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ADVANCED POLLUTION INSTRUMENTATION
Everywhereyoulook™

Teledyne API
Particulate Matter Instruments

Theory of Operation and Overview

July 28 & 29, 2015

CARB PQAO Training
Air Monitoring Instrument Operation
Sacramento, CA

Tim Morphy
Senior Product Manager

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TAPI PM Instruments

MODEL 602 Beta*Plus*

MODEL 633 Aethalometer®

MODEL 651 UFP

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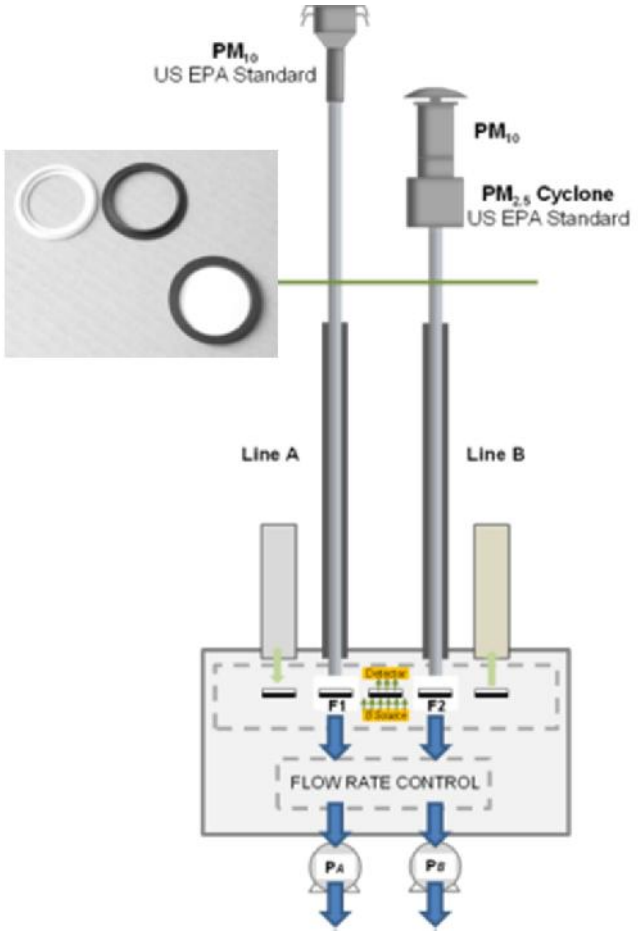
Model 602 Beta*PLUS*

- Dual-channel sequential sampler
  - Collect onto 47mm filters
  - Variety of filters can be used
- Internal PM mass measurement using beta attenuation with multi-step process
- Modes of operation: Hourly mass, Multi-time mass, or Sampler only
- Variety of potential inlet configurations
- Performs automatic leak and flow checks using internal flow standard
- Digital communications and remote access
- 2-year standard warranty



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Model 602 Installation

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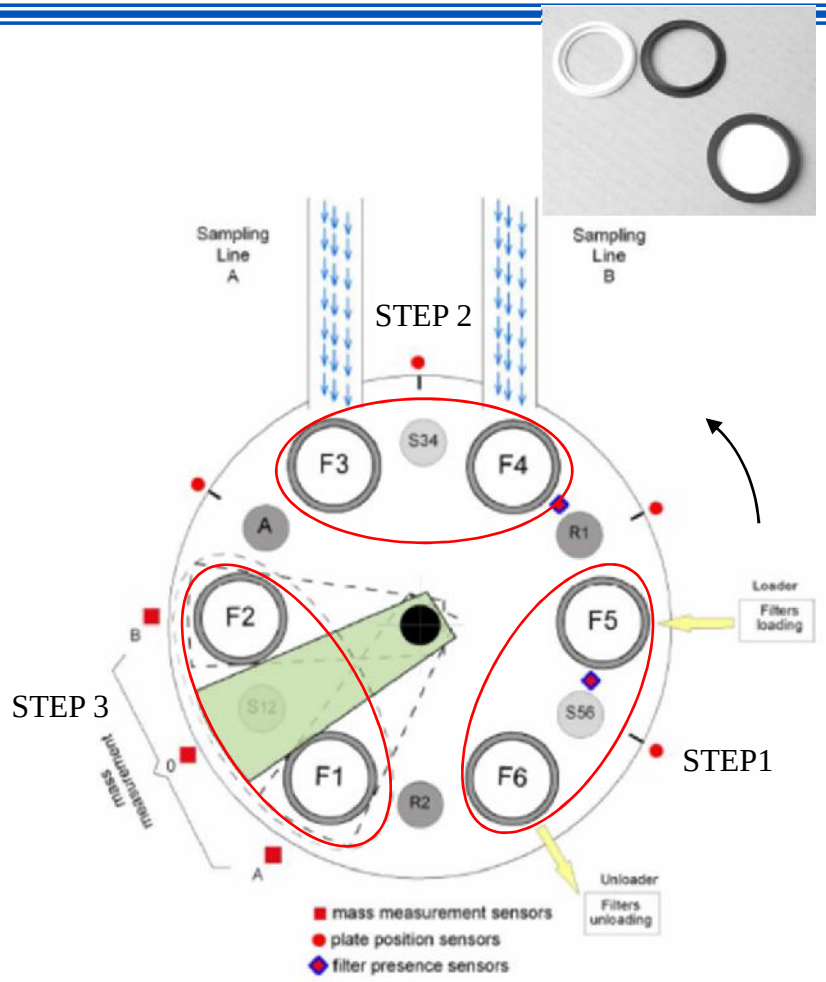
Instrument Operation

- Rotating plate filter holder design (3 positions)
  - Filter Loading / Unloading
  - Filter Sampling
  - Filter Analysis
- Additional reference filter positions
  - Mass calibration reference standards (R1, R2)
  - “Spy filters” account for humidity effects on filter during analysis
- Analysis takes place immediately following sampling
- Multiple step analysis process



