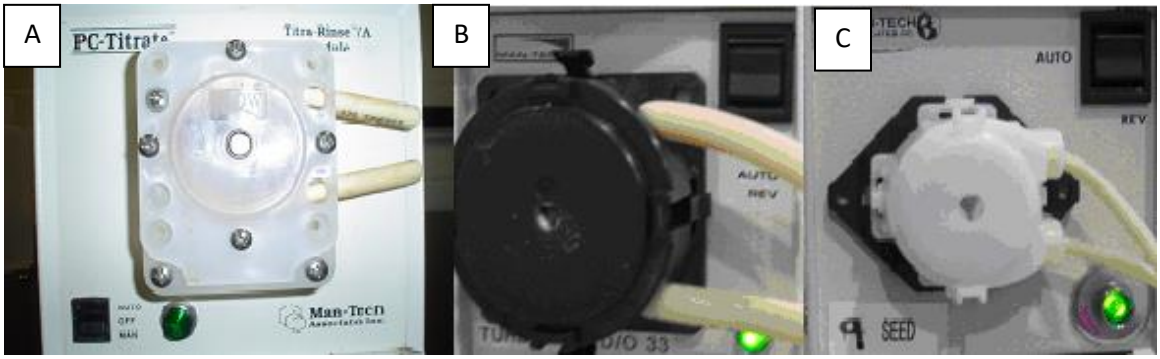
Complete tubing kits for each pump can be purchased from MANTECH or your local distributor to ensure correct tubing sizes and fittings are used.

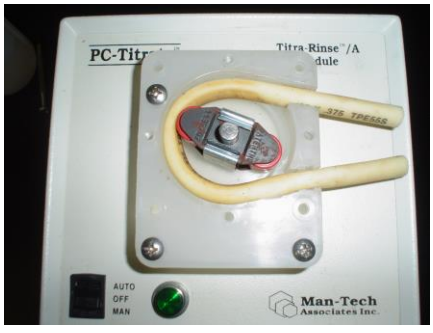
1. Lift the tubing in the reagent bottles above the liquid level in the bottle.
2. Place a beaker under the tips on the Autosampler arm to catch the waste. When emptying the dilution pump line it is best if the tips are in the beaker as the water will eject with some pressure. This can be done by moving the Autosampler in manual control or by holding the beaker up around the tips.
3. Manually turn on the pumps using the switch on the front of the module and let them run until the lines are empty. Turn off the pumps.
4. Place the tubing from the reagent bottles into a beaker of DI water.
5. Manually turn on the pumps and let the lines fill with DI water.

6. Once sufficient water is present, remove the ends of the tubing from the DI water beaker and let the lines fill with air. Turn off the pumps and place them in the 'Auto' position.
7. Remove the fittings and attached tubing from the yellow tubing that goes into the pumps.
8. Undo the spiral wrap from around the tubing going to the Autosampler arm and detach the tubing from the probe holder by pulling straight up.
9. All tubing should now be free to remove from the system. Note: you may want to keep the old lines so that they can be used to measure the new lengths of tubing.

Yearly, the inner pump tubing will need to be replaced. Look at the pumps shown below to determine the next step. If the system contains a pump like that shown in 'A' below, follow the instructions in steps 10-17. If the system contains a pump like those shown in 'B' or 'C' follow steps 18-23.

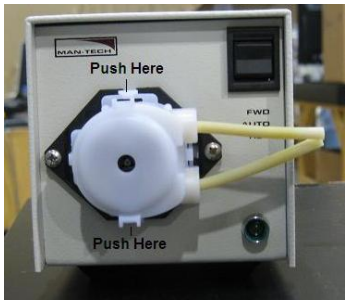


10. To change the inner pump tubing, the faceplate on the pump will need to be removed. Using a Philips screwdriver, undo the four screws holding the faceplate in place.
11. Gently pull out the yellow tubing from around the rollers by pulling it towards yourself.
12. Replace with the new tubing. In order to get the tubing back around the rollers it is often helpful to manually turn on the pump. This is more easily accomplished with slow speed pumps so be careful if using this technique with the rinse pump or dilution pump as they rotate quickly.
13. Once the tubing is in the place, replace the faceplate and secure it with the 4 screws.
14. Measure out the new tubing and attach it back to the pumps using the fittings included in the tubing kits. Note: the input tubing which comes from the reagent bottle should be attached to the bottom of the pump and the outlet to the sampler arm attached to the top.
15. Once all tubing is connected, use the spiral wrap to hold the tubing going to the sampler arm neatly together.



16. Perform a flow rate check on the pumps as described in Section 12.40.
17. Rinse the new lines with DI water and then with reagent prior to sample analysis.

The following instructions are applicable for both pump B and pump C shown above.

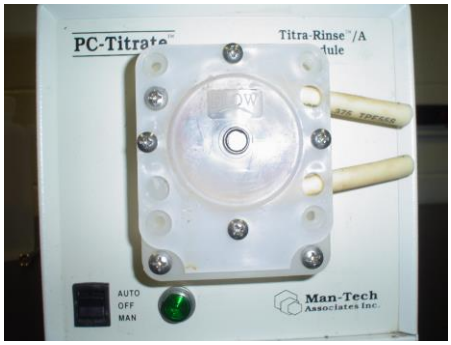


18. Remove the pump head by pushing on the clips at the top and bottom of the pump head and sliding it off.
19. Attach the new pump head by pushing it onto the shaft and clicking it into place.
20. Measure out the new tubing, using the old tubing if possible and attach it back to the pumps using the fittings included in the tubing kits. The pump head will have arrows depicting where the intake and outlet are; the intake of the pump should lead from the water carboy or reagent bottle.
21. Once all tubing is connected, use the spiral wrap to hold the tubing going to the sampler arm neatly together.
22. Perform a flow rate check on the pumps as described in Section 12.40.
23. Rinse the new lines with DI water and then with reagent prior to sample analysis.

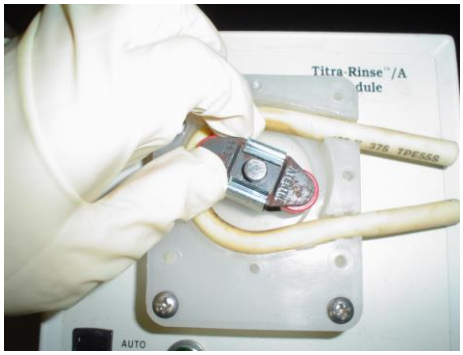
12.7 Replacing the Rollers in a Pump – Once a year

Every year, the rollers should be changed on the rinse/reagent addition pumps however it is best to change the rollers on the dilution pump every 6 months due to its speed. This will allow for best performance and delivery of your reagents and rinse waters. These parts can be purchased from MANTECH or by your local distributor.

1. Ensure the pump tubing is empty and rinsed of all reagent before proceeding. For instructions on this see Section 12.1.2.
2. Unplug the power cord and serial cable from the back of the pump.
3.



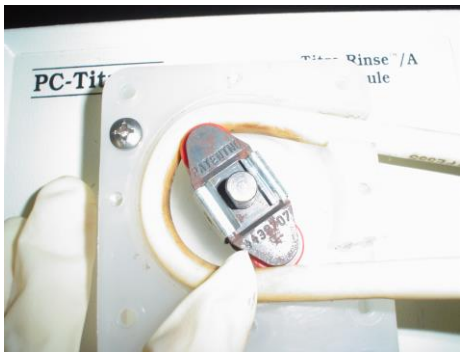
4. Unscrew the 4 screws from the pump head using a Phillips screwdriver and take off the faceplate.
5. Gently pry open the metal clip with a flat-head screwdriver on either side then carefully pull up the roller unit from the pump head and take out the tubing.



6. Lift the first metal piece off the rollers, and take off the red or black rollers, and set aside.
7. Remove the metal rods from inside the rollers.

8. Put the new rollers on the bottom metal roller device and insert the metal rods removed from the previous rollers.
9. Replace the top metal piece onto the roller unit.
10. Leave the unit unclipped until it is back in place on the pump head, and clip it back together with your fingers.

11. To get the roller unit seated on the tubing correctly, gently turn the roller unit to go over the tubing or follow suggestions in step 12 of Section 12.5.



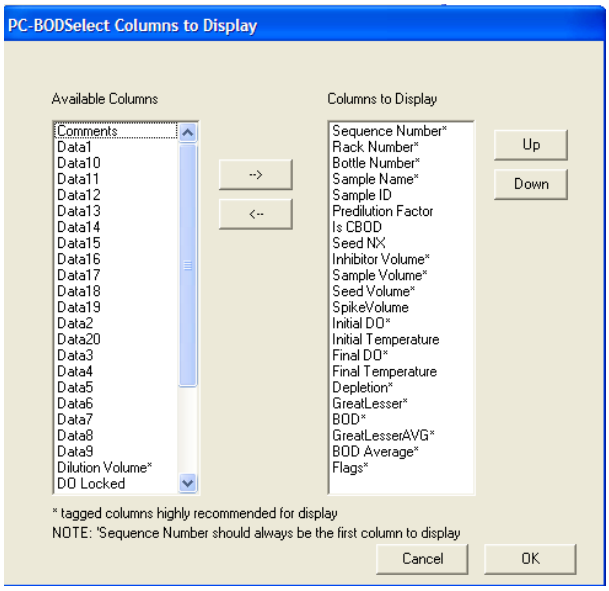
12. Replace the faceplate and the 4 screws using the Phillips screwdriver.
13. Plug the power cord and serial cable back in.
14. Rinse the lines with DI water and the reagent prior to analyzing samples.
15. Carry out a flow rate check as described in Section 12.4.

13.0 Software Customization

13.1 Setting up Columns for Display on Run Screen

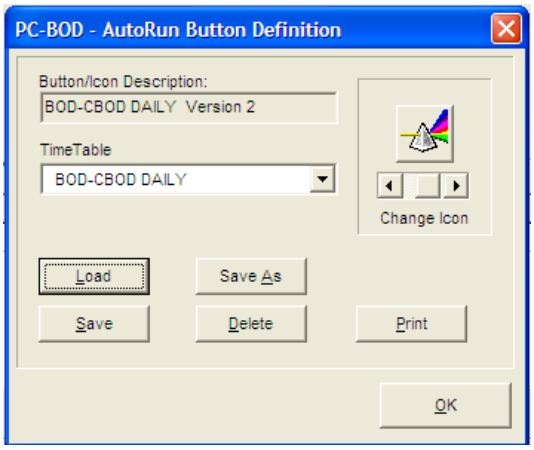
The layout and display of the BOD run screen is fully customizable. In order to remove, add or rearrange columns on the run screen (**BOD/Run BOD…**), follow the instructions below. See Appendix A for more information on each column. From the main menu, select '**Utilities**' and '**Setup Columns for Display'**. The screen shown will appear.

