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*Easy***PREP COD-200**

User Manual



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Ordering Information

INSTRUMENT

Description	Catalog No.
COD (110V/230V) with software	010-440-001

ITEMS INCLUDED IN THE BASIC CONFIGURATION

Description	Catalog No.
Spectrophotometer for COD-200	---
Digestion system, 217 positions for 12 ml tubes	---
Rack, Removable for tubes COD-200 (2 required)	010-440-011
Air assisted gripper (compressor not included)	---

SELECTION OF DETECTOR

Description	Catalog No.
Potassium Permanganate, 520 nm, ISO 8467	010-440-032
Potassium Dichromate, 590 nm, ISO 15705, EPA 410.4	010-440-030
Potassium Dichromate, 420 nm, ISO 15705	010-440-034
Turbidity Detection, 850 nm	010-440-036

ACCESSORIES

Description	Catalog No.
Air Compressor, 50 L/min - 1.77 CFM & 8 bar - 116 psi	010-400-060
Barcode reader, for rapid loading of sample identification	010-600-034
PC with Windows OS (Computer System Requirements can be found on page 13)	010-400-008

STANDARDS & REAGENTS

Description	Concentration	Qty	Catalog No.
COD Tubes	0-150 ppm	box/25	250-130-006
COD Tubes	0-1500 ppm	box/25	250-130-016
COD Tubes	0-15,000 ppm	box/25	250-130-026
COD Tubes	0-150 ppm	CS/200	250-130-007
COD Tubes	0-1500 ppm	CS/200	250-130-017
COD Tubes	0-15,000 ppm	CS/200	250-130-027
COD CRM	low level	5 ml	140-715-101
COD CRM	high level	20 ml	140-715-102
COD Control Solution	100 ppm O ₂	125 ml	250-130-512
COD Control Solution	100 ppm O ₂	500 ml	250-130-550
COD Control Solution	100 ppm O ₂	1L	250-130-551
COD Control Solution	1000 ppm O ₂	125 ml	250-130-602
COD Control Solution	1000 ppm O ₂	500 ml	250-130-600
COD Control Solution	1000 ppm O ₂	1L	250-130-601
COD Control Solution	10,000 ppm O ₂	125 ml	250-130-652
COD Control Solution	10,000 ppm O ₂	500 ml	250-130-650
COD Control Solution	10,000 ppm O ₂	1L	250-130-651

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CERTIFIED to comply with the following EMC:

NF EN 61000-4-2 (2009), NF EN 61000-4-3 (2010), NF EN 61000-4-4 (2012), NF EN 61000-4-5 (2014), NF EN 61000-4-6(2014), NF EN 61000-4-11 (2004), EN 55011-2016.

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1 Introduction

EasyPREP COD-200 is a robotic platform designed for automated Chemical Oxygen Demand (COD) analysis. This all-in-one, unattended COD analysis system automates the heating, cooling, mixing and analysis of COD samples. COD tubes are placed in a digestion block in order to be digested, followed by shaking and cooling. They are then transferred to the spectrophotometer for analysis. The measurement activity and concentration calculations are displayed in real-time on the screen. COD measurements are compliant with EPA 410.4, ISO 15705 and ISO 8467 methods.

The **COD-200** also offers turbidity detection. In turbid samples, light scattered from solid particles may interfere with the sample's measured absorbance. In COD analysis, the presence of suspended solids after digestion can cause deviations of up to 30% from the real sample value. The **COD-200's** turbidity detection capability allows the end user to confidently analyze samples knowing that the turbidity level is adequate for COD analysis.

The **EasyPREP COD-200** accommodates 208 positions for COD tubes.




Chemical Oxygen Demand (COD) is a measure of the oxygen-depletion capacity of a water sample contaminated with organic matter. Specifically, it measures the equivalent amount of oxygen required to completely chemically oxidize organic compounds in the sample.

The **EasyPREP COD-200** analyses COD and reports results according to US EPA 410.4, ISO 15705 and/or ISO 8467.

- EPA 410.4 requirements: Chemical Oxygen Demand is determined using potassium dichromate as an oxidizer. Samples are digested at 150 °C for 2 hours. Analyses are performed by spectrophotometry at 600 nm. Range of the method: 3 to 900 mg/L O₂.
The corresponding **COD-200** Method is the High Dichromate method (Range: 3-1500 mg/L O₂).
- ISO 15705 requirements: Chemical Oxygen Demand is determined using potassium dichromate as an oxidizer. Following sample digestion at 150 °C for 2 hours, analyses are performed by spectrophotometry at:
 - » 440 nm ± 20 nm for samples of concentration 0-150 mg/L O₂ (Low Dichromate Method; Range: 5-150 mg/L O₂)
 - » 600 nm ± 20 nm for samples of concentration up to 1000 mg/L O₂ (High Dichromate Method; Range: 3-1500 mg/L O₂)
- ISO 8467 requirements: Chemical Oxygen Demand is determined using potassium permanganate as an oxidizer. Following sample digestion at 100 °C for 30 minutes, analyses are performed by spectrophotometry at 540 nm. Range of the method: 0.5 to 10 mg/L O₂.
The corresponding **COD-200** method is the Permanganate Index Method (Range: 0.5-10 mg/L O₂).

The **COD-200** detects the presence of turbidity in the sample tube by measuring the light scattered by the solid particles within the tube. A detector is placed at a 90° angle from the LED light source. The reading is measured at a wavelength of 850 nm. The **COD-200's** turbidity method has a range of 2.5 – 50 NTU.

2 Cautions, Notes and Symbols

Symbol	Description	Symbol	Description
V	Voltage	I	Mains on
~	Alternating current	0	Mains off
A	Current		Attention, consult accompanying documents
Hz	Frequency		Protective conductor terminal
F	Fast-acting fuse	W	Watts
	Caution, hot surface		

CAUTIONS, WARNINGS AND NOTES ARE INCLUDED THROUGHOUT THIS MANUAL.



CAUTION

A caution is used to emphasize information pertaining to procedures that, if not strictly followed, may result in damage or destruction to the instrument or improper instrument operation.



WARNING

A warning is used to emphasize information about dangerous or hazardous conditions relating to the operation, cleaning or maintenance of the instrument that may result in personal injury.



NOTE

A note is used to emphasize procedures or conditions that may be misinterpreted or overlooked, and to clarify potentially confusing situations.

3 Warranty & Safety Information

SCP SCIENCE warrants this product free from defects in workmanship and materials for one (1) year from date of purchase.



Should the unit malfunction, please contact **SCP SCIENCE**'s Service Department or your local distributor for further instructions.

The warranty is void if the instrument shows evidence of tampering or has been subjected to excessive moisture, heat, corrosion or other misuse.

SCP SCIENCE shall not be responsible for any damage or losses, however caused, which may be the result of improper installation or misuse of this product.

Products are supplied for laboratory use only and should not be used for any household, medical or therapeutic application.

SCP SCIENCE shall not be responsible for whatever reason if overheated or overcharged samples that can explode are used in the **COD-200**.

SCP SCIENCE presumes that only trained and qualified individuals, familiar with procedures suitable for the safe operation of these instruments, will handle them. Our customers are solely responsible for the safe operation, handling and use of these products.