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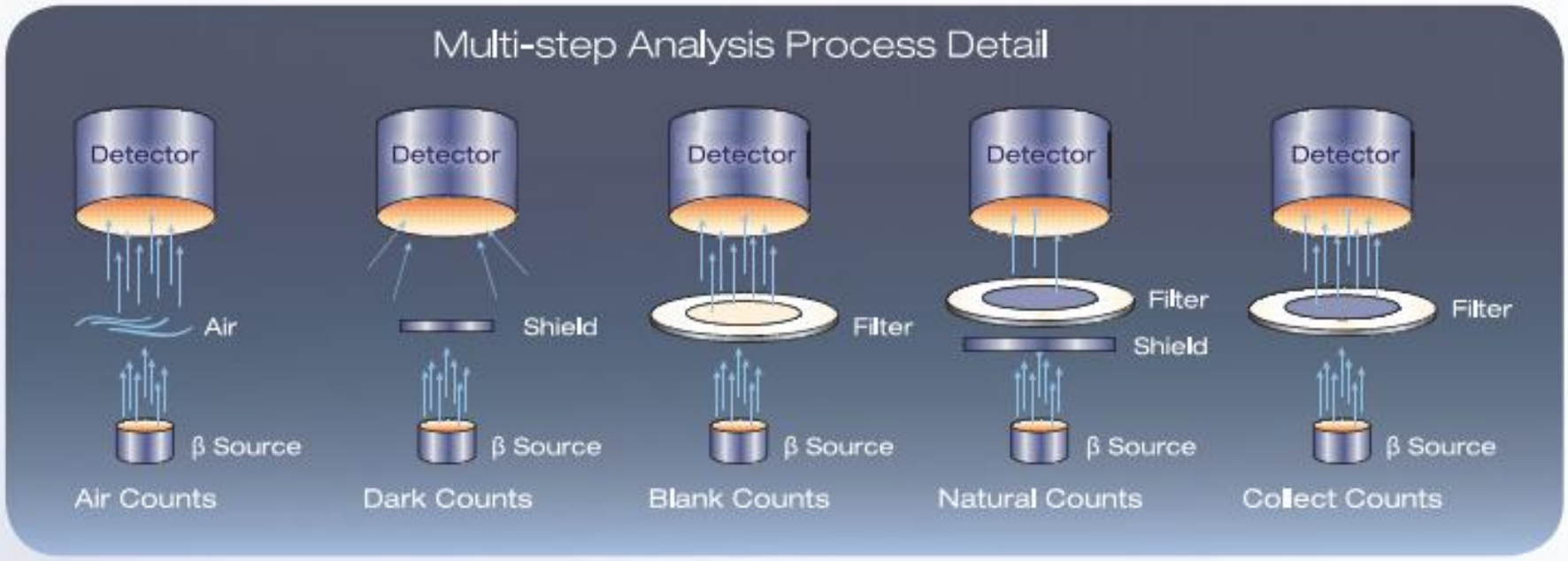
Multi-step Analysis Benefits

Eliminate Interferences:

- Assess changes in air density during analysis
- Measure background radiation in air
- Measure background radiation in sample dust
- Measure spy filter to account for humidity fluctuations during analysis

$$PM\ \left(\frac{\mu g}{m^3}\right) = \frac{\boldsymbol{Mass\ (\mu g)}}{Volume\ (m^3)}$$

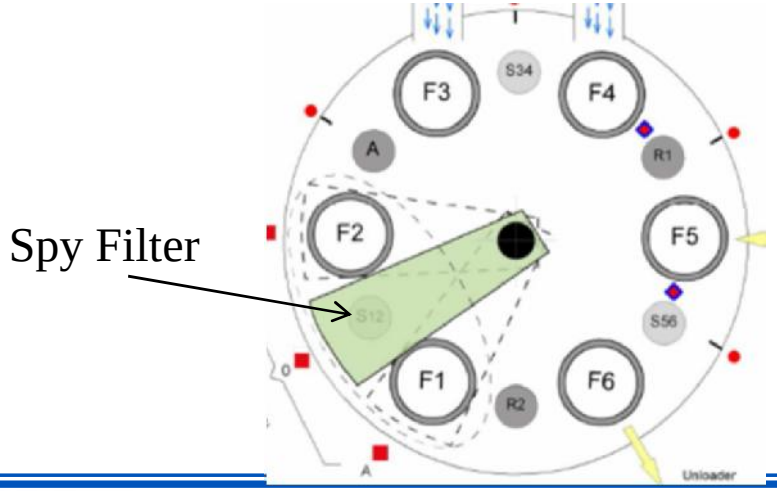


Unique Humidity Control

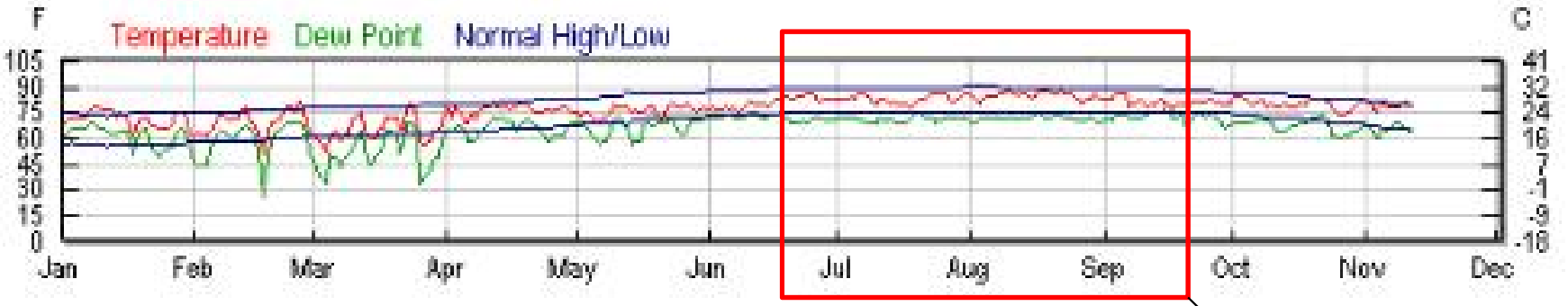
1) Sample filter humidity is controlled during sampling using a sample line heater(s) with %RH set point

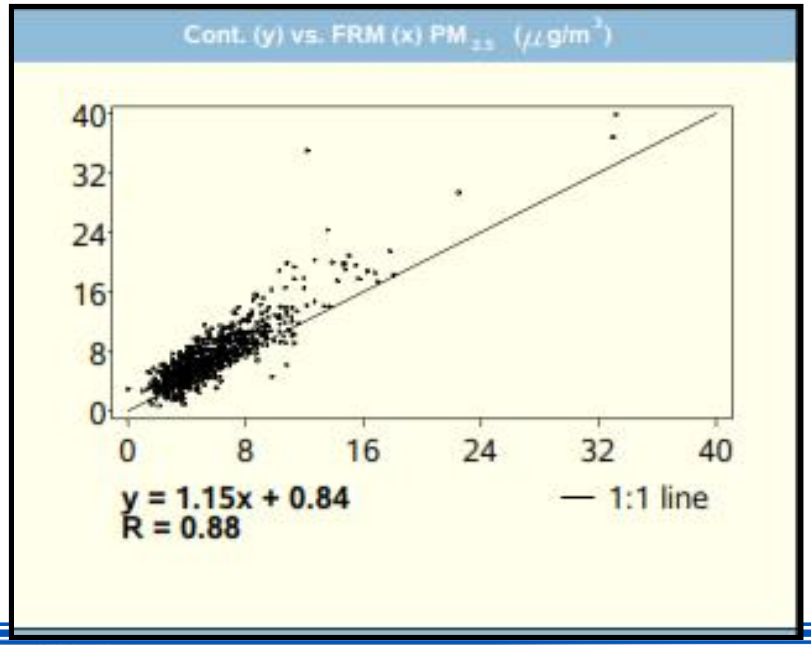
2) Sample filter humidity is controlled during analysis by referencing a ‘spy filter’

