

Introduction to the Desktop Photoelectric Aerosol Sensor



EcoChem Analytics

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Presentation Outline

- ◆ Safety Warnings & Precautions
- ◆ Working Principle
- ◆ Health Risk Perspective
- ◆ Analyzer Operations
 - Description of Instrument
 - Software
- ◆ Service and Maintenance
- ◆ Applications



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Safety Warnings and Precautions



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Safety Warnings & Precautions!

1. Never operate the instrument if the **cover is removed**.
2. Maintenance and repair work should only be done by **trained personnel**.
3. Care should be taken under extremely **humid conditions!**
The monitor should be prevented from becoming wet.
(If the sensor got wet and is not working properly, it should be placed into a dry place and left there for 1-2 days. This may restore the proper functioning.)

Safety Warnings and Precautions



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Safety Warnings & Precautions (Contd.)

4. Do not expose the instrument directly to rain or snow!
5. Always use the original serial cable supplied with the analyzer for downloading data.
6. Do not substitute the analyzer power supply with a standard laptop power supply (though they may look similar). You will seriously damage the analyzer by using an incompatible power supply unit.

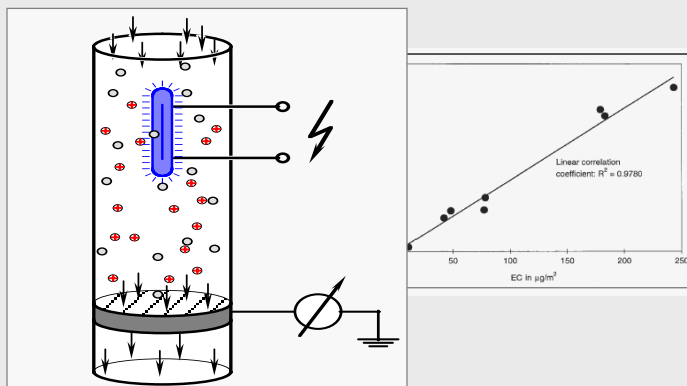


ATTENTION



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Working Principle



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Focus of Attention...



Working Principle

PAS 2000 measures
PARTICLE PAH / SOOT

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Photoelectric Aerosol Sensor -- PAS 2000



Working Principle

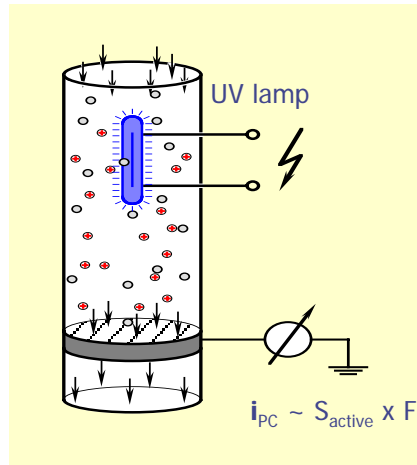
- Sensitive to surface chemistry
- Responds to ultrafine carbon particles
- High sensitivity, large measurement range
- Desktop or rack-mounted configuration

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Principle of the Photoelectric Aerosol Sensor (PAS)

Working Principle

- Excimer lamp used to produce UV radiation
- Photoionization of carbonaceous particles
- Collect particles in an electrically insulated filter
- Measure electric current flowing from filter (resolution ~1 femtoamp)



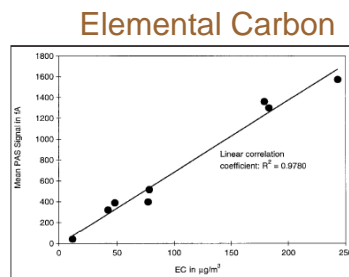
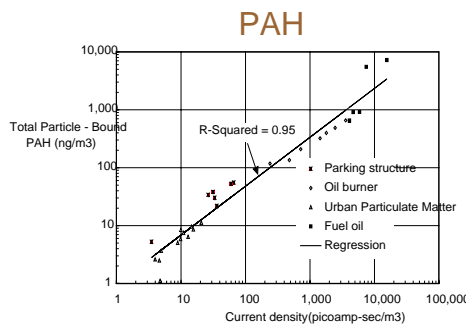
i_{PAS} = PAS Current
 S_{active} = Particle active surface area
 F = Surface chemistry factor

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What does the PAS measure...