1. The section on the right side of the screen shows the columns that are currently on the run screen and the order in which they appear.
2. To remove a column from the screen, click on the title of the column in the list and click the arrow pointing to the left.
3. To rearrange the order of the columns, click on the column to be moved so that it is highlighted and use the '**Up**' or '**Down**' buttons respectively. Note: It is important that the first 3 columns of the display be sequence number, rack number and bottle number as shown in the figure.
4. To add a new column, select it from the available columns list on the left side of the screen and click the arrow pointing to the right to move it to the columns to display section.
5. To move this column around on the screen, repeat step 4 above.
6. Once finished, press '**OK**' to exit back to the main screen.



13.2 Creating Autorun buttons

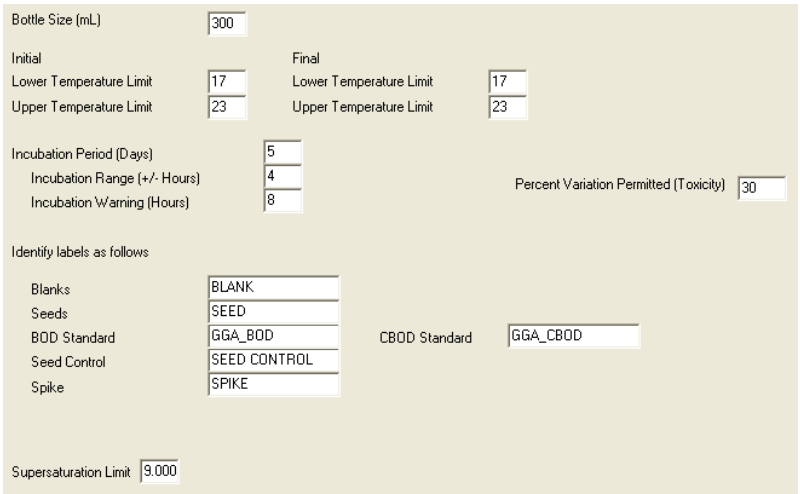
Autorun buttons are shortcuts to specific templates that appear on the main screen. They allow commonly used templates to be loaded in just one click. The instructions below require that the template for the AutoRun button to be already created and saved. If this has not been done, see Section 2 to create the template prior to continuing.



1. Click on the '**Utilities**' menu followed by '**Edit Autorun Buttons'**. Alternatively, the '**Link to Autorun'** button can be used on the run screen.
2. Select the timetable to be used for the Autorun button from the 'Timetable' drop down menu.
3. Using the arrows to scroll, select the icon to display.
4. Click on the '**Save As'** button and enter a name for the button. It is a good idea to use the same name for the button as was used for the template to prevent confusion. Press '**OK**' to save the Autorun button.
5. To make another button, repeat steps 2-4 above. When finished, click '**OK**' to exit back to the main screen. The Autorun buttons will now be present here.
6. If at any time the template referenced in the Autorun button is modified, the software will automatically use the most recent template version for that Autorun button.

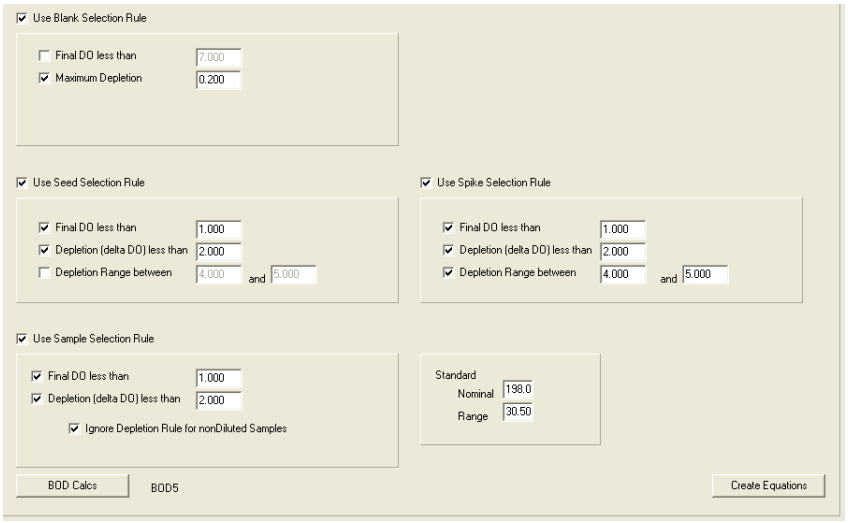
13.3 Viewing or Editing BOD Rules

The BOD rules which define the acceptable limits for seed, blanks, standards and samples are found in the BOD Method section of the software. In addition, parameters for other flags such as temperature and incubation time are setup here. When any of these values are outside the set limits, the software will display a warning or flag to identify in what manner a sample has failed. Any changes to this section can be made by changing the value in the text box and using the '**Save**' button.



1. From the main menu, click on '**Setup**' followed by '**BOD Method'.**
2. Click on '**Load**' and select the BOD Method used in your program. Most commonly this will be named either '**BOD5 CBOD5'** or '**BOD5 20th Seeded - 050307'**. Press '**OK**' to load the method.
3. The flags that are applied to all bottles are defined on the '**Settings**' tab. The temperature flags have lower and upper limits for both initial and final DO readings. These can be changed by typing the new value into the text box and clicking '**Save**'.
4. The settings in the '**incubation period'** and '**incubation range**' sections are used to determine if the sample incubation time was correct or if an incubation flag should be displayed.
5. The '**incubation warning hours'** determines when runs will appear in the '**runs due today**' section on the main screen and in the load existing runs tab on the BOD analysis screen.

6. The '**Identity labels'** are words reserved for specific functions within the software. These words are case sensitive and need to be used in the sample name column when setting up a run containing that sample type. This enables specific sets of rules to be applied to bottles with these specific sample names. For example, any bottles with the sample name 'seed' will be used to calculate the seed correction factor.
7. The '**Super-saturation limit'** is the maximum acceptable DO value; above this a super-saturation flag will be used.
8. Click on the '**BOD Rules**' tab to see the rules which are applied to BOD samples.
9. To change which rules are being applied, use the check boxes to the left of the rule. For additional information on the rules see Appendix F.
10. For more information on which flags will appear for each rule failure see the flag definitions in Appendix A.

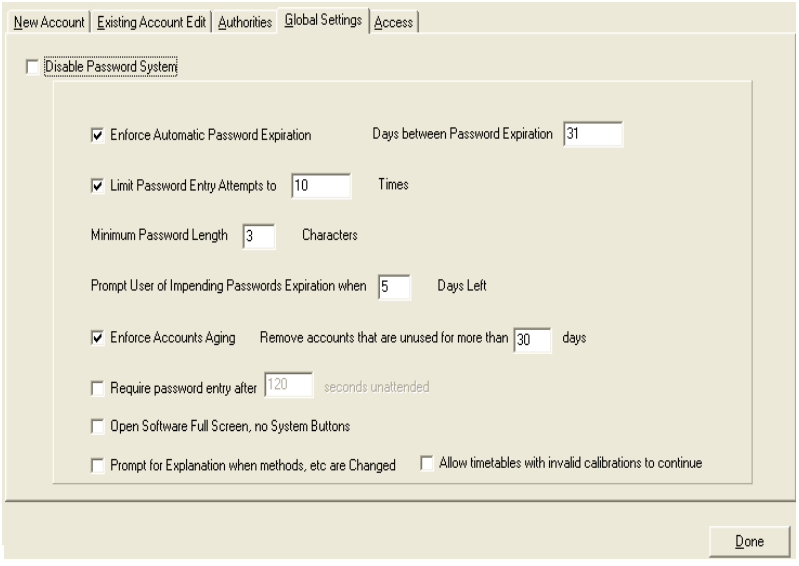


11. The same rules are present for CBOD samples on the '**CBOD rules'** tab. These can be selected and modified in the same way as the BOD rules.
12. If any changes have been made to the BOD method press the '**Save**' button before pressing '**OK**' to exit back to the main screen.

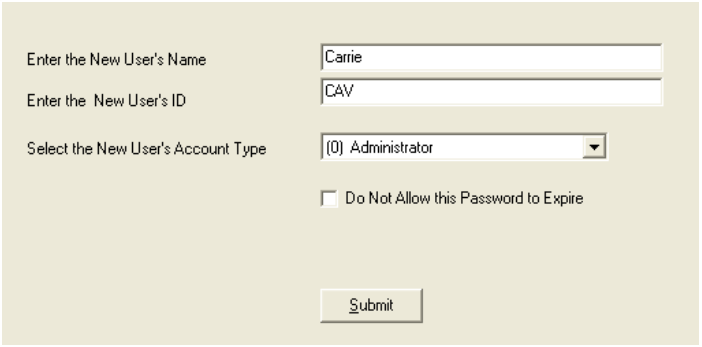
13.4 Enabling Passwords

The password section of the software allows control over which menu options are available to different users.

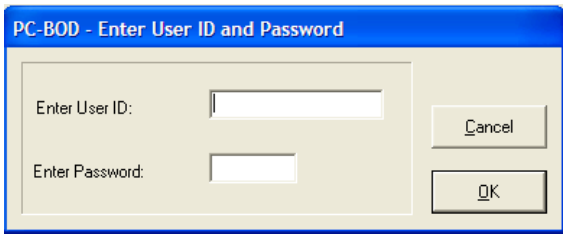
1. From the main menu, select the '**Utilities**' menu and click on '**Passwords**'.
2. Select the '**Access**' tab. This section is where access to specific screens is set up for each type of user. 'Hidden' menus will be inaccessible and 'Edit' menus will be fully accessible to users.
3. If the availability of a menu option needs to be changed for user, double click on the box containing the menu title to change it from 'Edit' to 'Hidden' or vice versa.
4. If changes have been made, click on the '**Save these Changes'** button.
5. Next, click on the '**Global Settings'** tab and un-check the '**Disable Password System**' box. The options below will appear.



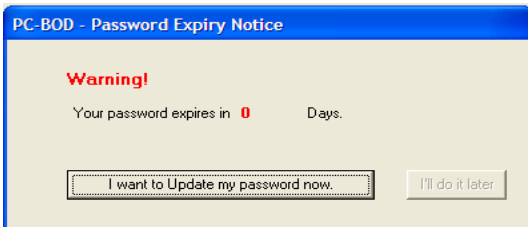
6. Read the options available for the passwords and select which ones to use by checking/un-checking the boxes.
7. Once complete, select the '**New Account**' tab to setup the users.
8. Enter the name of the user followed by the user ID; this is the user's initials in the example below. Select the account type from the drop down menu. These account types will correspond to the different types of users displayed in the '**Access**' tab.