MINIMUM SAFETY CONSIDERATIONS MUST BE FOLLOWED WHEN WORKING WITH *EasyPREP* COD-200 IN ORDER TO MAINTAIN GOOD LABORATORY PRACTICES:

3.1 MeASuReS FOR YOuR PROTeCTIOn:



When using chemicals and solvents, comply with the instructions of the manufacturer and the general lab safety rules.

Always wear safety glasses when handling samples and reagents

Always wear safety glasses when operating the **COD-200**.

Never disconnect the optical fiber line when operating the **COD-200**.

Always keep hands and fingers away of the tube gripper when you are operating it.

Never use samples that can explode if overheated or overcharged in the **COD-200**.

No User Serviceable parts inside.

Disconnect from Mains Power supply before connecting and disconnecting the umbilical cord of heater.



The Umbilical cord receptacle in **COD-200** is used only with Heating Block, Model *DigiPREP* MS.

The voltage rating of Umbilical cord receptacle in **COD-200** is 115V/230V, corresponding to input voltage of **COD-200**.

3.2 MeASuReS FOR YOuR OPeRATIOnAL SAFeTY



Make sure the **EasyPREP COD-200** is placed on a surface capable of supporting 85 kg (190 lbs).

EasyPREP COD-200 requires a clearance of five inches (12.7 cm) on all sides.



If moving the system, always use 2-3 people and do not lift by the Kydex panels. Lift by the bottom aluminum frame instead.



Keep hands and fingers away from the system when it is in motion to reduce the risk of pinching.

Always plug the **EasyPREP COD-200** in a properly grounded three-prong electrical outlet (100-240V receptacle).



Use a stabilized constant voltage AC power supply, with a voltage within +/-5% of the specified level.



Always use the provided mains power cord or one with the same manufacturer's specifications.



Always ensure that the voltage selector switch on the back of the block is set to your operating voltage before powering the instrument.

Always use the air compressor quick connect provided or one with the same manufacturer's specifications.

The **COD-200** Heating block is an elevated-temperature digestion system with exposed hot surfaces. Be careful around the instrument when it is in operation.

If the **COD-200** is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Always keep hands and fingers away of the tube gripper when you are operating it.

4 Specifications

DIMENSIONS – COD-200	
width	123 cm (48 ½ in.)
Depth	66 cm (26 in.)
Height	63 cm (24 ¾ in.)

ELECTRICAL	
Model number	<i>EasyPREP COD-200</i>
Voltage	115/230V
Power	1055W
Frequency	50/60 Hz

ENVIRONMENTAL	
Relative Humidity	30% to 80%
Altitude	up to 2000 m
Installation	Category II
Pollution	Degree 2
Ambient Operating Temperature	15 °C to 40 °C

AIR COMPRESSOR	
Outlet	6 mm OD tubing
Pressure	5 bar

FUSES-RATINGS



The Power Supply has over voltage, overload and short circuit protections.



For the heating block, replace fuses with the same type and rating, 15A/250V, fast blow ABC Ceramic. The fuses are located in the back panel. Call **SCP SCIENCE** or your Distributor for assistance.

5 Installation

5.1 BeFORe InSTALLATIOn

5.1.1 Overview

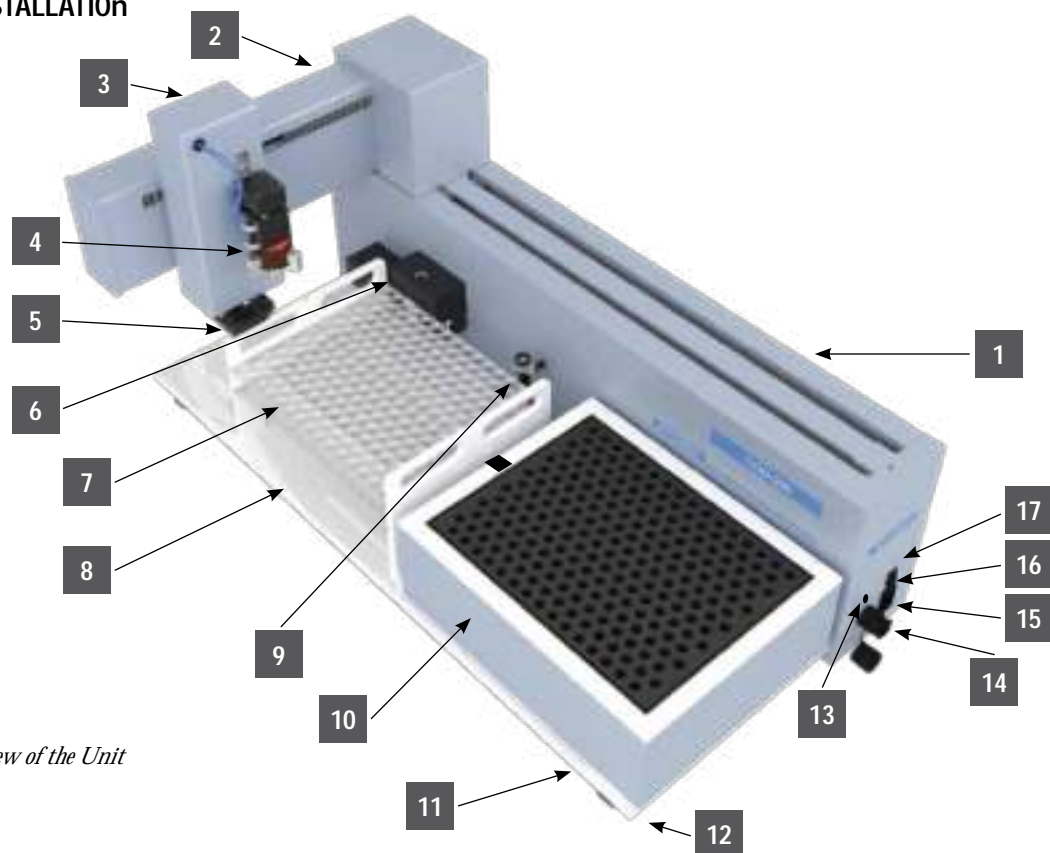


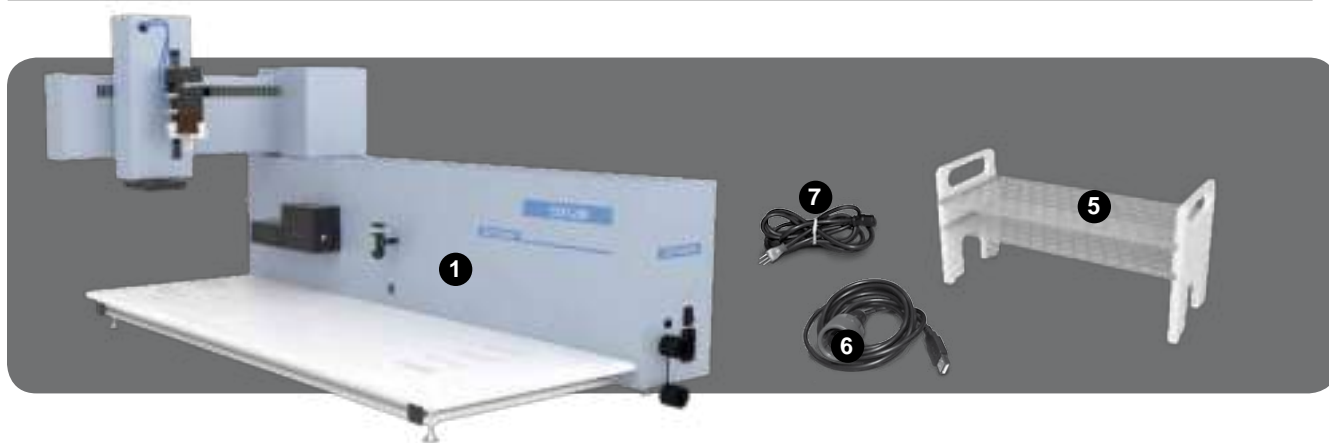
Figure 1: Front View of the Unit

Legend

Label	Description	Label	Description
1	X-arm	10	Digestion block
2	Y-arm	11	Chassis
3	Z-arm	12	Leveling Feet
4	Gripper	13	Air compressor quick-connect
5	Tube detection sensor	14	USB receptacle
6	Spectrophotometer	15	Power cord receptacle
7	COD tube rack	16	Power switch
8	Bottom table	17	Power on LED
9	Shaker		

