

Roy Cooper
Governor
Elizabeth Biser
Secretary
Michael A. Abraczinskas
Director



DAQ-09-002.1 Standard Operating Procedure (SOP) ATEC 8000 PAMS Sequential Carbonyl Sampler ECB RESPONSIBILITIES

Revision 1



North Carolina Department of Environmental Quality | Division of Air Quality
217 West Jones Street | 1641 Mail Service Center | Raleigh, North Carolina 27699-1641
919.707.8400

1.0 Approval Sign Off-Sheet

I certify that I have read and approve of the contents of the ATEC 8000 PAMS Carbonyl Sampler ECB Responsibilities Standard Operating Procedure with an effective date of July 1st, 2021.

Director, Air Quality Division

Michael Abraczinskas

DocuSigned by: Stephen G. Hall Acting for Michael Abraczinskas Date: 6/28/2021

Ambient Monitoring Section Chief

Patrick Butler

DocuSigned by: Patrick Butler Date: 6/28/2021

Laboratory Analysis Branch Supervisor

Jim Bowyer, Environmental Program Supervisor II

DocuSigned by: Jim Bowyer Date: 6/28/2021

Projects and Procedures Branch Supervisor

Joette Steger, Environmental Program Supervisor II

DocuSigned by: Joette Steger Date: 6/28/2021

Primary SOP Author

Brian D. Velleco, Chemist I

DocuSigned by: Brian D. Velleco Date: 6/28/2021

EPA Region 4

Designated Approving Official

Signature: _____ Date: _____

Disclaimer: This document, and any revision hereto, is intended solely as a reference guide to assist individuals in the operation of the instrument, related to the North Carolina Division of Air Quality's Ambient Monitoring Program.

SOP Acronym Glossary

ADQ - Audit of data quality

AQS - Air Quality System (EPA's Air database)

ASTM – American Society for Testing and Materials

°C – degrees Celsius

CASTNET – Clean Air Status and Trends Network

CFR – Code of Federal Regulations

CGA – Compressed Gasses Association

Chief – Ambient Monitoring Section chief

COC – Chain of custody

DAQ - North Carolina Division of Air Quality

DAS – Data acquisition system

DEQ – North Carolina Department of Environmental Quality

DI – deionized water

Director – Division of Air Quality Director

DNPH – 2,4-dinitrophenylhydrazine

ECB – Electronics and Calibration Branch

e-log – electronic logbook

EPA – United States Environmental Protection Agency

FAS – fixed asset number

FB – field blank

FEM – Federal equivalent method

FRM – Federal reference method

hrs - hours

in – inches

IR - Infrared

L – liters

L/min – liters per minute

LAB – Laboratory Analysis Branch – DAQ Lab located at 4403 Reedy Creek Rd in Raleigh, NC

MDL – Method detection limit

MFC – mass flow controller

min – minute

mm – millimeter

NC – North Carolina

NIST – National institute of standards and technology

PAMS – Photochemical assessment monitoring station

PDF – portable document format

PM – Particulate matter

PPB – Projects and Procedures Branch

PPE – Personal Protective Equipment

psi – pounds per square inch

QA – Quality assurance

QA/QC - Quality assurance/quality control

QAPP - Quality assurance project plan

QC – Quality control

RCL – Reedy Creek Lab

RCO – Raleigh central office

SIF – Sample Information Form

SN – serial number

SOP - Standard operating procedure

TSA - Technical systems audit

UAT – Urban Air Toxics

USB – Universal Serial Bus

µg – microgram

µm - micrometer

VOC – Volatile organic compound

± - Plus or minus

Table of Contents

1.0	Approval Sign Off-Sheet.....	2
	SOP Acronym Glossary	3
2.0	SCOPE AND PURPOSE	7
3.0	EQUIPMENT CHECKS AND MATERIALS	8
3.1	Equipment and Material List.....	8
3.2	Chemical and Material Checks.....	9
3.3	Support Equipment Checks.....	10
3.3.1	BGI-Tetracal Flow Meter Check	10
3.3.2	Ultra-Zero Air Cylinder Check (For Sampler Certification Only)	10
4.0	SITE CHECKS	10
5.0	DETAILED PROCEDURES.....	10
5.1	ATEC 8000 System Cleaning and Certification Preparation.....	10
5.2	ATEC 8000 Mass Flow Controller (MFC) Calibration.....	13
5.3	ATEC 8000 Certification Procedures (Positive Bias Check)	14
5.4	ATEC 8000 Site Installation	23
5.5	ATEC 8000 Sampler Software Update	23
6.0	DATA REVIEW.....	24
6.1	Self/Level 1 ATEC 8000 SIF and COC Review	24
6.2	Peer/Level 2 ATEC 8000 SIF and COC Review	24
6.3	Self/Level 1 Monitoring Site Logbook Review (ECB Operator)	24
6.4	Peer/Level 2 Monitoring Site Logbook Review.....	24
6.5	Self/Level 1 Cartridge Certification Data Review	24
6.6	Peer/Level 2 Cartridge Certification Data Review	25
7.0	FILE MANAGEMENT	25
7.1	Cartridge Chain of Custody and Sample Information Form Management	25
7.1.1	Gold Form (LAB).....	25
7.1.2	Pink Form (Site Operator)	25
7.1.3	White and Yellow Forms (Site Operator/LAB)	25
7.2	Monitoring Site Logbook (ECB Operator)	26
7.3	Monitoring Site Logbook (Peer/Level 2 Reviewer)	26
7.4	ATEC 8000 Sampler Certification Report (ECB Operator).....	26
8.0	DATA QUALITY ASSURANCE AND DATA HANDLING	26
8.1	Records Management.....	26

8.2 Data Archival and Digitization..... 27

9.0 TROUBLESHOOTING AND CORRECTIVE ACTIONS..... 27

9.1 Blank ATEC 8000 Display Screen..... 27

9.2 Failing Leak Check (Leak Rate is Too High) 27

10.0 REVISION HISTORY 27

11.0 REFERENCES..... 29

12.0 APPENDICES 29

Appendix A – Arc3 Purity Plus Specialty Gases Grade Specification Sheet..... 30

Appendix B – Carbonyls Cartridge Chain of Custody (COC) Form..... 31

Appendix C – Carbonyls Sample Information Form (SIF) 32

Appendix D – ATEC 8000 Monitoring Site Logbook Entry Sampler Installation Template 33

Appendix E – Example Sampler Certification Report 34

Appendix F – ATEC 8000 Replacement Parts List..... 35

2.0 SCOPE AND PURPOSE

The scope and purpose of this document is to describe the steps required to clean, certify, install, and update an ATEC 8000 Carbonyl Sampler. The ATEC 8000 Carbonyl Sampler is deployed at the North Carolina Photochemical Assessment Monitoring Station (PAMS). The PAMS is located at the Millbrook Site at 3801 Spring Forest Rd. in Raleigh, NC 27616. The Millbrook Site serves to monitor the Raleigh, NC metropolitan statistical area air shed.



Figure 1: ATEC 8000 Cartridge Sampler



Figure 2: Waters Sep-Pak 2,4-Dinitrophenylhydrazine-Silica Cartridge

The carbonyls sampler collects ambient air through a 2,4-Dinitrophenylhydrazine-Silica impregnated cartridge as depicted in figure 2. The cartridges are installed into the ATEC 8000 and the sampler maintains a set flow with a calibrated mass flow controller (MFC) over three preset collection periods. The ATEC 8000 samples ambient air sequentially, in three 8-hour increments, through the cartridges to sample over a 24-hour period. The standard sampling periods are 04:00 – 12:00, 12:00-20:00 and 20:00-04:00. Carbonyls in the cartridge react with the 2,4-Dinitrophenylhydrazine over the collection period to form stable hydrazine derivatives via the following reaction mechanism:

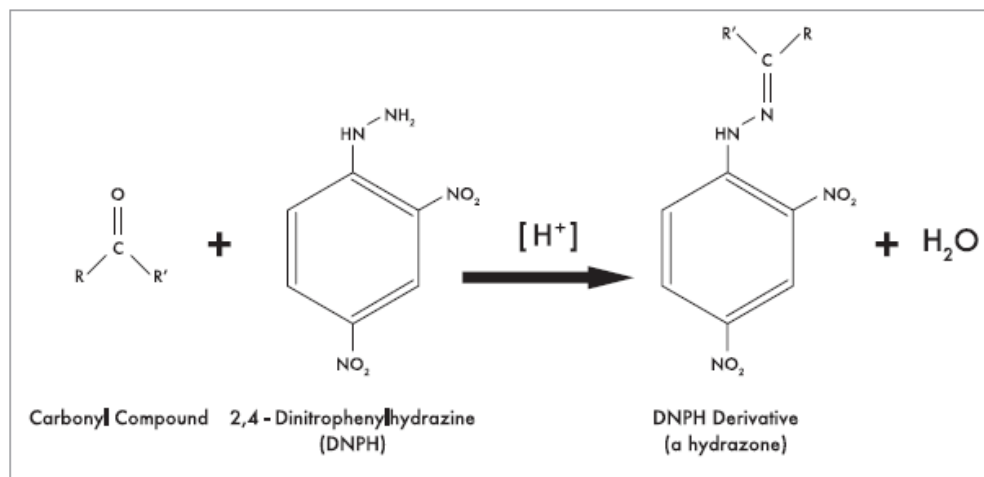


Figure 3: Carbonyl Derivatization Reaction Mechanism

The collected 24-hour sample can then be extracted and analyzed by **DAQ SOP-03.004.2 Thermo Ultimate 3000 Ultra-High Performance Liquid Chromatography Ultra-Violet and Mass Spectrometer Analysis**.