9. Click the '**Submit**' button. The information from the boxes will be cleared.
10. Repeat steps 8-10 for all new users, being sure to record the user name and ID for later use.
11. Click '**Done**' to exit back to the main screen.
12. Exit the PC-BOD software to allow the changes to take effect.



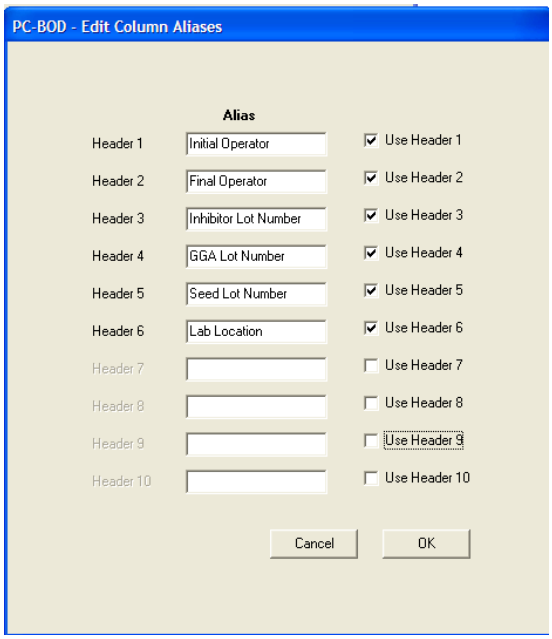
13. Upon opening the software the screen to the right will appear prompting for password entry.
14. Enter the user ID created previously in <u>both</u> the 'user ID' and 'Password' sections. The first time the software is entered the ID and password will be the same, but the password must be changed immediately. <u>Note</u>: These entries are case sensitive. Click '**OK**'.
15. Click '**I want to update my password now'**.
16. Enter your current password and press the '**Submit**' button.
17. Enter your new password and confirm it in the specified boxes. Click '**Submit**'.
18. Your password will now be updated. Click '**Done**' to exit to the main screen.



13.5 Changing Header Titles

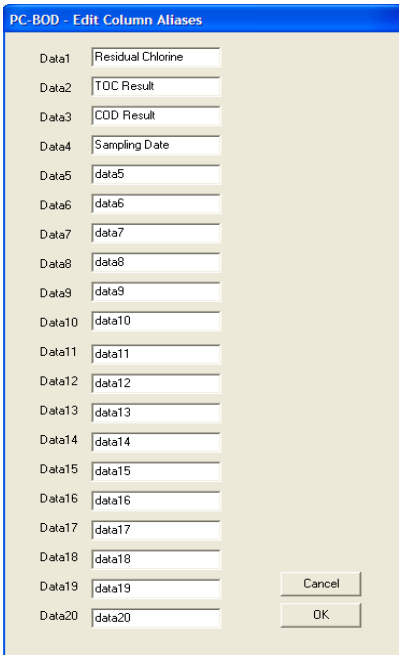
The headers are located on the top of the run screen (**BOD/Run BOD…**) and contain such information as initial and final operator. The headers can be modified to contain any information to suit the lab's needs by following the instructions below. In addition, headers can be removed or added to the display up to a maximum of 10 headers.

1. Click on the '**Utilities**' menu followed by '**Edit Headers**'. The screen shown to the right will appear.
2. To change the title of the header, simply type the new information into the text box. <u>Note</u>: each title can be a maximum of 20 characters in length however, if many wide letters such as 'w' are used the end of the title may be hidden from the display.
3. Use the check boxes on the right side of the screen to determine whether or not a given header will be displayed or hidden from the run screen.
4. When the desired changes have been made press '**OK**' to exit back to the main screen.



13.6 Changing Data Column Titles

The data fields are 20 extra columns in the software that allow users to fully customize their run screen. They are used when extra information, not available in the standard columns, is required for analysis.



1. From the main screen, click on the '**Utilities**' menu followed by '**Edit Aliases**'. The screen shown to the right will appear.
2. To change the title of the data field simply type the new information into the text box. This will be the title of the column on the run screen.
3. When the desired changes have been made, press '**OK**' to exit back to the main screen.
4. In order for this column to be shown on the run screen, it will need to be added to the 'columns to display'. To do this, follow the instructions found in Section 13.1 and select the data field which was modified to add to the screen.

14.0 PC-BOD Troubleshooting Guide

Always restart the software and turn off the instrument if any error messages occur. If problems still arise, try restarting the computer.

Category	Potential Problems	Possible Causes
BOD Test	Blanks too high	DO probe membrane is old or probe needs fill solution
		Calibration procedure is incorrect or inconsistent between analysts
		Poor water/aeration of water
		Dirty bottle(s)
		Dirty tubing
	Blanks too low	DO probe membrane old or probe needs fill solution
		Calibration procedure is incorrect or inconsistent between analysts
		Improperly sealed bottle (limited effects)
	GGA results too high	Contamination in tubing, glassware or rinse station
		Flow rate of seed pump is incorrect in Hardware Setup (too high)
		Calibration procedure is incorrect or inconsistent between analysts
	GGA results too low	Flow rate of seed pump is incorrect (too low)
		Poor quality seed being used

		Not enough seed being added to bottles
		Calibration procedure is incorrect or inconsistent between analysts
		GGA needs to be replaced
		Insufficient GGA added to bottle
	Super-saturation	Over aeration of dilution water
		Temperature of sample too cold
		Calibration procedure is incorrect
		Excessive algae in sample
	Sample depletion too high	Contamination of tubing, glassware or rinse station
		Flow rate of seed pump is incorrect
		Sample volume used was too large
	Sample depletion too low	Flow rate of seed pump is incorrect
		Calibration procedure is incorrect or inconsistent between analysts
		Sample was not de-chlorinated
		Insufficient sample added to bottle
	Seed depletion too high or too low	Contamination in tubing, glassware or rinse station
		Flow rate of seed pump is incorrect
		Incorrect amount of seed added to bottles
		Seed not being mixed correctly
PC-BOD Hardware/Software	Run is being displayed in the wrong section of 'load existing runs'.	All initial or final DO readings are not completed
		Run needs to be restarted to allow for correct transfer (all DO readings are populated)
	Stirrer not turning on	Stirrer switch on probe not on
		Cable connections not fastened (by DO meter on DO probe cable and at back of rinse pump or stirrer control box)
		Stirrer not inserted into DO probe correctly
		12V DC power supply on back of rinse pump/stirrer control box not connected/working.
	Bottles overflow with dilution water	Dilution water not made correctly
		User pre-filled bottles with dilution water
		Level sensor not in bottle/deep enough in bottle
		Correct sample volume not entered on the run screen
		Level sensor not plugged in correctly
		12V DC power supply on back of rinse pump/level control box not connected/working.
		Faulty level sensor cable
	Bottles not filling to the top	Level sensor too far down into bottle
		Foamy samples

		Improper dilution pump flow rate in Hardware Setup
		Splashing onto level sensor
		Max volume to inject set too low in Hardware Setup
	Seed pump not turning on	Pump is not in auto mode/power is not on
		Communication cable is loose/not plugged in at pump or interface
		Inappropriate schedule used (BOD 3 Pump-BOD 5 Pump is required)
		Seed volume not entered into run template
	Inhibitor pump not turning on	Pump is not in auto mode/power is not on
		Communication cable is loose/not plugged in at pump or interface.
		Inappropriate schedule used (BOD 4 or 5 pump is required)
		Inhibitor volume not entered into run template
		Is CBOD column not set to 'Yes' in run template
	Dilution pump not turning on	Pump is not in auto mode/power is not on
		Communication cable is loose/not plugged in at pump or interface.
		Inappropriate schedule used (BOD 2 Pump – BOD 5 Pump is required)
		Sample volume of 300ml (or volume that is equal to the bottle volume e.g. 60ml) is entered in Sample Volume column
	Rinse pump not turning on	Pump is not in auto mode/power is not on
		Communication cable is loose/not plugged in at pump or interface.
		Skip rinse function is being used and system is in the middle of a sample set.
	All results are zero	Sample volumes not entered into run template
		Pre-dilution factor set to 0
	Seed or spike correction factor is zero.	Seed or spike samples not analyzed in the run
		All seed/spike bottles in the run failed at least one of the depletion rules
	Probe misses bottle(s) on Autosampler	Bottles not correctly placed into racks
		Rack hooks bent
		Probe assembly loose or tilted
Error Messages	DO meter not found	Cable loose/not connected
		No power to DO Meter
		Meter not set to 'remote' or 'external control' mode.
		DO meter is displaying OVER during calibration or sample analysis
		Error message on meter

	Autosampler timeout exceeded	Autosampler cable is loose/not plugged in
		Autosampler does not have power
		Autosampler not selected in Hardware Setup
		Error message on front of sampler
		Tubing/DO probe cable interfering with sampler movement
	Cannot connect to TIS	Cable connecting interface to computer is loose
		Interface module does not have power
		Incorrect Com Port selected in Hardware Setup
	Unable to open com port	Computer needs rebooting
	Timetable contains errors	Some data required for run has not been entered (most often sample name). Use the 'check timetable' button to determine specific problem with template.
	Eq Error!	Results are being calculated with an equation set that no longer exists. This usually occurs in post run analysis. Refer to Appendix D to change the equation set to the current one.
	Unknown Gilson error	Sampler arm has felt resistance (i.e. from tubing or shelf). Remove resistance, restart sampler and software
	Z motor position error	Sampler arm has felt resistance. Remove source of resistance, restart sampler and software
	Z-arm height exceeded	Sampler has tried to move further than allowable. Restart sampler and software
	An Unspecified Error has occurred	General error message. Restart software
	Fatal Error: Aborting Timetable	General error message. Restart software
	Database Error	General error message. Restart software

If you have any questions that the Operator Manual does not answer, contact MANTECH or your local distributor for assistance.

For a complete list of available distributors, please consult our website at https://mantech-inc.com/locate-a-distributor/.

15.0 Appendices

A. Run Screen Column Definitions

* Tagged columns are required to be displayed and/or filled out by the user i.e. BOD*.
The columns below are listed alphabetically and do not reflect the appearance of the run screen which is fully customizable.