5.1.2 Basic Component List

ITEM	PART NUMBER	DESCRIPTION	QUANTITY
1	010-440-001	COD (110V/230V) with software	1 *
2	---	Air Assited Gripper	1 *
3	---	DigiPREP Block Digestion System (209 positions for 12 ml tubes)	1 *
4	---	Spectrophotometer for COD-200	1 *
5	010-440-011	Rack, Removable for tubes COD-200	2 *
6	E1749	USB Cable Male A to Male B-2m linking Main Unit to PC/Laptop	1 *
7		Main Unit Power Cable	1 *
OPTIONS			
8	010-400-060	Air Compressor, 50 l/min. - 1.77 CFM & 8 bar - 116 psi	1 *
9	010-600-034	Barcode reader, for rapid loading of sample identification	1 *
10	010-400-008	PC with Windows OS	1 *
11	010-440-030	Potassium Dichromate, 590 nm, ISO 15705, EPA 410.4	1 *
12	010-440-034	Potassium Dichromate, 420 nm, ISO 15705	1 *
13	010-440-036	Turbidity detection, 850 nm	1 *
14	010-440-032	Potassium Permanganate, 520 nm, ISO 8467	1 *



5.1.3 Unpacking and Inspection

The system weighs approximately 85 kg (190 lbs). Use 2-3 people to lift by the bottom aluminum frame and place the system on a flat surface where it will be used. Save the packing material for further use. Ensure all parts have been delivered; some parts may be in other boxes.

EasyPREP COD-200 may be attached to the packaging with bolts. Remove them prior to lifting the system out of the box. If damage is observed, contact the carrier to make a claim and then the Service Department.

5.2 HARDwARE InSTALLATIOn GuiDeLineS

5.2.1 Connect the air compressor

- Connect the instrument to an air compressor using the quick-connect fitting on the right end of the X-arm (Figure 1, Label 13) and the 6 mm OD tubing provided with the instrument.
- The air compressor supply should be set to a minimum of 5 bar (73 psi) pressure.

5.2.2 Cable Connections

Make sure that the Power button is turned off.

- Connect the Power Cable to the receptacle located on the end of the X-arm.
- Connect the USB utility cable to the receptacle located on the end of the X-arm. **Don't connect the uSB cable to the computer yet.**

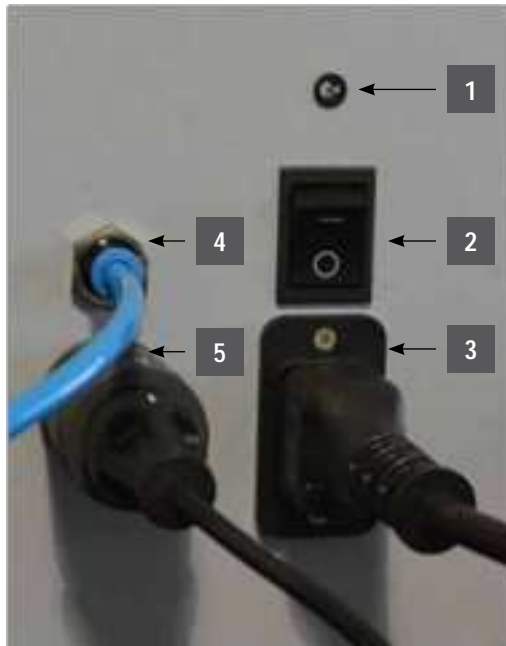


Figure 3: Power and USB plugs

Label	Description
1	LED to indicate power ON
2	Power Switch
3	Power Cord Receptacle
4	Air supply connection 6 mm
5	USB Cable connection

5.3. BeFORe SOFTwARE InSTALLATIOn

5.3.1 Computer System Requirements

- PC Processor: 1GHz or superior
- RAM memory: 1 GB RAM
- Disk min. space: 1 GB free
- Ports: 1 USB port available
- Operating System: Windows 7 / 10

6 Software

6.1 OVERVIEW OF SOFTWARE

6.1.1 Software Tabs

There are five (5) software tabs:

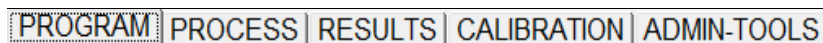


Figure 4: Five Tabs to Navigate the Software

- PROGRAM: Where the method is selected.
- PROCESS: Where the process is visualized in real time.
- RESULTS: Results are displayed in real time from from the process.
- CALIBRATION: Where the calibration curves are created and calibration information is reviewed
- ADMIN-TOOLS: User defined parameter setup. This tab is password protected.
 - » Movement speed of the robotic arm
 - » Digestion block temperature
 - » Cooling delay durations
 - » Spectrophotometer configuration

6.1.2 Operational Buttons

There are four (4) icons on the title bar.

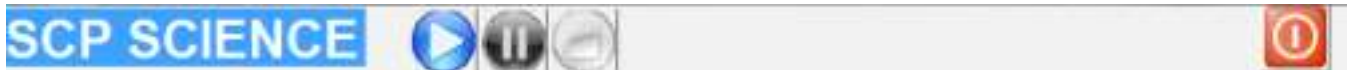






Figure 5: Title Bar Icons

- The  "Run" button is blue when enabled and grey when disabled.
- The  "Pause" button is blue when activated and grey when disabled, it turns to "RESUME" after being pressed. When resumed the sequence will continue from the break point.
- The  "Stop" button goes red when activated and grey when disabled. The sequence is interrupted; the test will stop after the current motion (action) is finished and the result table is displayed. If the "Run" button is pressed again, the sequence will restart from the beginning.
- The  "Emergency stop". The system stops completely and immediately. One has to exit and reload the software before restarting the tests.

6.1.3. Hardware Detection



Figure 6: Hardware Status Indicators

The four (4) indicators at the bottom of the software window indicate whether the modules have been detected by the instrument. A red indicator signifies that a module has not been detected or is faulty. A green indicator indicates the module has been detected and is ready for use.

"Robot" is for the robotic system. The green indicator confirms that the system recognizes the presence of the Robotic system.

"Spectrophotometer" is for the spectrophotometer. The green indicator confirms that the system recognizes the presence of the spectrophotometer.

"Heating block" is for the digestion block. The green indicator confirms that the system recognizes the presence of the digestion block.



If the indicator remains red after start up, go to the Troubleshooting section.