3.0 EQUIPMENT CHECKS AND MATERIALS

This section describes the equipment and materials that are required to complete the steps described in this document. Additional subsection(s) or SOPs will also describe the equipment and materials as needed.

3.1 Equipment and Material List

- ATEC 8000 Cartridge Sampler, Software Version 5.32 or later.
- ATEC Stylus Pen
- Newly Packed Activated Charcoal Cylinder with ¼-in Swagelok fittings
- Ultra-Zero Air (Arc3 Gases Grade 0.1 or equivalent – See Appendix A for gas purity information)
- CGA590 Regulator
- Cylinder Cart
- ¼-inch (in) Restek Humidification Chamber
- Type 1 American Society for Testing and Materials (ASTM) Deionized Water
- ¼-in Chromatographic grade stainless steel tubing and fittings
- 1/8-in stainless steel fittings
- Stainless Steel Conical Rain Guard
- 15-micrometer (μm) Particulate filter with ¼-in Swagelok fittings
- National Institute of Standards and Technology (NIST)-Traceable Flow Meter: BGI Tetracal with accessory pack or equivalent
- NIST-Traceable Clock: Fisherbrand Traceable Big-Digit Radio Atomic Wall Clock or equivalent
- NIST-Traceable Temperature Gun: Fisherbrand Traceable Infrared (IR) Thermometer Gun or equivalent

-
- 47 mm Teflon Filters [ATEC Part Number: 8000-200-6]
 - Replacement Polyethylene Cartridge Tubing Sets [ATEC Part Number: 8000-200-4]
 - Ozone scrubber (Potassium Iodide Denuder) [ATEC Part Number: 8000-200-11]
 - Waters Sep-Pak 2,4-Dinitrophenylhydrazine-Sicila (DNPH-Silica) Cartridge or equivalent
 - Cartridge Chain of Custody (COC) Form – An example form is in Appendix B
 - Sample Information Form (SIF) – An example form is in Appendix C
 - Insulated cooler and ice packs
 - NIST-Traceable Thermometer with Time/Date, Min/Max Memory, or equivalent inside
 - Clear Ziploc® bag or equivalent
 - Freezer – to store cooler/ice packs [no samples]
 - Temperature Logged Refrigerator for sample storage
 - Hand Tools:
 - Phillips-Head Screwdriver
 - 9/16-in Wrench
 - ½-in Wrench
 - 7/16-in Wrench
 - Two Filter Holder Wrenches
 - Tweezers
 - 12-in Adjustable Wrench or larger
 - Tape measure
 - Scissors
 - Personal Protective Equipment (PPE):
 - Gloves
 - Nitrile
 - Heat-Resistant, textured grip
 - Non-Slip steel toed shoes or boots
 - Safety glasses: prescription or impact resistant are acceptable
 - Monitoring Site Logbook (bound, numbered pages, laboratory grade)
 - Clear tape
 - Pen (blue or black ink)

3.2 Chemical and Material Checks

Chemicals and materials used in this SOP are inspected prior to use and upon receipt at the Laboratory Analysis Branch (LAB). No damaged, uncalibrated, or expired equipment is to be employed in the discharge of procedures detailed in this document. Cartridges are lot checked for impurities as detailed in **DAQ SOP-03.004.2 Thermo Ultimate 3000 Ultra-High Performance Liquid Chromatography Ultra-Violet and Mass Spectrometer Analysis** prior to their use in this SOP.

3.3 Support Equipment Checks

3.3.1 BGI-Tetracal Flow Meter Check

The BGI-Tetracal Flow Meter is calibrated annually by a third party NIST-traceable source. Ensure the calibration is within date before proceeding with the detailed procedures of this SOP. The expiration date can be determined by the adding one year to the sticker calibration date located on the bottom of the device.

3.3.2 Ultra-Zero Air Cylinder Check (For Sampler Certification Only)

- 1 Open the ultra-zero air cylinder and read the regulator pressure. The outlet pressure should be set to 45 pounds per square inch (psi).
- 2 If the regulator pressure gauge reads below 100 psi or the cylinder is expired, change the cylinder by closing the cylinder and loosening the regulator with an adjustable wrench. **Note:** CGA590 cylinders are reversed threaded.
- 3 Place the regulator on the bench and replace the cylinder. Be sure to use a cylinder cart to transport cylinders safely.
- 4 Reinstall the regulator by tightening the nut and open the cylinder. The pressure will read about 2400 psi.
- 5 Close the ultra-zero air cylinder and regulator after ATEC 8000 certification sampling operation is complete.

4.0 SITE CHECKS

Site Checks do not fall under the purview of this SOP. For operator site checks please refer to **DAQ SOP-09-002.2 ATEC 8000 PAMS Carbonyls Sampler Operator Responsibilities**.

5.0 DETAILED PROCEDURES

5.1 ATEC 8000 System Cleaning and Certification Preparation

- 1 Place the ATEC 8000 sampler on a workbench and remove the four top cover screws. These are located on the sides of the unit: two on the left and two on the right.
- 2 Remove the top cover. It will look like what is depicted below in the following figure:

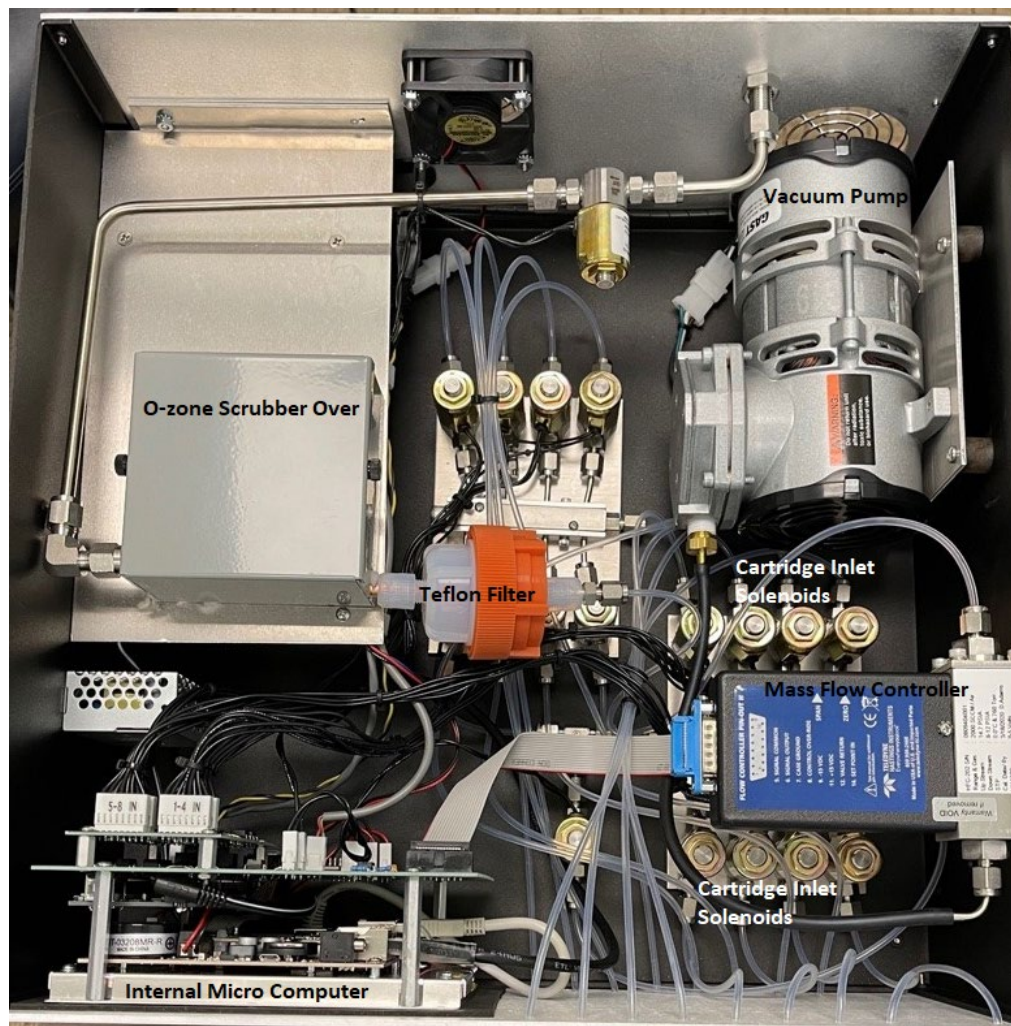


Figure 3: ATEC 8000 Internal Components

- 3 Remove the ozone scrubber oven cover.
- 4 Remove the Teflon™ filter holder.
- 5 Remove the insulation from the scrubber and set aside for re-installation in a subsequent step.
- 6 Disconnect the remaining stainless-steel fittings connecting the ozone scrubber to the ATEC sampler and remove the used ozone denuder.
- 7 Install a new ozone scrubber by adding a new stainless-steel nut and ferrule to one end of the ozone scrubber. Reposition the ozone scrubber into the oven and swage the new stainless-steel fitting to the ATEC sampler.
- 8 Gently pull back on the connection to ensure the ferrule is seated properly onto the ozone scrubber.
- 9 Reinstall the insulation put aside in step five and then re-install the oven cover.
- 10 Open the Teflon filter holder using the filter holder wrenches.
- 11 Remove the used 47-mm Teflon filter media with tweezers and replace with a new 47-mm Teflon filter. Use tweezers to install.
- 12 Re-assemble the filter holder and tighten with the filter holder wrenches.
- 13 Slide the top cover back on the ATEC sampler and re-install the top cover screws.

