MAN-MD-P-0700-02



## MANTECH-INC.COM

# PeCOD Pro™ Operation Manual

## For Benchtop PeCOD® COD Analyzers

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#### Typical Operation Quick Reference

- 1. Prepare Calibrant solutions: Prepare pre-mixed blank and pre-mixed calibrant.
  - a. See: 8.1 COD Solution Preparation Instructions
- Launch Software and connect to PeCOD: Launch PeCOD Pro<sup>™</sup> and connect to the PeCOD.
   a. See: 1.1 Connecting to the PeCOD
- 3. **Run QC Regime:** Use PeCOD Pro<sup>™</sup> to run a QC regime (calibrations + QC check to validate).
  - a. See: 2.0 Calibration and QC Regimes
- 4. **Produce QC Reports:** 
  - a. See: 2.3 Calibration Results
- 5. **Prepare Samples:** Determine interferences, filter samples, dilute samples (if required), and prepare by mixing with the appropriate ratio of electrolyte.
  - a. See: 8.0 Solution Preparation
- 6. **Run Samples:** Use PeCOD Pro<sup>™</sup> to run samples
  - a. See: 3.0 Samples
- 7. Produce Reports: Use PeCOD Pro<sup>™</sup> to produce Sample Reports
  - a. See: <u>3.4 Sample Results</u>
- 8. Troubleshoot (if required): Refer to troubleshooting section if required.
  - a. See: 7.0 Troubleshooting



#### 1.0 Getting Started

#### 1.1 Introduction

The purpose of the PeCOD Pro<sup>™</sup> Operation Manual is to streamline the calibration and sampling process for users by outlining recommended procedures. For further description on the functions of the PeCOD Pro<sup>™</sup> software refer to the PeCOD Pro<sup>™</sup> Documentation pdf included in the software folder. For instructions on installing PeCOD Pro<sup>™</sup> software, refer to documentation PDF or the MANTECH YouTube channel: <u>www.mantech-inc.com/PeCODProTutorials</u>.

When the program is launched for the first time, it will show an "update tour" outlining new features in that version. This tour will be shown every time the program is launched unless the "Don't show tour again on program start" box is checked.



When the tour is closed, or on normal launch, the main window of the program will be shown. The functionality is fairly limited until connected to a PeCOD, but previous .CAL and .BATCH files can be loaded via the QC Report and Sample Report tabs, without connecting to a PeCOD.

S MANTECH PeCOD® Pro v1.3.7.0		1 23
File     Utilities     Help       USB COMM.     Info       Port     COM6       Connect     Current Sensor 0       Disconnected     Start Date: N/A       Not Connected     Status:	Control     Prime       Exit     Ax1       T     Bx1       Enter     Calibrate	Ax3 Bx3
AutoQC       QC Report       Sample       Sample Report       Live Plot       Settings       Logs         Configuration       ID:       Cal_20190109_092936       Initial Primes:       A:       3       B:       3       Initial Primes:       A:       A: <th>Start Delay             No Delay          Delay Start Until:         January -09-19          ①         ①         9.29         ①         Data Storage         Save Cal file automatically         C:\Program Files (x86)\MANTECH\PeCODPro         Change Location         Open Location         Save curve data to file automatically         C:\Program Files (x86)\MANTECH\PeCODPro         Change Location         Open Location         Open Location         Start         Cancel</th> <th></th>	Start Delay             No Delay          Delay Start Until:         January -09-19          ①         ①         9.29         ①         Data Storage         Save Cal file automatically         C:\Program Files (x86)\MANTECH\PeCODPro         Change Location         Open Location         Save curve data to file automatically         C:\Program Files (x86)\MANTECH\PeCODPro         Change Location         Open Location         Open Location         Start         Cancel	
Status		





#### 1.2 Connecting to the PeCOD

- 1. Connect the PC to the PeCOD via USB cable. Make sure the PeCOD is on.
- 2. Select Port: **COM6** on the drop down selection.
- 3. Click **Connect**. As the program connects, it gets information from the PeCOD, and the progress will be displayed:

S MANTECH PeCO	0® Pro v1.3.7.0	
File Utilities H	łelp	
USB COMM. Port COM6 Connect	Info Serial #: MT-0A0-0000 Current Sensor: 0 Update Sensor Active 11 Control Exit Ready	Prime Ax1 Ax3
Connecting Not Connected AutoQC QC Re	OPTIMIZE YOUR RESULTS. PROTECT OUR ENVIRONMENT.	Bx1         Bx3           Ax3 + Bx3
Configuration – ID: Cal_20190 Initial Primes: QC Regime:	Connecting: Getting PeCOD Parameters	Á
Description Regime to This regir check to re-verifica	Got controller parameter: 47	Location
	Start C	Location
	Current Status: 2019/01/09/10:10:03: Requesting parameters from PeCOD to verify connection.	

4. Once connected the progress panel will disappear, the **Connect** button will change text to: **Disconnec**t, the status below the button will show "Connected" and the box below that will display the **COD range**:

MANTECH PeCOD®	Pro v1.3.7.0		
File Utilities Help			
USB COMM.	Info	Manual Control	
Port COM6 -	Serial #. MT-0A0-0000 Current Sensor: 0 Update Sensor	Menu Exit Ready	Prime Ax1 Ax3
Disconnect	Analyses: I   Calibrations: U		
Connected	Start Date: N/A Current Status:		Bx1 Bx3
GREEN	2019/01/09/10:10:06: COM OPEN	Enter	Analyze Ax3 + Bx3

5. After the software is connected, the QC Regime, Sampling, Settings, Logs, and additional functions become active and can be used.



#### 2.0 Calibration and QC Regimes

The PeCOD should be calibrated each day before sample analysis. Calibrations can be setup to run unattended immediately or delayed to a user-specified date and time. Calibration times vary for each COD range.

The program is designed to run "QC Regimes" which are automated behaviours to preform the appropriate number of calibrations as well as analyzing calibrant as a QC-Check sample, to verify that the calibration was successful.

Approximate QC Regime durations are listed in Table 1 and are based on the *Startup (Daily) QC Regime*, using the default preferences. Calibration durations may vary by user based on customized parameters and QC Regime preferences.

Table 1: Approximate times to complete Startup (Daily) QC Regime

COD Range	Approximate Time to Complete Startup (Daily) (mins)
ADVANCED BLUE	30
GREEN	45
YELLOW	55
RED	90

#### 2.1 Hardware Setup

Ensure that the PeCOD matches the image below.

- Port A tubing in pre-mixed calibrant bottle
  - o 8.0 Solution Preparation
- Port B tubing in pre-mixed blank bottle
  - 8.0 Solution Preparation
- Port W tubing into waste Bottle (ensure waste bottle is emptied).







#### 2.2 Software Setup

Ensure the PeCOD is connected to the computer and COM6 is connected in PeCOD  $Pro^{M}$  (See <u>1.1 Connecting to the</u> <u>PeCOD</u>). Select the "AutoQC" tab from the main window. To run a QC Regime:

- 1. Set Initial Primes to A: 3, B:3.
- 2. Select the appropriate QC Regime type
  - a. **Startup (Daily):** most commonly used, for daily calibrations with a previously used sensor.
  - b. Startup (New Sensor): used when installing a new sensor. See special notes: 2.2.1 Startup (New Sensor)
  - c. **QC Routine:** used after prolonged sample analysis or extended idling to determine if the daily calibration is still valid. See special notes: <u>2.2.2 QC Routine</u>
- 3. **Start Delay**: Select either **No Delay** to begin QC Regime upon **Start**, or select **Delay Start Until** and set the date and time for the Regime to start.
- 4. Data Storage: Select Save .Cal file automatically and/or Save curve data to file automatically, to store the calibration data after completion. Note, saving the curve data can use large amounts of memory/storage on the computer. Saving the .Cal files and curve data is optional for the user, but not necessary for completing calibrations.

S MANTECH PeCOD® Pro v1.3.6.12				
File     Utilities     Help       USB COMM.     Info     Manual       Port     COM6     Current Sensor: 0     Update Sensor       Disconnect     Sait Date: N/A     Menu       Connected     Current Status:     2018/11/21/11:11:36: COM OPEN	I Control Exit Ready Code = 200.8 Refer To Manual 2018/11/21 12:10:46▼ Enter Calibrate Analyze Ax3 + Bx3			
Configuration ID: Cal_20181121_110251 Initial Primes: A: 3  B: 3  QC Regime: Startup (Daily) Startup (New Sensor) QC Routine	Start Delay  Start Delay  Delay Start Until: Wednesday. November 21, 21  Tota Storage Save .Cal file automatically			
Description: Regime to be run daily to prepare the PeCOD for sampling. This regime will calibrate the PeCOD and perform a Quality Control check to verify the calibration. If the check fails, re-calibration then re-verification is attempted.	S:\Software\Mantech Software\PeCOD\PeCODPro_Internal Change Location Open Location Save curve data to file automatically S:\Software\Mantech Software\PeCOD\PeCODPro_Internal Change Location Open Location			
Current Status: 2018/11/21/11:11:36: COM OPEN	Start Cancel			

- 5. Click Start to begin the QC Regime, or to put the program into the mode which awaits the delayed start specified.
  - a. While the QC Regime is running, the front of the PeCOD screen will blink yellow. Once the regime has finished, the front of the PeCOD screen will show a green light.
  - b. Upon successful calibration, a pop-up window will display **PASS**. Select **OK** and proceed to the **QC Report** to view the calibration values, or to the **Sample** tab to begin sample analysis. If the pop-up window displays **FAIL**, the calibration isn't valid.



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#### 2.2.1 Startup (New Sensor)

Sensors are consumed by calibrations and analyses, as well as by contact with air and light. The user must replace the sensor once a used sensor has expired. The lifetime of a sensor varies by frequency of use and by the abrasive nature of the samples being analyzed. An approximation of sensor life is one month; however, a better indicator of an expired sensor is the calibration values. Calibration values are found in the **QC Report** tab of PeCOD Pro<sup>™</sup>. Each COD range has specific passing criteria for the calibration values. The passing criteria for each COD range is listed in Table 2: Passing calibration criteria for each COD range.