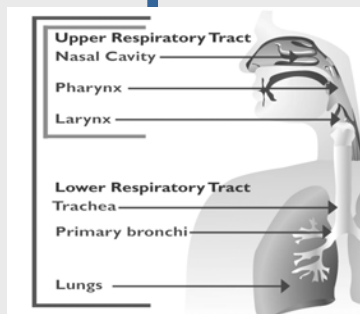
The PAS analyzer estimates **TOTAL PARTICLE BOUND PAH**. The analyzer signal has also been correlated to other related compounds like **Soot, Elemental Carbon and Black Carbon**.

Working Principle



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Health Risk Perspective



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What are PAH

- ◆ PAH – are POLYCYCLIC AROMATIC HYDROCARBONS ... also frequently referred to as Polynuclear Aromatic Compounds (PNA)
- ◆ PAH are primarily products of incomplete combustion

Health Risk Perspective

TYPICAL PAH COMPOUNDS

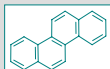
Naphthalene



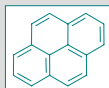
Phenanthrene



Chrysene



Pyrene



Benzo(a)pyrene



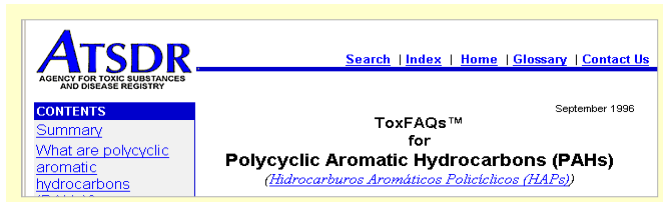
Benzo(g,h,i)perylene



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Why measure PAH Compounds

- ◆ The U.S. Department of Health and Human Services has determined that PAHs may reasonably be anticipated to be carcinogens.
- ◆ Several of the PAHs, including benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, have caused tumors in laboratory animals when they ate them, when they were applied to their skin, or when they breathed them in the air for long periods of time.
- ◆ Reports in humans show that individuals exposed by breathing or skin contact for long periods of time to mixtures of other compounds and PAHs can also develop cancer.



<http://www.atsdr.cdc.gov/tfacts69.html>

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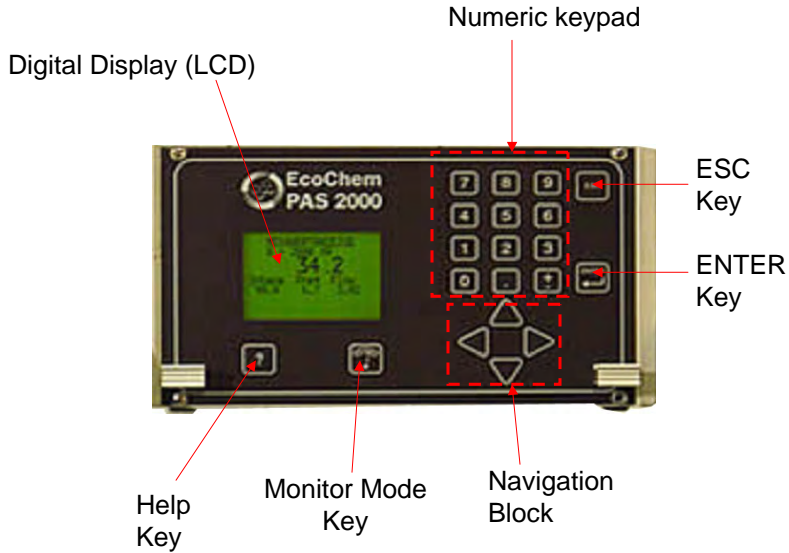
Analyzer Operations