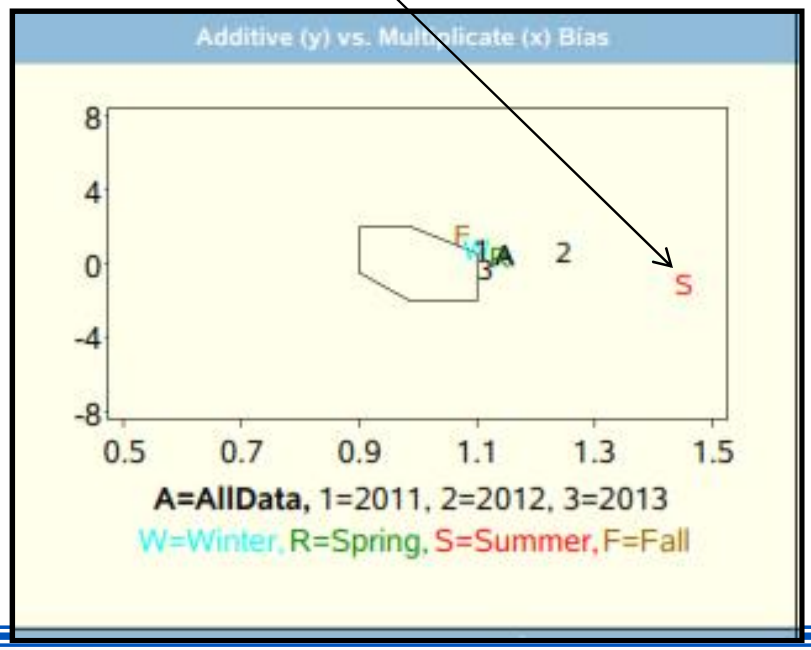
- The spy filter is a representative ‘punch’ of the sample filter media
- The spy filter is independently measured throughout the analysis process accounting for humidity effects on the filter media
- Measurement Sequence
  - F1→S12→F2→S12→F1→S12…..
  - 4 minute analysis intervals



High Ambient Dew Point Effects







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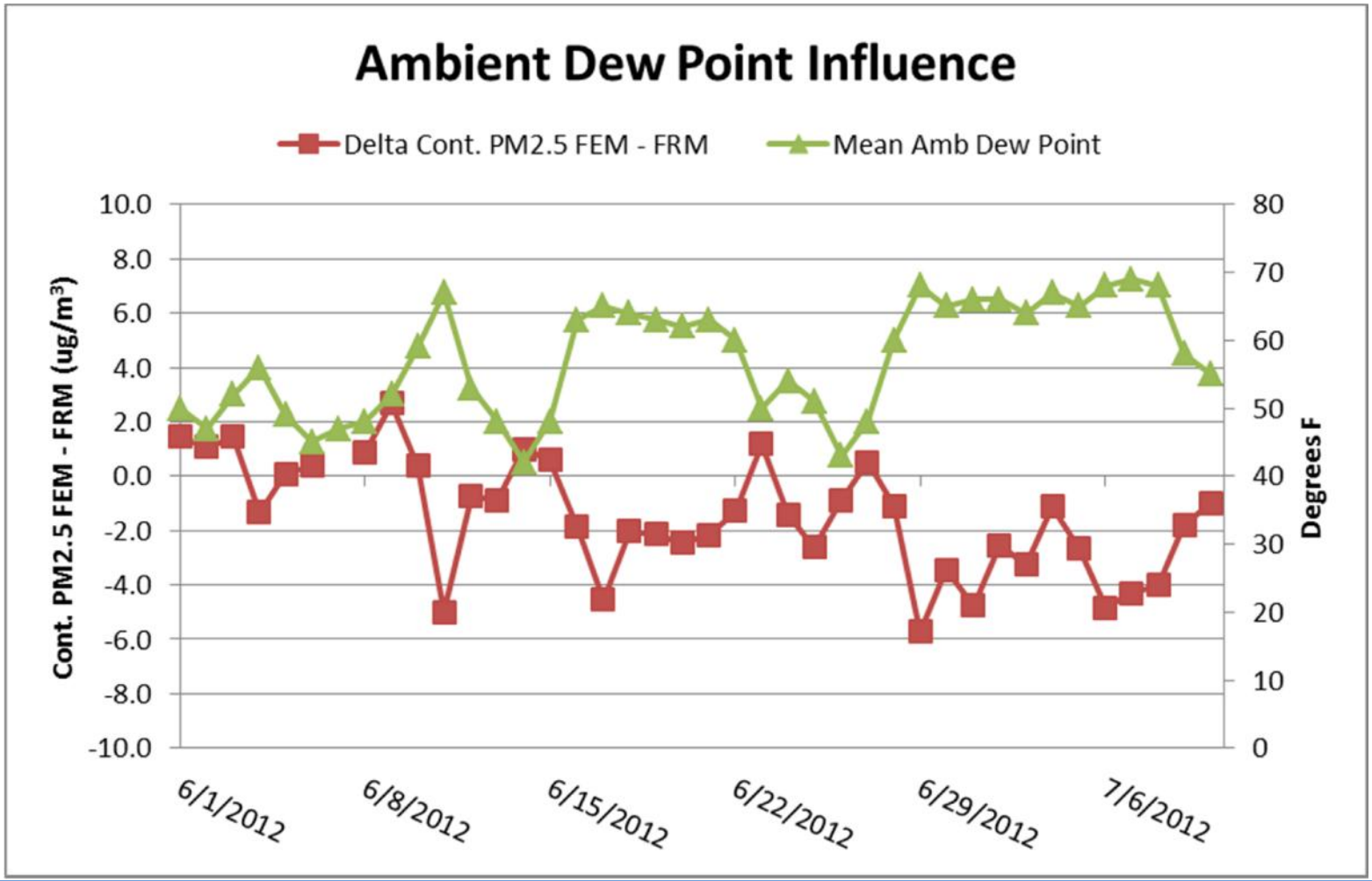
High Ambient Dew Point Effects