When using "Startup (New Sensor)" as the QC Regime option:

- After clicking **Start**, a pop-up window will prompt for the sensor serial number.
- Select **OK** to add the sensor serial number located on the sensor package (this is recommended to track the lifetime of the sensor, which allows the user to determine the sensor life when used for the specific sample matrix).
- In the next window, enter the sensor serial number beside New Sensor Serial # and select Add and Make Current. Then select OK.

Manage Sensors							
Sensor Selection Current Sensor: NONE Analyses:   Calibrations: Start Date: (N/A days ago)							
Saved Sensors:   Make Current Delete							
Add New Sensor							
New Sensor Serial #. 21337 Add and Make Current							
Sensor Data							
Sensor Serial Analyses Calibrations Start Date							
Copy Table to Clipboard Save Table As CSV							
Load Sensor Data From File							
Load and Overwrite Load and Append							
OK Cancel							

#### 2.2.2 QC Routine

The QC Routine can be used to verify if the daily calibration is still valid. This function can be used after extensive sampling or if the PeCOD has sat idle for more than 2 hours. The QC Routine performs a QC Check using the pre-mixed calibrant solution. If the QC Check passes, then the calibration is valid and the PeCOD is ready to analyze samples. If the QC Check fails, the software will recalibrate the PeCOD and perform another QC Check following a successful calibration. Make sure port A is in Pre-Mixed Calibrant, as it is primed up to the sensor.



2.3 Calibration Results

- Once the QC Regime is finished, click on the QC Report tab. The calibration results table displays the M, C, LED, Qnet, and Iterm values. The PeCOD Pro<sup>™</sup> software evaluates the values from the last calibration, as well as the QC-Check result, to determine if the calibration is valid. The software notifies the user of a successful calibration with the PASS pop-up window. Passing calibration criteria are COD range-specific and are listed in *Table 2: Passing calibration criteria for each COD range*.
- 2. The QC Report tab allows a variety of output options:
  - a. Save Table to a CSV File: Saves the table in its current arrangement to a CSV File
  - b. Save to File: saves the QC Regime data to a .CAL file. This file type can be loaded back into the program on the QC Report tab and contains all the data collect (not just what is currently displayed in the table).
  - c. Generate Report (printable): Will produce a printable HTML formatted report (will open in default browser) which includes the current table as well as a more organized summary of the QC Regime, passing values, etc. The report can be printed from the browser or saved to PDF.

S MANTECH PeCOD®	Pro v1.3.6.12										
File Utilities Help											
USB COMM.	Info Serial # MT-0	00-000	0			Man	ual Co	ontrol			Prime
Port COM6 -	Current Sensor	: 0	Up	odate S	ensor	Mer	nu	<b>Exit</b>	Ready		Ax1 Ax3
Disconnect	Analyses: 22	8   Cali	brations	: 115							
Connected	Current Status:	A									BX1 BX3
ADV.BLUE	2018/11/21/12:0	)0:15: C	OMOP	EN			E	Enter	Calibrate	Analyze	Ax3 + Bx3
AutoQC QC Report	Sample Sam	ple Re	port L	ive Plot	t Settin	gs Lo	gs				
Cal_20181113_1419	12 🔹 Loa	d from	File	Save	e to File					Generate R	eport (printable)
Edit Table Lay	out Sa	ave Cur	rent Lay	rout as	Default			Copy Table to	Clipboard	Save Tab	le to CSV File
Date/Time	Туре	М	С	LED	COD	Qnet	Iterm	Error Descrip	otion		
2018/11/16 12:20:58	Cal:Blank	-	123.88	21.5	-	123.88	12.87	No descriptio	n available.		
2018/11/16 12:24:54	Cal:Reference	0.033	-	21.5	-	584.88	12.29	No descriptio	n available.		
2018/11/16 12:33:05	Cal:Blank	-	129.34	33.5	-	129.34	18.70	No descriptio	n available.		
2018/11/16 12:37:01	Cal:Reference	0.033	-	33.5	-	587.15	18.20	No descriptio	n available.		
2018/11/16 12:44:00	QC-Check	-	-	-	19.23	569.51	17.97	No descriptio	n available.		
Cur	rent Status: 2018/1	1/21/12	:00:15: C	OM OPE	EN						

- 3. To customize the information visible in the exported or printable report press **Edit Table Layout** to open the window shown below.
  - a. Data driven columns can be shown/hidden by checking/unchecking the boxes.
  - b. Custom (user fillable) columns can be added.
  - c. Columns can be re-ordered.



S MANTECH PeCOD® Pro v1.3.7.0	
File     Utilities     Help       USB COMM.     Info       Port     COM6     Serial #: MT-0A0-0000       Current Senace 0     Lindate Senace       Disconnect     Analys     Table Editor	Manual Control Menu Exit Ready
Connected       Current S         Current S       2019/07/1         GREEN       Image: Connected S         AutoQC       QC Report         Sample       Image: Connected S         Image: Connected C       Image: Connected S         AutoQC       QC Report         Sample       Image: Connected S         Image: Connected C       Image: C	Column Editor         Column Name:       Rename         Add New       Delete Selected         Preview / Re-Order         Date/Time       Type         M       C         LED       COD         Quet       Iterm         Description    Save and Exit Cancel

Table 2: Passing calibration criteria for each COD range

COD Range	M (COD/μC)	C (μC)	lterm (µA)	QC-Check (mg/L)
ADVANCED BLUE	0.01 - 0.08	50 - 300	> 16	17 – 23
GREEN	0.02 - 0.06	150 – 700	> 16	115 – 125
YELLOW	0.02 – 0.06	200 – 750	> 14	<u> 1150 – 1250</u>
RED	0.02 - 0.06	250 - 800	> 14	11500 – 12500

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3.0 Samples

- 3.1 Sample Preparation
  - Ensure the sample contains no particulates >50μm, has a pH between 4 and 10, and the chloride concentration is within the limits outlined in <u>8.2 Allowable COD/Chloride Concentration Combinations for peCOD Analysis</u>. For instructions on filtering samples, refer to: <u>8.3 Sample Filtering Guide for peCOD Analysis</u>.
  - 2. Prepare the sample according to the COD range mixing ratios listed in Table 3: COD range mixing ratios for sample preparation. See <u>8.2 PeCOD Dilution Charts for Sample Preparation</u> and/or <u>8.4 Using the Bottle Top Dispenser for Electrolyte Addition for Sample Preparation</u> for additional detail.
  - 3. Screw on a lid to the sample tube and invert several times to ensure the sample is well mixed.

COD Range	Mixing ratio	Volume Sample (mL)	Volume Electrolyte (mL)
ADVANCED BLUE	3:1	15	5
GREEN	1:1	10	10
YELLOW	1:9	2	18
RED	1:49	0.5	24.5

#### Table 3: COD range mixing ratios for sample preparation

#### 3.2 Hardware Setup

- 1. Place Port A in a beaker of DI water.
- 2. Prime Port **A x 3**, to rinse the Port A tubing. This can be done using the Ax3 button in the Prime section of the Manual Control group.

Manual Control	Prime	
	Ax1	Ax3
	Bx1	Bx3
Enter Calibrate Analyze	Ax3 +	Bx3

3. Place the Port A tubing into the sample tube with the prepared sample. (Port B will remain in the pre-mixed blank bottle).

#### 3.3 Software Setup

Go to the "Sample" tab of the software.

- 1. Match the computer screen to the image below to setup the sample analysis:
  - a. Click on the Sample tab.
  - b. Click New Batch.
  - c. Beside **Batch ID**, type in the custom ID or leave as the default date and time.
  - d. Enter the name of the **Operator** (optional), and/or **Notes** (optional).
  - e. Click Update Batch Info to update the customized settings.
  - f. Pre-Sample Primes A :3 and Pre-Sample Primes B: 0.
  - g. Sample ID: Enter sample name.



- h. **Replicates**: Enter the number of replicates. Replicates = 1 will run the sample twice total and give an average value.
- i. **Dilution Factor:** Enter the dilution factor of the sample. The dilution factor can be calculated by dividing the diluted sample volume before electrolyte is added by the pure sample volume.
- j. Select the box beside **Save .Batch file automatically** and/or **Save curve data to file automatically** to store the sample data after completion. Note, saving the curve data uses large amounts of memory on the computer. Saving the .batch files and curve data is optional for the user, but not necessary for completing samples.
- 0 X MANTECH PeCOD® Pro v1.3.6.12 File Utilities Help USB COMM. Manual Control Info Prime Serial #: MT-0A0-0000 Port COM6 Ready Exit Menu Update Sensor Current Sensor: 0 Ax1 Ax3 Disconnect Analyses: 228 | Calibrations: 115 Start Date: N/A Bx1 Bx3 Connected Current Status: 2018/11/21/12:13:03: COM OPEN ADV.BLUE Calibrate Enter Analyze Ax3 + Bx3 AutoQC QC Report Sample Sample Report Live Plot Settings Logs а. Select Batch nole Configurat g. New Load Save to Pre-Sample Primes - A: 3 \* Sample ID: b. Batch\_20181121\_121412 Batch From File File Pre-Sample Primes - B: 0 . Batch Info Replicates to run: 0 h. Dilution Factor: 1.000 Batch ID: Batch 20181121 121412 с. e. Update Batch Info Post Sample Configuration Peter Operator: d. j. Save .Batch file automatically Change Location Notes: C:\Program Files (x86)\MA Save curve data to file automatically Change Location Calibration Data Associated with Next Sample C:\Program Files (x86)\MA Update via: Update Run Sample(s) Cancel k. Calibration: 2018/06/18 12:17:20 LED Qnet: 1742.81 M: 0.043 C: 358.75 Iterm: 20.37 Sample Status QC-Check: 2018/06/18 12:22:44 Awaiting Next Sample COD: 121.81 Current Status: 2018/11/21/12:13:03: COM OPEN
- k. Click **Run Sample(s)** to start the sampling operation.