BOD*

- After the completion of all final DO measurements, the BOD/CBOD value calculated by the software will appear here.
- See Appendix B for the calculations.
- Also see the 'GreatLesser' definition

BOD Average*

- The average of all passing dilutions of a BOD/CBOD sample will appear in this column in the row of the last sample in a set. The same sample is indicated by having the same description in the 'sample name' column.
- Only the samples meeting the pass criteria will be used in the calculation.
- If all samples fail due to the final DO being too low, the software will report the value for the sample with the highest dilution (lowest sample volume) as the average and display a greater than (>) symbol.
- If all samples in a set fail the depletion rule and the average result is greater than the minimum detection, the software will report the value for the sample with the lowest dilution (highest sample volume) and display a less than (<) symbol.
- When all samples in a set have a depletion of less than that specified in the BOD Method, and the lowest dilution (highest sample volume) result is less than the minimum detection for a given sample condition, the average will be displayed as follows:
    - Diluted samples with no seed added < 2
    - Diluted samples with seed added < 1
    - Undiluted samples with no seed added < 0.1
    - Undiluted samples with seed added < 0.0

Bottle Position*

- This is automatically populated by the software when a rack is started.
- The quantity of bottles numbered depends on the rack size specified in the software.
- This column should be the third column displayed on the run screen

Comments

- This column can be used to write anything a customer deems relevant for a given sample.

Data Fields (Data1-Data20)

- Fields that can be used upon request. These are used for additional data that would not be standard on the manufacturer's template/report.

- For more information, see Section 13.6.

Depletion*

- The difference between the initial and final DO readings.
- This is automatically calculated by the software upon completion of the final DO measurement(s).
- If the depletion is not within the specified rules, flags will be displayed.
- This value is used in the BOD/CBOD calculations. See Appendix B for more information.

Dilution Volume

- The volume of dilution water added to a given bottle in ml.
- The accuracy of this volume depends on the flow rate of the dilution pump being correctly established.
- This volume is not used in the calculations.

Final DO*

- The final DO measurement taken from the meter by the software will be located here in mg/L
- These measurements can be reset and re-analyzed by following the instructions found in Section 6.
- DO values cannot be typed into the template

Final pH

- Final pH of a sample after pH adjustment
- pH data is input into the template by the user just before starting the run; it cannot be saved into a template
- If you wish to be able to enter the sample pH values, save them and exit the run screen prior to starting a run, contact MANTECH or your local distributor to change this column to a data field.

Final Temperature

- The temperature of the sample at the time of the final DO measurement.
- This is automatically populated from the meter if this column is displayed.
- If the temperature is not within the range specified in the BOD Method a flag will be shown.

Flags*

- Contains any flags indicating that a BOD/CBOD rule has been violated for a specific sample or group.
- These are automatically populated by the software after the BOD calculations have been performed.
- The rules used for the majority of the flags are located in the BOD Method section of the software. For more information, please refer to Section 13.3.

- The flags are as follows:

Flag	Definition	When it Occurs
SR	Standard outside range	If a GGA standard is not within the specified range
SAR	Standard average outside range	If the average of all GGA samples in a run is not within the specified range
SS	Super-saturation	If the initial DO is greater than the specified value
bDe	Blank depletion	If the blank depletion is greater than the specified value
cD	Seed depletion	If the depletion in a seed sample is less than the specified value
cF	Seed final DO	If the final DO of a seed sample is less than the specified value
cR	Seed range	If the depletion in a seed sample is not within the specified range
kD	Spike depletion	If the depletion in a spike sample is less than the specified value
kF	Spike final DO	If the final DO of a spike sample is less than the specified value
kR	Spike range	If the depletion in a spike sample is not within the specified range
sD	Sample depletion	If the depletion of a sample is less than the specified value
sF	Sample final DO	If the final DO of a sample is less than the specified value
gF	Group failure	All samples in a dilution set/group have a final DO less than that specified
gD	Group depletion	All samples in a group have a depletion less than that specified
gT	Group toxicity	The variance between BOD/CBOD values in a sample set is greater than the specified amount. This value is normally set to 30% and a value greater than this may indicate matrix interference. This value is calculated by the following formula for a given sample set: (highest BOD/CBOD – lowest BOD/CBOD) / lowest BOD/CBOD
In^-	Incubation too short	If the incubation time is less than the specified allowable range
In^+	Incubation too long	If the incubation time is greater than the specified allowable range
iT	Initial temperature out of range	Initial temperature is outside the specified range
fT	Final temperature out of range	Final temperature is outside the specified range

GreatLesser*

- This column should always be located to the left of the 'BOD' column.
- It is automatically populated by the software after the calculations have been performed.
- A greater than symbol (>) will appear when a sample has a final DO reading which is less than the specified minimum in the BOD Method. This indicates that the result is only an estimate of the actual sample BOD.
- A less than symbol (<) will appear when a sample has a depletion which is less than the specified minimum in the BOD Method. This indicates that the result is only an estimate of the actual sample BOD.
- If all samples fail one of the above rules, the software will use the depletions from the numbers present to calculate the BOD even though the bottles failed a rule.
- If some samples passed, the passing bottles will be used to determine the BOD average.
- See the BOD average section for additional information

GreatLesserAVG*

- This column should always be located to the left of the 'BOD Average' column.
- It is automatically populated by the software after the calculations have been performed.
- If all samples fail the final DO rule, the software will report the value for the sample with the highest dilution (lowest sample volume) and display a greater than (>) symbol.
- If all samples in a set fail the depletion rule and the BOD of the bottle with the lowest dilution (highest sample volume) is greater than the minimum detection, the software will report the value for the sample with the lowest dilution (highest sample volume) and display a less than (<) symbol.
- A less than symbol (<) will appear when all samples in a set have a depletion of less than that specified in the BOD Method. If the BOD of the bottle with the lowest dilution (highest sample volume) is less than the minimum detection for a given sample condition, the average will be displayed as follows:
    - Diluted samples with no seed added < 2 mg/L
    - Diluted samples with seed added < 1 mg/L
    - Undiluted samples with no seed added < 0.1 mg/L
    - Undiluted sampled with seed added < 0.0 mg/L
- Note: If some samples pass, the software will only use these values in the BOD average and no '<' or '>' signs will appear.

Inhibitor Volume*

- Volume of inhibitor in mL to be put into the samples via a pump.
- This information is entered by the user if running a CBOD sample and using liquid inhibitor.
- If liquid inhibitor is being added manually this column can be used for reference purposes if desired, but it is not required since it is not used in the CBOD calculation.
- If inhibitor is being added to the sample, ensure the 'Is CBOD?' section is set to 'Yes'. This is changed by double clicking on the 'No' in the 'Is CBOD?' column.
- If no liquid inhibitor is used leave this column blank or use a 0.

Initial DO*

- The initial DO measurement taken from the meter by the software will be located here in mg/L
- These readings can be reset and re-analyzed by following the instructions found in Section 6.
- DO readings cannot be typed into the template

Initial pH

- Initial pH of a sample prior to pH adjustment
- This data is input into the template by the user just before starting the run and cannot be saved into a template.

- If you wish to be able to enter the sample pH values, save them and exit the run screen prior to starting the run contact MANTECH INC or your local distributor to change this column to a data field.

Initial Temperature

- The temperature of the sample at the time the initial DO measurement is taken.
- This is automatically populated from the meter if this column is displayed.
- If the temperature is not within the range specified in the BOD method, a flag will be shown

Is CBOD?*

- Tells the software whether the bottle is being analyzed for BOD or CBOD.
- When running CBOD on a sample, double click to change 'Is CBOD' for that sample to 'Yes'.
- If 'NO' is selected, the software will not turn on the inhibitor pump even if a volume is specified in the inhibitor volume column.
- If using powdered inhibitor this column needs to be changed to 'Yes' even though the inhibitor volume column is blank.
- This column is used to select the appropriate seed correction factor and calculation for both BOD and CBOD samples.

Is NX?

- 'NX' refers to seed with nitrifying bacteria inhibitor added.
- This column is only used for CBOD samples when inhibitor and seed are combined and added to the samples from a single pump.
- The default on this column is 'NO', but double clicking on the desired cell changes the cell to 'Yes'.
- When entering the volume of seed/inhibitor to add, put this number into the seed column not the inhibitor column on the run screen.

Pre-dilution Factor

- The factor by which the sample is diluted PRIOR to being placed in the bottle is entered here.
- For example: 10 ml of influent was added to a 100ml volumetric and filled with DI water and 50ml of this sample was then placed into the BOD bottle on the system. In this case a 10 would be placed in the pre-dilution column and a 50 in the sample volume column.
- If no pre-dilution is performed this column should say 1; do not leave this column blank.

Rack Number*

- The user is prompted to enter the rack number when starting/re-starting a rack. This value is then automatically populated by the software onto every line in that rack.
- This field is case sensitive and can contain numbers or letters
- It is **not** recommended to put spaces in the rack number as it will become confusing when trying to run the final DO readings.
- This column must be the second column on the run screen.

Sample ID

- A location for extra information about a sample
- This is not a required field and is not used for a specific purpose within the run (unlike sample name).

Sample Name*

- Must be filled out as it is used to specify sample groups and other sample types such as seed and blanks. All lines with the same sample name will be averaged throughout the entire run.
- The following sample names have been identified in the BOD Method with special meaning – BLANK, SEED, SEED CONTRL, SPIKE, GGA_BOD and GGA_CBOD. These should not be used for the names of samples.
- These specific names are not case sensitive and can be customized if requested. See the BOD Method for the specific names used on your system.
- '!' cannot be used anywhere on the run grid as this is a schedule interruption key and will cause template buttons to become unavailable.
- Sample names other than those specified in the BOD method are case sensitive so 'Effluent' is different than 'effluent'.
- The same sample name cannot be used for a sample set that is BOD and one that is CBOD; the names must be different.
- The skip rinse feature allows for time efficiency by only rinsing before and after a sample set. A skip rinse sample set is determined by having the same sample name sequentially in a template.
- When using skip rinse in a run like that shown below, the software would only rinse at the beginning of the run, between samples Monday and Wednesday, Wednesday and Friday, and Friday and Monday.
- Upon completion, the software would average all 4 of the Monday samples together even though they are separated in the run since they have the same sample name.