6.2. PROGRAM TAB

6.2.1 Program Tab Overview

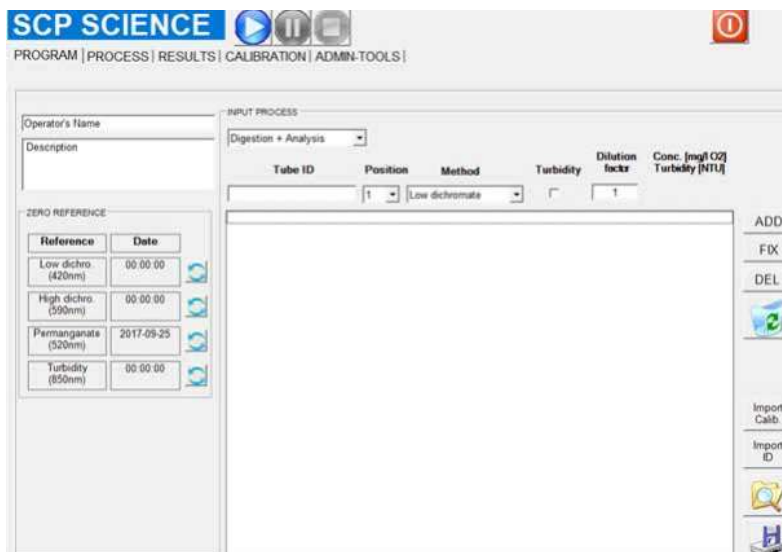


Figure 7: Program Tab


- The "OPERATOR'S NAME". Stores the name of the operator of the run.
- The "COMMENT". Use this field to store any additional information about the method or samples.

6.2.2 Zero Reference

In order to correct for any variations in analytical conditions, a Zero Reference tube should be measured before starting a new sequence. The Zero Reference tube must be kept clean of any dust, marks or scratches. Wipe clean with a lint-free cloth before use.

Reference	Date	
Low dichro (420nm)	00:00:00	
High dichro (590nm)	00:00:00	
Permanganate (520nm)	2017-09-25	
Turbidity (850nm)	00:00:00	

Figure 8: Measuring Zero Reference

- Manually place the Zero Reference tube in the tube holder of the **COD-200**'s spectrophotometer.
- Press the Update button  to measure the zero reference for the method in use (Low Dichromate, High Dichromate, Permanganate or Turbidity method).
- Repeat for all methods used in the sequence.

NOTE

The Zero Reference tube must have similar optical properties to the COD sample tubes. Use a clean, empty 16 mm tube filled with dilute (20%) H_2SO_4 for the Low and High Dichromate methods, or with water for the Permanganate and Turbidity methods.

6.2.3 Input Process

INPUT PROCESS


Digestion + Analysis

Tube ID	Position	Method	Turbidity	Dilution factor	Conc. (mg/L O ₂)	Turbidity (NTU)
		Low dichromate	1"		1	

ADD


FIX

DEL



Input Calc

Input ID






Figure 9: Input Process

6.2.3.1 Select test procedure

Procedure can be built to either:

- Digest and Analyze samples, OR
- Analyze samples only

6.2.3.2 Edit sequence

- The "ADD" icon, adds a new line to the input process table
- The "FIX" icon, corrects the selected (highlighted) line.
- The "DEL" icon, deletes the last line OR the selected line in the input process table.
- The "Recycle bin" icon, clears the entire process table.
- The "Import Calib" icon, imports the Calibration Sequence from the Calibration tab.
- "Import ID" imports sample IDs from a text file. The imported information fills the Tube ID column in the sequence. The text file can be loaded from any directory.

Methods can be saved by pressing the save icon  or recalled by pressing the search file icon .



Figure 10: Save and Recall Methods

6.2.3.3 Process table fields

Tube ID	Position	Method	Turbidity	Dilution	Conc. [mg/l O ₂] Turbidity [NTU]
	1	Low dichromate	<input type="checkbox"/>	1	

Figure 11: Process Input Zone

Tube ID: Input the sample identification

Position: Indicate the location of the tube on the tube rack

Method: Select the method of analysis. Select between Low Dichromate (analysis at 420 nm), High Dichromate (analysis at 590 nm) and Permanganate (analysis at 520 nm).

nOTeS:

- Only the methods purchased with the **COD-200** are available when building the method.
- A sequence can include both Low Dichromate and High Dichromate sample tubes since they use the same digestion temperature and duration. The default digestion temperature (150 °C) and digestion duration (2 hours) will be used when selecting the High and/or Low

Dichromate methods.

- Permanganate method, however, must be run separately. The default digestion temperature (100 °C) and digestion duration (30 minutes) will be used when selected the Permanganate method.

Turbidity: Enable/disable turbidity detection. Turbidity is only enabled if the wavelength has been purchased with the system. This can be added any time by purchasing the 'key code'.

Dilution: Input the sample's dilution factor. Undiluted samples have a dilution factor of 1. Samples diluted 1 : 5 (or N/5) have a dilution factor of 5, etc.



The analytical ranges of the methods are described in section 1 Introduction. Choose the COD tube appropriate for the concentration range of the samples, OR dilute the sample beforehand so that the diluted sample concentration falls within range of the method.

Conc. (mg/L O₂): Concentration of the COD calibration standard. This field is activated when the calibration sequence is imported (see "Import Calib").

Turbidity (nTu): Concentration (in NTU) of the turbidity calibration standard. This field is activated when the turbidity calibration sequence is imported (see "Import Calib").

6.3. PROCeSS TAB

The rack visualization window indicates the status for each sample tube. Each sample is represented by its corresponding status color.

The time to the end of the current step can be seen for each individual tube by placing the mouse cursor over the tube.



Figure 12: Process Tab

6.3.1. Information

"Start Date/Time": Records the start time of the process, from the moment that the "Run" button is pressed.

"End Date/Time": Records the time required to reach the end of the process when the last sample has been analyzed.






"Heating Block Temperature": Indicates the current and Setpoint temperatures of the digestion block.

"Spectrometer": Indicates tube presence when a sample in a COD digestion tube.

"Shaker": Indicates tube presence when being shaken (homogenized).

6.3.2 Conventions

Every tube in the sequence is represented by an indicator color in the rack visualization. The indicators are colored according to the present status of the tube.

 In line	Tube waiting to be placed in the digestion block.
 Step in process	Step (digestion, cooling, shaking or spectrophotometer) in process.
 Step completed	Step (digestion or cooling) completed. The tube is waiting to be moved to the next location.
 Process completed	Tube analysis is completed.
 Error	Error in tube processing. The tube was not correctly moved from its current position, i.e. it is not detected by the tube detector.

n0TeS:

- If an error occurs because a tube becomes stuck either in the shaker or the spectrophotometer, the sequence will be stopped. An error message will be displayed.
- If a tube becomes stuck either in the tube rack or digestion block, the instrument will move on to the next sample. An error message will be displayed in the Comments column of the missed tube, in the RESULTS tab.

6.4 ReSuLTS TAB: ReAL-TIME View OF ReSuLTS



Figure 13: Results Tab

6.4.1 Information Field

In this tab, process results are displayed and saved into a .csv file located in C:\Program Files\COD-200\ Results. The following data fields are stored in the results file.

- "Process Date": Date of testing.
- "Operator": Operator's name.
- "Digestion time per sample": Digestion duration defined in the method selected
- "Digestion temperature": Digestion temperature defined in the method selected.