2. The PeCOD will begin by priming Port A with sample 3x and then begin COD analysis. A yellow status light will flash on the PeCOD while it's analyzing. After finishing the first sample, it will immediately begin the replicate, if applicable. Once completed, the PeCOD status light will remain green.

#### 3.4 Sample Results

To view the sample results, select the Sample Report tab.

- 1. Look in the table to find the sample COD values. "COD" indicates the reading from the instrument and "COD(d)" indicates the reading, adjusted by the dilution factor ("D.F.").
  - a. The dilution factor (D.F.) and the Replicate group (Rep. Group) can be edited after the samples have been run. Changing D.F. will change the factor that the measured COD value is multiplied by to calculate the diluted COD\*(D.F.) The Rep.Ave and Rep.%Diff are calculated for each sample with the same Rep.Group; samples run as replicates are in the same Rep.Group by default. Results can be excluded from an average or percent difference calculation by assigning a new Rep.Group value to the results which should be included in the new calculation.





- 2. The average of the replicate samples is displayed under the **Rep. Ave**. column. The percent difference between the sample and the average is displayed under the **Rep %Diff** column.
- 3. To save the data to a CSV file, click Save to CSV File.
- 4. To generate a printable report, click **Generate Report (printable)**. The report will open in a browser as a HTML file.
- 5. To create a custom report, press the **Edit Table Layout.** Select the categories to display on the report.

MANTECH PeCOD® Pro v1.3.6.14												
File Utilities Help												
USB COMM. Manual							I Control					
Port COM6 -	Serial #: MT-118-0	239	Indata 9	Concor	Menu	A Ex	it Ready	/			'rime	
Disconnect	Analyses: 2281(	ے alibration	ne: 115	belisui							Ax1 Ax3	
Disconnect	Start Date: N/A	andratio	13. 113								By1 By2	ר
Connected	Current Status:											
YELLOW	2018/11/23/09:52:4	9: COM O	PEN			Enter	Calib	orate A	nalyze		Ax3 + Bx3	
AutoQC QC Report	Sample Sample	Report	Live Plo	t Set	tings Logs							
Report Selection	0.000	ratar C	= ^			Associated	Calibration	e				
AllCombos	✓ Ope	rator: Gi es	EA			Cal # 1	Calibration	Seria	al#: M	T-0A1-	0000	
Load from File S	Save to File Sam	ples wer	e not pre	serve	d.	Cal. #. Sensor #:						
						Cal.: 2017/02/22 12:40:47 QC Check: 2017/02/22 12:45:10						
Generate Report (	printable) 4.					M: 0.032 C. 333.12 COD: 119.07						
E						Iterm: 12.31 LED: 21.5						
J.					_							=
Edit Table Layou	it Save Cu	rent Layo	ut as De	fault		3. s	ave Table t	o CSV File	Сор	y Tab	le to Clipboard	1
Date/Time	Sample ID	Qnet	COD	D.F.	COD*(D.F.)	Rep.Group	2 <sup>Rep.Ave</sup>	Rep.%Diff	lterm	Cal.	Error Description	*
2017/02/22 12:48:18	Sample1	1950.17	119.42	1	119.420	1	119.015	0.34	17.37	1		≡
2017/02/22 12:56:09	Sample1-1	1	118.610	1	119.015	0.34	16.64	1				
2017/02/22 13:04:01	Sample1-2 1927.61 117.74 2 235.4					2	234.750	0.31	16.26	1		_
2017/02/22 13:11:45 Sample1-3 1917.81 117.01 2 234.020					234.020	2	234.750	0.31	15.91	1		
2017/02/22 13:19:28	3	1,175.700	0.00	15.55	1		-					
Current status: 2018/11/23/09:52:49: COM OPEN												



4.0 Live Plot

The oxidation curves during a calibration or sample analysis can be viewed in the Live Plot tab.

- Crosshair: The crosshair position can be placed to investigate the I Work at a specific time.
  - $\circ$   $\;$  Click on the plot once to make the crosshair follow the mouse.
  - Click again to leave the crosshair in that position.
- Saving Data: The current plot can be saved to a CSV file by clicking the "Save Plot Data to File"
- Loading External Data: Previously saved CSV data of a plot can be loaded (for quick comparison/inspection) by clicking the "Load External Data" button.

File       Utilities       Help         USB COMM.       Info       Serial #: MT-118-0239       Manual Control         Port       COM6       Current Sensor. 26862       Update Sensor         Disconnect       Analyses: 631   Calibrations: 182       Start Date: 2018-8-21 (94 days ago)       D18/11/20 08:22:44▼       Bx1       Bx3         Connected       Current Status:       2018/11/20 08:22:44▼       Enter       Calibrate       Ax3 + Bx3         YELLOW       Vill8/11/2/10:53:11: User Terminated       Dest       Calibrate       Analyze       Ax3 + Bx3         AutoQC       QC Report       Sample       Sample Report       Live Plot       Settings       Logs         Data       Total Time (s):       545.6       Load External Data       Crosshair position       Time(s): 329.5 I Work(µA): 77.11         120       Gonol       (µA)       48       44       44       44       44         YMax       120       (µA)       48       44       44       44       44         20 or (last 100       points)       points       44       44       44       44       44	6 MANTECH PeCOD® Pro v1.3.6.14		_ <b>_</b> X
USB COMM. Port COM6 → Disconnect Disconnect VELLOW VELLOW Current Status: 2018/11/23/10:53:11: User Terminated Operation Current Status: 2018/11/23/10:53:11: User Terminated Operation AutoQC QC Report Sample Sample Report Live Plot Settings Logs Data Total Time (s): 545.6 Stage Time (s): 240 LED (mA): 28.7 I Work (µA): 2.94 diw/dt (µA/s): -0.0092 Port A 3/3 Oxidation Chart Tools Y Max 120 ↔ (µA) X Window: 120 ↔ (s) Z Orom (last 100 ↔ points) AutoQC (last 100 ↔ points) Comments (s): 240 LED (mA): 120 ↔ (s) Y Max 120 ↔ (µA) X Window: 120 ↔ (s) Z Orom (last 100 ↔ points)	File Utilities Help		
Port       COM6       Senal #: M1-118-0239         Disconnect       Analyses: 631   Calibrations: 182         Start Date: 2018-8-21 (94 days ago)         Current Status:       2018/11/20 08:22:44▼         Bx1       Bx3         Current Status:       2018/11/20 08:22:44▼         2018/11/20 08:22:44▼       Bx1         VELLOW       Current Status:         2018/11/20 08:22:44▼       Bx1         AutoQC       QC Report         Sample       Sample Report         Live Plot       Settings         Data       Clear External Data         Total Time (s):       545.6         Stage Time (s):       240         LED (mA):       28.7         IWork (µA):       2.94         diw/dt (µA/s):       -0.0092         Port       A 3/3 Oxidation         Y       Y         Wax       120         Y       Max         Y       (s)         Y       (µA)         X       (µA)         Y       (a)         Data       Clear External Data         Clear External Data       Clear External Data         Y       Y         Y	USB COMM. Info	Manual Control	Primo
Disconnect       Analyses: 631   Calibrations: 182 Start Date: 2018-8-21 (94 days ago) Current Status: 2018/11/23/10:53:11: User Terminated Operation       Image: Colibration of the status o	Port: COM6 Serial #: M Current Sens	sor: 26862 Update Sensor Menu A Exit Ready	
Connected         Start Date: 2018-8-21 (94 days ago) Current Status: 2018/11/23/10:53:11: User Terminated Operation         D         2018/11/20 08:22:44         Bx1         Bx3           AutoQC         QC Report         Sample         Sample Report         Live Plot         Settings         Logs         Ax3 + Bx3           AutoQC         QC Report         Sample         Sample Report         Live Plot         Settings         Logs           Data Total Time (s):         545.6         Load External Data         Clear External Data         Crosshair position Time(s):         329.5 I Work(μA):         77.11           120         48         48         48         48         48         48         48         44 <t< td=""><td>Disconnect Analyses:</td><td>: 631   Calibrations: 182</td><td></td></t<>	Disconnect Analyses:	: 631   Calibrations: 182	
Current Status:       2018/11/23/10:53:11: User Terminated       Enter       Calibrate       Analyze       Ax3 + Bx3         AutoQC       QC Report       Sample       Sample Report       Live Plot       Settings       Logs         Data       Total Time (s):       545.6       Load External Data       Clear External Data       Crosshair position         Total Time (s):       240       Load External Data       Clear External Data       Crosshair position         IED (mA):       28.7       Iuwork (µA):       2.94       96 -       96 -         dw/dt (µA/s):       -0.0092       96 -       96 -       96 -       96 -         Y Max:       120       (µA)       XWindow:       120       (µA)       48 -       24 -         Zoom (last 100       points       24 -       -       -       -       -	Connected Start Date	a: 2018-8-21 (94 days ago)	Bx1 Bx3
YELLOW     Diff (1/2)	Current Statu 2018/11/23/1	US:	
AutoQC       QC Report       Sample       Sample Report       Live Plot       Settings       Logs         Data Total Time (s):       545.6	YELLOW Operation	Enter Calibrate Analyze	Ax3 + Bx3
Data Total Time (s): 545.6 Stage Time (s): 240 LED (mA): 28.7 I Work (µA): 2.94 diw/dt (µA/s): -0.0092 Port A 3/3 Oxidation Chart Tools Y Max: 120 ↓ (µA) X Window: 120 ↓ (s) Prev. I Term (15.87) Zoom (last 100 ↓ points)	AutoQC QC Report Sample S	Sample Report Live Plot Settings Logs	
Total Time (s):       545.6         Stage Time (s):       240         LED (mA):       28.7         IWork (μA):       2.94         diw/dt (μA/s):       0.0092         Port:       A         Y Max:       120         Y Prev. I Term (15.87)         Zoom (last 100       points)	Data		
Stage Time (s): 240         LED (mA):       28.7         IWork ( $\mu$ A):       2.94         diw/dt ( $\mu$ A/s):       -0.0092         Port:       A         3/3 Oxidation $48 - 48 - 48 - 48 - 48 - 48 - 48 - 48 -$	Total Time (s): 545.6	Load External Data Clear External Data Time(s): 329.5 I Work(µA): 77.11	
LED (mA): 28.7 I Work (µA): 2.94 diw/dt (µA/s): -0.0092 Port A 3/3 Oxidation Y Max: 120 ↓ (µA) X Window: 120 ↓ (s) Prev. I Term (15.87) Zoom (last 100 ↓ points)	Stage Time (s): 240	100	
I Work (μA):       2.94       96 -         diw/dt (μA/s):       -0.0092         Port:       A       3/3 Oxidation            ✓       72 -         Chart Tools       ✓         Y Max:       120       (μA)         X Window:       120       (s)         Ø Prev. I Term (15.87)       24 -         Zoom (last 100 - points)       -	LED (mA): 28.7	120-	
diw/dt (μA/s):       -0.0092         Port       A       3/3 Oxidation         Chart Tools       Y Max:       120       (μA)         X Window:       120       (s)       24 -         Zoom (last       100 ÷ points)       points)       -	I Work (μΑ): 2.94	96 -	
Port A       3/3 Oxidation         Chart Tools       Y         Y Max:       120         120       (μA)         X Window:       120         Y Prev. I Term (15.87)       24 -         Zoom (last 100       points)	diw/dt (μA/s): -0.0092		
Chart Tools       Y Max:       120       (μA)         Y Max:       120       (μA)         X Window:       120       (s)         Zoom (last 100       points)       24 -	Port: A 3/3 Oxidation	₹ <u>72</u>	
Y Max: 120 → (µA) → 10 X Window: 120 → (s) V Prev. I Term (15.87) Zoom (last 100 → points)	Chart Tools	¥ <sup>1</sup> 0 48	
✓ Window.         120         ✓ (s)         24 -           ✓ Prev. I Term (15.87)         ✓ Zoom (last 100 → points)         ✓	Y Max: 120 😴 (µA)		
✓ Prev. Term (15.87) ✓ Zoom (last 100 → points)	∧ window. 120 (s)	24	
	Toom (lost 100 A points)		
2/4.5 294.5 314.5 334.5 354.5 3/4.5 394.5 Save Plot Data to File	Save Plot Data to File	Z74.5 294.5 314.5 334.5 354.5 374.5 Time (e)	394.5
		(2)	
Current Status: 2018/11/23/10:53:11: User Terminated Operation	Current Status: 201	18/11/23/10:53:11: User Terminated Operation	