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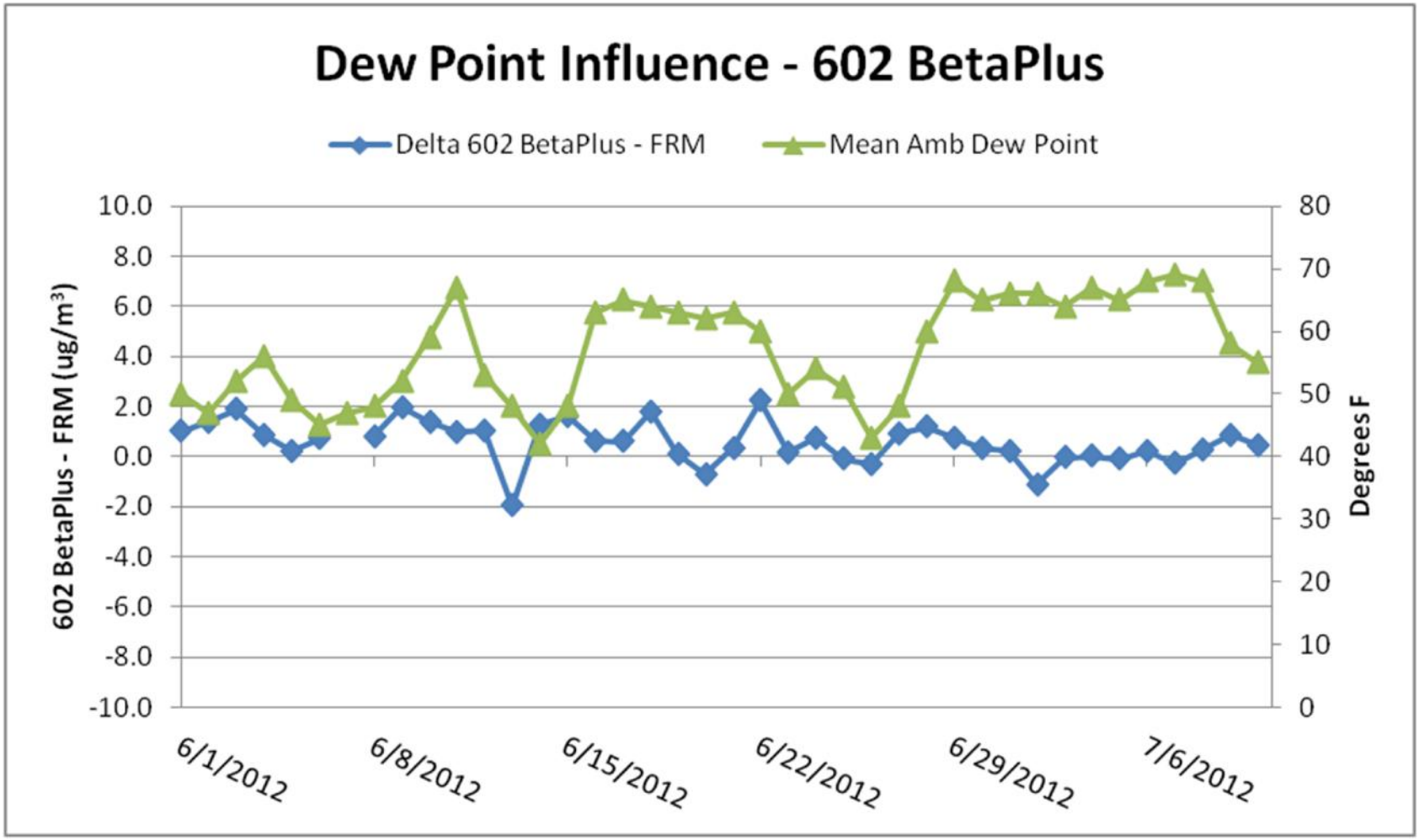
High Ambient Dew Point Effects



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Routine Maintenance

- Every two weeks
  - Reload filter cassette magazine
  - Check flow rates (automatic or manual)
  - Download / Review data using 602betaplusmanager.net
- Once per month
  - Clean size selective inlets
  - Leak check (automatic or manual)
  - Verify temperature and pressure sensor readings
- Once per six months (or as needed)
  - Calibrate flows
  - Check beta calibration (automatic)
  - Rebuild vacuum pumps (carbon rotary vane)
  - Calibrate pressure sensors

Documentation

Operating Manual

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OPERATION MANUAL

MODEL 602 BETA^{PLUS}
Particle Measurement System

Toll-free Phone: 800-324-5190
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Email: api-sales@teledyne.com
Website: http://www.teledyne-api.com/

07318B DCN6410
16 Mar 2012

Standard Operating Procedure

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Model 602 BetaPLUS Particle Measurement System

Standard Operating Procedure

Tim Morphy
5/10/2012

The purpose of this document is to provide guidance on the installation, setup, calibration, and operation of the Model 602 BetaPLUS Particle Measurement System.

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Why Black Carbon PM?

- A primary component of wood smoke
- A primary component of Diesel Particulate Matter
- Diesel Particulate Matter is a listed Air Toxin by the State of California
- Traffic related pollutant and recommended for the Near-roadway monitoring network
- Differentiate between diesel and gasoline vehicles
- Light (and heat) absorbing characteristics in the atmosphere

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What is the Aethalometer®?

- A registered trademark owned by Magee Scientific
- The most widely used BC method in the world
- Over 1,000 units installed since 1980