Operator :	<input type="text"/>	Process date:	<input type="text"/>
Digestion time per sample:	<input type="text"/>	Description:	<input type="text"/>
Digestion temperature:	<input type="text"/>		

Figure 14: Information Field



If "Analysis only" is selected in the PROGRAM Tab, the "Digestion time per sample" and "Digestion temperature" fields will be left blank.

6.4.2. Results Field

- "Date/Time": Date and Time of analysis of the sample tube
- "Position": Position of the tube on the rack
- "ID": Sample identification
- "Method": Method of analysis: Low Dichromate (analysis at 420 nm), High Dichromate (analysis at 590 nm) or Permanganate (analysis at 520 nm).
- "Dilution Factor": Dilution factor of the sample.
- "Absorbance": Measured absorbance of the sample.
- "Sample concentration": Measured concentration of the sample, in mg/L O₂.
- "Final concentration": Sample concentration, corrected for the dilution factor, in mg/L O₂.
- "Turbidity": Indicates whether turbidity was detected within the sample.
- "Comments": Field where the software reports any errors having occurred during the digestion and analysis of the sample.
- "Reprocess concentration": Reprocess all sample results currently loaded into the Results tab using new calibration information.
- LOAD: Reload results for reprocess
- SAVE: Reprocessed results

Operator :	<input type="text"/>	Process date:	<input type="text"/>	
Digestion time per sample:	<input type="text"/>	Description:	<input type="text"/>	
Digestion temperature:	<input type="text"/>			

Reprocess concentration		
-------------------------	--	--

Date/Time	Position	ID	Method	Dilution Factor	Absorbance	Sample Concentration	Final Concentration	Turbidity	Comment
	8		High			mg/L O ₂	mg/L O ₂	NTU	

Figure 15: Results Field

6.4.3 Guidelines on Reprocessing

In case it is necessary to reprocess sample results with new calibration information:

- Make sure the data loaded in the RESULTS tab is the data that needs to be reprocessed. The entire results file will be reprocessed.
- In CALIBRATION Tab, make sure the appropriate calibration file is loaded.
- In the RESULTS tab, press “Reprocess”
- The sample concentration results will be recalculated.
- To save the new sample concentrations, press the “Save” icon and input the name for the new Results file.

6.5 CALIBRATION TAB

In the CALIBRATION Tab, the calibration graph of Absorbance vs Concentration is displayed. Calibration curves can be saved by pressing the “Save” button or recalled by pressing the “Load” button.

The CALIBRATION Tab is split into three sections: Graph Settings, Sequence and Information.

6.5.1 Graph Settings

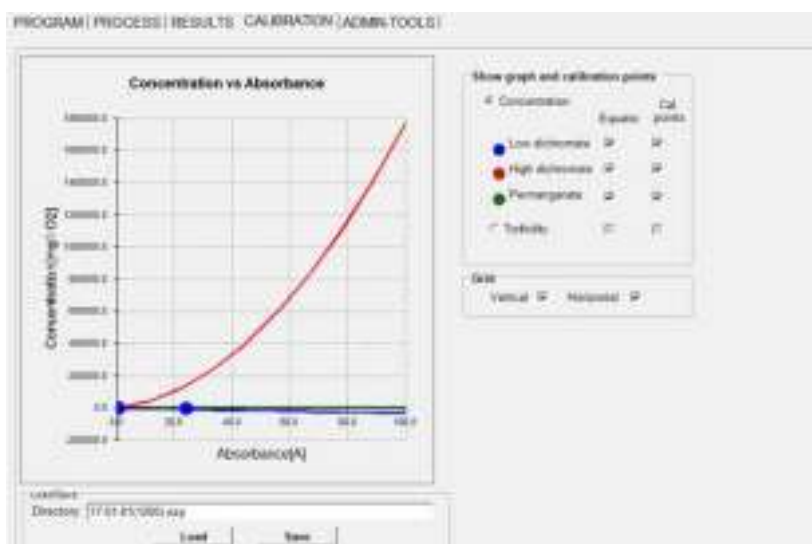


Figure 16: Calibration Tab/Graph Settings

“Show graph and calibration points”: Select which method calibration curves to display onto the Calibration Graph. Also select whether only the calibration curve (“Equation”) and/or Calibration Points will be displayed.

“Grid”: Enable/disable the vertical and horizontal grid lines of the Calibration Graph.

“Load ”: Recall calibration curve

“Save”: Save calibration curve

6.5.2 Sequence

The Sequence window of the CALIBRATION Tab is used to build the sequence of calibration standards that will be used to calibrate the instrument.

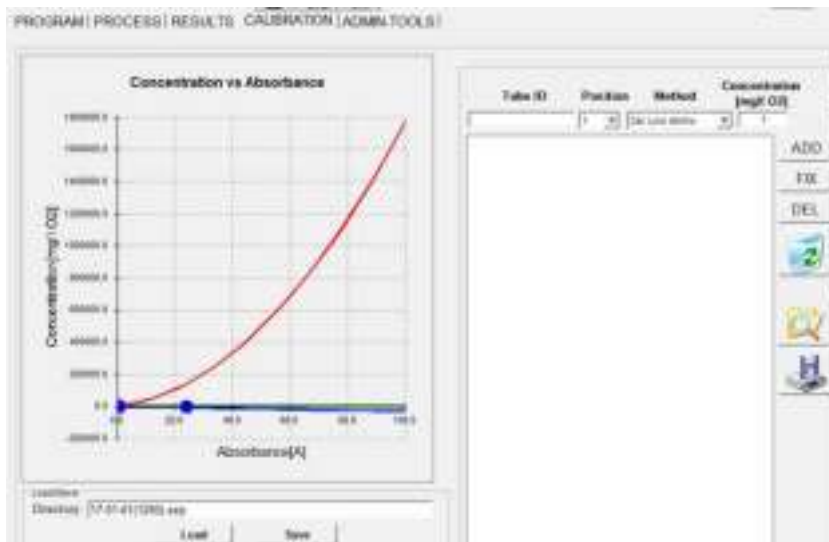




Figure 17: Calibration Tab/Sequence

6.5.2.1 Sequence edit

- The “ADD” icon, adds a new line to the input table
- The “FIX” icon, corrects the selected (highlighted) line.
- The “DEL” icon, deletes the last line OR the selected line in the input table.
- The “Recycle bin” icon, clears the entire table.
- The  icon, saves the calibration sequence.
- The  icon, recalls the saved calibration sequences.

6.5.2.2 Input Table

- **Tube ID:** Input the calibration standard identification
- **Position:** Indicate the position of the tube on the tube rack
- **Method:** Select the method of analysis. Select between Low Dichromate (analysis at 420 nm), High Dichromate (analysis at 590 nm), Permanganate (analysis at 520 nm) and Turbidity (850 nm).



Only the methods selected when purchasing the COD-200 are available when building the calibration sequence.

A sequence can include both Low Dichromate and High Dichromate calibration standards since they use the same digestion temperature and duration. The default digestion temperature (150 °C) and digestion duration (2 hours) will be used when selecting the High and/or Low Dichromate methods.

Conc. (mg/L O₂): Concentration of the COD calibration standard.

Turbidity (nTu): Concentration (in NTU) of the turbidity calibration standard.

6.5.3 Information

The Information section of the CALIBRATION Tab displays calibration curve and linearity information.