- 14 Connect a clean activated charcoal cylinder to the inlet fitting/port on the back panel of the ATEC sampler.
- 15 Plug in the ATEC and turn on the power switch.
- 16 The ATEC main display should appear on the panel. Wait until the sampler has warmed up to 50 degrees Celsius (°C). Allow the system to equilibrate at the oven temperature set-point for at least 30 minutes. The current oven temperature can be monitored at the bottom of the display screen as shown, below, circled in red:

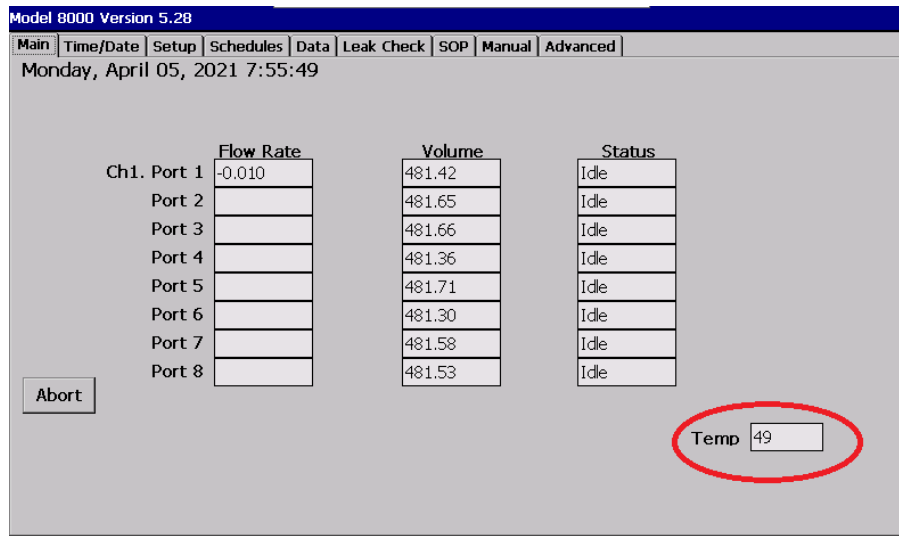


Figure 4: ATEC 8000 Main Screen with Oven Temperature Circled in Red

- 17 Using the ATEC stylus pen, select the manual tab. The following will appear:

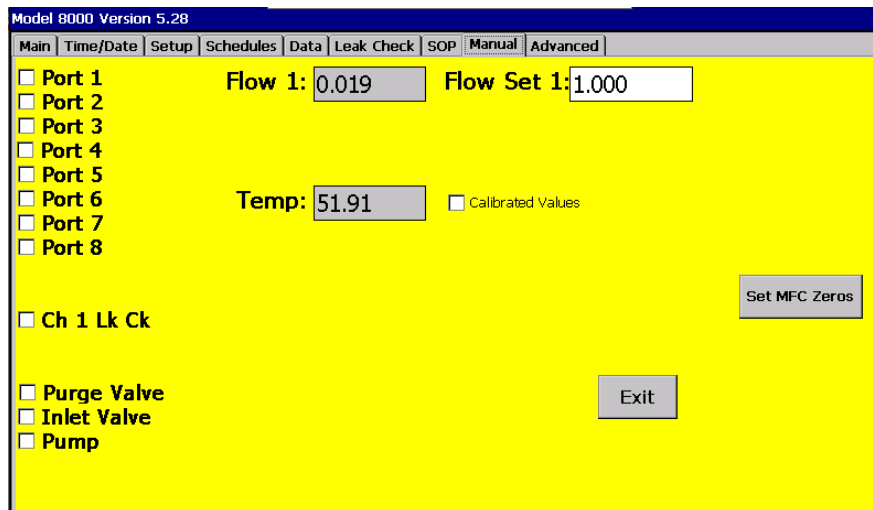


Figure 5: ATEC 8000 Manual Tab

- 18 Check the **Inlet Valve** box and **Pump** box on the ATEC 8000 screen and allow the activated charcoal system purge to flow for at least 8 hours. **Note:** This step can be performed overnight.
- 19 When the system purge is complete, uncheck the **Inlet Valve** and **Pump** on the ATEC 8000 screen. Press exit.
- 20 Disconnect the activated charcoal cylinder from the rear inlet of the ATEC 8000.

5.2 ATEC 8000 Mass Flow Controller (MFC) Calibration

- 1 Remove the four top cover screws and cover from the ATEC 8000.
- 2 Select the **Advanced** tab on the ATEC 8000 sampler display screen. The following will display on screen:

Figure 6: ATEC 8000 Advanced Tab

- 3 Set the slope to 1.0 and the intercept to 0.0. Hit **Exit** to save.
- 4 Enter the manual screen and without the pump running, observe the MFC flow rate. The flow rate will fluctuate, but it must be within 0.00 ± 0.02 liters per minute (L/min). If it is outside 0.00 ± 0.02 L/min manually adjust the MFC output by turning the **zero** adjust screw on the side of the MFC until the displayed flow rate is 0.00 ± 0.02 L/min.
- 5 Install the 0.1 to 1.2 L/min flow rate orifice into the BGI-Tetracal flow meter. Turn on the flow meter and allow it to zero and warm up for 30 seconds. During the warmup period, the flow meter will briefly display the flow range of the orifice that is inserted into the flow meter.
- 6 Disconnect the luer fitting of port 1 on the ATEC front panel and connect the BGI-Tetracal with the supplied tubing and flow check cartridge.
- 7 Turn on the sampler flow by selecting the **Manual** tab on the sampler display home screen with the ATEC Stylus Pen. Check the **Port 1** box, the **Pump** box, and the **Inlet Valve** box. The sampler will turn on and gas will begin flowing through the sampler. The MFC flow set point should be 1.000 L/min and the actual flow rate will be displayed in the **Flow 1** box on the sampler display screen. Read the flowmeter value displayed on the ATEC 8000 screen after the flow has stabilized for 5 minutes. This is the X value.
- 8 Read the BGI-Tetracal device value. This is the Y value.
- 9 Calculate the new MFC slope using equation 1:

$$(1) \text{ MFC slope} = \frac{Y}{X} = \frac{\text{BGI Tetracal Flow Rate}_{L/MIN}}{\text{ATEC 8000 Flow Rate}_{L/MIN}}$$

- 10 Navigate back to the **Advanced** tab and enter the new slope value. Press **Exit** to save changes.

- 11 Navigate to the **Manual** tab and check the **calibrated values** box.
- 12 Start the pump and open the port 1 solenoid valve. Verify the displayed flow rate is the same as the value displayed on the BGI Tetracal.
- 13 The flow controller calibration procedure is valid for one year and must be completed on an annual basis.
- 14 Record the slope values in the designated sampler laboratory logbook.
- 15 Reinstall the four set screws and cover on the ATEC 8000.
- 16 Install a MFC Calibration sticker on the unit, indicating when the calibration was performed and when it expires. This can be done after completion of section 5.3 – ATEC 8000 Certification Procedures

5.3 ATEC 8000 Certification Procedures (Positive Bias Check)

- 1 Request blank DNPH cartridges, SIF, and a COC from the LAB. The LAB will fill out the **Laboratory Setup Information** section of the SIF form. The ATEC 8000 sampler will need one cartridge per sample port: eight total.
- 2 Sign the COC **Received by** field and fill in the **date/time** of sampling media acceptance.
- 3 Begin by completing the **Field Setup Information** section as detailed in the subsequent steps:
- 4 Locate the ATEC 8000 sampler serial number (SN) or Fixed Asset Number (FAS). Record the number in the **Sampler SN or FAS#** field on the Cartridge SIF form.
- 5 Record the sampler certification expiration date in the **Sampler Expiration Date** field on the SIF form.
- 6 Record the initials of the operator, including the date and time of the cartridge setup in the **Site Operator (Initial, Date, and Time of Setup)** field of the SIF.
- 7 Record the date and time displayed on the ATEC 8000 sampler screen in the **As Found Sampler Display Date and Time** field on the Cartridge SIF form.
- 8 Record the date and time displayed on the NIST-traceable time keeping device along with the associated serial number in the **NIST Device Date, Time, S/N** field on the SIF.
- 9 Calculate the absolute time difference, in minutes, and record the result in the **Time Difference (min)** field on the SIF. Circle the appropriate response in the **Time Difference Less than 5minutes?** field.
- 10 If the sampler display time differs more than or equal to 5 minutes, use the ATEC stylus to select the **Date/Time** tab on the sampler screen. A popup window titled **Date/Time Properties** will appear as shown below:

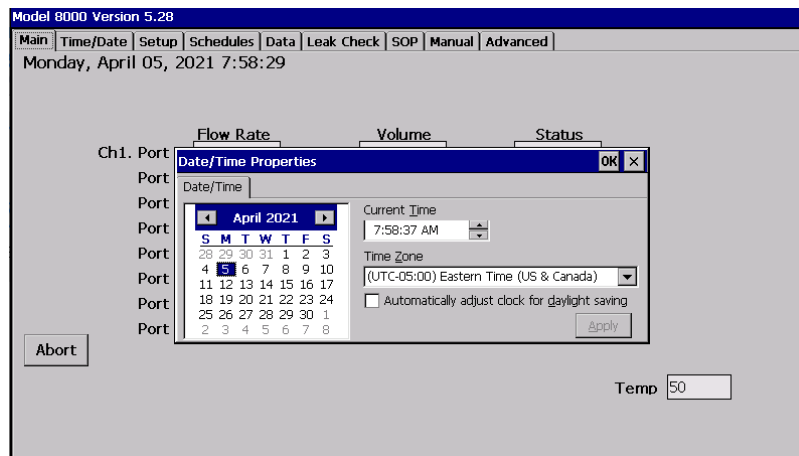


Figure 7: ATEC 8000 Time/Date Tab

- 11 Adjust the date and/or time to match the NIST-traceable date and time device. Click **Apply** when finished to push the settings to the instrument. Record the newly adjusted sampler display date and time in the **As Left Sampler Display Date and Time (if adjustment made)** field on the SIF form. If no adjustment was required, put a line through the entry field or write N/A. **Note:** The North Carolina Division of Air Quality (DAQ) does not observe daylight savings times on ambient monitoring equipment and no offset will be applied when daylight savings occurs. All recorded times are Eastern Standard Time.
- 12 Attach the ultra-zero air cylinder and pre-filled humidification chamber with type 1 ASTM deionized water to the inlet/fitting port on the rear of the ATEC 8000. Open the cylinder and regulator.
- 13 Perform a pre-sampling flow check of the ATEC 8000 sampler by installing the designated flow check DNPH cartridge to the outlet line of port 1 on the ATEC 8000 sampler. Leave the cartridge inlet disconnected from the inlet line of port 1 on the ATEC 8000 sampler as depicted below:



Figure 8: ATEC 8000 DNPH Cartridge Flow Check Connection Setup

The cartridge is inserted in this direction due to the design and a cutaway view is provided by Waters

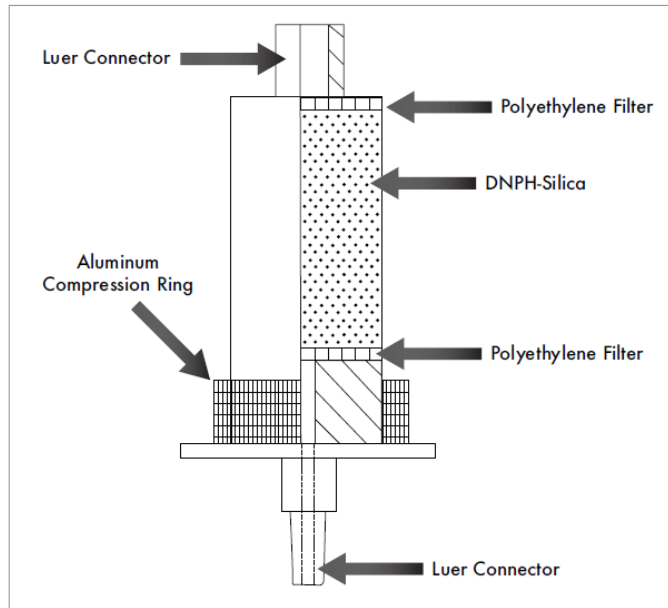


Figure 9: Waters Cartridge Design

- 14 Turn on the sampler flow by selecting the **Manual** tab on the sampler display home screen with the ATEC Stylus Pen. Check the **Port 1** box, the **Pump** box, the **Inlet Valve** box, and check **Use Calibrated Values** box. The sampler will turn on and gas will begin flowing through the sampler. The MFC flow set point should be 1.000 L/min and the actual flow rate will be displayed in the **Flow 1** box on the sampler display screen as shown below:

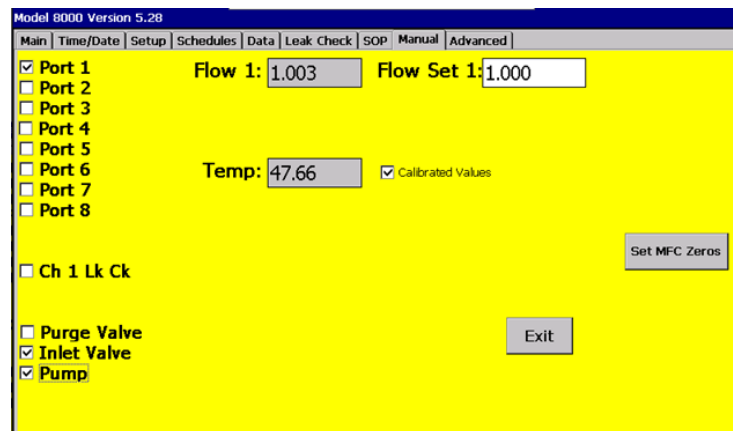


Figure 10: ATEC 8000 Flow Check Configuration for Port 1

Allow the sampler to equilibrate for 5 minutes.

- 15 Install the 0.1 to 1.2 L/min flow rate orifice into the BGI-Tetracal flow meter. Turn on the flow meter and allow it to zero and warm up for 30 seconds. During the warmup period, the flow meter will briefly display the flow range of the orifice that is inserted into the flow meter. Record the flow meter serial number and expiration date into the **NIST Flow Standard (SN, Exp. Date)** field on the SIF form.

- 16 Connect the BGI-Tetracal to the open end of flow check DNPH cartridge installed on the sampler as depicted below:



Figure 11: ATEC 8000 DNPH Cartridge Flow Check Setup

- 17 Allow the two systems to equilibrate for one minute and read the flow rate displayed on the BGI-Tetracal. Record the flow rate in the **Measured Pre-Sample Flow Rate (L/min)** field on the SIF form.
- 18 Turn off the BGI-Tetracal and disconnect it from the flow check DNPH cartridge.
- 19 Remove the flow check DNPH cartridge from the system.
- 20 Inspect the supplied DNPH cartridge from the LAB. It will be labeled with a sampler number on the foil pouch. This number should match the sampler number listed on the COC and SIF form. In the event these two do not match, the operator can correct the sample number on the foil pouch (or corresponding form in the event the SIF does not equal the COC) to match the sample number on the SIF and COC forms. The operator must document this change with a comment in the **Field Comments** section of the SIF form. An example comment would be **cartridge sample number did not match SIF/COC sample number; operator corrected**. These comments are paramount to reconstruct the sampling activities when post-collection review occurs.
- 21 Repeat steps 13-20 for each port to be certified: ports 2 - 8.
- 22 Proceed to connect the certification sample cartridge to port 1.
- 23 Connect the sample cartridge to the ATEC 8000 in the orientation depicted below in figure 12. Use a slight twisting motion while connecting the ATEC sampler to the DNPH cartridge to make luer fitting leak-tight connections.



Figure 12: ATEC 8000 DNPH Cartridge Collection Setup

24 Select the **Leak Check** tab on the ATEC sampler touch screen. The following will appear:

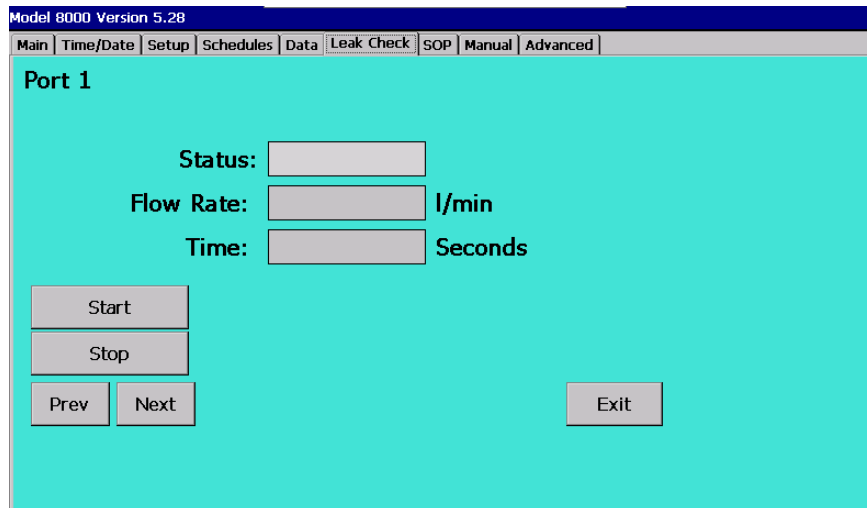


Figure 13: ATEC 8000 Leak Check Tab

25 Press the **Start** button. The leak check takes approximately 20 seconds to complete.

- 26 Record the value in the **Flow Rate** box on the ATEC 8000 sampler screen in the **Leak Rate (L/min)** field on the SIF form. If the leak rate passes acceptance criteria, circle **Yes** in the **Leak Check Pass? (Circle one)** field on the SIF form. If the leak rate fails to meet criteria, circle **No** in the same field and see section 9.2 of this document for troubleshooting a failed leak check. Do not proceed with collection if the leak check fails.
- 27 Repeat steps 22-26 for ports 2 - 8. To perform a leak-check on the next port hit the next button in the lower left of the leak check tab. Then hit start. The top left corner of the display panel will indicate the current port being leak checked.
- 28 The scheduled sample date should be pre-recorded in the **Scheduled Sampling Date** field on the COC and SIF form. If that field happens to be empty, the sample date can be found coded in the **Sample #** field on the SIF form or on the foil pouch. If the sample number is PC060121M1, the scheduled sample date is June 1st, 2021. Record the scheduled sampling date and time in the **DNPH Cartridge Scheduled Sampling Date/Time** field.
- 29 Select the **Schedules** tab on the ATEC 8000 display with the stylus. A new window will appear as shown below:

Figure 14: ATEC 8000 Scheduling Tab

- 30 Use the drop-down arrow to select the Start Date for port 1. This date should match the date recorded in the **DNPH Cartridge Scheduled Sampling Date/Time** field on the SIF form. The Start Time can be adjusted, and corrected, to whenever the operator wants to begin the certification process in conjunction with schedule availability. Use the Left and Right arrows to adjust the start time. The Duration should always be 8.00 hours as this is the collection time for the PAMS carbonyls collection detailed in the approved **PAMS QAPP DAQ-01-007**. Highlight the value entered in the Duration field. A new popup window will appear looking like a calculator; select 8.00, click apply when done. The Run Label should be the Sampler Certification Port#. An example label for port 1 would be **Sampler Certification 1**.
- 31 Press next to configure the next port (port 2). Configure the start time to begin 8 hours after that of previous port (Port 1). Check the **follow previous port box** to immediately follow the previous sample port.
- 32 Repeat step 31 for ports 3 – 8 for the certification process.
- 33 Once the final port start date, time and duration has been entered, click the **Exit** button in the lower right corner of the Schedules screen. You should return to the sampler main display screen.