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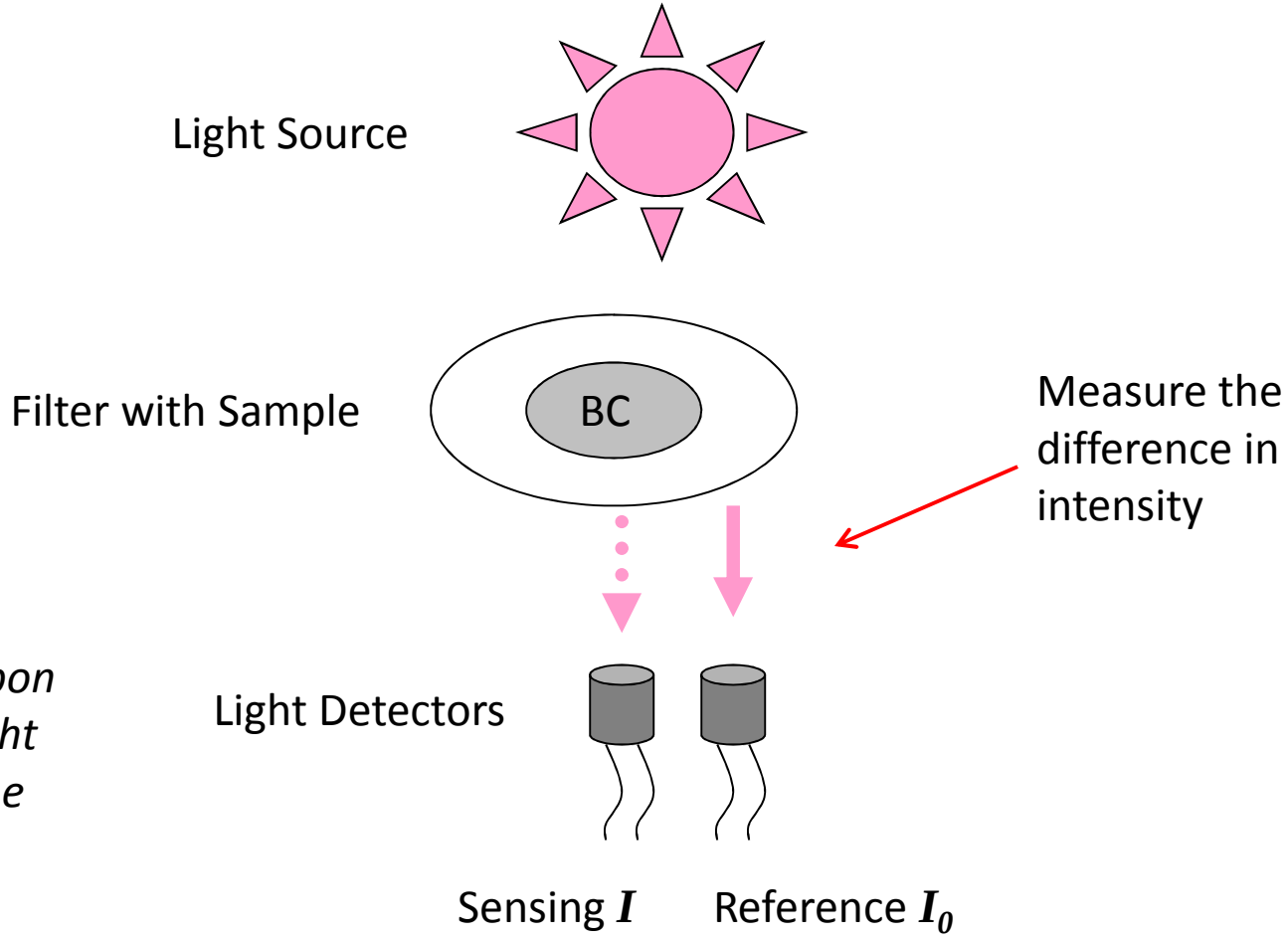
Aethalometer® Method



NOTE: "Black" Carbon particles absorb light uniformly across the entire wavelength spectrum

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Unique Advantage

- Measures optical absorption at multiple wavelengths
- Provides the ability to decipher between diesel and wood smoke
- Well understood capability within the US monitoring community

UV	370 nm
Blue	470 nm
Green	520 nm
Yellow	590 nm
Red	660 nm
IR-1	880 nm
IR-2	950 nm

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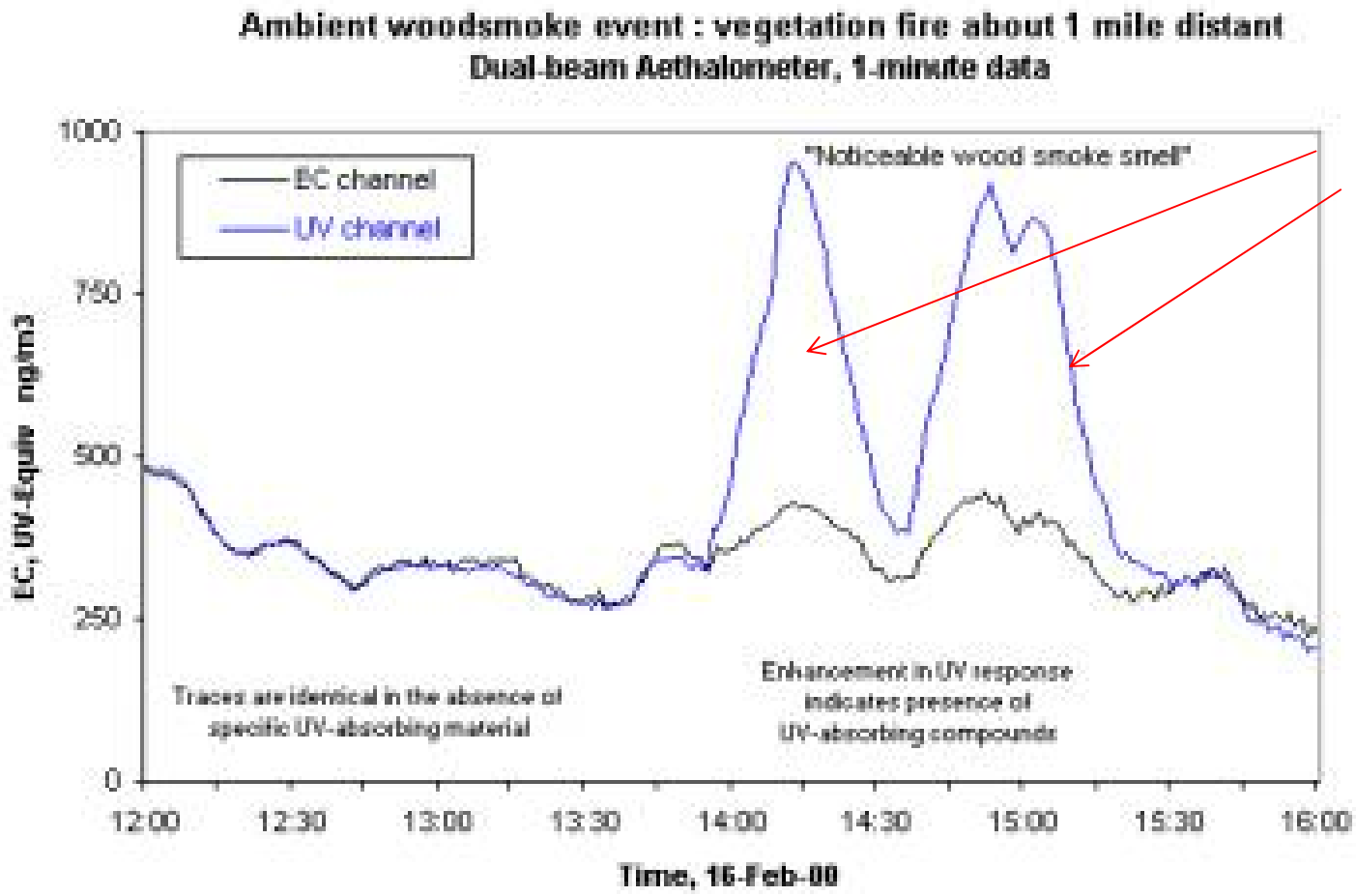
Wood Smoke vs Diesel Smoke



"Delta-C" = UV - BC

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What is the Model 633?