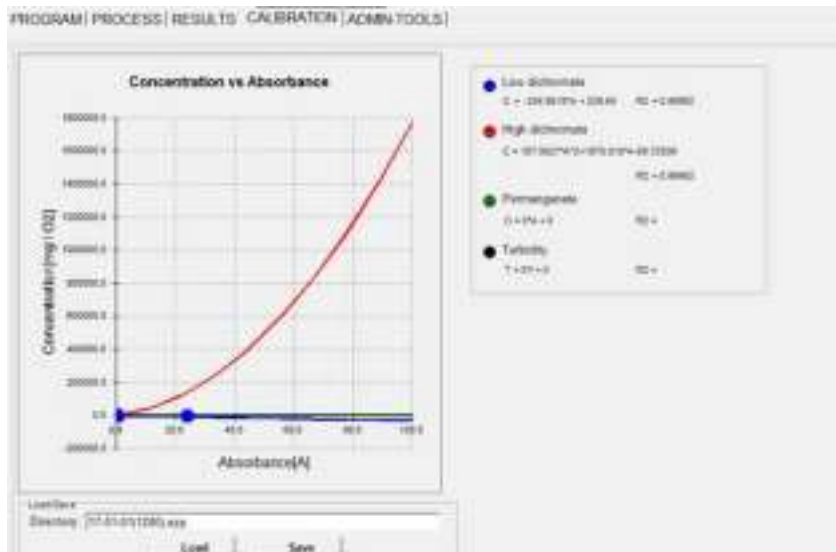


Figure 18: Calibration Tab/Information

6.6 ADMIN-TOOLS



Figure 19: Admin-Tool Tab Screen

ADMIN-TOOLS is a tab where advanced parameters can be accessed and modified. This tab is password protected. **Password: SCP123.**



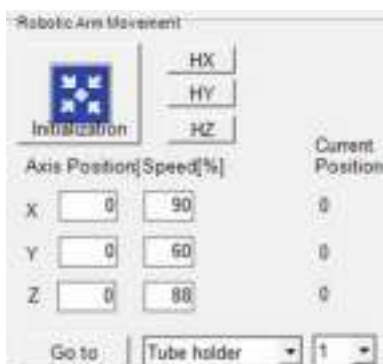
Username

Password

Figure 20: Access protected by password

6.6.1 Robotic Arm

- "HX": Individually initializes the X axis. The robotic arm moves the X axis to the furthest position (home position).
- "HY": Individually initializes the Y axis. The robotic arm moves the Y axis to the furthest position (home position).
- "HZ": Individually initializes the Z axis. The robotic arm moves the Z axis up to home position.
- "Initialization": Initializes each axis sequentially starting with Z followed by Y and then X.
- "Axis X": Allow for direct displacement along the X axis, based upon the value given in mm and after pressing the "Enter" key.
- "Axis Y": Allow for direct displacement along the Y axis, based upon the value given in mm and after pressing the "Enter" key.
- "Axis Z": Allow for direct displacement along the Z axis, based upon the value given in mm and after pressing the "Enter" key.
- "Speed X": Allow speed adjustment on X axis (1-100-- 1 is the slowest and 100 is the fastest) after pressing the "Enter" key. The default factory setting is 100.
- "Speed Y": Allow speed adjustment on Y axis (1-100-- 1 is the slowest and 100 is the fastest) after pressing the "Enter" key. The default factory setting is 100.
- "Speed Z": Allow speed adjustment on Z axis (1-100-- 1 is the slowest and 100 is the fastest) after pressing the "Enter" key.
- "Go to" position: Go to the selected position among the Tube rack positions, Digestion block positions, shaker and spectrophotometer positions.



Axis	Position	Speed[%]	Current Position
X	<input type="text" value="0"/>	<input type="text" value="90"/>	0
Y	<input type="text" value="0"/>	<input type="text" value="60"/>	0
Z	<input type="text" value="0"/>	<input type="text" value="88"/>	0

Go to Tube holder

Figure 21: Robotic Arm Field

6.6.2 Gripper

- **“Pickup from”**: Pick up the tube located at the position defined in the “Go To” field. The robot will move to the selected location, move the gripper down to pick up depth, close the gripper and lift the selected tube up to Z=0.
- **“Release in”**: Release the tube held by the gripper into the position selected in the “Go To” field. The robot will move to the selected location, move the gripper down to release depth and open the gripper to release the tube.
- **“Grab”**: Manually close the gripper. The gripper will close, then move up to Z=0.
- **“Drop”**: Manually open the gripper.

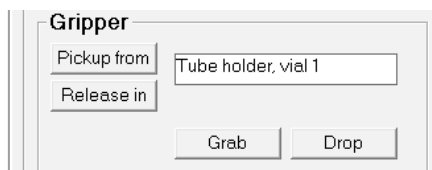


Figure 22: Gripper Field



If the tube is not detected after trying to pick it up, the arm will move the tube down and slowly up to try to detect again. If the tube is still not detected, the arm will go down, open the gripper, go lower and try to pick up the tube again. This routine will repeat 3 times or until the tube is detected.

6.6.3 Heating Block

- **“Cool down time”**: Define the time delay to cool the tubes to room temperature after the digestion and before analysis.
- **“Run in test mode”**: Check to disable the wait for heating.
- **“Manual Digestion”**: Used to manually control the heating of the digestion block, for example for a manual digestion of samples.
- **“Temperature”**: Set point temperature of the digestion block.
- **“Start heating”**: Starts heating the digestion block until it reaches the programmed Temperature.
- **“Stop heating”**: Stops heating of the digestion block.
- **“Read T °C”**: Read the current digestion block temperature.
- **“Re-connect”**: Reset the connection between the digestion block and the computer.

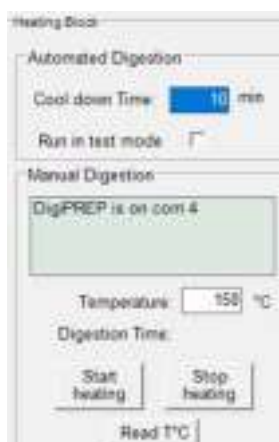


Figure 23: Heating Block Field

6.6.4 Spectrophotometer

Perform a manual absorbance measurement:

- Place a tube in the spectrophotometer's tube holder.
- Select the method of analysis (Low Dichromate, High Dichromate, Permanganate, Turbidity).
- Press "Read".
- The software will measure and calculate the tube's absorbance or turbidity.
- If a calibration curve is loaded in the software's calibration tab, it will also calculate the sample tube's concentration.



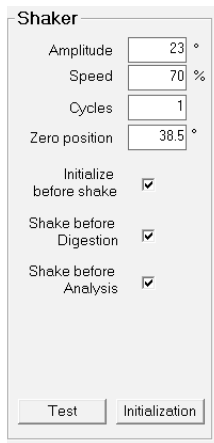
Only the methods that have been purchased and that are presently installed in the **COD-200** can be accessed for manual absorbance measurement.

Figure 24: Spectrophotometer Field

- **"Open key file"**: To activate post-purchased methods.