#	Rack Num	Bot. Num	Sample Name	Sample ID	Pre-Dilution	Is CBOD?	Is NX?	Inhib. Vol (mL)	Sample Vol (mL)	Seed Vol (mL)
1			Monday		1	No	No		25	3
2			Monday		1	No	No		50	3
3			Monday		1	No	No		100	3
4			Wednesday		1	No	No		25	3
5			Wednesday		1	No	No		50	3
6			Wednesday		1	No	No		100	3
7			Friday		1	No	No		25	3
8			Friday		1	No	No		50	3
9			Friday		1	No	No		100	3
10			Monday		1	No	No		10	3

Sample Volume*

- Volume of sample in ml placed into the BOD bottle.
- If no sample is present in the bottle (blanks and seed samples) leave this column blank.
- This value is used in the BOD/CBOD calculation.

Seed Volume*

- Volume of seed added to the bottle in ml.
- This must be entered whether the seed is added manually or automatically as it is used in the calculation. See Appendix B for calculation information.

Sequence Number*

- Indicates the number of bottles in a run.
- This must always be the first column in the display and is automatically populated by the software upon adding lines to a template.
- The maximum sequence number is 512 as this is the maximum number of lines in a template.

Spike Volume

- Volume of spike added to the sample in ml.
- This volume is only required when running spike samples.
- It is used in the BOD/CBOD calculations

B. BOD Formulas

B1 PC-BOD

Explanation of Parameters

DEPLE: Total depletion in the BOD bottle over the duration of the test

DEPSE: Depletion due to seed when using seeded dilution water.

DOINIT_MGL: Initial DO measurement in mg/L

DOFIN_MGL: Final DO measurement in mg/L

SAMPLE_VOL: Volume of sample in the BOD bottle

PREDILUTION: Dilution factor from any dilutions made prior to putting the sample in the bottle.

CORR_FACTOR_KT: Factor used to correct BOD results to 5 days if the samples are measured before or after this time.

If an incubation time less than 1 day is used, a correction factor is not applied to the results The correction factor is determined by the start date and finish date. Therefore, it is possible to have the incorrect correction factor used if all the initial DO's are reset on a different day than the run was started on.

AVGSPIKE_DEPDIVVOL: The average spike depletion **per mL of spike** used. This is the spike correction factor.

AVG_SEED_DEPDIVVOL: The average seed depletion **per mL of seed** used. This is the seed correction factor.

AVG_BLANK_DEPL: Average blank depletion.

'C': A 'C' placed in front of a parameter indicates it is specific for CBOD in that there was nitrogen inhibitor present. These calculations will be used for all samples with 'Yes' in the 'Is CBOD?' column.

BOD

DEPLE = DOINIT_MGL – DOFIN_MGL

SVOL = SAMPLE_VOL

PD = PREDILUTION

KT = CORR_FACTOR_KT

SPIKE = AVGSPIKE_DEPDIVVOL

SEED = AVG_SEED_DEPDIVVOL

BLDEP = AVG_BLANK_DEPL

BODS = ((DEPLE)/(SVOL/BOTTLESIZE))*PT*KT

BOD = ((DEPLE – (SEED*SEED_VOL) – (SPIKE*SPIKE_VOL)) / (SVOL/300))*PD*KT

BOD - Seeded Dilution Water

PD = PREDILUTION

KT = CORR_FACTOR_KT

DEPLE = DOINIT_MGL – DOFIN_MGL

DEPSE = (AVG_BLANK_DEPL*((300 – SAMPLE_VOL) / 300))

BOD = ((DEPLE) – DEPSE)*(300/SAMPLE_VOL)*PD*KT

CBOD

DEPLE = DOINIT_MGL – DOFIN_MGL

SVOL = SAMPLE_VOL

PD = PREDILUTION

KT = CORR_FACTOR_KT

CSPIK = C_AVGSPIKE_DEPDIVVOL

CSEED = C_AVG_SEED_DEPDIVVOL

CBLDE = C_AVG_BLANK_DEPL

CBODS = ((DEPLE)/(SVOL/BOTTLESIZE))*PT*KT

CBOD = ((DEPLE – (CSEED*SEED_VOL) – (SPIK*SPIKE_VOL)) / (SVOL/300))*PD*KT

CBOD - Seeded Dilution Water

PD = PREDILUTION

KT = CORR_FACTOR_KT

DEPLE = DOINIT_MGL – DOFIN_MGL

DEPSE = (C_AVG_BLANK_DEPL*((300 – SAMPLE_VOL) / 300))

CBOD = ((DEPLE) – DEPSE)*(300/SAMPLE_VOL)*PD*KT

Examples

Calculation of BOD Seed Correction Factor

Volume of Seed in BOD bottle	Initial DO/Final DO (mg/L)	Depletion (mg/L)	Depletion/ml of seed
5	8.67 / 7.94	0.73	Not used: depletion < 2
10	8.69 / 7.23	1.46	Not used: depletion < 2
15	8.67 / 6.32	2.35	0.157
20	8.70 / 5.26	3.44	0.172
25	8.71 / 4.12	4.59	0.184

Average: 0.171 depletion/ml of seed

In the BOD calculation, this number is multiplied by the volume of seed used in each bottle to give the total depletion due to seed. This number is subtracted from the total depletion to give the depletion due to the sample. That value is then used to calculate the sample BOD. See the example below for more information.

BOD Example

Initial DO = 8.69

Final DO =4.62

Depletion = 4.07

Seed correction factor (from above) = 0.171

Volume of seed = 3 ml

Sample volume: 6 ml

Pre-dilution factor = 1 (no dilution)

KT = 1 (sample was measured on 5th day)

Sample was not spiked.

BOD = ((DEPLE – (SEED*SEED_VOL) – (SPIKE*SPIKE_VOL)) / (SVOL/300))*PD*KT

BOD = ((4.07- (0.171*3) - (0*0)) / (6/300)*1*1

= (4.07 – (0.513)) / 0.02

= 3.557 / 0.02

= 177.85

BOD: Seeded Dilution Water Example

Initial DO = 9.0 mg/L

Final DO = 2.0 mg/L

Sample volume = 10mL

Blank initial DO = 9.0 mg/L

Blank final DO = 8.0 mg/L

Average blank depletion = 9.0 – 8.0 = 1.0 mg/L

Pre-dilution factor = 1 (no dilution)

KT = 1 (sample was measured on 5th day)

DEPSE = (AVG_BLANK_DEPL*((300 – SAMPLE_VOL) / 300))

= (1* ((300-10)/300))

= 1 * (0.96666)

= 0.96666

BOD = ((DEPLE) – DEPSE)*(300/SAMPLE_VOL)*PD*KT

= ((9 – 2) – 0.96666)*(300/10)*1*1

= (7 – 0.96666)*(30)

= (6.0333)*(30)

= 181 mg/L

B2 Standard Method 5210 B – 20th Edition

Seeded dilution water

BOD_5, mg/L = $(((D_1 - D_2) - (B_1 - B_2)\ f) / P)$

Unseeded dilution water

BOD_5, mg/L = $((D_1 - D_2) / P)$

D_1 initial DO, mg/L

D_2 final DO, mg/L

P decimal volumetric fraction of sample used

B_1 initial DO of seed control, mg/L

B_2 final DO of seed control, mg/L

F ratio of seed in dilution sample to seed in control sample = (% seed in diluted sample)/(% seed in seed control)

B3 Standard Method 5210 B – 21st Edition – 23rd Edition

Seeded dilution water

BOD_5 mg/L = $(((D_1 - D_2) - (S_{avg}) V_t) / P)$

Unseeded dilution water

BOD_5 mg/L = $((D_1 - D_2) / P)$

Same formula as above except that S_{avg} is "0" if samples are not seeded

D_1 initial DO, mg/l

D_2 final DO, mg/l

P decimal volumetric fraction of sample used

S $(B_1 - B_2)/V_S$ in each seed control bottle

B_1 initial DO of seed control, mg/L

B_2 final DO of seed control, mg/L

V_S volume of seed in respective seed control bottles, ml

S_{avg} average of S values for all qualified seed control bottles, ml of seed added per bottle

V_t milliliters of seed in the respective BOD test bottles

B4 European Standard EN1899 – 1 & 2

Seeded dilution water

$BOD_n = ((C_1-C_2) – ((V_t-V_e)/V_t) * (C_3-C_4)) * (V_t / V_e)$

Unseeded dilution water

$BOD_n = (C_1-C_2)$

C_1 initial DO, mg/L

C_2 final DO, mg/L

C_3 initial DO of seeded dilution water, mg/L

C_4 final DO of seeded dilution water, mg/L

V_e volume of sample, mL

V_t total volume of bottle

C. BOD Method Comparision Chart

	5210B 20th edition	**5210B 21st edition**	**5210B 22nd edition**	**5210B 23rd edition**	**European Standard EN 1899-1 & EN-1899-2**
Dilution water blank maximum level	0.2 mg/L	0.2 mg/L - minimum initial DO 7.5mg/L	0.2 mg/L	0.2 mg/L	- minimum initial DO 8.0 mg/L
GGA (glucose-glutamic acid check- BOD result)	198 +/-30.5 mg/L	198 +/- 30.5 mg/L	198 +/- 30.5 mg/L	198 +/- 30.5 mg/L	210 +/- 20 mg/L
Sample pH	If not between 6.0 and 8.5 adjust to 6.5 to 7.5	If not between 6.0 and 8.0 adjust to 7.0 to 7.2	If not between 6.0 and 8.0 adjust to 7.0 to 7.2	If not between 6.0 and 8.0 adjust to 6.5 to 7.5	If not between 6.0 and 8.0 neutralize it
Super-saturation	Initial DO >9.0 mg/L	Initial DO >9.0 mg/L	Initial DO >9.0 mg/L	Initial DO >9.0 mg/L	Initial DO >9.0 mg/L
Dilution water depletion	Between 0.1 and 0.2	Between 0.1 and 0.2	Between 0.1 and 0.2	Between 0.1 and 0.2	Between 0.1 and 0.2
Incubation temperature	20 +/- 1º C	20 +/- 1º C	20 +/- 1º C	20 +/- 1º C	20 +/- 1º C
Incubation period	5 days	5 days +/- 6hr	5 days +/- 6hr	5 days +/- 6hr	5 days +/- 4hr
Sample selection criteria	Depletion > 2.0 Final DO > 1.0	Depletion > 2.0 Final DO > 1.0	Depletion > 2.0 Final DO > 1.0	Depletion > 2.0 Final DO > 1.0	
Seeded BOD_5 formula*	BOD_5, mg/L = $(((D_1 - D_2) - (B_1 - B_2)\ f) / P)$	BOD_5, mg/L = $(((D_1 - D_2) - (S_{avg})\ V_s) / P)$	BOD_5, mg/L = $(((D_1 - D_2) - (S_{avg})\ V_s) / P)$	BOD_5, mg/L = $(((D_1 - D_2) - (S_{avg})\ V_s) / P)$	$BOD_n = ((C_1-C_2) - ((V_t-V_e)/V_t) * (C_3-C_4)) * (V_t / V_e)$
Unseeded BOD_5 formula*	BOD_5, mg/L = $((D_1 - D_2) / P)$	Same formula as above except that S_{avg} is "0" if samples are not seeded	Same formula as above except that S_{avg} is "0" if samples are not seeded	Same formula as above except that S_{avg} is "0" if samples are not seeded	$BOD_n = (C_1-C_2)$
Blank correction	No	No	No	No	No