5.0 Settings

The Settings tab can be used to update the PeCOD date and time, change the working COD range, and adjust PeCOD parameters.

- 1. To update the PeCOD date and time to the PC time, select **Update** under the Date/Time Parameter header.
- 2. To change the COD working range, click on the drop-down menu beside **Reagent Pack**, and select the desired COD range. Then click **Update**.
- 3. To reset the PeCOD parameters, refer to 7.4.2 Uploading PeCOD Parameters in PeCOD Pro<sup>™</sup>.

MANTECH PeCOD® Pro v1.3.6.12
File Utilities Help
USB COMM.       Info         Port       COM6         Disconnect       Analyses: 228   Calibrations: 115         Start Date: N/A       Current Status:         QREEN       Collocation
AutoQC QC Report Sample Sample Report Live Plot Settings Logs
Get parameters from PeCOD Load from File Save to File
Common Parameters All Parameters
Date/Time Parameter         PecOD:         2018/11/21 14:53:20         PC:         2018/11/21 14:20:10         Update         Target Iterm:         20.0
Reagent Pack Update
Precision:       PRECISE       Dilution Ratio: 2.000 Reference COD: 120.0 Over-range Multiplier: 2.00 Pre-Burn Time: 500 Burn Time: 500 Burn Time: 60       Unit Serial #: MT-0A0-0000
Current Status: 2018/11/21/12:13:03: COM OPEN





6.0 Logs

The **Logs** tab can be used to load, save, and erase data from the PeCOD. Calibration, sample, and error code data is stored in the peCOD and must be erased regularly to prevent the internal storage space from filling up. It is recommended to erase peCOD data each time the sensor is changed.

To load data from the PeCOD:

- 1. Go to the drop-down window below **PeCOD Logs** and select **Primary Logs**. Primary Logs refers to all sample analysis and QC Check data.
- 2. Click on **Get Logs from PeCOD**. A table of data should populate at the bottom of the window.
- 3. To save the Primary Logs from the peCOD, click on **Save Table to CSV File**, and save the files to the desired location.

S MANTECH PeCOD® Pro v1.3.6.12											
File Utilities Help											
USB COMM.       Info         Port       COM6         Disconnect       Analyses: 228   Calibrations: 115         Start Date: N/A       Current Status:         2018/11/21/12:13:03: COM OPEN       Enter         Calibrate       Analyze								Ax3 Bx3 Bx3			
AutoQC QC Re	eport Sampl	e Sample Report I	Live Plo	t Settings L	.ogs						
Copy to Clipt Save to Fil Clear Status	2018 2018 2018 2018 2018 2018 2018 2018	//11/21/12:12:59: Oper //11/21/12:13:00: COM //11/21/12:13:00: Requ //11/21/12:13:03: Got e	ning ser 16 conne uesting j expected	ial connection acted parameters fro d response to	at COM6 om PeCOD parameter	to verify c fetch requ	onnectior Jest.	l.			E E
PeCOD®Logs	1.		2.			1		3			
Primary Logs		Get Logs from PeC	0D®	Clear Logs fr	om PeCOD	® Sav	ve Table t	o CSV File	Сору	Table to Clip	board
Replicate	Sample	Date/Time	Fluid	Mode	Qnet	COD	SD	BOD	Qtotal	Duration	ltei 📤
1	1	2018/03/23 09:14:32	83	49	1257.89	464.43	0.00	-1.00	5418.3	240.0	17.:
1	2	2018/03/23 09:36:13	83	49	1640.11	698.72	0.00	-1.00	5860.3	240.0	17.
1	3	2018/03/23 12:07:51 83 49		49	2136.55	1277.12	0.00	-1.00	7299.0	240.0	21.
1	4	2018/03/26 13:20:37 83 49		49	1865.01	1084.71	0.00	-1.00	6585.3	240.0	19.6
1 5 2018/03/27 08:49:44 83 49 1924 82 1181 69 0.00 -1.00 6902 9 240 0 20 · · ·											
Current Status: 2018/11/21/12:13:03: COM OPEN											

- 4. To erase the Primary Logs from the peCOD memory storage, click on **Clear Logs from PeCOD**.
- 5. Repeat Steps 1 to 4 with each of the peCOD Logs: **Secondary Logs**, **Calibration Logs**, and **Event Logs**. Note, loading the Secondary Logs may take a few minutes as it contains more data.
- 6. **IMPORTANT STEP**: After erasing the peCOD Logs, power the peCOD off and on again, using the power button on the peCOD screen.
- 7. Reconnect to PeCOD Pro<sup>™</sup> and proceed with calibrations or analyses. Note, erasing the calibration logs may require the peCOD to be recalibrated prior to sample analysis.



#### 7.0 Troubleshooting

#### 7.1 Failed Calibration

If the pop-up window displays FAIL after performing a QC Regime, click **OK**, to close the window, and follow the steps below:

- 1. Navigate to the **QC Report** tab.
- 2. Examine the calibration values on the latest calibration and QC Check and verify if they're within the COD range-specific passing criteria listed in Table 2: Passing calibration criteria for each COD range. If the M and/or C values are outside the passing criteria and the sensor has been used for approximately one month, or greater than 150 samples, the sensor may be expired. Install a new sensor and perform the 2.2.1 Startup (New Sensor).
- 3. If the values are within the range specified in Table 2: Passing calibration criteria for each COD range, proceed to 7.6 Restoring the QC Regime Criteria to Default and then reattempt the Startup (Daily), following the steps from 2.2 Software Setup.
- 4. If the M and C values are outside the passing criteria, but the sensor is less than one month old and has analyzed less than 150 samples, remake the pre-mixed blank and pre-mixed calibrant solutions. Improper mixing and contamination of peCOD reagents can lead to failed calibrations and QC Checks.
- 5. Ensure that the reagent bottles have enough solution for the tubing to be submerged, and that no air is within the tubing.
- Ensure there is no clogging or partial clogging within the PeCOD. Verify that each prime of Port A or Port B is between 1.8 and 2.5 mL. If the prime volume is less than 1.8mL or air remains within the tubing after priming each port 3 times, proceed to 7.3 Removing Blockages within the PeCOD<sup>®</sup> COD Analyzer.

MANTECH PeCOD® Pro v1.3.6.12											
File Utilities Help											
USB COMM. Info Manual Control											
Port COM6 - Ser	rial #: MT-0 rent Sensor	A0-000	)0 Up	date S	ensor	Men	u	Exit	Ready		
Disconnect A	Analyses: 22	8   Cali	brations	: 115							AXI AXS
S	Start Date: N	/A					1	▼ ►			Bx1 Bx3
Connected	rent Status:	0.15.0									
ADV.BLUE 201	0/11/21/12:0	U: 15: C		EIN			E	nter	Calibrate	Analyze	Ax3 + Bx3
Autoon OC Papert o					l our						
AutoQC QC Report Sa	imple   Sam	ріе ке	port   Li	ve Plo	t   Settin	igs   Lo	gs				
Cal_20181113_141912	- Loa	d from	File	Save	e to File					Generate R	eport (printable)
Edit Table Layout	Sa	ive Cur	rent Lay	outas	Default			Copy Table to	Clipboard	Save Tab	le to CSV File
Date/Time Ty	ре	М	С	LED	COD	Qnet	lterm	Error Descrip	tion		
2018/11/16 12:20:58 Cal:	:Blank	-	123.88	21.5	-	123.88	12.87	No descriptio	n available.		
2018/11/16 12:24:54 Cal:	:Reference	0.033	-	21.5	-	584.88	12.29	No descriptio	n available.		
2018/11/16 12:33:05 Cal:	:Blank	-	129.34	33.5	-	129.34	18.70	No descriptio	n available.		
2018/11/16 12:37:01 Cal:	Reference	0.033	-	33.5	-	587.15	18.20	No descriptio	n available.		
2018/11/16 12:44:00 QC-	-Check	-	-	-	19.23	569.51	17.97	No descriptio	n available.		
Current S	Status: 2018/1	1/21/12	:00:15: C		IN						
							_	_	_		



7.2 PeCOD Error During Calibration or Sample Analysis

System errors are reported and stored in the event log. The following table lists the error codes and description of possible causes, as well as suggested actions to rectify the error. Error codes are reported as: (Error Group).(Sub Code) eg. "2.1".