6.6.5 Shaker

- **"Amplitude"**: Rotation (in incremental steps of the shaker's motor) of the tube during shaking.
- **"Speed"**: Percentage of the total speed of the shaker.
- **"Cycles"**: Number of rotations during each shaking.
- **"Zero position"**: Initialization positions (in increments) of the shaker.
- **"Initialize before shake"**: Select to make the shaker initialize before each homogenization.
- **"Shake before digestion"**: Check to activate.
- **"Shake before analysis"**: Check to activate.
- **"Test"**: Activate the shaker using the parameters presently selected.
- **"Initialize"**: Initialize the shaker.



Shaker

Amplitude °

Speed %

Cycles

Zero position °

Initialize before shake ☒

Shake before Digestion ☒

Shake before Analysis ☒

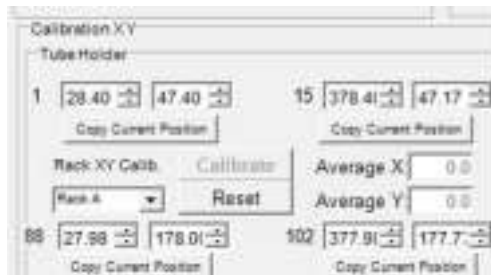
Figure 25: Shaker Field

6.6.6 Calibration X Y

Reset tube positions on Tube Holder and Heater Block

6.6.6.1 Tube Holder

- Use Gripper to obtain the coordinates (X, Y) of positions 1, 16, 187, and 202, and enter these coordinates into this table respectively .
- Click "Calibrate" to obtain the average X and Y.
- Click "Reset" to activate the new set of position parameter.



Calibration X Y

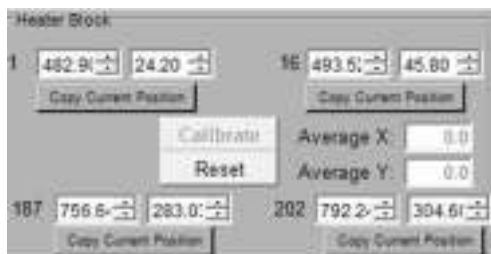
Tube Holder:

1	<input type="text" value="28.40"/>	<input type="text" value="47.40"/>	15	<input type="text" value="378.41"/>	<input type="text" value="47.17"/>
<input type="button" value="Copy Current Position"/>		<input type="button" value="Copy Current Position"/>			
<input type="button" value="Copy Current Position"/> <input type="button" value="Calibrate"/> <input type="button" value="Reset"/>			<input type="text" value="Average X: 0.0"/> <input type="text" value="Average Y: 0.0"/>		
88	<input type="text" value="27.88"/>	<input type="text" value="178.01"/>	102	<input type="text" value="377.91"/>	<input type="text" value="177.7"/>
<input type="button" value="Copy Current Position"/>		<input type="button" value="Copy Current Position"/>			

Figure 26: Tube Holder Field

6.6.6.2 Heater Block

The procedure is the same as in Tube Holder.



Heater Block:

1	<input type="text" value="482.91"/>	<input type="text" value="24.20"/>	16	<input type="text" value="493.61"/>	<input type="text" value="45.80"/>
<input type="button" value="Copy Current Position"/>		<input type="button" value="Copy Current Position"/>			
<input type="button" value="Copy Current Position"/> <input type="button" value="Calibrate"/> <input type="button" value="Reset"/>			<input type="text" value="Average X: 0.0"/> <input type="text" value="Average Y: 0.0"/>		
187	<input type="text" value="756.61"/>	<input type="text" value="283.01"/>	202	<input type="text" value="792.21"/>	<input type="text" value="304.61"/>
<input type="button" value="Copy Current Position"/>		<input type="button" value="Copy Current Position"/>			

Figure 27: Heater Block Field

7 Guidelines on using the COD-200

7.1 SAMPLE PREPARATION

- Transfer 2 ml of the sample into an **SCP SCIENCE** pre-filled COD tube (see Ordering Information, page 2). Homogenize the sample before transfer to ensure it is representative of the sample.
- Make sure to tighten the tube cap to avoid evaporation of the sample during digestion. Also make sure there are no marks, dust or scratches on the tubes before placing them on the COD tube rack.

7.2 CALIBRATION STANDARD PREPARATION

- Prepare your calibration standards by dilution of COD control solutions of known certified concentration (see Ordering Information, page 2). Transfer 2 ml of the calibration standards into **SCP SCIENCE** pre-filled COD tubes.



No limit to the number of calibration standards has been programmed in the **COD-200** software. Follow the Quality Control requirements of the established norms or Standard Operating Procedures applicable to your laboratory.

- Make sure to tighten the tube cap to avoid evaporation of the sample during digestion. Also make sure there are no marks, dust or scratches on the tubes before placing them on the COD tube rack.

7.3 SAMPLE ANALYSIS

When all the solutions are prepared, one can power on the instrument and begin sample analysis.

7.3.1 Establish Analysis Condition

- In ADMIN-TOOLS/Heating Block: Set the digestion temperature and cool down time if "Digestion + Analysis" is chosen for sample analysis. With standard method EPA410.4, for example, digestion temperature is set to 150 °C, and cool down time is 30 minutes.
- In ADMIN-TOOLS/Shaker: Set shaker actions, according to specific application. (refer to section 6.6.5)

7.3.2 Edit Calibration Standard Sequence

- In CALIBRATION Tab/Sequence: Select the method of analysis and enter the concentration of the calibration standards, as well as their location in the COD tube rack to build the calibration standard sequence. Put the standard tubes at the corresponding position in the tube holder. (Refer to section 6.5.2).
- Save the calibration sequence by pressing the "Save" icon if required for future re-use.
- In PROGRAM: Select whether the tubes will be digested and analyzed, or analyzed only.
- Press "Import Calib" to import the calibration standard sequence from the Calibration Tab. The calibration standard sequence will populate the first rows of the test sequence.

7.3.3 Edit Sample List

- Following the calibration standard rows, edit sample list by entering the sample ID, location in the COD tube rack, method of analysis and sample dilution factor of the samples to be analyzed. Select, for each sample, whether or not turbidity detection is to be enabled. Put the sample tubes at the corresponding position in the tube holder.

7.3.4 Zero Reference Measurement

- In order to correct for any variations in analytical and environmental conditions, a Zero Reference tube should be measured before running the analysis sequence.
- The Zero Reference tube must be kept clean of any dust, marks or scratches. Wipe clean with a lint-free cloth before use.
- Manually place the Zero Reference tube in the detection holder of the **COD-200**'s spectrophotometer.
- Press the Update button to measure the zero reference for the method in use (Low Dichromate, High Dichromate, Permanganate or Turbidity method).
- Repeat for all methods to be used during the sequence.



The Zero Reference tube must have similar optical properties to the COD sample tubes. Use a clean, empty 16 mm tube filled with dilute (20%) H_2SO_4 for the Low and High Dichromate methods, or with water for the Permanganate and Turbidity methods.

7.3.5 Start Analysis Sequence

- Press "Play" on the title bar to start the analysis sequence.
- The instrument will follow the pre-set procedure to execute each step, Real-time status displays in RESULTS Tab.
- The instrument stops automatically when the last sample is measured. Results are saved automatically, too.



If "Digestion + Analysis" is selected, the process will wait until the heater block has reached the set point temperature of the selected method before moving the tubes to the digestion block. After the last tube in the sequence is digested, the heater Block shuts off automatically.

In ADMIN-TOOLS Tab, heater block can be preheated before starting sample measurement to eliminate the waiting time.



Do not touch the heater Block surface to avoid injury.