* See Appendix B for formula definitions i.e. B_1, D_2

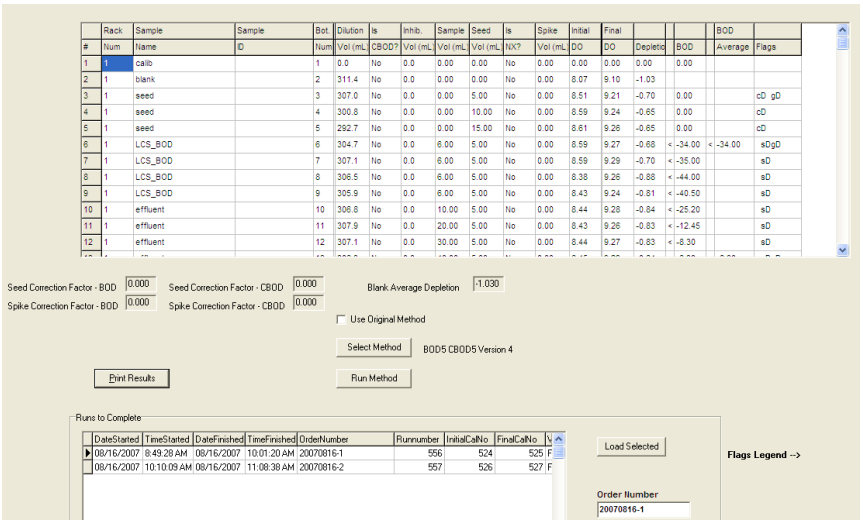
Note: EN-1899-1 determination of biochemical oxygen demand after *n* days – Part 1 – dilution and seeding method with allylthiourea

EN-1899-2 determination of biochemical oxygen demand after *n* days – Part 2 – method for undiluted samples

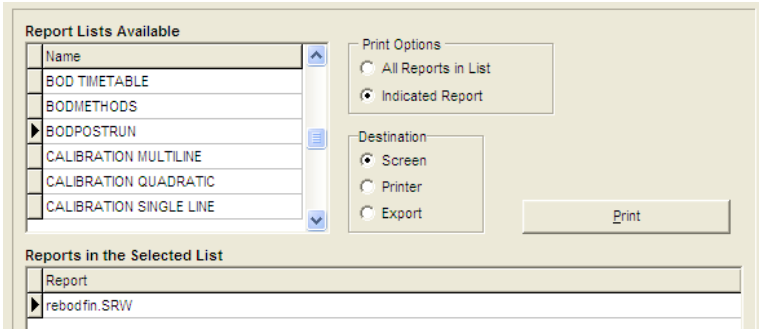
D. Changing Equations for Post Run BOD Analysis Report

The following steps are most commonly used to apply a new set of BOD rules (via BOD Method) to a previously completed set of data.

1. From the main menu, go to the **'BOD'** menu and select **'Post Run BOD Analysis'**.
2. In the **'Runs to Complete'** section at the bottom of the screen, select the desired run. The most recent runs will be at the bottom of the list. Click on the **'Load Selected'** button.



3. Un-check the **'Use Original Method'** box.
4. Click on the **'Select Method'** button followed by the **'Load'** button.
5. Select the new method or method version from the list and press **'OK'**.
6. Click on the **'Run Method'** button.
7. To print the data, press the **'Print Results'** button which has now become available.
8. Select the destination for the report and select **'Print'**.



E. Text File Format for Importing Data

For instructions on importing a text file into the software see Section 3.3

1. The first line of the text file contains the information that is not repeated for each sample and is listed below. If you do not want this information imported, leave the first line of the text file blank.

   schedule name,cal schedule,order number,rack number,header1,header2,
   header3,header4,header5,header6,header7,header8,header9,header0

2. Subsequent lines of the text file contain the information that is used to make the list of samples, with each line of text representing one line in the timetable.

   sample name,sample ID,Sample Volume,,Predilution,Seed Vol,Is CBOD (Use Yes or No),,,,Is NX (Use Yes or No),Inhib Vol,Spike Vol,data1,data2, data3,data4,data5,data6,data7,data8,data9,data10,data11,data12,data13, data14,data15,data16,data17,data18,data19,data20

Note: In a text file the information will actually appear on the same line. i.e. All information in #2 will be on one line not three.

To receive an example text file contact MANTECH or your local distributor.

F. Definitions

F1. Run Screen Button Definitions

Add X Rows: Allows user to add the desired number of rows (bottles) to a template when creating a BOD/CBOD run. The maximum number of rows in a template is 512.

Auto-Generate Order number: Creates a run-specific batch number using the date. A unique order number is required for each run to help keep track of the data. This number may also be typed in manually, but it cannot be more than 20 characters in length.

Calibration Schedule: Allows selection of the method used to calibrate the dissolved oxygen probe. This only needs to be populated if a calibration is being performed in the run. A calibration is denoted by writing 'calib' in the sample name column. The same calibration schedule should always to be used to ensure a consistent DO probe calibration.

Check Timetable: Checks the template created to ensure all required information is present. Any problems will be listed on the screen. Note: columns such as sample volume are not checked for data because in some instances they remain empty (i.e. when running a blank).

Clear Timetable Grid: Removes all sample lines and information from the run grid. Use with caution!

Delete: Allows a user to remove a template. Note: deleting a template does not allow the name of that template to be used again.

Delete Highlighted Row: Removes a template line from the timetable grid. Lines that have been partially or completely analyzed can not be removed. Always delete blank lines from a template before starting the run.

Done: Allows users to leave the run screen and go back to the main menu. This button is not available when the run is in progress.

Edit/Done Edit: Allows users to enter in/out of the edit mode in the software. This mode allows the user to modify run information such as sample volume, comments and schedule name as well as insert and delete rows and reset DO readings. This button is located on the '**Run Information/Template Controls**' tab of the run screen (**BOD/Run BOD**).

Erase Rack DOs: Allows an entire rack of DO's to be reset at a time so that they can be measured again. This button is only available while in Edit mode. This button can be used during both the initial and final DO measurements.

Insert X Rows: Allows users to insert rows into a template above or between rows which have not yet been analyzed. If the bottle below where the lines are to be inserted has been started this button will be unavailable. This button is only available in Edit mode.

Load from Text File: Allows user to select a text file from which to load data onto the run screen. See Appendix E for the required format of the text file and Section 3.3 for instructions on how to load this file.

Load Template: Allows users to load a pre-saved set of samples in the creation of their daily runs. One or multiple templates can be loaded to create a run. See Section 2 and Section 3.2 for more information.

Link to Autorun: Allows a template to be associated with an autorun button. These buttons are present on the main screen of the software and are shortcuts to the specified template.

Print Existing Timetable: Prints specific data present in the timetable grid. Initial and final DO values do not show up on this report as it only contains information that is present BEFORE a run is started.

Schedule: allows selection of the method used to analyze the BOD/CBOD samples. A schedule must be selected before a run can be started. One schedule is used for all samples in a run. The main sample analysis schedules listed in the following table.

Current Schedule Name	Former Schedule Name	Description
BOD-STAND ALONE	BOD5-STAND ALONE	No autosampler on system; user prepares bottles and moves probe to bottles and rinse station following OK messages in the schedule.
BOD-READ ONLY	BOD5 - 1 PUMP	User prepares bottles manually and places them onto the autosampler for automated DO measurement. Automated rinsing is included.
BOD-DILUTION	BOD5 - 2 PUMPS	System performs automated dilution water addition, DO measurement, and rinsing.
BOD-DILUTION-SEED	BOD5 - 3 PUMPS	System performs automated dilution water and seed addition, DO measurement, and rinsing.
BOD-DILUTION-SEED-INHIB	BOD5 - 4 PUMPS	System performs automated dilution water, seed, and inhibitor addition, DO measurement, and rinsing.
Not applicable to current release systems – spike pump not included in standard database	BOD5 - 5 PUMPS	System performs automated dilution water, seed, inhibitor, and spike addition, DO measurement, and rinsing.

Although, only one schedule will be primarily used, if hardware issues arise the schedule can be changed.

Save: Saves a template using the same template name. The old version of the template is over written. If the template modified is associated with an autorun button, the most current version will automatically be used when the button is selected.

Save As: Saves a template and allows user to enter a new name for the data.

Start: Begins the run. This button is not available while in edit mode. The run will start where it left off unless DO's have been reset in the current rack (then it will re-read those first).

Stop: Stops the run immediately. Users can edit run info or exit to main screen after pressing this button. The run will continue where it left off once it is started again unless DO's have been reset (then it will re-read those first).

F2. BOD Method Rule Definitions

Final DO Less Than: If the final dissolved oxygen value is less than that specified in the text box, a flag will appear and the bottle will be excluded from calculations (if applicable). This rule is found in all 4 sections of the BOD and CBOD rules; blank, seed, spike and sample. The flag that is displayed will depend on what section this rule is under. This rule is not commonly used in the blank section as it is only a safety net to ensure the calibration was performed accurately and dilution water was made correctly.

For example: This rule is activated in the seed section of the BOD rules and it is set to 'final DO less than 1'. A seed bottle with a final DO of 0.92 mg/L is analyzed. The software will exclude this value from the calculation of the seed correction factor and display a sF flag in the flags column.

Maximum Depletion: If the depletion is greater than the value specified in the text box a flag will appear. This rule is only present in the blank section of the BOD and CBOD rules and is very commonly used.

For example: This rule is activated in the blank section of the BOD rules and is set to 'Maximum depletion of 0.2 mg/L'. A blank sample is analyzed and the depletion is 0.3 mg/L. A bDe flag will appear beside this bottle in the flags column.

Depletion (delta DO) Less Than: If the depletion is less than that specified in the text box, a flag will appear and the bottle will be excluded from calculations. This rule is found the seed, spike and sample sections of the BOD and CBOD rules. The flag displayed will depend on what section the rule is under.

For example: This rule is activated in the sample section of the BOD rules and it is set to 'depletion less than 2'. An effluent sample is analyzed and the depletion is 1.5 mg/L. An sD flag will appear next to this bottle and this value will be excluded from the BOD average calculation if other bottles pass.