Error Group	Sub Code	Name	Description of Problem	Suggested actions
2	1	Terminated by User	The exit button on the PeCOD display was selected	<ul> <li>Error indicating the user has terminated the current analysis.</li> <li>If the error is generated when using MANTECH software, the time delay set for sample analysis is too short which is causing the analysis to be interrupted. Contact MANTECH or your local MANTECH distributor for assistance in increasing the time delay.</li> </ul>
2	2	Sensor Uncalibrated	Error indicating the sensor is not calibrated	• Run new sensor routine or run calibration.
3	1	COD out of Range	Sample concentration is too high.	<ul> <li>Dilute original sample with COD free water and re-mix with electrolyte (remember to multiply this dilution factor to obtain the final COD value).</li> <li>Alternatively, switch to using a different range electrolyte and re-prepare your sample. Note: you will need to recalibrate in the new range.</li> </ul>
3	2	Reference < Blank	Reference (calibrant) solution charge obtained is less than zero solution.	• Check that calibrant solution is correctly mixed with electrolyte and re-calibrate.
3	3	COD Less Than Blank	COD result is less than the blank solution.	<ul> <li>Check that sample is mixed with electrolyte in proper ratio and that lines are primed.</li> <li>Check blank solution for contamination.</li> <li>Sample may be below the operating range. Switch to a lower range (e.g. blue), re-calibrate and then re-run sample</li> </ul>
3	4	Failure Qnet < Zero	Resultant charge is too low (i.e. not enough signal detected)	<ul> <li>Ensure that sample is mixed with electrolyte in proper ratio and lines are primed.</li> <li>Check electrical contacts between the connection pins on analyser board with the electrode block. Very gently clean using isopropanol and a lint free cloth.</li> <li>If the above do not rectify the problem, the sensor or electrode block may need to be replaced.</li> </ul>
7	1	Pump failure	Pump error	<ul> <li>Prime lines, and check sufficient solution is being expelled from the analyser. If this does not rectify the problem, please contact MANTECH or your local MANTECH authorised representative.</li> </ul>



Error Group	Sub Code	Name	Description of Problem	Suggested actions
7	2	Pump did not initialize	Pump error	<ul> <li>Prime lines, and check sufficient solution is being expelled from the analyser. If this does not rectify the problem, please contact MANTECH or your local MANTECH authorised representative.</li> </ul>
8	4	Sol'n not Presented	User did not press enter upon system prompt.	<ul> <li>Restart calibration and ensure to press enter within 6 minutes after prompt to avoid timeout.</li> </ul>
11	2	Analyser Lid Open	Lid is open or not securely latched.	Make sure analyser lid is closed and correctly secured via the front latch.
11	4	V <sub>aux</sub> out of range	Auxiliary voltage is over range	<ul> <li>Make sure there are no bubbles present in the line; prime lines, and then re-run analysis.</li> <li>Check electrical contacts between the connection pins on analyser board with the electrode block. Very gently clean using isopropanol and a lint free cloth.</li> <li>Upload the peCOD parameters to ensure default parameter values are set; update the peCOD to the working COD range after loading default parameters.</li> <li>If the above do not rectify the problem, replace the sensor and reattempt calibration.</li> </ul>
11	6	I <sub>work</sub> out of range	Current is over-range	<ul> <li>Make sure there are no bubbles present in the line; prime lines, and then re-run analysis.</li> <li>Check electrical contacts between the connection pins on analyser board with the electrode block. Very gently clean using isopropanol and a lint free cloth.</li> <li>Upload the peCOD parameters to ensure default parameter values are set; update the peCOD to the working COD range after loading default parameters.</li> <li>If the above do not rectify the problem, replace the sensor and reattempt calibration.</li> </ul>
11	9	LED Over Current	Occurs during normalization step of calibration. Too much current was applied to LED to obtain desired baseline.	<ul> <li>Make sure there are no bubbles present in the line; prime lines, and then re-run analysis.</li> <li>Ensure that the solutions are mixed with electrolyte in appropriate ratios and the PeCOD is set to the correct operating range.</li> <li>Check electrical contacts between the connection pins on analyser board with the electrode block. Very gently clean using isopropanol and a lint free cloth.</li> </ul>



Error Group	Sub Code	Name	Description of Problem	Suggested actions
11	10	FIFO Overrun	Too much processor activity	<ul> <li>Erase logs, power cycle the PeCOD, and re-run sample.</li> <li>If the calibration logs are erased, the PeCOD will require re-calibration; to avoid re-calibrating, erase only the Primary and Secondary Logs.</li> <li>If error occurs on a calibration, erase all logs.</li> </ul>
11	14	COD Out of Range	The COD concentration is too high to report in the working COD range.	<ul> <li>Dilute original sample with COD free water and re-mix with electrolyte (remember to multiply this dilution factor to the final COD value).</li> <li>Alternatively, switch to using a higher range electrolyte and re-prepare the sample. Note: the peCOD will require recalibration in the new COD range</li> </ul>
11	15	Incomplete oxidation	The sample concentration may be too high (sample oxidation did not complete)	<ul> <li>Dilute original sample with COD free water and re-mix with electrolyte (remember to multiply this dilution factor to the final COD value).</li> <li>Alternatively, switch to using a higher range electrolyte and re-prepare the sample. Note: the peCOD will require recalibration in the new COD range</li> </ul>
14	1	Burn-in Failed	System failed to stabilize.	<ul> <li>Try to re-calibrate or re-run sample.</li> <li>If the problem persists, a new sensor may be required.</li> </ul>

<u>Additional Error Codes</u> may appear when an internal communication error occurs. These errors will typically prompt the user to "Refer to Manual". Most often the error can be cleared by attempting to re-run the sample. Erasing all logs may also be necessary. Internal communication error codes may include (but are not limited to) codes:

0.1, 2.27, 8.2, 8.3, 9.1, 9.2, 10.1, 10.2, 11.1, 13.1, 13.2, 102.2, 203.1, 203.2, 204.1, 205.1, 205.2, 205.3, 205.4, 211.7, 215.1

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#### 7.3 Removing Blockages within the PeCOD® COD Analyzer

Samples with suspended solids can sometimes cause blockages in the PeCOD<sup>®</sup> COD Analyzer. The peCOD method only oxidizes dissolved organics; therefore, it is suggested to filter samples before analysis.

If there is no solution flowing from the waste port when priming Port A, there is likely an internal blockage within the fluidics path. Follow the instructions below to back flush the lines and clear the electrode block.

NOTE: If priming Port B does also not result in solution flowing from the waste port and/or you cannot hear the pump turning on, the blockage may be deeper into the fluidics which may require service from a MANTECH representative.

#### **General Checks**

- 1. Open the PeCOD lid and remove the sensor.
- 2. Look at the back of the sensor all 3 holes should be completely clear and not partially obscured by the white rubber seals. (Example of a good sensor shown below).



3. Ensure that the electrode block is sitting flat in the analyzer block. If not, remove the 4 thumbscrews and make sure the 3 o-rings are seated at each port. When installing the electrode block back into the analyzer, ensure that each screw is tightened evenly.



#### **Back-flushing Port A**

You will require a syringe fitted with a modified 200uL pipette tip to perform this operation. These have been provided with the PeCOD system, part number PQA-85014.

- 1. Fill the syringe with DI water, and attach the narrowest pipette tip.
- 2. Open the PeCOD lid and remove the sensor. Place Port A tubing into a waste container as shown below.

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3. Insert the syringe into the hole shown below. The tip should fit snuggly into the hole so that no air gets in.



- 4. Go into MENU/OPERATION/PRIME LINES/PRIME PORT A. Press ENTER, and at the same time gently push on the plunger of the syringe. You must prime Port A to open the valves of the internal fluidics path. Observe the flow of water out of the Port A tube. Stop pushing the plunger when you hear the pump stop.
- 5. Repeat step 4 a few times to ensure the flow out of Port A is strong.
- 6. If there is no solution coming out the waste port while priming Port B, the same process can be repeated by selecting prime Port B instead of Port A. Use the same hole for the syringe tip, as shown in the picture above.

NOTE: This operation back-flushes fluid lines between the sensor inlet and Port A, which is the most likely place for particles to be lodged. This back-flushing procedure usually clears any blockages. A flow of water out of Port A during this operation indicates this part of the fluid path is clear. Verify this by placing the Port A line into a beaker of water and attempting to prime as usual. If this does not clear the blockage, continue to the next section.

#### Flushing the Electrode Block

- 1. With a lint-free tissue wipe the top of the block to remove any liquid. If there are white salt deposits on the electrode block, gently wipe them off with lint-free tissue that has been dampened with DI water.
- 2. Remove the electrode block by unscrewing the 4 thumbscrews.
- 3. Observe the 3 fluid ports on the underside of the electrode block.
- 4. Fill a syringe with DI water and attach the larger pipette tip. Insert the tip into each hole to flush out the port.
- 5. Ensure there is a strong flow in both directions. Note that two of the ports are "straight through" and one is an "Internal Channel".

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If these procedures do not result in a steady flow of solution from the waste port during priming operations, please contact a MANTECH representative for assistance.