- 34 The **Status** field on the main screen should change to display **Waiting** as shown below. This may take a few seconds to appear. The **Waiting** status indicates the sampler has accepted the programmed start date, time and duration and will wait to start until the date and time has occurred locally on the unit.

	Flow Rate	Volume	Status
Ch1. Port 1	-0.006	481.42	Waiting
Port 2		481.65	Waiting
Port 3		481.66	Waiting
Port 4		481.36	Idle
Port 5		481.71	Idle
Port 6		481.30	Idle
Port 7		481.58	Idle
Port 8		481.53	Idle

Temp 51

Figure 15: ATEC 8000 Status Waiting Screen

- 35 All ports should show the **Waiting** status dialogue. Return to the sampler within 48 hours after the sampling event completes. **Note:** The certification procedure will take 2 days and 16 hours to complete.
- 36 Record your initials, date, and time of sample pickup in the **Site Operator (initial, date, time of pickup)** field in the **Field Recovery Information** section of the SIF form.
- 37 Touch the ATEC display screen to wake it up. The Status field on the main screen should display **Finished** for each port.
- 38 Using the Stylus, select the **Data** tab and a screen like the example below should appear for the sampling event.

Port 1

Started: 6/12/2021 4:00:02 AM

Stopped: 6/12/2021 12:00:31 PM

Flow: 1.00 1.00 1.00 lpm
Avg Min Max

Status: OK No Errors

Volume: 481.5 Liters Elapsed Time: 8.00 Hours

Prev Next Store Label Exit

Figure 16: ATEC 8000 Data Screen Displaying Post-Sampling Data

- 39 Record the **Started** and **Stopped** dates and times that are displayed in the **Sample Start Date & Time** and **Sample Stop Date & Time** fields on the SIF form.

- 40 Record the **Volume** displayed on the ATEC 8000 screen in the **SAMPLE VOLUME (L)** field on the SIF form.
- 41 Record the **Elapsed Time** displayed on the ATEC 8000 screen in the **Sample Duration (hrs)** field on the SIF.
- 42 Insert a Universal Serial Bus (USB) storage device into the ATEC 8000. The port is located on the front panel underneath the touch display screen. Press the **Store** button with the stylus. This will download data from all eight ports simultaneously. The following dialogue box will appear to confirm the data download:

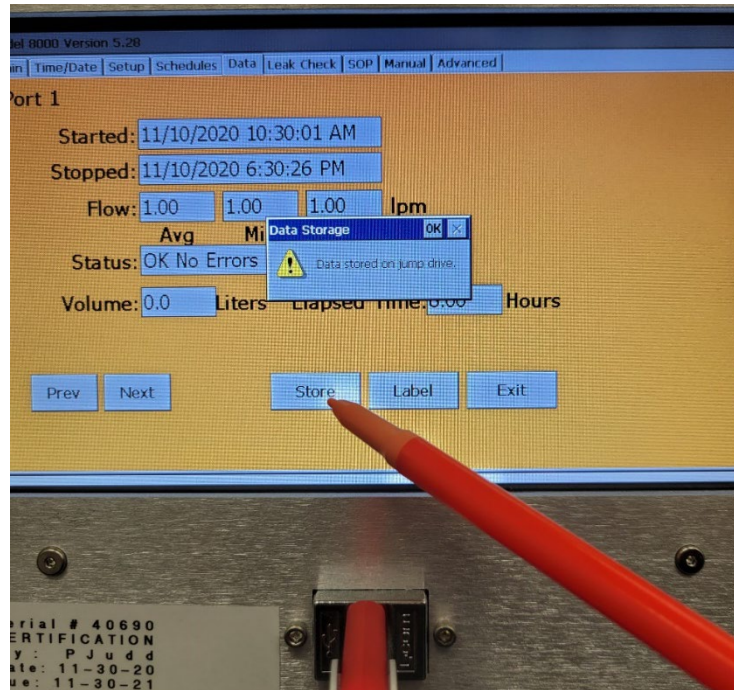


Figure 17: ATEC 8000 Data Download Confirmation

- 43 Repeat steps 39-41 for each cartridge by hitting the next tab in the lower left corner of the display.
- 44 While wearing nitrile gloves, remove each sampled DNPH cartridge from the ATEC 8000 sampler. Install the end caps and place the cartridge in the labeled foil pouch that it was removed from during sample setup. Seal the foil pouch closed.
- 45 Place the foil pouch inside a clear Ziploc bag and seal closed. Place the cartridge in the insulated cooler, in between the ice packs with a NIST-Traceable min/max temperature device inside.
- 46 Perform a post-sampling flow check of the ATEC 8000 sampler. Install a designated flow check DNPH cartridge to the outlet line of port 1 on the ATEC 8000 sampler. Leave the cartridge inlet disconnected from the inlet line of port 1 on the ATEC 8000 sampler as configured previously in Section 5.1, figure 6.
- 47 Turn on the sampler flow by selecting the **Manual** tab on the sampler display home screen with the ATEC Stylus Pen. Check the **Port 1** box, the **Pump** box, the **Inlet Valve**, and check **Use Calibrated Values** box. The sampler will turn on and gas will begin flowing through the sampler. The MFC flow set point should be 1.000 L/min and the actual flow rate will be displayed in the **Flow 1** box on the sampler display screen. Allow the sampler to equilibrate for 5 minutes.
- 48 Install the 0.1 to 1.2 L/min flow rate orifice into the BGI-Tetracal flow meter. Turn on the flow meter and allow it to zero and warm up for 30 seconds. During the warmup period, the flow meter will briefly display the flow

- range of the orifice that is inserted into the flow meter. Record the flow meter SN and expiration date into the **NIST Flow Standard (SN / Exp. Date)** field on the SIF form.
- 49 Connect the BGI-Tetracal to the open end of flow check DNPH cartridge installed on the sampler as done previously in figure 11.
 - 50 Allow the two systems to equilibrate for one minute and read the flow rate displayed on the BGI-Tetracal. Record the flow rate in the **Measured Post Sample Flow Rate (L/min)** field on the SIF form.
 - 51 Repeat steps 44-50 for each sample port certified: ports 2 – 8.
 - 52 Turn off the BGI-Tetracal and disconnect it from the flow check DNPH cartridge.
 - 53 Remove the flow check DNPH cartridge from the system.
 - 54 At this point all fields in the **Laboratory Setup Information; Field Setup Information; and Field Recovery Information** of the SIF should be filled out in their entirety.
 - 55 Remove the bottom copy (pink) of the SIF. Fill out in-person for the **Shipment Method** and N/A in the **Tracking Information** field on the COC form. Remove the bottom (pink) copy of the COC and store it with the other certification materials in the LAB electronics technician's office.
 - 56 Place the SIF and COC form in the document sized Ziploc bag and seal it. Place the forms on top of the ice packs inside the insulated shipper containing the recently retrieved DNPH certification cartridges.
 - 57 Allow the cartridges to cool down to 4°C. This may take several minutes. Transfer custody to the LAB by signing the **Relinquished by** field of the COC and filling out the **Date/Time** field contemporaneously.
 - 58 Upon receipt by another LAB staff member, measure the temperature of the collected or delivered samples with a NIST-Traceable IR gun. Mark the **Receipt Temperature** and **IR Gun Serial Number** on the SIF in the **Laboratory Receipt/Login Section**. Sign the **Sample Received By:** field and contemporaneously record the **Receipt Date/Time** on the SIF and COC. **Receive Custody** of the cartridges by signing the COC form. Store the samples in RCL fridge 2. Fill RCL fridge 2 in the **Post-sample Storage Location** on the COC.
 - 59 Upload the downloaded data files from the ATEC 8000 to the P-drive in the following location: **P:\LAB (Laboratory Analysis Branch)\PAMS\ATEC 8000 Data**. Create a folder for each sampling event in the following formation: **YYYY-MM-DD Serial Number Certification**. An example data folder name of a certification performed on June 1st, 2021 with serial number 40690 would be: **2021-06-01 40690 Certification**. Copy the files from the USB storage device to this newly created folder.
 - 60 Place a certification sticker after analysis by **DAQ SOP-03-004.2 Thermo Ultimate 3000 Ultra-High Performance Liquid Chromatography Ultra-Violet and Mass Spectrometer Analysis** confirms the sampler is contributing no bias to the collection process. All target compounds of **DAQ SOP-03-004.2** must be <0.20 micrograms (µg)/cartridge. The certification sticker should include the sampler serial number, certifying operator, date performed, date due and the scrubber due date. An example certification sticker is shown below:

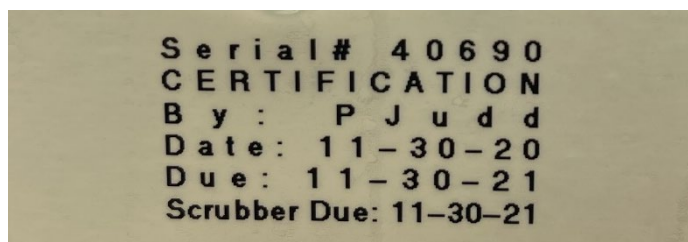


Figure 18: ATEC 8000 Sampler Certification Sticker

5.4 ATEC 8000 Site Installation

- 1 Transport the ATEC 8000 and inlet materials to the Millbrook site.
- 2 Install the ATEC 8000 in the rack mount within the shelter.
- 3 Replace the inlet tubing with new ¼-in chromatographic grade stainless steel tubing, fittings, and ferrules as well as the inverted conical stainless steel rain guard and 15-µm particulate filter with ¼-in Swagelok fittings. Existing inlets should be replaced annually at a minimum.
- 4 Connect the inlet to the rear of the ATEC 8000.
- 5 Power on the unit and allow it to warm up to 50°C. The ATEC 8000 will be flow checked by the site operator prior to the next sampling date.
- 6 Measure the length of the inlet and record the total length within the site logbook along with the installation date and operator initials and serial number of the sampler installed. An example logbook entry template is in Appendix D and is available in a printable format at **P:\LAB (Laboratory Analysis Branch)\Forms and Templates**.
- 7 Alert the site operator(s) that the sampler is installed and ready for use.

5.5 ATEC 8000 Sampler Software Update

Periodically, updates are released by ATEC for the ATEC 8000 sampler software. Updates may be big or small and are released to correct errors or bugs identified within the sampler software. To install an update:

- 1 Contact ATEC to obtain the latest version of the ATEC 8000 software. At the time of this publication, v5.32 was the current software revision. ATEC can be contacted at techsup@atec-online.com.
- 2 Rename the downloaded file from a **.txt** extension to a **.zip** extension. Unzip the file. **Note:** file extension types must be enabled in windows explorer to do this.
- 3 Rename the **update.dat** file to **update.exe** and the **Model8000.dat** file to **Model8000.exe**.
- 4 Copy these two files to a FAT32 formatted USB drive.
- 5 With the sampler running, insert the USB drive with the new software into the ATEC 8000 USB port.
- 6 Select the **Setup** tab and press the **Update** button. It will take a few seconds to update the sampler.
- 7 The sampler will automatically reboot once updated and will read with the new revision number in the top left corner. E.g., Version 5.32.
- 8 Remove the USB drive and document the upgrade in the appropriate logbook.
- 9 Upload the current version of the ATEC 8000 software to the **P-drive** for backup in the following location:
P:\LAB (Laboratory Analysis Branch)\Instrument Software\ATEC

6.0 DATA REVIEW

This section of the SOP describes steps required to perform a self/Level 1 review on the ATEC 8000 sampler data. Additionally, this section describes steps required for LAB personnel not directly involved in the ATEC 8000 operation process to perform a peer/Level 2 data review. The review of the analyzed cartridge certification data, while separate in scope, is also considered in this SOP. Ultra-High Performance Liquid Chromatography operation is not covered in this SOP and is reserved for qualified operators only. Please see **DAQ SOP-03.004.2 Thermo Ultimate 3000 Ultra-High Performance Liquid Chromatography Ultra-Violet and Mass Spectrometer Analysis** for details.

6.1 Self/Level 1 ATEC 8000 SIF and COC Review

Review the completed sections of the cartridge SIF and COC form. Review the SIF and COC form for completeness and accuracy. Confirm that all equipment serial numbers, expiration dates, times and other manual entries match the work performed. The LAB primary reviewer will review all entries under procedures in **DAQ SOP-03.004.2 Thermo Ultimate 3000 Ultra-High Performance Liquid Chromatography Ultra-Violet and Mass Spectrometer Analysis**.

6.2 Peer/Level 2 ATEC 8000 SIF and COC Review

Review the completed sections of the cartridge SIF and COC form. Review the SIF and COC form for completeness and accuracy. Confirm that all equipment serial numbers, expiration dates, times and other manual entries match the work performed. The LAB peer reviewer will review all entries under procedures in **DAQ SOP-03.004.2 Thermo Ultimate 3000 Ultra-High Performance Liquid Chromatography Ultra-Violet and Mass Spectrometer Analysis**.

6.3 Self/Level 1 Monitoring Site Logbook Review (ECB Operator)

Review the completed sections of the logbook entry. Confirm that all equipment SNs, expiration dates and other manual entries match the work performed. Initial and date the logbook entry to indicate a level 1 review has occurred and submit for secondary, level 2 peer review. It is the responsibility of the primary, level 1, operator to find a suitable reviewer in a timely manner.

Note: The site logbook is to remain at the monitoring site. Logbook review will occur onsite.

6.4 Peer/Level 2 Monitoring Site Logbook Review

Review the completed sections of the logbook entry. Confirm that all equipment SNs, expiration dates and other manual entries match the work performed. Initial and date the logbook entry to indicate a level 2 review has occurred.

Note: The site logbook is to remain at the monitoring site. Logbook review will occur onsite periodically.

6.5 Self/Level 1 Cartridge Certification Data Review

Review that data meets requirements in **DAQ SOP-03.004.2 Thermo Ultimate 3000 Ultra-High Performance Liquid Chromatography Ultra-Violet and Mass Spectrometer Analysis**. Complete the ATEC Sampler

Certification Report – an example report is included in appendix E. All target compounds must be below 0.20 µg/cartridge to certify the sampler for use. The certification is good for one year past the date of sample collection. Initial and date the certification report to indicate a level 1 review of the data has occurred. Be sure to include the supporting data with the certification report.

6.6 Peer/Level 2 Cartridge Certification Data Review

Review that data meets requirements in **DAQ SOP-03.004.2 Thermo Ultimate 3000 Ultra-High Performance Liquid Chromatography Ultra-Violet and Mass Spectrometer Analysis**. Complete the ATEC Sampler Certification Report – an example report is included in appendix E. All target compounds must be below 0.20 µg/cartridge to certify the sampler for use. The certification is good for one year past the date of sample collection. Initial and date the certification report to indicate a level 2 review of the data has occurred. Be sure to include the supporting data with the certification report.

7.0 FILE MANAGEMENT

This section of the SOP describes the different files generated during the ATEC 8000 operation processes and procedures as well as the individual required to manage the file. Files include the cartridge COC form, SIF, and monitoring site logbook.

7.1 Cartridge Chain of Custody and Sample Information Form Management

This form contains four-carbonless-copies (gold, pink, yellow, and white). During the DNPH cartridge sample setup and installation the COC and SIF form should only contain three of the four carbonless copies. The bottom copy should be pink.

7.1.1 Gold Form (LAB)

The LAB keeps the gold copy as a record of DNPH cartridge SIF creation and COC form creation. If the bottom copy is gold, please remove the gold copy and return it to the LAB for record storage.

7.1.2 Pink Form (Site Operator)

After the DNPH cartridge sample has been retrieved, all **Laboratory Setup Information, Field Setup Information, and Field Recovery Information** fields on the SIF form should be completed. Remove the pink copy of the SIF and COC form to keep as a backup record for the DNPH cartridge sampling event. Store the pink copy at the field site or in the site operator's office.

7.1.3 White and Yellow Forms (Site Operator/LAB)

Place the white and yellow copies of the form in the clear Ziploc bag and place in the insulated cooler for return to the LAB. These are used to transfer custody of the sample from the field to the LAB and to record the sampling data used in data reduction in **DAQ SOP-03-004.02**. These become part of the final data package and are electronically memorialized on the **P-drive**.

7.2 Monitoring Site Logbook (ECB Operator)

This record is stored at the monitoring site and maintained by the ECB operator. During the sampler installation, the ECB operator will fill out the logbook by initialing and dating the logbook entry using blue or black indelible ink. Include a summary of the site activities performed and results of instrument checks (if any performed).

Site logbook entries should include:

- Date of Sampler Installation
- Operator ID
- ATEC 8000 SN or FAS#
- Total inlet length
- ATEC 8000 has reached 50°C check (Y/N entry)
- ATEC 8000 Certification Date
- ATEC 8000 Certification Expiration Date

An ATEC 8000 monitoring site logbook entry sampler installation template is available in appendix D. If the template is to be used, cut, and paste it into the site logbook. Initial and date over the interface where the logbook entry meets the logbook page. Place a piece of clear tape over the entry. Secure the entire entry to the logbook.

Logbook entry mistakes/typos will be crossed out with a single line with the initials and date of when the correction was made. Write the corrected entry next to the crossed-out errata. The logbook entries are considered a primary record of the installation event. There may be instances when copies of the logbook entries must be sent via email or stored electronically for equipment troubleshooting and data validation procedures.

7.3 Monitoring Site Logbook (Peer/Level 2 Reviewer)

The ECB operator will store the completed ATEC 8000 logbook entry within the Monitoring Site Logbook. The reviewer does not need to maintain this entry.

7.4 ATEC 8000 Sampler Certification Report (ECB Operator)

The ECB operator will store a copy of the completed ATEC Sampler Certification Report in the ATEC binder in the Electronic Technician's office at the LAB. The certification is valid for one year past the date of the certification sample collection.