Depletion Range: If the depletion is not within the specified range a flag will be displayed and value will be excluded from calculations of the correction factor. This rule is only found in the seed and spike sections of the BOD and CBOD rules. The flag displayed will depend on what section the rule is under. This rule is usually used on its own as it conflicts with the other rules in the section.
For example: This rule is activated in the spike section of the BOD rules and it is set to 'depletion range 4 to 6'. A spike bottle is analyzed and the depletion is 6.1 mg/L. A kR flag will be displayed next to this bottle and it will be excluded from the calculation of the spike correction factor.

Standard Nominal: This is the true value of the standard used for quality control. This is most often Glucose-Glutamic Acid (GGA) with a BOD value of 198 mg/L.

Standard Range: This is the allowable variation from the standard nominal value that is acceptable. If the average of all bottles containing standard is outside this range the value will be flagged.

G. Tips for Creating and Editing BOD Run Templates

- The software allows the use of the standard Microsoft keyboard shortcuts cut (ctrl x), copy (ctrl c), and paste (ctrl v) to move data quickly around the template.
    - Can copy a single value into multiple cells by highlighting the cells before using paste

- One entire line can be moved or copied
- Can copy multiple values into a single column
  - Often used when populating sample volumes. E.g. If you want to copy the sample volumes 25, 50, 75, 100 down the column, highlight and copy (ctrl c) all 4 values. Highlight the blank cell where the first sample volume in the set should go and press paste (ctrl v). Each sample volume will be pasted into a separate cell down the template column.
  - Make sure the box is highlighted as opposed to the cursor flashing when pasting data otherwise all data will be put into one cell instead of multiple cells

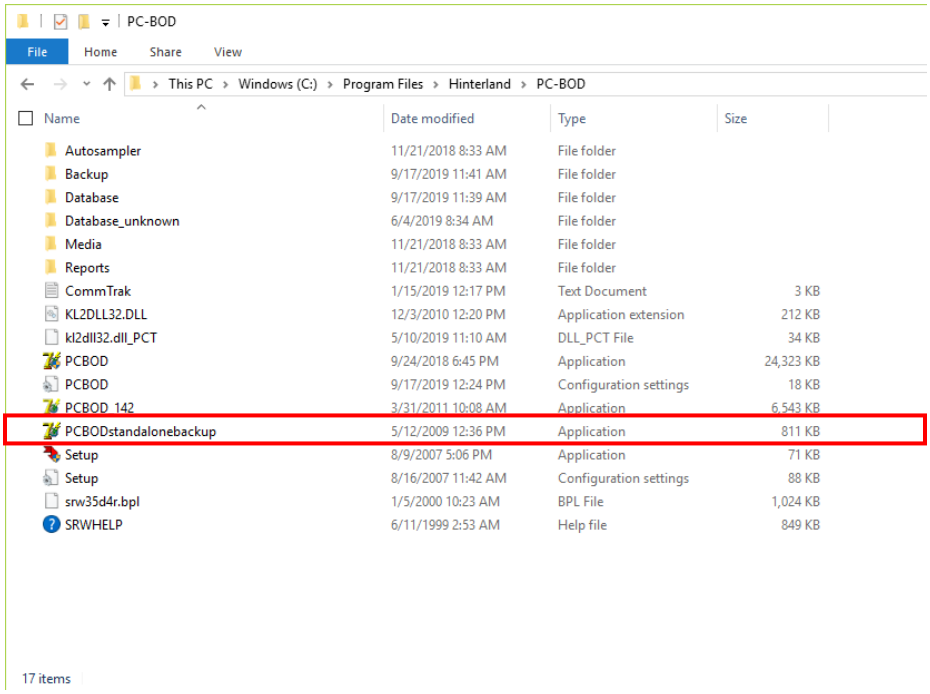
- Always delete the information from a cell before typing in new information.
- To change any information, the '**Edit**' button must be pressed on the '**Run Information/Template Controls'** tab
- Whenever possible create sample sets for samples which are analyzed often. For more information, refer to Section 2.
  - This allows runs to be created by loading and appending multiple sample sets/templates instead of typing in all of the information manually.
- Before the '**Insert x Rows**' button is available, you must click on the cell you wish to insert above in the template
  - Rows cannot be inserted above or between bottles which have already been partially or fully analyzed. If this is attempted the '**Insert x Rows**' button will become unavailable.
- Before the '**Delete highlighted row**' button is available, the row to be deleted must first be selected. Rows which have been partially or fully analyzed cannot be deleted. If this is attempted the '**Delete highlighted row**' button will not become available.
- '!' cannot be used anywhere on the run grid as this is a schedule interruption key and will cause template buttons to become unavailable.
- The chart below describes the columns on the run screen that must be filled out for specific bottles if these bottles are included in the run.

Sample Name Column	Other fields to fill out
Calib	none
Blank	none
Seed	Seed volume, Is CBOD
Spike	Spike volume, Is CBOD

*the above information does not include the standard auto-populated fields (i.e. pre-dilution). If not mentioned these do not need to be modified.

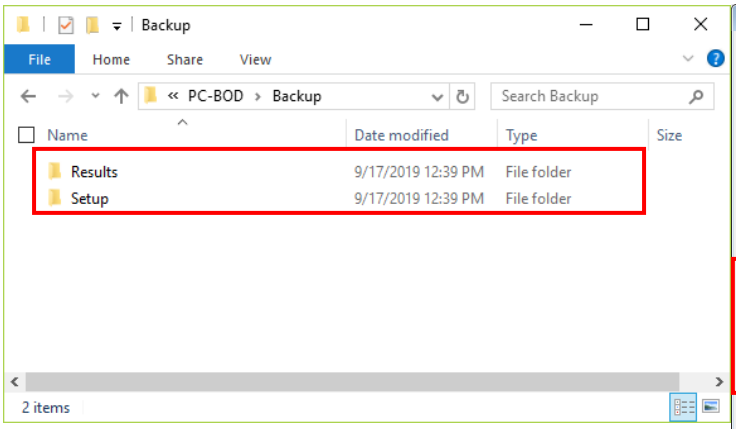
H. PC-BOD Stand Alone Backup

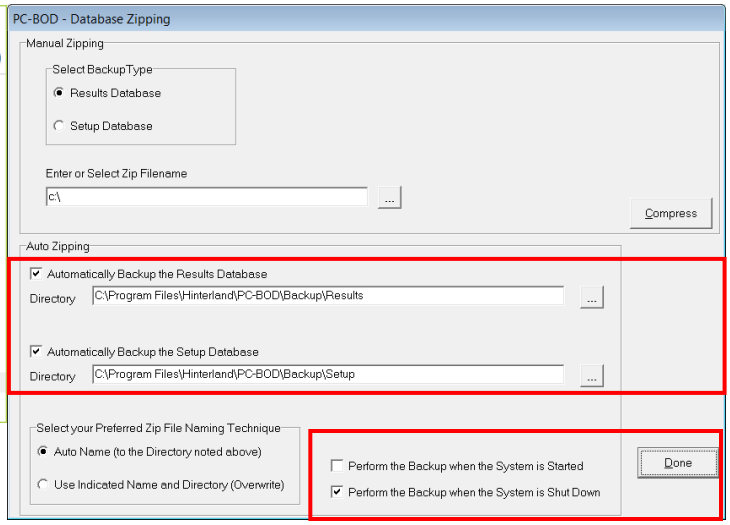
PCBODstandalonebackup is an external application used to backup data during BOD analysis of a batch of samples. Typically, PC-BOD is setup to run the external application after each rack is completed. The backup files are saved in the location as set in the PC-BOD software. This backup location can be determined by the user.



1. From the main menu of PC-BOD, go to **'Utilities\Database Zipping'**.

2. Within the **'Auto Zipping'** section, choose the folder location for creating a backup copy of the **'Results'** and **'Setup Tables'.** If a folder location has not been created, it is recommended to create a folder named **'Backup'** within **'C:\Program Files\Hinterland\PC-BOD'**. Within the **'Backup folder'**, create one folder named **'Results'** and one named **'Setup'**. Once these folders have been created, choose the appropriate folder within the **'Auto Zipping'** section.



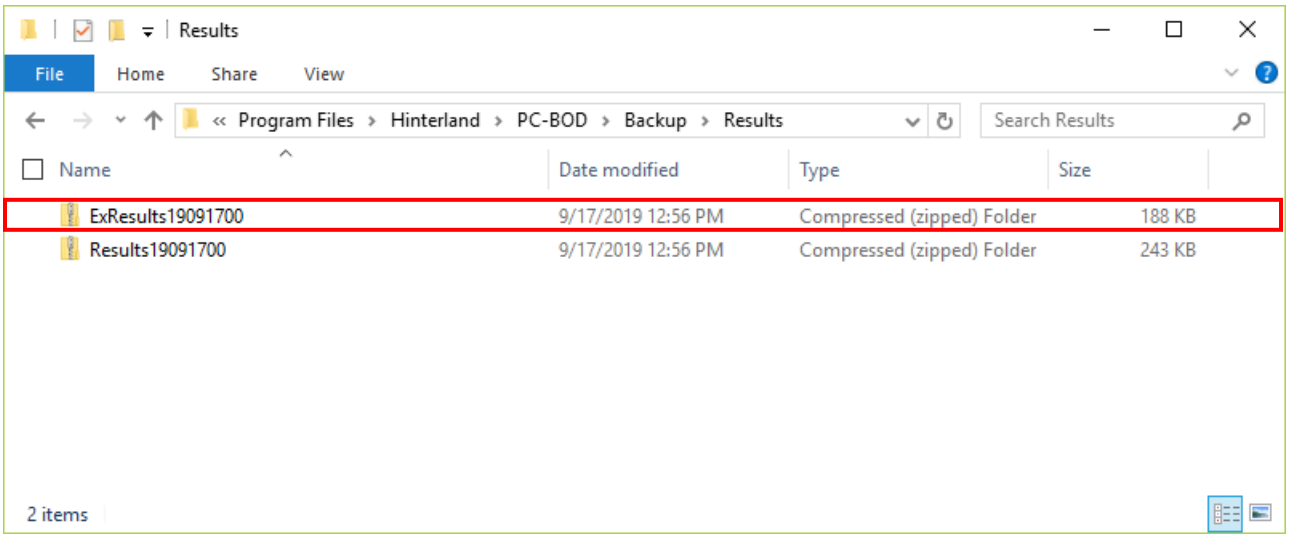


3. Within the **'PC-BOD - Database Zipping'** window, an automatic backup of the **'Results'** and **'Setup'** tables can be completed upon start-up or shut down. Select the desired automatic backup procedure.