#### 7.4 Resetting PeCOD Parameters to Default

#### 7.4.1 Downloading peCOD Parameters in PeCOD Pro™

1. After connecting to the PeCOD, navigate to the **Settings** tab. Next, select **Get parameters from PeCOD** then select **Save to File.** 

C MANTECH PeCOD® Pro v1.3.6.12
File Utilities Help
USB COMM.       Info         Port       COM6         Disconnect       Analyses: 228   Calibrations: 115         Start Date: N/A       Current Status:         Q018/11/21/12:13:03: COM OPEN       Enter         Calibrate       Analyze
AutoQC   QC Report   Sample   Sample Report   Live Plot   Settings   Logs
Get parameters from PeCOD Load from File Save to File
Common Parameters All Parameters
PeCOD:         2018/11/21         PC:         2018/11/21         14:20:10         Update         Target Iterm:         20.0         Image: Control of the control of
Reagent Pack Update
Precision:       PRECISE       Dilution Ratio: 2.000         Reagent Pack:       GREEN       Dilution Ratio: 2.000         No. Burn Time: 500       Dire-Burn Time: 500         Burn Time: 500       Burn Time: 60
Current Status: 2018/11/21/12:13:03: COM OPEN

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- 2. Give the file a unique name containing "Parameters" and save.
- 3. The PeCOD can now be used. Send the files to a MANTECH support member to facilitate troubleshooting, if required.

C Load PeCOD Parameters fr	om File	A	
🚱 🗢 📕 🕨 PeCOD pa	arameters 🗸	✓ Search PeCOD	parameters 🔎
Organize 🔻 New folde	:r	-	= • <b>]</b> 🔞
★ Favorites	Name	Date modified	Туре
Desktop	PeCOD_Parameters.peconfig	10/12/2018 11:48	PECONFIG File
Downloads     Recent Places			
Creative Cloud Fi			
ConeDrive			
🕞 Libraries			
Documents			
👌 Music			
Pictures			
Videos			
🖳 Computer 📼	٠		
File na	ime:	PeCOD Param F	iles (*.peconfig 🔻
		Open 😽	Cancel

7.4.2 Uploading PeCOD Parameters in PeCOD Pro™

After connecting to the PeCOD, navigate to the Settings tab. Then select Load from File....

MANTECH PeCOD® Pro v1.3.6.12	
USB COMM Port COM6 Disconnect Connected GREEN Info Serial #: MT-0A0-0000 Current Sensor: 0 Update Sensor Update Sensor Update Sensor Current Status: 2018/11/21/12:13:03: COM OPEN	Manual Control     Prime       Menu     ▲     Exit       Code = 200 8     Ax1       Ax1     Ax3       Bx1     Bx3       Enter     Calibrate       Analyze     Ax3 + Bx3
AutoQC       QC Report       Sample       Sample Report       Live Plot       Settings         Get parameters from PeCOD       Load from File	0 Update Target Iterm: 20.0 *
Reagent Pack Precision: PRECISE Dilution Ratio: 2 000 Reference COD: 120.0 Over-range Multiplier: 2 00 Pre-Burn Time: 500 Burn Time: 500 Burn-In Time: 60	Update Unit Serial #: MT-0A0-0000 Update Update
Current Status: 2018/11/21/12:13:03: COM OPEN	

- 1. Select the **PeCOD\_Parameters.peconfig** (or similar name) file supplied on the MANTECH USB or from a MANTECH support team member, and then **Open**.
- 2. The parameters in this file will be uploaded to the PeCOD. This may take several seconds. Once complete, the Serial number may need to be corrected. Press the **Update** button under the **Unit Serial #** header, and enter the number as shown on the back of the PeCOD, if applicable.

C.COM

OPTIMIZE YOUR RESULTS. PROTECT OUR ENVIRONMENT.	MANTECH-IN
AutoQC QC Report Sample Sample Report Live Plot Settings Logs	
Get parameters from PeCOD Load from File Save to File	
Common Parameters All Parameters	
Date/Time Parameter	
PeCOD: 2018/11/21 14:53:20 PC: 2018/11/21 14:20:10 Update	Target Iterm: 20.0
Reagent Pack	Update
Precision:       PRECISE       Dilution Ratio: 2.000         Reagent Pack:       GREEN       Over-range Multiplier: 2.00         Pre-Burn Time: 500       Update         Min. Burn Time: 100       Burn Time: 500         Burn Time: 60       Burn Time: 60	Unit Serial #: MT-0A0-0000 2. Update
Current Status: 2018/11/21/12:13:03: COM OPEN	

3. If required, select the appropriate Reagent Pack for the range of your samples (Advanced Blue, Green, Yellow or Red), followed by **Update.** To save these settings, select **Save to File...**.

4.	The PeCOD time must also be updated by selecting the Update button under the Date/Time Parameter hea	ider.

MANTECH PeCOD® Pro v1.3.6.12	
File Utilities Help	
USB COMM. Port COM6 Disconnect Connected GREEN Info Serial #: MT-0A0-0000 Current Sensor: 0 Analyses: 228   Calibrations: 115 Start Date: N/A Current Status: 2018/11/21/12:13:03: COM OPEN	Manual Control       Menu       Exit       Ready Code = 200.8 Refer To Manual 2018/11/21 13:55:08▼       Prime         Image: Control International
AutoQC QC Report Sample Sample Report Live Plot Sett	ings Logs
Get parameters from PeCOD Load from File	Save to File
Common Parameters All Parameters	
Date/Time Parameter <b>PeCOD</b> : 2018/11/21 14:53:20 <b>PC</b> : 2018/11/21 14:	20:10 Update 4. Target Iterm: 20.0
Reagent Pack	Update
Precision:       PRECISE       Dilution Ratio: 2.000         Reagent Pack:       GREEN       Over-range Multiplier: 2.         Pre-Burn Time: 500       Min. Burn Time: 100         Burn Time: 500       Burn Time: 60	00 Update Unit Serial #: MT-0A0-0000 3. Update
Current Status: 2018/11/21/12:13:03: COM OPEN	

5. The PeCOD can now be used for normal operation.





#### 7.4.3 Restore to Factory Diagnostic Values in PeCOD Pro™

Warning!: Parameters must be reset after this procedure. Refer to 7.4.2 Uploading PeCOD Parameters in PeCOD Pro<sup>™</sup>, prior to using the PeCOD after restoring Factory Diagnostic settings.

PeCOD Pro<sup>™</sup> has a built-in function to return the factory diagnostic settings. This clears a variety of internal settings, but also resets the parameters to their factory settings. This is a useful function to recover from certain error states but the parameters which are populated, will not be the current recommended parameters. As such, after using the factory diagnostic reset, the parameters should be updated to the most recent "good set".

- 1. Select the **Settings** tab, and then the **All Parameters** sub-tab.
- 2. Click "Restore to Factory Diagnostic Values" button. A message will appear to confirm the action. Press OK and the action will occur.
- 3. Follow the instructions from 7.4.2 Uploading PeCOD Parameters in PeCOD Pro<sup>™</sup> to upload a "good" set of parameters.

AutoQC QC	Repo	ort Sample	Sample Report Live Plot Settings Logs
Get para	ameter	s from PeCOE	) Load from File Save to File
Senc	'arame I to Pe	COD	Restore to Factory Diagnostic Values
Туре	#	Name	
controller	0	CRC	Restore to Default?
controller	1	Saved by V	
controller	2	Unit Addres	Are you sure you want to restore to default?
controller	3	Model	This will return the PeCOD settings to their factory diagnostic state. The
controller	4	Serial #	parameters will need to be updated after this operation for the PeCOD to run
controller	5	Diagnostic	properly.
controller	6	LCD Viewing	
controller	7	LCD Light Ti	OK Cancel
<u>، ،</u>	-	l	

#### 7.5 Applying a Hard Reset

After applying a hard reset to the PeCOD, the PeCOD parameters must be reset! Refer to 7.4.2 Uploading PeCOD Parameters in PeCOD Pro<sup>™</sup>, prior to using the PeCOD after a hard reset.

- 1. Disconnect the USB cord between the PeCOD and computer.
- 2. Rotate the PeCOD so that the back is facing forward.
- 3. Lift the top flap on the back of the PeCOD. In the compartment below the flap is a connection for the optional battery and reset button.



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- 4. With the PeCOD plugged into power, hold down the reset button for 1 second.
- 5. Upon releasing the reset button, a beep should sound and the PeCOD will power on.
- 6. Proceed with 7.4.2 Uploading PeCOD Parameters in PeCOD Pro™.

#### 7.6 Restoring the QC Regime Criteria to Default

The QC Regime passing criteria, as well as behaviour (number of repetitions/reattempts, etc) can be customized by the user. To restore these behaviours to the default value:

- 1. Select **File** and **Preferences** from the top left corner of the PeCOD Pro<sup>™</sup> window.
- 2. Select QC Passing Criteria.
- 3. Ensure the correct COD Range is selected, and then click Restore Range to Default.

	Preferences	
2.	General QC Passing Criteria - YELLOW	QC Regimes Time Estimates
	QC Passing Criteria	
3.	COD Range YELLOW - F	Restore Range to Default
	Calibration C: 200	0 A to 750 A uC
	Calibration M: 0.0	
	Calibration Itorm:	
	QC Check COD: 115	50 😴 to 1250 🤤 COD

- 4. Select QC Regimes.
- 5. Select the Startup (Daily) tab.
- 6. Select **Restore All to Default**.

	Preferences					
4.	General QC Passing Criteria - YELLOW QC Regime	es Time Estimates				
5.	Startup (Daily) Startup (New Sensor) QC Routine					
	STAGE A: Initial Calibration	STAGE A: Passing Criteria				
	Calibrate: 3 🚔 times at max.	Does not Result in Error				
	Evaluate results on and after #: 2	M within range: 0.02 - 0.06				
	If no cal. passes: END REGIME: FAIL	C within range: 200 - 750				
	On first passing: continue to STAGE B	I greater than: 14				
	STAGE B: Intial Calibrant Readback	STAGE B: Passing Criteria				
	Readback Calibrant 1 🚔 times at max.	Does not Result in Error				
	Evaluate results on and after #: 1	COD within range: 1150 - 1250				
	If no readback passes: continue to STAGE C					
	On first passing: END REGIME: PASS					
	STAGE C: Re-Calibration	STAGE C: Passing Criteria				
	Calibrate: 1 🚔 times at max., evaluate all	Does not Result in Error				
	If no cal. passes: END REGIME: FAIL	M within range: 0.02 - 0.06				
	On first passing: continue to STAGE D	✓ C within range: 200 - 750				
		I greater than: 14				
	STAGE D: Re-Calibrated Calibrant Readback	STAGE D: Passing Criteria				
	Readback Calibrant 1 🚔 times at max.,	Does not Result in Error				
	evaluate all	COD within range: 1150 - 1250				
	If no readback passes: END REGIME: FAIL					
6.	On first passing: END REGIME: PASS	Restore All to Default				
	1	OK Cancel				

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#### 7. Select the Startup (New Sensor) tab.