8.0 DATA QUALITY ASSURANCE AND DATA HANDLING

8.1 Records Management

Printed records will be held at the DAQ LAB for the period specified in the DAQ document retention guidelines.

8.2 Data Archival and Digitization

Reviewed COC records from each month will be scanned and archived on the P: drive. Scanned SIFs are digitized and memorialized on the P: drive per extraction batch.

9.0 TROUBLESHOOTING AND CORRECTIVE ACTIONS

The following troubleshooting and corrective actions can be performed by the operator in the event a DNPH cartridge sampling issue occurs. The most common issues encountered during DNPH cartridge sampling are discussed below. Please refer to the instrument manual for additional troubleshooting steps in the event a sampling issue occurs that is not described below.

9.1 Blank ATEC 8000 Display Screen

The ATEC 8000 display screen has a time out, or screen saver, feature that will cause the screen to go dark when not in use. Simply touch the screen to wake it up and you should be able to select sampler display menu screens and functions. If the screen does not come back on, try to power the instrument on and off again. During power up the display screen should illuminate with various starting windows. If the display screen continues to remain blank, the touchscreen likely requires replacement. Contact ATEC for replacement parts at techsup@atec-online.com. See Appendix F for a replacement part listing.

9.2 Failing Leak Check (Leak Rate is Too High)

If a failing leak check occurs, where the leak rate exceeds the acceptance criteria listed in the SIF form, remove the sampled DNPH cartridge and re-install. Pay close attention to how snug the sampler line fittings attach to the DNPH cartridge. Remember the connection is not threaded; it is a luer-lock type fitting. This means that a slight push and twist motion should create a leak tight fitting between the DNPH cartridge and sampler lines. If the leak check continues to fail, the sampler requires further maintenance. The polyethylene tubing is likely cracked or worn and requires replacement. Maintain a supply of replacement tubing and contact ATEC for replacement parts at techsup@atec-online.com as needed.

10.0 REVISION HISTORY

1. Rev 0 – **BDV** 04/15/2021 Original Publication
2. Rev 1 – **BDV** 07/01/2021 Changes:
 - a. Updated equipment and materials list.
 - b. Section 3.2.1 – added how to determine the expiration date of the BGI TetraCal.
 - c. Added new PAMS Chain of Custody Form
 - d. Changed existing Chain of Custody (COC) Form to Sample Information Form (SIF) and changed previous references to the COC to SIF. The new COC is referenced where appropriate.
 - e. Formatted items in quotations to bold for emphasis.
 - f. Updated figures 8, 11 and 12 to reflect the cartridge orientation utilized by DAQ.

- g. Updated figure 16 to reflect data generated from a sampling event, previous figure had zero in the volume field and might lead to confusion as this is not what should be displayed after a successful sampling event.
- h. Added use of humidification chamber in sample certification as to reconcile differences between this SOP and the approved PAMS QAPP **DAQ-01-007**.
- i. Section 5.3 – Added data upload location for clarification
- j. Added section 5.5 sampler software updates for operator reference.
- k. Section 7.0 – Fixed typo in section header that referred to precision diluter process. Carryover from a previous SOP template.
- l. Section 7.1 – Added SIF reference and simplified section to apply to the SIF and COC.
- m. Section 9.2 – Added maintain a supply of replacement polyethylene tubing as to prevent sampler downtime. DAQ only owns one ATEC 8000 sequential sampler and will try to obtain another as funding allows.

11.0 REFERENCES

1. ATEC (2019) Model 8000 Automated Sampler: Operations and Maintenance Manual. Version 3.02. Malibu, CA. ATEC Atmospheric Technology.
2. Waters (2009) Waters SEP-PAK DNPH-Silica Cartridge: Care and Use Manual. Revision B. Milford, MA Waters Corporation.
3. United States Environmental Protection Agency: Office of Research and Development (1999). Compendium Method TO-11A: Determination of Formaldehyde in Ambient Air using Adsorbent Cartridge Followed by High Performance Liquid Chromatography (HPLC). Second Edition. Cincinnati, OH. William T. "Jerry" Winberry Jr., Silvestre Tejada, Bill Lonneman and Ted Kleindienst.
4. United States Environmental Protection Agency: Office of Air Quality Planning and Standards (2016). Technical Assistance Document for the National Air Toxics Trends Station Program. Revision 3. Research Triangle Park, NC. Authored by Battelle Memorial Institute (Columbus, OH).
5. United States Environmental Protection Agency: Office of Air Quality Planning and Standards (2019). Technical Assistance Document for Sampling and Analysis of Ozone Precursors for The Photochemical Assessment Monitoring Stations Program. Revision 2. Research Triangle Park, NC. Publication Number EPA-454/B-19-004.

12.0 APPENDICES

1. Appendix A – Arc3 Purity Plus Specialty Gases Grade Specification Sheet
2. Appendix B – Carbonyls Cartridge Chain of Custody (COC) Form
3. Appendix C – Carbonyls Sample Information Form (SIF)
4. Appendix D – ATEC 8000 Monitoring Site Logbook Entry Sampler Installation Template
5. Appendix E – Example Sampler Certification Report
6. Appendix F – ATEC 8000 Replacement Parts List

Appendix A – Arc3 Purity Plus Specialty Gases Grade Specification Sheet



PURE GAS GRADE SPECIFICATIONS

CONTAMINATE LEVELS (UNLESS OTHERWISE NOTED AS %)

PRODUCT	GRADE	PURITY	PART #	VALVE	O2	THC*	H2O	CO	CO2	N2
ACETYLENE										
ATOMIC ABSORPTION<->	2.6	99.6%	ACE-26-300	510	< 4000 PPM (combined)	-	-	-	-	-
⇨ < 20 PPM PH3										
AIR										
ULTRA ZERO	0.1	-	AIR-UZ-300	590	19.5% - 23.5%	<0.1 ppm	<3 ppm	<1 ppm	<1 ppm	-
ZERO	1.0	-	AIR-ZE-300	590	19.5% - 23.5%	<1 ppm	-	-	-	-
EXTRA DRY	-	-	AIR-ED-300	590	19.5% - 23.5%	-	<8 ppm	-	-	-
ARGON										
RESEARCH	6.0	99.9999%	CDI-50-60	580	<0.2 ppm	<0.1 ppm	<0.2 ppm	<0.1 ppm	<0.1 ppm	<0.4 ppm
CHROMATOGRAPH	5.5	99.9995%	ARG-55-XX	580	<1 ppm	<0.1 ppm	<1 ppm	-	-	<3 ppm
NITROGEN FREE	5.0	99.9990%	ARG-NF-XX	580	<2 ppm	<0.5 ppm	<2 ppm	-	-	<4 ppm
UHP	5.0	99.999%	ARG-50-300	580	<1 ppm	<0.5 ppm	<1 ppm	-	-	-
PREPURIFIED	4.8	99.998%	ARG-48-300	580	<5 ppm	<2 ppm	<5 ppm	-	-	-
ZERO	4.8	99.998%	ARG-ZE-300	580	-	<0.5 ppm	-	-	-	-
CARBON DIOXIDE										
RESEARCH	5.0	99.999%	CDI-50-50	320	<1 ppm	<0.5 ppm	<2 ppm	<0.1 ppm	99.999%	<1 ppm
Scientific	4.8	99.998%	CDI-48-50	320	<2 ppm	<2 ppm	<3 ppm	<1 ppm	99.998%	-
LASER	4.5	99.995%	CDI-45-50	320	<5 ppm	<1 ppm	<5 ppm	-	99.995%	-
COLEMAN/ INSTRUMENT	4.0	99.99%	CDI-40-50	320	<20 ppm	-	<10 ppm	-	99.99%	<50 ppm
ANAEROBIC	3.0	99.9%	CDI-30-50	320	<20 ppm	-	-	-	99.9%	-
BONE DRY	2.8	99.8%	CDI-28-50	320	-	-	<20 ppm	-	99.8%	-
HELIUM										
GRADE 7	7.0	99.99999%	HEL-70-300	580	<50 ppb	<20 ppb	<50 ppb	<20 ppb	<20 ppb	<50 ppb
RESEARCH	6.0	99.9999%	HEL-60-300	580	<0.2 ppm	<0.1 ppm	<0.2 ppm	<0.1 ppm	<0.1 ppm	<0.4 ppm
CHROMATOGRAPH	5.5	99.9995%	HEL-55-XX	580	<1 ppm	<0.5 ppm	<1 ppm	-	-	<3 ppm
UHP	5.0	99.999%	HEL-50-300	580	<1 ppm	<0.5 ppm	<1 ppm	-	-	-
PREPURIFIED	4.7	99.997%	HEL-47-300	580	<5 ppm	-	<5 ppm	-	-	-
ZERO	4.8	99.998%	HEL-48-300	580	-	<0.5 ppm	-	-	-	-
HYDROGEN										
RESEARCH	6.0	99.9996%	HYD-60-300	350	<0.2 ppm	< 0.1 ppm	<0.5 ppm	<0.1 ppm	<0.3 ppm	-
Grade 5.5	5.5	99.9995%	HYD-55-300	350	<0.5 ppm	<0.2 ppm	<2 ppm	<0.2 ppm	<0.1 ppm	<2 ppm
UHP^	5.0	99.999%	HYD-50-300	350	<1 ppm	<0.5 ppm	<1 ppm	-	-	<5 ppm
ZERO	4.5	99.995%	HYD-45-300	350	-	<0.5 ppm	-	-	-	-
PREPURIFIED	4.0	99.99%	HYD-40-300	350	<20 ppm	-	<10 ppm	-	-	-
NITROGEN										
RESEARCH	6.0	99.9999%	NIT-60-300	580	<0.2 ppm	<0.1 ppm	<0.2 ppm	<0.1 ppm	<0.1 ppm	-
CHROMATOGRAPH	5.5	99.9995%	NIT-55-XX	580	<1 ppm	<0.1 ppm	<1 ppm	<1 ppm	<1 ppm	-
UHP	5.0	99.999%	NIT-50-300	580	<1 ppm	<0.5 ppm	<1 ppm	-	-	-
ZERO	4.8	99.998%	NIT-ZE-300	580	-	<0.5	-	-	-	-
PREPURIFIED	4.8	99.998%	NIT-48-300	580	<5 ppm	-	<5 ppm	-	-	-
Oxygen Free	4.8	99.998%	NIT-OF-300	580	<0.5 ppm	-	-	-	-	-
NITROUS OXIDE										
ATOMIC ABSORPTION	2.6	99.6%	N2O-26-50	326	*	-	<30 ppm	-	-	*
* N2O-AA: AIR<2000 ppm										
OXYGEN										
RESEARCH***	5.0	99.999%	OXY-50-300	540	99.999%	<0.5 ppm	<1 ppm	<1 ppm	<5 ppm	-
UHP**	4.3	99.993%	OXY-43-300	540	99.993%	<0.5 ppm	<3 ppm	-	-	<10 ppm
ZERO	2.8	99.8%	OXY-28-300	540	99.8%	<0.5 ppm	-	-	-	-
EXTRA DRY	2.6	99.6%	OXY-26-300	540	99.6%	-	<10 ppm	-	-	-
					O2-UHP <40 ppm Ar	*O2-RESEARCH <5 ppm Ar				
ppm = Parts Per Million					ppb = Parts Per Billion			THC = Total Hydrocarbons		