- Magee Scientific's 'Next Generation' Rack-mount Aethalometer® distributed through TAPI – Currently **US and Canada**
- Represents a **complete platform improvement** including a new mechanical and electronic design: color touchscreen display, Ethernet/USB, and field serviceable, modular components
- Introduces new measurement advances to handle sample **spot saturation** and **high humidity** environments

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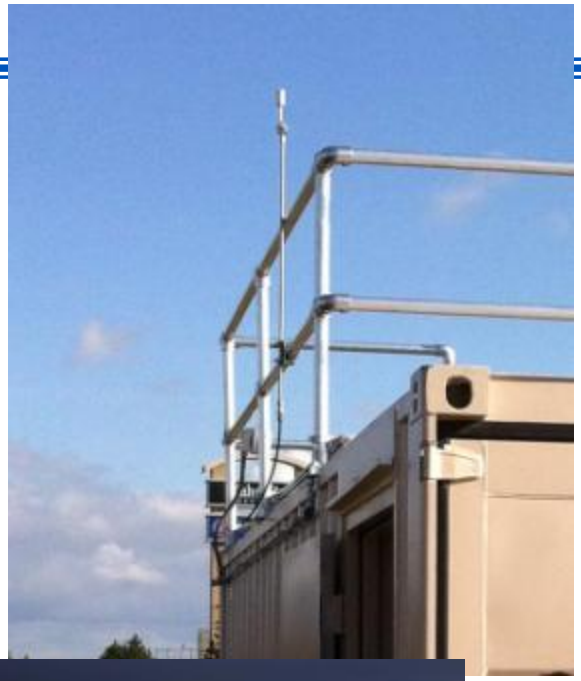
Specifications

- Standard 7-wavelength configuration
- One-second minimum time resolution
- 19” Rack mount chassis
- 2-5 lpm flow rate
- DualSpot™ technique for active loading compensation measurement
- 8” Color touchscreen graphics display
- RS232 and USB communications (Ethernet TCP/IP-ready)
- Inlet Mounting Kit with $PM_{2.5}$ Cyclone
- 2 year standard warranty



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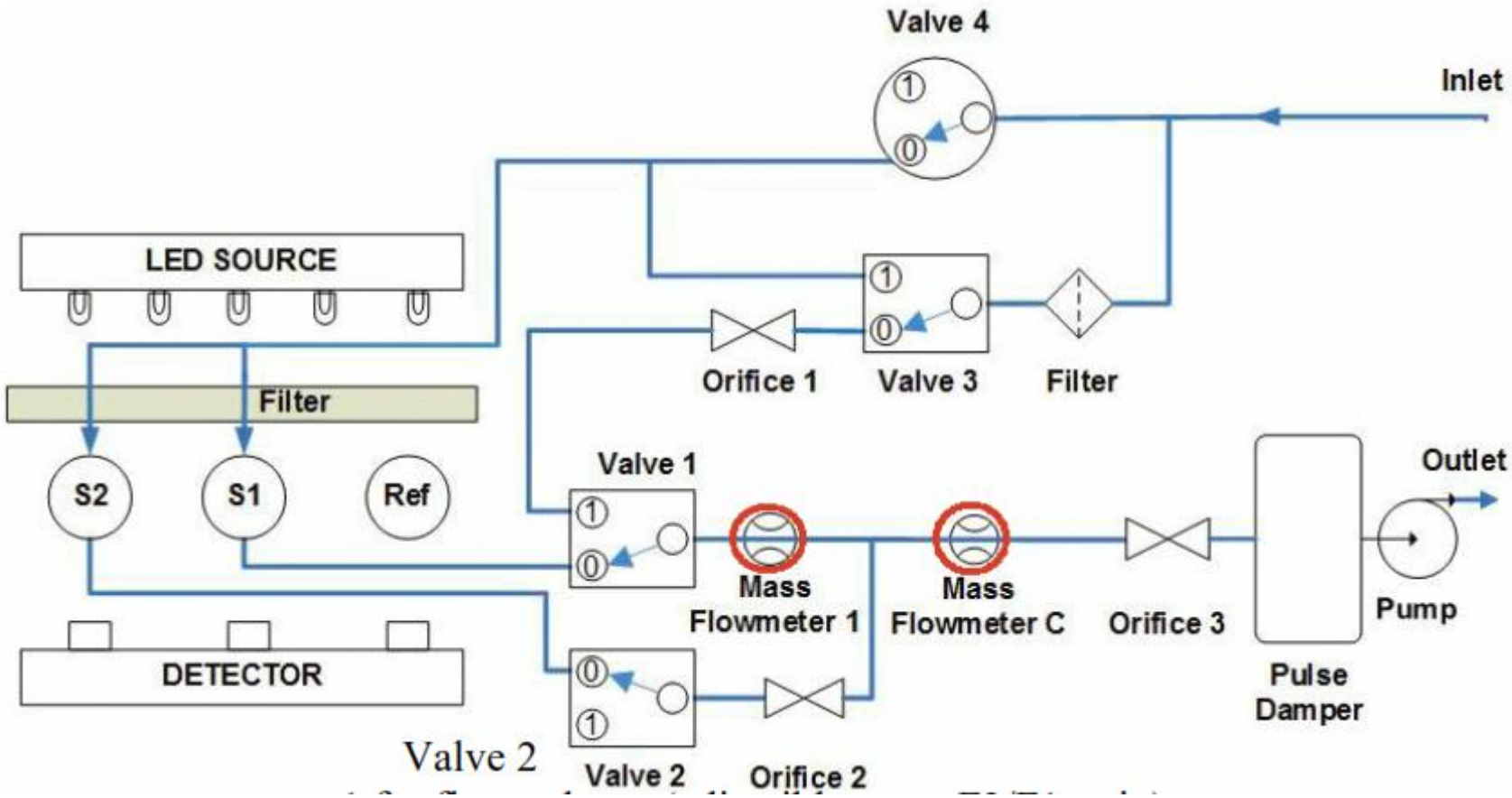
633 – Flow Diagram