General QC Passing Criteria - Red QC Regimes	
Startup (Daily) Startup (New Sensor) QC Routine	
STAGE A: Initial Calibration         Calibrate:       4       itimes at max.         Evaluate results on and after #:       4       *         If no cal. passes:       END REGIME: FAIL       -         -OR -       On first passing: continue to STAGE B         STAGE B: Initial Calibrant Readback         Readback Calibrant:       1       *         If no readback passes: continue to STAGE C       -       -         -OR -       On first passing: continue to STAGE C       -         -OR -       -       On first passing: END REGIME: PASS	STAGE A: Passing Criteria Does not Result in Error M within range: 0.02 - 0.06 C within range: 250 - 800 I greater than: 14 STAGE B: Passing Criteria Does not Result in Error COD within range: 11500 - 1250
STAGE C: Re-Calibration Calibrate: 1 💮 times at max., evaluate all If no cal. passes: END REGIME: FAIL - OR - On first passing: continue to STAGE D	STAGE C: Passing Criteria Does not Result in Error M within range: 0.02 - 0.06 C within range: 250 - 800 I greater than: 14
STAGE D: Re-Calibrated Calibrant Readback Readback Calibrant 1 🔄 times at max, evaluate all If no readback passes: END REGIME: FAIL - OR - On first passing: END REGIME: PASS	STAGE D: Passing Criteria Construction Does not Result in Error COD within range: 11500 - 1250 Restore All to Default

- 8. Select Restore All to Default.
- 9. Select the **QC Routine** tab.
- 10. Select Restore All to Default.
- 11. Select **OK** to close the window and return to the main screen.

Startup (Daily) Startup (New Sensor) & Routine	
Readback Calibrant 1 Times at max	V Does not Result in Error
Evaluate results on and after #: 1 = If no readback passes: continue to STAGE B - OR - On first passing: END REGIME: PASS	COD within range: 11500 - 12500
STAGE B: Re-Calibration	STAGE B: Passing Criteria
If no cal. passes: END REGIME: FAIL	Does not Result in Error
-OR-	C within range: 250 - 800
On inst passing, continue to STAGE C	✓ I greater than: 14
STAGE C: Re-Calibrated Calibrant Readback	STAGE C: Passing Criteria
Readback Calibrant 1 🚔 times at max.	Does not Result in Error
If no readback passes: END REGIME: FAIL	COD within range: 11500 - 12500
On first passing: END REGIME: PASS	Restore All to Default



#### 8.0 Solution Preparation

This section outlines the solution preparation required to operate the PeCOD.

#### 8.1 COD Solution Preparation Instructions

Select the appropriate electrolyte for your COD range. Blank, Calibrant and Sample solutions must be mixed with the same color electrolyte, and in specified ratios:

		Mixing Ratio		
RANGE	Expected COD Concentration (mg/L)	Blank, Calibrant, or Sample	Electrolyte	
ADVANCED BLUE	<25 Drinking Water	3	1	
GREEN	<150	1	1	
YELLOW	<1,500	1	9	
RED	< 15,000	1	49	

RANGE Blank Solution (500mL)		Calibrant Solution (~250mL)	Sample (recommend ~20mL per analysis)	
	375mL DI Water	180mL Original Calibrant	15mL Sample	
ADVANCED BLUE	+	+	+	
	125mL Blue Electrolyte	60mL Blue Electrolyte	5mL Blue Electrolyte	
	250mL DI Water	125mL Original Calibrant	10mL Sample	
GREEN	+	+	+	
	250mL Green Electrolyte	125mL Green Electrolyte	10mL Green Electrolyte	
	50mL DI Water	25mL Original Calibrant	2mL Sample	
YELLOW	+	+	+	
	450mL Yellow Electrolyte	225mL Yellow Electrolyte	18mL Yellow Electrolyte	
	10mL DI Water	5mL Original Calibrant	0.5mL Sample	
RED	+	+	+	
	490mL Red Electrolyte	245mL Red Electrolyte	24.5mL Red Electrolyte	

#### 8.2 Allowable COD/Chloride Concentration Combinations for peCOD Analysis

High chloride can interfere with both the dichromate and peCOD techniques. While the dichromate method makes use of the hazardous compound mercuric sulfate to bind chloride, the peCOD method employs a special "doping" effect in the sensor to reduce its sensitivity to the ion. There are still limitations; therefore, to reduce its effect on peCOD analysis, ensure that, after dilution with electrolyte, the chloride concentration is <200mg/L. This means that the allowable chloride concentration of the original sample varies depending on the COD range (outlined in the chart below). If necessary, do a pre-dilution of sample with deionized water before mixing with electrolyte.

Note that the central sensor element of a chloride-tolerant sensor appears black in color. A white sensor element indicates that the sensor has lost some/all chloride tolerance, even if the sensor is passing calibrations. To test whether a sensor has lost its chloride tolerance, one may wish to spike a known COD standard with a chloride solution to check recovery.





Recommended COD/[Cl-] Combinations for peCOD analysis. The coloured regions indicate the allowed combinations of COD & [Cl-] for the different measurement ranges. The grey region indicates those combinations of COD & [Cl-] that are not suitable for analysis by peCOD without prior pre-dilution.

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## 8.3 PeCOD Dilution Charts for Sample Preparation

Please consult the subsection of the appropriate range.

#### 8.3.1 Advanced Blue Range

Dilution	Volume (mL)			
Factor (D.F.)	Sample	COD-Free Water**	Electrolyte	Total
1	15.0	0.0	5.0	20.0
2	*7.5	*7.5	5.0	20.0
3	5.0	10.0	5.0	20.0
5	*3.0	12.0	5.0	20.0
6	*2.5	*12.5	5.0	20.0
7.5	*2.0	13.0	5.0	20.0
15	*1.0	14.0	5.0	20.0

\*It is recommended to use a 1mL variable pipette for measuring volumes less than 4mL.

\*\*Ensure that dilution water is free of COD, i.e. deionized, distilled, or ultrapure.

The ratio of sample to electrolyte must be 3:1, for Advanced Blue Range. For example, if 15mL of sample are used, 5mL of electrolyte must be added to the sample, for a total of 20mL.

Dilution Factor = Total Volume / Initial Volume For example, when Dilution Factor = 2 2 = 7.5 mL of sample/Total Volume Volume total = 7.5 ml \* 2 Volume total = 15 mL Volume of COD\_Free Water = Volume total - Sample Volume Volume of COD\_Free Water = 15 mL - 7.5 mL Volume of COD\_Free Water = 7.5 mL

When performing dilutions, the **total sample volume** is the **volume of sample** plus the **volume of COD-free water**. For example, when preparing a 2x dilution, pipette 7.5mL of sample and 7.5mL of COD-free water (for 15mL of total sample), then mix with 5mL of electrolyte for a total volume of 20mL.

Ensure samples are well mixed with the electrolyte prior to running analysis. To calculate the final COD result, multiply the COD value by the D.F., or include the D.F. in the setup of the sample tab, following the steps in 3.3 Software Setup.

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8.3.2 Green Range

Dilution	Volume (mL)			
Factor (D.F.)	Sample	COD-Free Water**	Electrolyte	Total
1	10.0	0.0	10.0	20.0
2	5.0	5.0	10.0	20.0
4	*2.5	*7.5	10.0	20.0
5	*2.0	8.0	10.0	20.0
10	*1.0	9.0	10.0	20.0

\*It's recommended to use a 1mL variable pipette for measuring volumes less than 4mL.

\*\*Ensure that dilution water is free of COD, i.e. deionized, distilled, or ultrapure.

The ratio of sample to electrolyte must be 1:1, for Green Range. For example, if 10mL of sample are used, 10mL of electrolyte must be added to the sample, for a total of 20mL.

Dilution factor = Total Volume / Initial Volume For example, when Dilution Factor = 2 2 = Total Volume/5 ml Volume total = 2 \* 5 ml Volume total = 10 mL Volume of COD\_Free Water = Volume total - Sample Volume Volume of COD\_Free Water = 10 mL - 5 mL Volume of COD\_Free Water = 5 mL

When performing dilutions, the **total sample volume** is the **volume of sample** plus the **volume of COD-free water**. For example, when preparing a 2x dilution, pipette 5mL of sample and 5mL of COD-free water (for 10mL of total sample), then mix with 10mL of electrolyte for a total volume of 20mL.

To calculate the final COD result, multiply the COD value by the D.F., or include the D.F. in the setup of the sample tab, following the steps in 3.3 Software Setup.



8.3.3 Yellow Range

Dilution	Volume (mL)				
Factor (D.F.)	Sample	COD-Free Water*	Electrolyte	Total	
1	2.0	0.0	18.0	20.0	
2	1.0	1.0	18.0	20.0	
3	0.5	1.0	13.5	15.0	
4	0.5	1.5	18.0	20.0	
5	0.4	1.6	18.0	20.0	
10	0.2	1.8	18.0	20.0	

\*Ensure that dilution water is free of COD, i.e. deionized, distilled, or ultrapure.

Note, the volumes for DF =3, uses 13.5mL of electrolyte, which is not the set volume on the dispense pump. To do a 3x dilution, pipette the 13.5mL of electrolyte, or reset the dispense pump to 13.5mL. Return the dispense to 18mL after finishing sample preparation to prevent mixing ratio issues for the next use.