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Front Panel

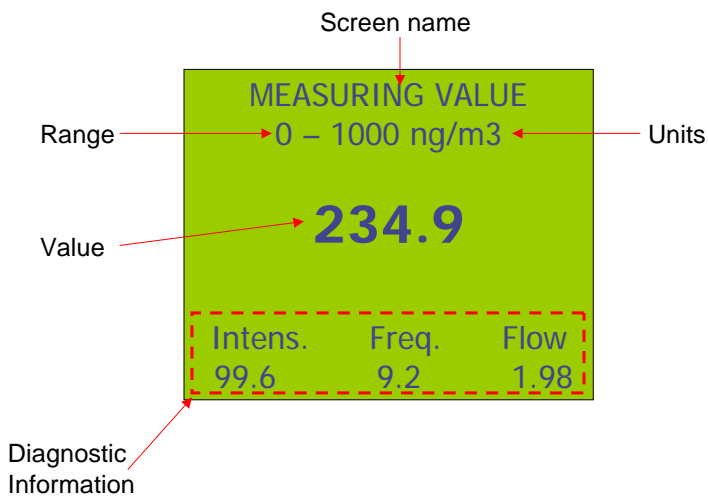
Analyzer Operations



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LCD on Front Panel

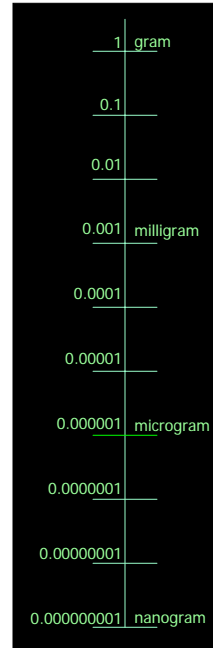
Analyzer Operations



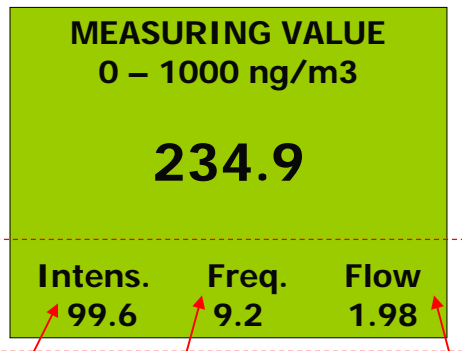
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Instrument Readings

- ◆ Measurements made by the PAS 2000CE are ng/m³ (nanogram per cubic meter) or ug/m³ (microgram per cubic meter) of PPAH (particle-bound PAH)
- ◆ Raw signal is also available in ionization current (femtoamp or picoamp)



Front Panel Diagnostic Messages

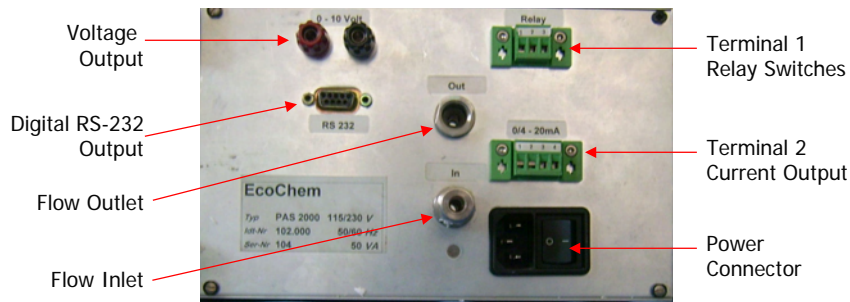


Lamp Intensity should be between 95 to 105 (normalized number)

Lamp frequency should be between 8 kHz (new lamp) to 15 kHz (lamp needs replacement)