Appendix B – Carbonyls Cartridge Chain of Custody (COC) Form



DAQ-16-008 Carbonyl Cartridge Sample Chain of Custody Form

Sample ID	Pre-sample Storage Location	Sample Type	Scheduled Sample Date	Shipment Method*	Shipment Tracking Number	Post-sample Storage Location
Relinquished by		Date/Time		Received by		Date/Time

DAQ-16-008
 Revision 0.1
 Effective: 07-01-2021

*Shipment Abbreviations: **UPS** = United Parcel Service
FEDEX = FedEx Corporation
SV = State Vehicle

Appendix C – Carbonyls Sample Information Form (SIF)

North Carolina Division of Air Quality Laboratory Analysis Branch DAQ-16-009 Carbonyl Cartridge Sample Information Form (SIF)							
<small>NC DAQ Laboratory Analysis Branch: 4403 Reedy Creek Road, Raleigh, NC 27607 Phone: (919)-733-9777</small>							
<small>Document #: DAQ-16-009, Revision 0.0, Effective: 7/1/2021</small>							
Laboratory Setup Information							
Sample Program (Circle one): PAMS UAT							
Sample Type (Circle one): SAMPLE FIELD BLANK TRIP BLANK DUPLICATE/COLLOCATED SAMPLER CERTIFICATION							
QC Sample Type (Circle One): CARTRIDGE BLANK CARTRIDGE SPIKE CARTRIDGE SPIKE DUPLICATE MDL SPIKE PT SPIKE CATRIDGE LOT BLANK							
Sampling Site:				Sample #:			
DNPH Cartridge Lot#:				Sample Channel #:			
Lab setup by (initial & date):				Scheduled Sampling Date:			
Field Setup Information							
Sampler SN or FAS#:				Site Operator (initials, date & time of setup):			
Sampler Expiration Date:				NIST Device Date, Time and S/N:			
As Found Sampler Display Date & Time:				AS Left Sampler Display Date, Time: (if adjustment made)			
Time Difference (mins):	Time Difference less than 5 minutes?						
	Yes	No					
NIST Flow Standard (S/N and Exp. Date):				Measured Pre Sample Flow Rate (L/min):	<small>Acceptable Range (0.9 L/min - 1.1 L/min)</small>		
DNPH Cartridge Scheduled Sampling Date/Time:				Leak Check Pass? (Circle One):	<table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>Yes</td> <td>No</td> </tr> </table>	Yes	No
Yes	No						
					<small>Acceptable Range < 0.03 L/min</small>		
Field Recovery Information							
Site Operator (initials, date, time of pickup)				Sample Start Date & Time:			
				Sample Stop Date & Time:			
SAMPLE VOLUME (L):				Sample Duration (hrs):			
NIST Flow Standard (S/N and Exp. Date):				Measured Post Sample Flow Rate (L/min):			
Field Comments:							
Laboratory Receipt/Login Information							
Sample Received by:				Sample Receipt Temperature (°C):			
Date and Time Sample Received:				S/N of NIST Traceable IR-Gun:			
Laboratory Comments:							
Extraction Date:	Extracted by (initials):			Extraction Manifold Port Number:			

Appendix D – ATEC 8000 Monitoring Site Logbook Entry Sampler Installation Template

North Carolina Department of Environmental Quality, Division of Air Quality Laboratory

ATEC 8000 Monitoring Site Logbook Entry Sampler Installation Template			
Date:		Inlet Composition	1/4in Chromatographic Grade (0.21in ID) stainless steel tubing connected to a 15µm particulate filter and inverted stainless steel conical rainguard.
Operator ID:			
ATEC 8000 S/N or FAS#:			
ATEC 8000 Reached 50°C?	Y N (Circle One)		
ATEC 8000 Certification Date:			
		Inlet Length (ft)	
		ATEC 8000 Certification Expiration Date:	
Additional Site Activities Performed:			
Field Comments:			
Level 1 Review:		Level 2 Review:	

A printable PDF version of this template is available at **P:\LAB (Laboratory Analysis Branch)\Forms and Templates**

Appendix E – Example Sampler Certification Report

Sampler Certification Report			
Sampler Serial Number or FAS Number			
300544			
Actual Start Date/Time			
1/26/2021 8:00			
Actual Stop Date/Time			
1/27/2021			
			Cell Color indicates:
			PASS
Pre-Sample Measured Flow Rate (L/min)	1.052	Target (0.90 L/min - 1.10 L/min)	
Post-Sample Measured Flow Rate (L/min)	1.052	Target (0.90 L/min - 1.10 L/min)	
24 hr AVG Sampler Display Flow Rate (L/min)	1.052	Target (0.90 L/min - 1.10 L/min)	
24 hr AVG Sampler Volume (L)	1441.9	Target (1242 L - 1650 L)	
24 hr AVG Sampler Volume (m ³)	1.44190		
Sample Analysis			
UHPLC Serial Number		UHPLC Detector Calibration Date	
8078932		1/26/2021	
Sample ID			
C012621 Sampler Cert 300544			
Extraction Date		Extraction Volume (mL)	
1/27/2021		5	
Analysis Date		Sequence Name	
1/27/21 0:00		012621_Aldehyde Run_UV	
Analyte	Amount (ug/ml)	Amount (PPB)	PASS/FAIL
Formaldehyde	0.022	0.062	PASS
Acetaldehyde	0.012	0.024	PASS
Acetone	0.000	0.000	PASS
Acrolein	0.000	0.000	PASS
Propionaldehyde	0.000	0.000	PASS
Crotonaldehyde	0.000	0.000	PASS
2-Butanone (MEK)	0.000	0.000	PASS
Methacrolein	0.000	0.000	PASS
Butyraldehyde	0.000	0.000	PASS
Benzaldehyde	0.000	0.000	PASS
Isovaleraldehyde	0.000	0.000	PASS
m-tolualdehyde	0.000	0.000	PASS
Hexaldehyde	0.004	0.003	PASS
Comments:			
Approved by			
Analyst:	CB	Approval Date	2/2/2021
Level 2 Reviewer			
Level 3 Reviewer	SW		2/10/2021

Appendix F – ATEC 8000 Replacement Parts List

These are standard replacement parts and part numbers from the manufacturer, ATEC (Malibu, CA). For quotes and support contact sales@atec-online.com

Chassis	8000-100-1
Front Panel	8000-100-2
Rear Panel	8000-100-3
Mass Flow Controller (Specify Range)	8000-200-1
Cartridge Tubing Set	8000-200-4
Cartridge Filter Holder	8000-200-5
Cartridge Filter (47mm Teflon)	8000-200-6
Ozone Scrubber Heater (Complete)	8000-200-10
Ozone scrubber (KI copper coil)	8000-200-11
Heater Relay	8000-300-1
Vacuum Pump	8000-200-12
Vacuum Pump Relay	8000-300-2
2-Way Solenoid Valve	8000-200-13
Single Board Computer	8000-400-1
GPIO Board	8000-400-2
Interface Board	8000-400-3
Temperature Probe	8000-400-4
Power Supply	8000-300-3
Cooling Fan	8000-300-4
Power Switch	8000-300-5
Fuse Holder	8000-300-6
Pump Fan Guard	8000-500-1
Cooling Fan Guard	8000-500-2
Vacuum Line Tubing Set	8000-200-16
MFC Cartridge Ch.1 Cable	8000-700-3
MFC Cartridge Ch.2 Cable	8000-700-4
GPIO Cable Set	8000-700-5
Rear Panel Output Cable Set	8000-700-7
Interface Board Ribbon Cable Set	8000-700-8
Vacuum Pump Relay Cable	8000-700-10