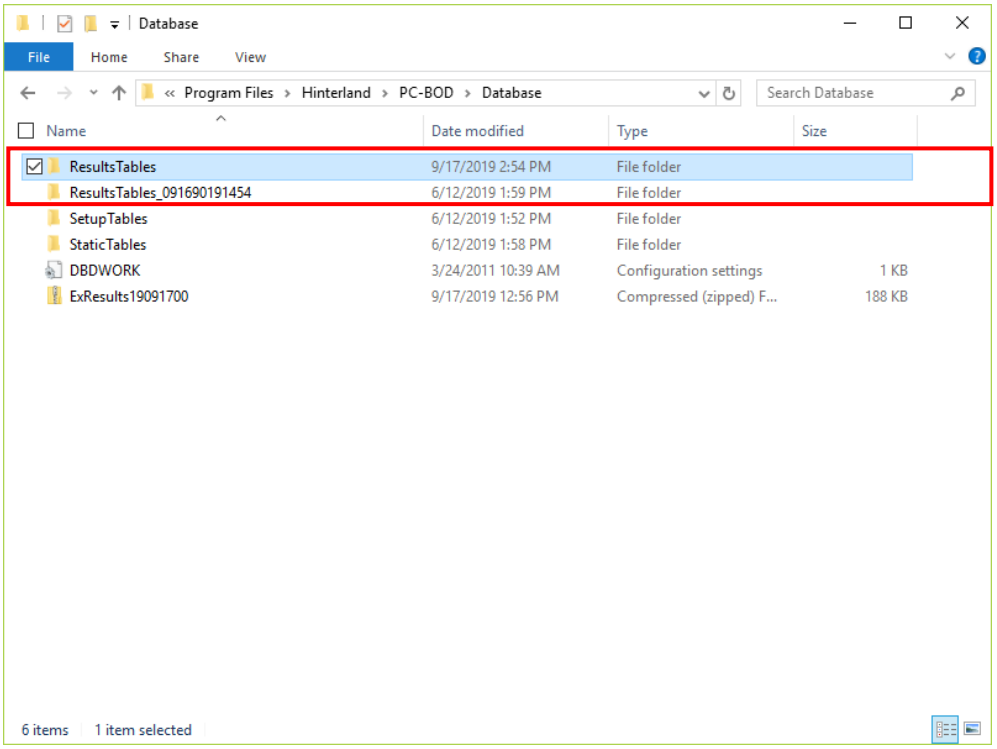
**Please note, PCstandalonebackup will run independently of the above automatic backup procedure settings in Step 3. It will perform a backup of the results tables only during a sample run, using the same folder destination as described in Step 3.*

4. Click **'Done'** to save the changes and exit.

5. The results backup will save as a zipped file in the designated folder. The file name is **'ExResultsYYMMDDXX'**.



6. If the backup results tables need to be reviewed, proceed with the following steps:
   a. Close any PC-BOD windows that are open.
   b. Navigate to **'C:\Program Files\Hinterland\PC-BOD\Database'**.
   c. Rename the current **'ResultsTables'** folder to **'ResultsTables_DateTime'**.
   d. Copy and paste the **'ExResultsYYMMDDXX'** file from the previous folder in Step 5.
   e. Unzip the file and rename the unzipped folder **'ResultsTables'**. This is now that active **'ResultsTables'** that PC-BOD will use.



f. Launch PC-BOD and review the data, as necessary. Please note, only data up to the date and time of the backup will be visible.
g. To proceed with BOD analysis, revert to the previous **'ResultsTables'**, or proceed using the latest backup results as the current **'ResultsTables'**.

I. Known Software and Training Challenges

Issue with	Issue	Solution
Autorun Button	Can make an autorun button with 'no template selected' as the template selected.	Always select a template to use when making an autorun button.
BOD Method	If the check box for Calculate BOD for Seed and Blanks is checked, and if the run contains BOD and CBOD for seeds, an average will be calculated for all – not just BOD or CBOD seeds.	No action required.
BOD Method	After making changes to the BOD Method and Saving, the software will always prompt "Recent changes may be lost without saving", each time the OK message is selected to leave the menu.	Select Save once to save changes then exit the window. The changes will be saved.
Calibration	A calibration cannot be performed in the last position of a rack or run	Calibrate the DO probe at a different time in the run, such as the first bottle of the run (most common).
Calibration	If a calibration is the only line in a template, a schedule will still need to be selected	Select both the calibration schedule and schedule to use before starting the run.
Calibration	Calibration line will always have temperature flags present (iT and fT)	Dis-regard these flags on calib bottles
Calibration	If you have a calibration sample in the first position in each rack in the run, and you go back to read a rack that is already complete, you will be asked if you want to re-run the calibration twice – once for the calibration sample in that rack, and again for the calibration is the next rack.	No action required

Calibration	The YSI ProOBOD cannot be calibrated via the PC-BOD software	A manual meter calibration is required by the enduser – OK messages from the PC-BOD software will guide through this process.
Columns for Display	There is no reason to display following columns on the run screen: Reset DO, Reset Final DO, DO Locked, Final DO Locked	Do not select these columns from the menu in the setup columns for display screen
Flags	Incubation flags are not correct until the run is complete. This is only an issue when running equations in real time.	Wait until the final report is displayed to look at the incubation flags Do not have your equations performed until all finals DO values are taken.
Header Titles	If too many wide letters such as 'w' are used in the header title, it will become cut off on the run screen.	For most titles this will not become an issue. If it is an issue, use a different title.
In Run	If the template is scrolled through during an autosampler move step, the software will pause the sampler until the scrolling is complete	No corrective action required. Once scrolling is complete the run will continue.
In Run	If the template is scrolled through during a pump step, it is possible that more reagent is added than was specified in the volume column.	Don't scroll through the template while pump is activated. If this is done, the volume is correctly recorded by the software. Keep the volume entered; do not change it back to what was originally input. Results will be correct.
In Run	Although users can type into the initial or final DO column, this information will not used/saved.	Only data taken from the meter will be accepted. A cell which has been typed into will be treated as empty and that DO will be re-read upon starting the run
In Run	Stirrer may turn on and off quickly after the DO reading has been taken.	No action required
In Run	Do not highlight lines in the template from right to left.	If highlighting is required select the cell on the right and drag left.

	This may allow the rack and bottle number to be deleted	Only use the delete highlighted row button to delete rows.
In Run	The software will slow down slightly (5 additional minutes per rack) during the final DO measurements if the equations are performed in real time.	Have the calculations done at the end of each rack or at the end of the run instead if a quicker analysis time is important.
In Run	If data is not deleted from a cell before typing into it, the decimal point will not be displayed.	Always erase data from a given cell using the delete key on the keyboard before typing in new data.
In Run	When the run is complete, and the results are calculated, if using Significant Figures for the results, zeros are not included – e.g. if the result is 75.2mg/L, and the significant figures is set to 5, the result will not be 75.200mg/L but will remain as 75.2	No Action required.
In Run	If a sample is reset in a run, when the rack is complete the sampler will return to the first bottle before pausing to add the next rack.	Do not place stoppers in bottles until the rack in complete.
In Run	Auto-export of results at the end of a run is not available	When the results are displayed in the report on the screen, select File/Export to manually export the file to a desired location.
In Run	BOD values are present in the calib line for all calibrations that are not in the first row of the template. The BOD value is identical to the BOD of the row before	No action required.
In Run	If using the YSI ProOBOD probe and “capture GLP data” is activated in the Hardware setup, will result is a slow capture of the DO value	Do not activate GLP Capture
In Run	The seed and decimals to carry also changes the display for the spike on the Run Screen and Post Run. However, it does not use this	For information purposes – no action required.

	modifed value in the calculation – it still uses all the decimals	
In Run (and Run Template)	If you append a text file containing headers, it will overwrite the current headers	When appending text files, ensure the first line is blank. For correct txt file format refer to Text File Format section
In Run	At the end of an initials run, the software will display the "Replace rack with additional rack, then press Start" OK message twice, back-to-back.	Press "OK" twice and proceed.
Printing a Report	If the run was converted from finals to initials or loading from recently completed, when the Start button is pressed, and a rack number (other than the last on the run is entered) the sampler will move to the first bottle of the next rack, then to the rinse station before the report is printed	Enter the LAST rack number in the run to have the report printed
Printing a Report	When trying to automatically export a txt file for the Initial Report you get a "Capability not supported" message	When the report is on the screen, go to File/Export to manually export the report.
Recently Completed	After the run if converted back to Finals to Finish, if it is just closed, it will remain there	See Section 6.3
Run Template	If multiple cells have been copied and the cursor in the destination cell is flashing, all data will be copied into one cell.	Have the destination cell highlighted (one click) instead of flashing (2 clicks) before pasting in data. This will allow multiple cells to be copied into multiple cells instead of just one. If all data is copied into one cell, delete this data and try again.
Run Template	If there are 17 or more samples in a template, and you Delete Highlighted Rows from the bottom, the scroll bar will disappear at row 16.	Click in the Sample column, and use the cursor keys to scroll to the top of the screen

	You cannot scroll up to the top of the screen	
Run Template	Pressing Start you are prompted for a Rack number. Pressing the Space bar is allowed as a character. This may pose problems when trying to run the finals as the correct characters are required including spaces	Do not use spaces when prompted for Rack number
Run Template	When loading a run from an autorun button, the first time the run grid is clicked, the cursor will move quickly to the bottom of the template.	Once cursor is at the bottom of the run, continue normally.
Run Template	No Sample Volume for Seed Bottles and “Calculate BOD for Seed and Blanks” not activated will still give <1 in the BOD average column when calculated. The reason being is that the software is trying to average zeros, but because it is less than the minimum detection, <1 is displayed	Activate “Calculate BOD for Seeds and Blanks” in BOD Method
Schedule	DO read stability takes the DO reading too quickly.	Have the stability set up outside of the DO read step using the ‘wait until’ function. This should already be done in the database upon install or update.

Document Change Log

Version	Date	Author	Changes
2	31-July-2019	Heather Jasumani	• Document ID assigned • Formatting
3	07-August-2019	Maggie Grierson	• Examining Historical Calibrations section added
4	09-January-2019	Maggie Grierson	• YSI 4010 Meter Calibration Added
5	11-May-2020	Maggie Grierson	• Updated Main Menu screen, AutoRun buttons, schedule names, digital configurations, PCBODStandalonebackup description

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