The ratio of sample to electrolyte must be 1:9, for Yellow Range. For example, if 2mL of sample are used, 18mL of electrolyte must be added to the sample, for a total of 20mL.

 $\begin{array}{l} \text{Dilution factor} &= \frac{\text{Total Volume}}{\text{Initial Volume}}\\ \text{For example, when Dilution Factor} &= 2\\ 2 &= 1\text{mL of Total Volume/Initial Volume}\\ \text{Volume total} &= 2 * 1 \text{ ml}\\ \text{Volume total} &= 2 \text{ mL}\\ \text{Volume of COD_Free Water} &= \text{Volume total - Sample Volume}\\ \text{Volume of COD_Free Water} &= 2 \text{ mL} - 1 \text{ mL}\\ \text{Volume of COD_Free Water} &= 1 \text{ mL} \end{array}$ 

When performing dilutions, the **total sample volume** is the **volume of sample** plus the **volume of COD-free water**. For example, when preparing a 2x dilution, pipette 1mL of sample and 1mL of COD-free water (for 2mL of total sample), then mix with 18mL of electrolyte for a total volume of 20mL.

To calculate the final COD result, multiply the COD value by the D.F., or include the D.F. in the setup of the sample tab, following the steps in 3.3 Software Setup.

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8.3.4 Red Range

Dilution	Volume (mL)				
Factor (D.F.)	Sample	COD-Free Water*	Electrolyte	Total	
1	0.5	0.0	24.5	25.0	
2	0.5	0.5	49.0	50.0	
2.5	0.2	0.3	24.5	25.0	
5	0.2	0.8	49.0	50.0	
10	0.2	1.8	98.0	100.0	

\*Ensure that dilution water is free of COD, i.e. deionized, distilled, or ultrapure.

Note, the volumes for D.F. equal to 2, 5, and 10 use more electrolyte. If using the dispense pump set to 24.5mL; D.F. 2 and 5 require 2 pumps (49mL) and D.F. 10 requires 4 pumps (98mL).

The ratio of sample to electrolyte must be 1:49, for Red Range. For example, if 0.5mL of sample are used, 24.5mL of electrolyte must be added to the sample, for a total of 25mL.

 $\begin{array}{l} \text{Dilution factor} = \frac{\text{Total Volume}}{\text{Initial Volume}} \\ \text{For example, when Dilution Factor} = 2 \\ 2 = \text{Total Volume/0.5 ml} \\ \text{Volume total} = 2 * 0.5 ml \\ \text{Volume total} = 1 mL \\ \text{Volume of COD_Free Water} = \text{Volume total - Sample Volume} \\ \text{Volume of COD_Free Water} = 1 mL - 0.5 mL \\ \text{Volume of COD_Free Water} = 0.5 mL \\ \end{array}$ 

When performing dilutions, the **total sample volume** is the **volume of sample** plus the **volume of COD-free water**. For example, when preparing a 2x dilution, pipette 0.5mL of sample and 0.5mL of COD-free water (for 1mL of total sample), then mix with 49mL of electrolyte for a total volume of 50mL.

To calculate the final COD result, multiply the COD value by the D.F., or include the D.F. in the setup of the sample tab, following the steps in 3.3 Software Setup.



8.4 Sample Filtering Guide for peCOD Analysis

Samples must be filtered prior to peCOD analysis to ensure that no particulates greater than 50µm are primed into the PeCOD. Particulates larger than 50µm can cause clogging, which can lead to damage of the internal fluidics of the machine. For pulp and paper and wastewater applications, MANTECH recommends using a 35µm polyethylene (PE) syringe filter. These filters can contribute trace amounts of organics, which are negligible for wastewater applications. For drinking and source water applications it's important to use a filter that does not contribute organics to the filtered sample. One of MANTECH's research partners has recommended a 0.45µm polyethersulfone (PES) filter; however, other filter types may also be acceptable, if no organics are contributed by the filter. Since these applications traditionally see less particulates, having a smaller pore size filter hasn't shown an impact on the peCOD results.

To prevent clogging and damage, follow the steps below:

1. Gather the following supplies: 10mL syringes, 35µm PE syringe filters (or similar filter that doesn't contribute COD to the samples), sample tubes and lids, and the unfiltered samples.



2. Fill the syringe with the unfiltered sample. **Attach the filter** and ensure that it is fastened securily. Push the sample through into a new tube labeled Filtered. *Please note, if samples are to be diluted, ensure that the sample is filtered before diluting with DI water.* 



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3. Once there is sufficient filtered sample, measure the correct volume of sample for the working COD range into a new sample tube, labeled Mixed. Add the correct volume of electrolyte for the COD working range to the Mixed tube. For mixing ratios of each working COD range, refer to Table 3: COD range mixing ratios for sample preparation. Screw on the sample tube lid and invert several times to mix the sample.



4. Once the samples are filtered and mixed at the correct ratio with the electrolyte, proceed with sample analysis.

#### 8.5 Using the Bottle Top Dispenser for Electrolyte Addition for Sample Preparation

#### 8.5.1 Setting up the Bottle Top Dispenser

- 1. Unpack the bottle top dispenser and follow the manufacturer's instructions for setup.
- 2. Following the MANTECH label provided on the bottle top dispenser box, set the dispense volume according to the desired COD range.



3. For example, if the PeCOD is operating in Red range, set the dispense volume to 24.5mL.





#### 8.5.2 Priming the Bottle Top Dispenser Before Use

- 1. Pour **100% electrolyte** into the 1L glass bottle provided.
- 2. Attach the bottle top dispenser onto the bottle (the adapters provided with in the box won't be needed for the 1L glass bottle). Cut the filling tube attached to the dispenser so that the top can screw completely onto the bottle and the tube is close to the bottom of the inside of the bottle.
- 3. Ensure that the dispense volume is set to the correct measurement according to COD range (provided in the label on the bottle top dispenser box).
- 4. Remove the stopper cap and place a waste beaker directly below to catch the solution dispensed while priming.



- 5. Push the top of the dispense pump down completely.
- 6. Release to pump slowly until it's raised approximately 30mm before pushing down quickly again.
- 7. Repeat step 6. five times or until no bubbles remain inside the dispense pump (a few bubbles smaller than 1mm are permissible).









#### 8.5.3 Preparing Samples with the Bottle Top Dispenser

- 1. Place a clean sample tube underneath the dispenser and press down to dispense the electrolyte into the tube. The accurate volume should be dispensed in one pump.
- Next, measure the correct sample volume into the tube with the electrolyte. Depending on the COD operating range, use either a pipette, or graduated cylinder and disposable pipettes, to measure the accurate sample volume. The required volumes are listed in Table 4: Volumes of sample and electrolyte for each COD range.
- 3. Screw on a sample tube lid and invert the sample several times until it's well mixed.

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Table 4: Volumes of sample and electrolyte for each COD range

COD Range	Volume of Electrolyte (mL)	Volume of Sample (mL)	
ADVANCED BLUE	5	15	
GREEN	10	10	
YELLOW	18	2	
RED	24.5	0.5	

Pump the electrolyte into the sample tube.



Measure the correct sample volume into the sample tube.



9.0 Electrode Block and Sensor Installation and Storage

Caution: Always keep the internal channel of the Electrode Block filled with solution; do not leave it dry. Deionized water is most suitable for storage up to 4 weeks. For longer storage, use 3M NaCl solution.

#### 9.1 Installation

- 1. Unpack the electrode Block. There should be one electrode block, three spare O-rings and 4 thumbscrews.
- 2. Peel off the tape that seals the end of the internal channel. Make sure the 3 O-rings are placed properly in the cavities and that they aren't stuck to the tape.



3. Peel off the tape that seals the other end of the internal channel on the other side of the electrode block.





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4. Open the analyzer head and place the electrode block inside. The electrode block can only be installed in one orientation using the 3 different-sized metal pins.



5. Use the 4 thumbscrews to secure each corner the electrode block inside of the analyzer head.



6. Install the sensor by placing it directly on top of the electrode block. With the blue side facing up, the sensor can only be installed in one orientation using the two different-sized metal pins.



7. Close the analyzer head lid securely by using the palm of your hand to push down on the fixed bar and latch (not the analyzer head itself). Ensure the lid is shut completely by listening for a click sound. Then, gently push down on the outer lid until it clicks closed.

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#### 9.2 Storage

To store the system after daily use, ensure that the system is thoroughly rinsed with deionized water, to flush out any excess sample. Prime Port A three times to confirm that the internal channels of the electrode block remain in a wet condition.

9.2.1 Short Term Storage (i.e. up to 14 days)

- 1. Prime Port A several times with DI Water.
- 2. Prime Port B with DI water or the pre-mixed blank solution.
- 3. The sensor and electrode block can be left in the unit. If the seal is broken, i.e. the analyzer lid is opened, re-prime Ports A and B.

#### 9.2.2 Long Term Storage (i.e. greater than 14 days)

- 1. After priming both Ports, A and B, several times with DI water, remove the sensor and electrode block from the peCOD.
- 2. Using a syringe with a narrow tip attached, flush the internal channel of the electrode block with 10mL of DI water, as shown below.





- 3. Push more DI water through the channel and ensure that the channel is filled to keep the block hydrated.
- 4. Tape each end of the channel with electrical tape to store the DI water inside.







5. Tape the O-rings to the block so they are not lost.

#### 9.3 Shipping Requirements

Should the peCOD ever need to be shipped somewhere (e.g. sending in for service), all solution should be drained from the system, and the sensor and electrode block removed and stored following the long-term sensor and electrode block storage requirements described above



#### **Document Change Log**

Version	Date	Author	Changes
1.1	Jan. 9 <sup>th</sup> 2019	Graham	• Document updated to reflect changes between software version
		Ashby	1.3.6.0 to 1.3.7.0
			Added change notes table
1.1	Jan. 10 <sup>th</sup> , 2019	Maggie	• Edits to error codes 11.4, 11.6, 11.10, 11.14
		Grierson	
1.2	May 22, 2019	Maggie	Section 9 added
		Grierson	
2	Aug 7 <sup>th</sup> , 2019	Heather	Doc ID and formatting
		Jasumani	



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