Flow rate should be between 1.9 to 2.1 lit/min

Back Panel



Measurement Capabilities

- Variable averaging time
- Flexibility in setting up measurement range
- Variable lamp ON/OFF time for extended lamp life
- Live zero offset – measurement made with ON and OFF lamp modes
- Site-specific calibration curve can be entered

Calibration Approaches

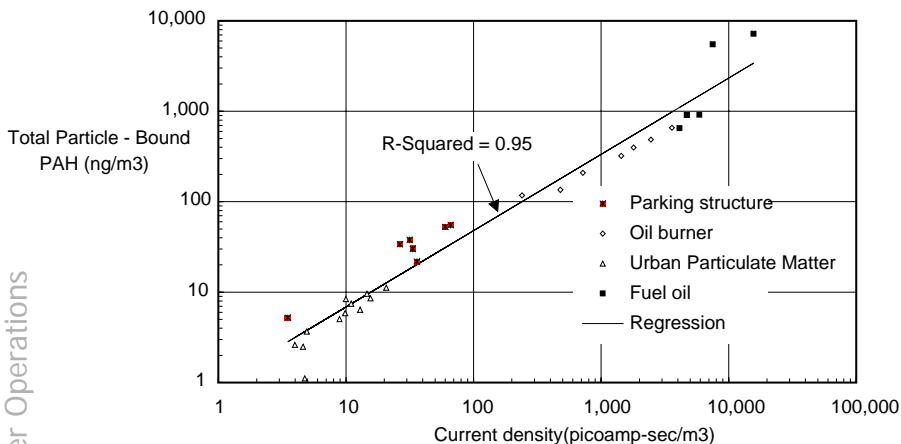
Analyzer Operations

- ◆ Screening
 - Data from several sources are combined to obtain an approximate Calibration Curve.
 - Used for “semi-quantitative” numbers, relative screening and prioritization of sources
- ◆ Site - Specific
 - Simultaneous measurements of PAS and chemical analysis to obtain a site-specific Calibration Curve.
 - Used for accurate, absolute numbers from one specific source
- ◆ Development of Calibration Sources
 - Graphite particle generator
 - Precise combustion source

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Approximate Calibration

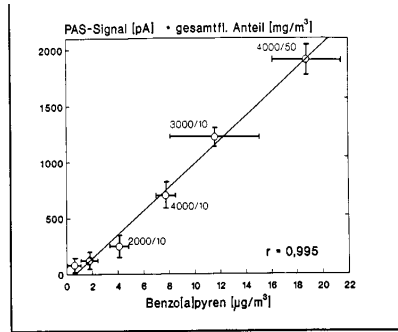
Analyzer Operations



See CARB Report -- Improved Methods for PAH Combustion Source Sampling, Contract No. A932-098, Oct 1996, Page 11-12 for another example of the Universal Calibration curve

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Site-Specific Calibration



Y-Axis: PAS Signal
 X-Axis: Analytically determined
 B(a)P
 Data points parameterized by RPM
 and torque

Martin Backer, Dissertation
 in German, University of
 Dortmund, Use of the
 Photoelectric Aerosol Sensor
 for measuring particle-
 bound PAH from automobile
 and diesel engines, 1991

Abb. 45: Korrelation zwischen dem PAS-Signal und der Benzolalpyren-Konzentration unter Berücksichtigung des gesamtflüchtigen Anteils. Der berechnete Korrelationskoeff. $r = 0.995$ zeigt eine lineare Korrelation mit einer stat. Sicherheit von 99 % an. Die Streubalken geben den Vertrauensbereich bei einer statistischen Sicherheit von 95 % an.