7.3.6 Turn off the Instrument

- Close the **COD-200** software
- Shut down the computer
- Power off the instrument

8 Maintenance

In case of spillage of COD tube contents, parts in contact with liquids must be wiped immediately.

All surfaces may be cleaned with warm soapy water and then rinsed with DI water.

SPILLS:

Minor Spill

While wearing the appropriate safety equipment, soak up the liquid with a paper towel. If the liquid is in a well or cavity, use a pipette tip to suck up the remaining liquid.

Major Spill

An example of a major spill would be if the liquid has entered the electronics area. Turn the system off and disconnect the power supply cord from the back of the **EasyPREP COD-200**. Soak up the liquid and allow the system to dry prior to turning the system back on. The back may be removed for access to the electronic areas.

9 Troubleshooting

9.1 DOWNLOAD THE TEAMVIEWER SOFTWARE TO ALLOW THE SUPPORT DEPARTMENT TO REMOTE YOUR DESKTOP OR LAPTOP FROM A DISTANCE

Download the TeamViewer software at: <http://www.teamviewer.com/en/download/windows.aspx>

9.2 TROUBLESHOOTING-- GENERAL CASES: TOPIC

Topic	Suggestion(s)
Arms not moving:	Switch the unit off and check manually to see if something is hindering one of the arms from moving.
no initialization:	Check if something hinders one of the arms from moving back to the initial position.
Software doesn't recognize one of the items while starting:	Check if the USB cable is connected properly.
Heating block is not working:	Verify that the right temperature set-up was followed for the selected method used. If not, make the correction and restart the process. If it is correct, turn off the system and verify that the digestion block is connected to the correct switching button 115V/230V and the fuses are not blown out. If it is the case, replace them with the same type of fuses. Turn the system on and restart the process. If the same case happens again, contact technical support at SCP SCIENCE .
Invalid Absorbance or Turbidity Value:	Verify that you had followed correctly the appropriate method at 420nm or 520nm or 590nm or 850nm. Make sure that the sample and calibration standards preparation were done according to the procedure. The zero reference tube was perfectly maintained according to the specifications and was measured before starting the analysis process. Then, restart the process. If the same case happens again, contact the technical support at SCP SCIENCE .

10

Standard Preparation for COD

10.1 Low AnD HIGH DICHROMATe CALIBRATION STAnDARD PRePARATIOn:

A. Material(s) and Reagent(s)

- Volumetric flasks.
- Pipettes.
- COD Control Solution (Catalog No. for 500 ml volume) 1000 µg/ml (Cat. No. 250-130-600), 10,000 µg/ml (Cat. No. 250-130-650), 100 µg/ml (Cat. No. 250-130-550).
- Low dichromate COD Tubes 0-150 ppm (Cat. No. 250-130-007).
- High dichromate COD Tubes 0-1500 ppm (Cat. No. 250-130-017).
- DI water.

B. Calibration standard solution preparation

- Choose an appropriate starting Control solution to prepare four to five standards with concentrations listed below (example).
- Normalize to final volume in volumetric flasks with DI water.

STD #	STD COnC. (µg/ml)	FInAL VOL. (ml)	CRM (µg/ml)	ALIQUOT (ml)
blank	0	25		
1	10	25		
2	25	25		
3	50	25		
4	100	25		
5	150	25		

Table 1. Low Dichromate

STD #	STD COnC. (µg/ml)	FInAL VOL. (ml)	CRM (µg/ml)	ALIQUOT (ml)
blank	0	25		
1	50	25		
2	250	25		
3	500	25		
4	1000	25		
5	1500	25		

Table 2. High Dichromate

C. Calibration COD tube preparation

- **LOW DICHROMATE.**
Pipette 2 ml of each low dichromate standard solution into low dichromate COD tube, then follow the same digestion procedure as samples for creating low dichromate calibration curve in **COD-200**.
- **HIGH DICHROMATE**
Aliquot 2 ml of each high dichromate standard solution into high dichromate COD tube, then follow the same digestion procedure as samples for creating high dichromate calibration curve in **COD-200**.

D. Reference Solution: Low or high dichromate 20% H₂SO₄ (v/v)**10.2 TuRBIDITY CALIBRATIOn STAnDARD PRePARATIOn**

A. Material(s) and Reagent(s)

- Volumetric flasks.
- Pipettes.
- Certified Reference Materials: 1000 NTU.
- Empty COD Tubes.
- DI water.

B. Calibration standard solution preparation.

- Aliquot CRM to prepare four to five standards with concentrations listed below (example).
- Normalize to final volume in volumetric flasks with DI water.

STD #	STD CONc. (µg/ml)	FIInAL VOL. (ml)	CRM (µg/ml)	ALIQUOT (ml)
blank	0	25		
1	5	25		
2	10	25		
3	20	25		
4	30	25		
5	40	25		

C. Calibration COD tube preparation

- Aliquot 5 or 6 ml of each standard solution into empty COD tube, and create turbidity calibration curve in **COD-200**.

D. Reference Solution: DI water

10.3 PeRMANGAnATe InDex CALIBRATIOn STAnDARD PRePARATIOn

A. Material(s) and Reagent(s)

- Volumetric flasks.
- Pipettes.
- 1N KMnO₄ stock solution.
- Empty COD Tubes.
- Conc. H₂SO₄ acid.
- Reagent grade glucose.
- DI water.

B. Reagent preparation

- Preparation of a 20% H_2SO_4 acid (v/v): 25 ml H_2SO_4 (conc.) in 100 ml total volume using DI water.
- Preparation of a 0.01N KMnO_4 solution from a 1N stock solution: dilute 0.05 ml of the KMnO_4 in 50 ml total volume, using DI water for dilution.

C. Stock glucose solution (100 ppm) preparation

- Dry some reagent grade glucose at 100 °C for 1-2 hours.
- Diluent preparation (2L): the diluent used to prepare the stock & working standards should be: 1 ml of the 25% H_2SO_4 per liter of DI water. The diluent should have a pH of 2.
- Dilute 93.8 mg of the dried glucose in 1L total volume using this diluent.

D. Preparation of calibration standards

- Aliquot glucose stock to prepare four to five standards with concentrations listed below (example).
- Normalize to final volume in volumetric flasks with DI water.

STD #	STD COnC. ($\mu\text{g}/\text{ml}$)	FinAL VOL. (ml)	STOCK STD. (ppm)	ALIQUOT (ml)
blank	0	50		0
1	0.5	50	100	0.25
2	1	50	100	0.5
3	2.5	50	100	1.25
4	5	50	100	2.5
5	10	50	100	5.0

E. Preparation of the test tube (standard and sample)

- Take new empty COD tubes
- Pipette into each tube:

Standard or sample	4 ml
25% H_2SO_4	0.8 ml
KMnO_4 (0.01N)	0.4 ml

3. Cap the vials and bring them to the **COD-200**.

- Digest and analyze the tubes using the Permanganate Index method.

F. Reference Solution: 20% H_2SO_4 (v/v)

G. Typical absorbance results

STD (ppm)	ABS (nm)
0.5	0.413
1	0.404
5	0.357
10	0.302



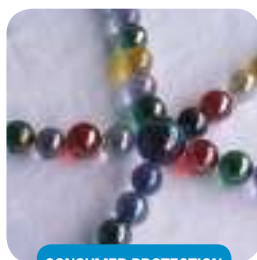
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