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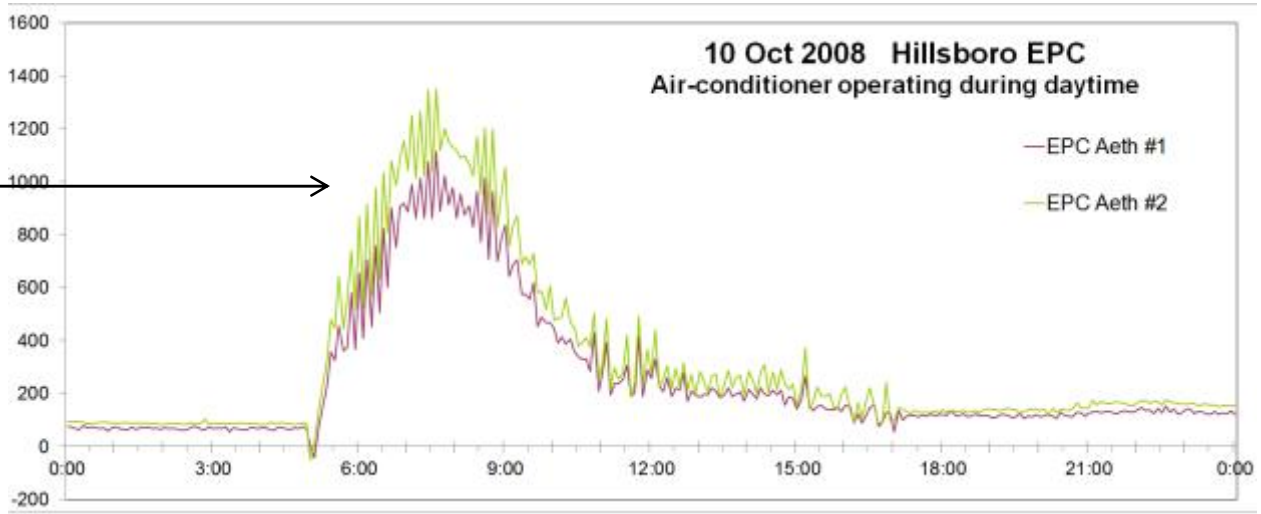
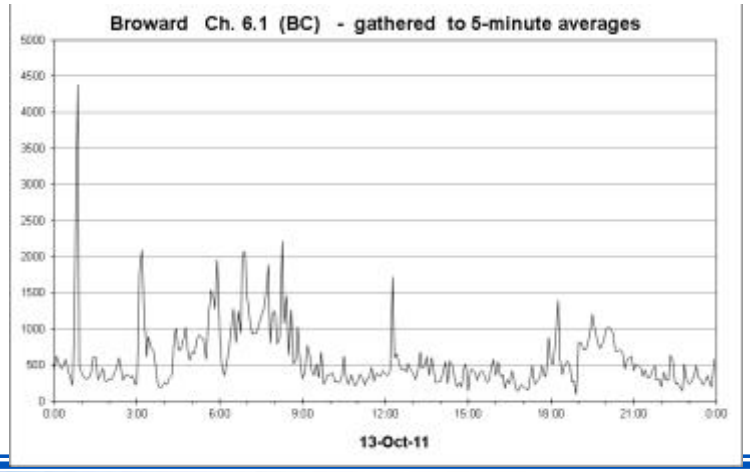
Improvements in High Humidity

2 – AE21
5-min
timebase

Identical conditions: 70-75F ambient dew point



1 – Model 633
5-min timebase



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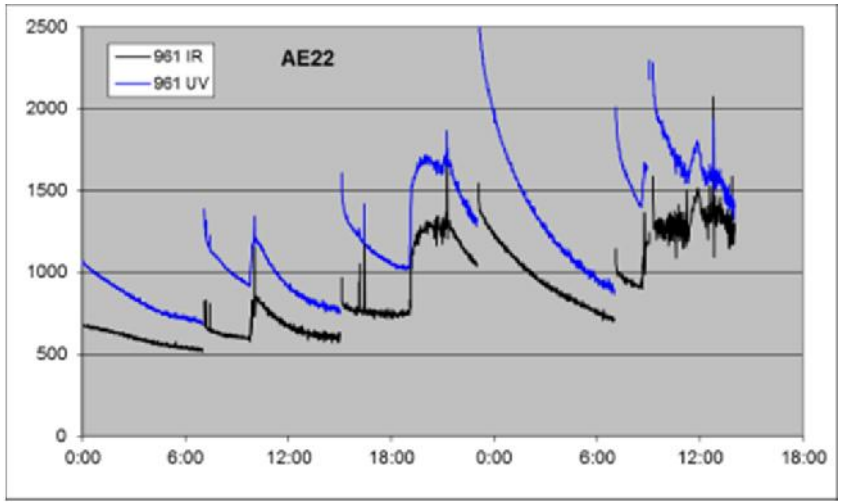
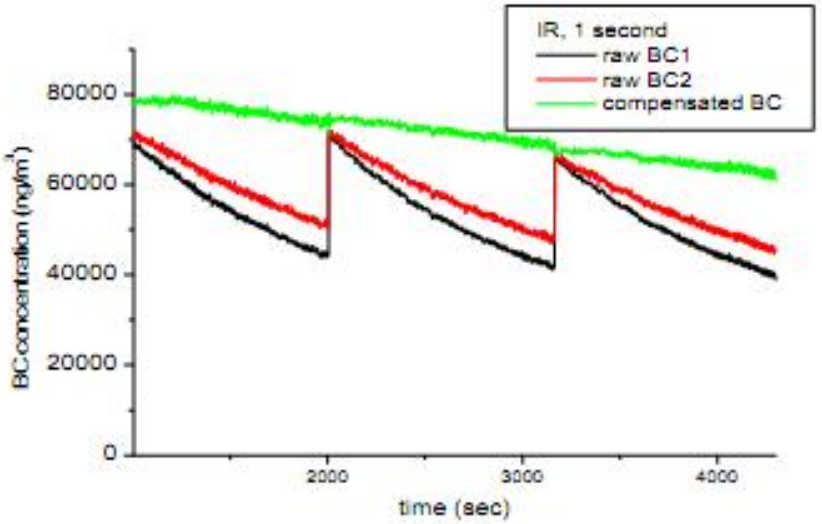
DualSpot™ Results

Traditional AE22 instrument response in presence of fresh BC aerosols



Illustrates the 'data jump' that occurs following a tape advance. The larger the jump, the more loading effect is occurring. This changes based on aerosol composition.

New Model 633 instrument response in same environment using DualSpot™ **Active Loading Compensation**



Active loading compensation provides data corrected to zero loading conditions on the filter in real-time.

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Other Improvements

- Neutral Density Filter Kit
  - Optical Span Validation
  - Traceable to NIST SRM8785
  - Traceable to “Gold” standard factory instrument

- Local Temperature and Pressure Compensation
  - Ambient Weather Station Option
  - Temp, Pressure, %RH

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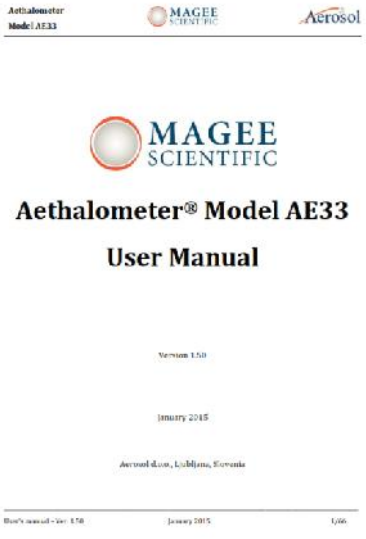
Routine Maintenance