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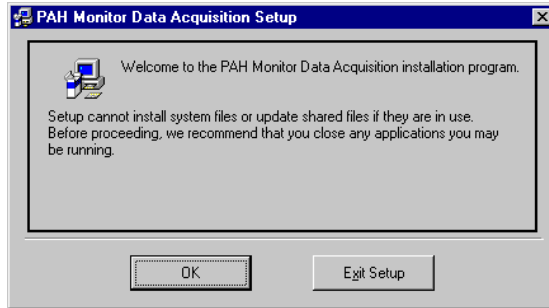
Data Acquisition Options

- ◆ Analog
 - 0 – 10 volts corresponds to measurement range
 - 0/4 – 20 mamp corresponds to measurement range
- ◆ Digital – RS 232 output
 - PAHDAS software
 - Windows HyperTerminal
- ◆ Onboard Memory
 - 8000 data points, date/time and value

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PAHDAS Software Installation

- ◆ Run SETUP program (software on CD-ROM or from www.ecochem.biz)

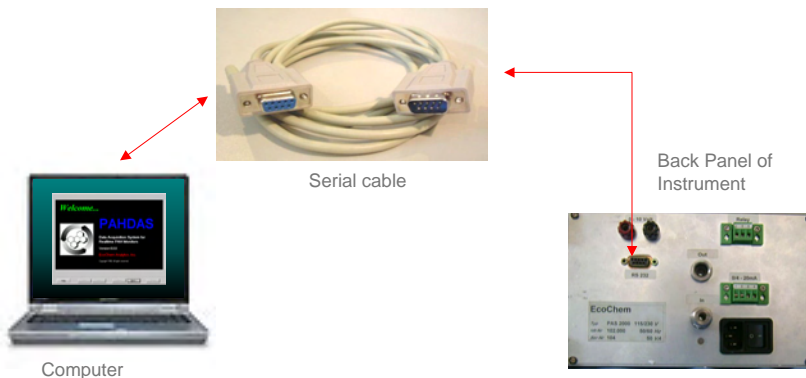


Analyzer Operations

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Communicating with the Instrument

Use the serial cable provided with instrument to connect PC to analyzer

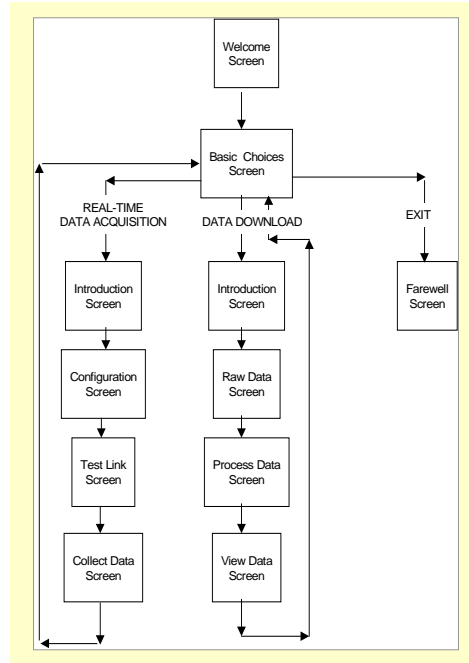


Analyzer Operations

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Software Overview

Analyzer Operations

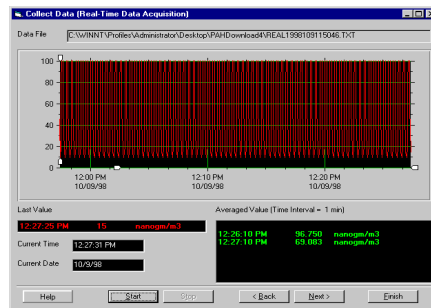


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PAHDAS Capabilities

1. Realtime collection of data
 - Variable time averaging
 - Flexible stripchart plotting
 - Data collected in CSV TXT files
2. Download data points stored in the analyzer

Analyzer Operations



View Data (Data Download)

Please Use Output File Buttons to select a file name containing imported data.

Output File: C:\WINNT\Profile\Administrator\Desktop\PAHD\download\REAL1998103115046.TXT

Please Press the Table Buttons with the desired file path (background).

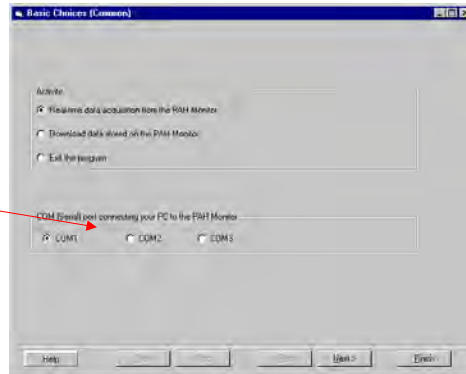
DATE	TIME	DATA	UNIT	LOC	
7/14/98	10:40:00 AM	7/14/98	10:40:00 AM	-300.00	KA
7/14/98	10:40:05 AM	7/14/98	10:40:05 AM	-300.00	KA
7/14/98	10:40:10 AM	7/14/98	10:40:10 AM	-280.00	KA
7/14/98	10:40:15 AM	7/14/98	10:40:15 AM	-280.00	KA
7/14/98	10:41:00 AM	7/14/98	10:41:00 AM	-849.00	KA
7/14/98	10:41:05 AM	7/14/98	10:41:05 AM	-849.00	KA
7/14/98	10:42:00 AM	7/14/98	10:42:00 AM	-60.00	KA
7/14/98	10:42:05 AM	7/14/98	10:42:05 AM	-60.00	KA
7/14/98	10:43:00 AM	7/14/98	10:43:00 AM	-274.00	KA
7/14/98	10:43:05 AM	7/14/98	10:43:05 AM	-274.00	KA
7/14/98	10:44:00 AM	7/14/98	10:44:00 AM	-1000.00	KA
7/14/98	10:44:05 AM	7/14/98	10:44:05 AM	-1133.00	KA
7/14/98	10:44:10 AM	7/14/98	10:44:10 AM	-1000.00	KA
7/14/98	10:44:15 AM	7/14/98	10:44:15 AM	-700.00	KA
7/14/98	10:44:20 AM	7/14/98	10:44:20 AM	-2384.00	KA
7/14/98	10:44:25 AM	7/14/98	10:44:25 AM	-807.00	KA

Please Press the Table Buttons if you want to DELETE the existing contents of the Output File's Data Memory.

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Communication Port

- ◆ Select correct **COM port** (used by RS-232 serial cable)
- ◆ If you have a computer without an RS-232 serial port you need a **USB to Serial port converter** (commonly available at computer stores)



Typical USB/Serial Adapter
Made by Belkin

Data File Contents

- ◆ Plain text file
- ◆ Time and Value on each line
- ◆ Open with Notepad, Word, Excel etc

Date	Time	Date-Time	Value	Units
4/9/2001	9:55:56 AM	4/9/2001 9:55	4.50	nanogm/m3
4/9/2001	9:56:56 AM	4/9/2001 9:56	4.25	nanogm/m3
4/9/2001	9:57:56 AM	4/9/2001 9:57	4.86	nanogm/m3
4/9/2001	9:58:56 AM	4/9/2001 9:58	2.38	nanogm/m3
4/9/2001	9:59:56 AM	4/9/2001 9:59	4.86	nanogm/m3
4/9/2001	10:00:57 AM	4/9/2001 10:00	4.00	nanogm/m3
4/9/2001	10:01:57 AM	4/9/2001 10:01	3.86	nanogm/m3
4/9/2001	10:02:57 AM	4/9/2001 10:02	4.13	nanogm/m3

Software Troubleshooting Tips

1. Make sure that you are using the **correct serial cable**.
2. The serial cable should be connected to the **right serial port** on the computer (make sure you know whether it is COM1 or COM2).
3. Follow the **right sequence** to ensure a smooth download.



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Service and Maintenance



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Training and Maintenance Interval

- ◆ The instrument is a sensitive electronic device and should be serviced only by **appropriately trained personnel**.
- ◆ Depending upon usage of the instrument, it is typically recommended that the instrument be sent back to the factory for service and maintenance **every 12 to 24 months**.
- ◆ Excimer lamp and pump rebuild are commonly encountered maintenance activities.

Service and Maintenance

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Precision Components



Service and Maintenance

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Other Activities...

Call for assistance before doing these activities!

- Excimer lamp replacement instructions given in the User's Guide
- Pump replacement needs skilled technician

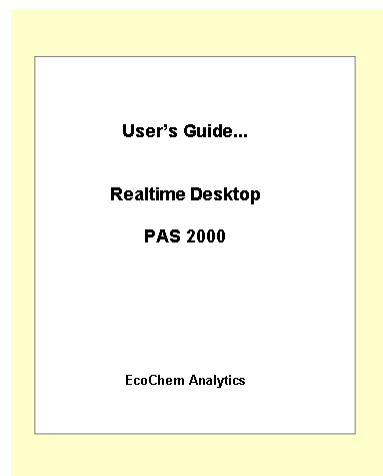
Call for assistance before doing these activities!



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When in doubt...

- ◆ Refer to the User's Guide
- ◆ Contact EcoChem by sending email to info@ecochem.biz



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Analyzer Applications

Monitoring diesel particulates in working areas with the photoelectric aerosol sensor

K. Przybilla, W. Berkahn, H. Burtscher, D. Dahmann, U. Matter, P. Rietschel

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As
ultrafir

Children's Pollutant Exposure During School Bus Commutes

Paper # 617

Dennis R. Fitz, David V. Pankratz, and Kurt Bumiller

University of California, Riverside
College of Engineering-Center for Environmental Research and Technology
1084 Columbia Avenue, Riverside, CA 94022

Arthur M. Winer, Lisa D. Sabin, Eduardo Behrentz, Seong J. Lee, and Steven D. Colome

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Example Application Paper

Aerosol Science and Technology, 39:799-809, 2005
Copyright © American Association for Aerosol Research
ISSN: 0278-6826 print / 1521-7388 online
DOI: 10.1080/02786820500247363



Particulate Emissions from in-use Commercial Aircraft

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John T. Jayne,¹ Manjula R. Canagaratna,¹ Jillian Grygas,² Thomas Lanni,²
Bruce E. Anderson,⁴ Doug Worsnop,¹ and Richard C. Miake-Lye¹

¹Aerodyne Research, Inc., Billerica, Massachusetts, USA

²New York State Department of Environmental Conservation, Albany, New York, USA

³Virginia Tech, 411 Durham Hall, Blacksburg, Virginia, USA

⁴Atmospheric Sciences Division, NASA Langley Research Center, Hampton, Virginia, USA

Analyzer Applications

Contact info@ecochem.biz for other studies

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Example Application Paper (Contd.)

Analyzer Applications

TECHNICAL PAPER

ISSN 1047-3289 J. Air & Waste Manage. Assoc. 53:740-748
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The Mobile Source Effect on Curbside 1,3-Butadiene, Benzene, and Particle-Bound Polycyclic Aromatic Hydrocarbons Assessed at a Tollbooth

Amir Sapkota and Timothy J. Buckley
Department of Environmental Health Sciences, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland

ABSTRACT
On-road mobile sources contribute substantially to ambient air concentrations of the carcinogens 1,3-butadiene, benzene, and polycyclic aromatic hydrocarbons (PAHs). PAH, 1,3-butadiene, and benzene, respectively, than do 2-axle vehicles. This study provides a model for estimating curbside pollution levels associated with traffic that may be relevant to exposures in the urban environment.

Contact info@ecochem.biz for other studies

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Questions & Answers ?

For more information...



Email: info@ecochem.biz

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