- Once per month
  - Verify flow rate at the inlet
  - Inspect and clean cyclone inlet (BGI SCC)
  - Inspect and clean bug screen/water trap
  - Verify Date / Time, update if necessary
- Once per six months
  - Inspect and clean optical chamber (can be done during tape roll replacement)
  - Leak test (following tape roll change)
  - Check optical response using ND filter kit
  - Clean air test (unless automated)
- Once per year
  - Change bypass cartridge filter
- As needed
  - Change filter tape roll
  - Calibrate flow

Documentation

Operating Manuals


Aethalometer
Model AE33
MAGEE SCIENTIFIC
Aerosol

MAGEE SCIENTIFIC

Aethalometer® Model AE33

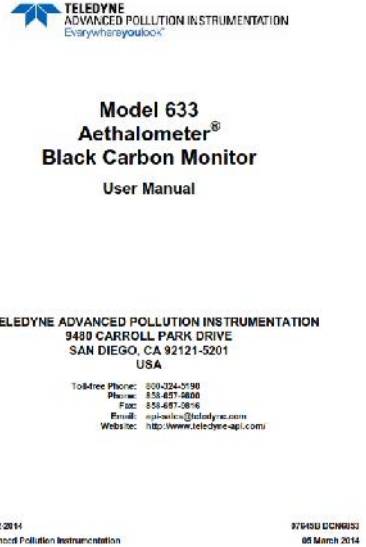
User Manual

Version 1.50

January 2015

Aerosol d.o.o., Ljubljana, Slovenia

User's manual – Ver. 1.50 January 2015 1/66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Model 633
Aethalometer®
Black Carbon Monitor

User Manual

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97045D ECN053
05 March 2014

Standard Operating Procedure


BAY AREA AIR QUALITY MANAGEMENT DISTRICT

TECHNICAL SERVICES DIVISION

QUALITY ASSURANCE PROJECT PLAN

AIRMON SOP XXX

AETHALOMETER MODEL 633

REVISION #X.X.XX 10/01/2013

DRAFT

Glen Colwell, Air Monitoring Manager
Technical Services Division

Mark Stoelting, QA Officer
Technical Services Division

TECHNICAL SERVICES DIVISION 939 ELLIS STREET SAN FRANCISCO, CA 94109 415.749.0

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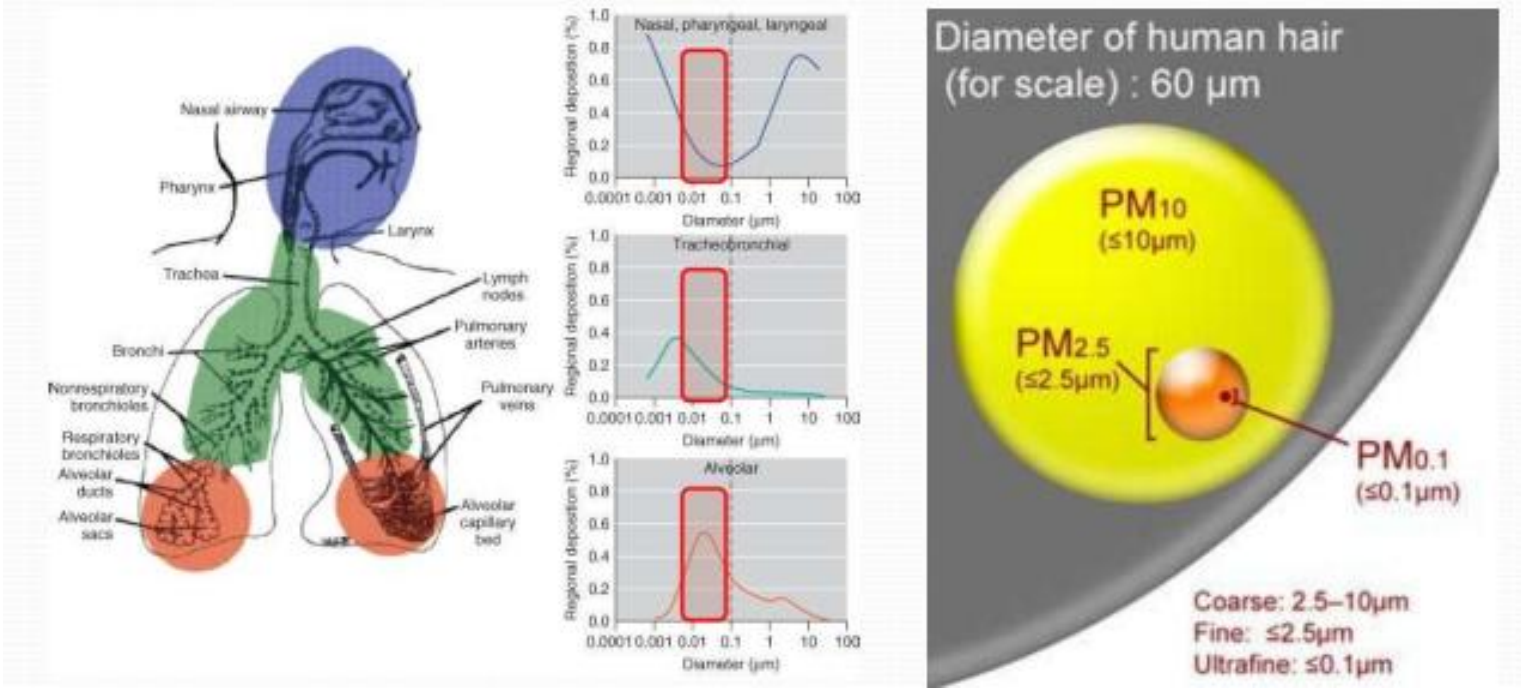
Ultrafine Particles



- More Toxic Than PM2.5
- Can cross cell membranes and move into the circulatory system
- Suspected as one of the causative pollutants in near-traffic epidemiology studies

Courtesy of A. Polidori (SCAQMD)

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Ultrafine Particle Monitoring

- Single ultra-fine particle (UFP) counting
- One second minimum time resolution
- 19” Rack mountable chassis
- 0.6 - 3 lpm inlet flow rate
- Long autonomy period – 30 day maintenance period
- 30 day maintenance items – refill water reservoir and clean inlet screen
- 7 nanometer detectable particle size
- Color touch screen display with real-time graphing
- Ethernet and USB Communications

Model 651 Ultrafine PM Monitor

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What is the Model 651?

- The result of an **OEM agreement with TSI Incorporated** for their Model 3783 Water-based CPC Ultrafine particle counter
- The first continuous, real-time Ultrafine Particle Counter instrument designed for long term, routine ambient air monitoring
- TAPI is the **exclusive distributor** in the US and Canada for the products used in 'Government Agency' monitoring applications (i.e. Near-road monitoring)
- TAPI provides direct sales and service support
- Specially packaged for long term ambient air monitoring applications
  - Includes vacuum pump, proper fittings, annual maintenance package
  - Cyclone, inlet mounting kit, and rack mount kits for routine ambient monitoring

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Ultrafine Particle Counting

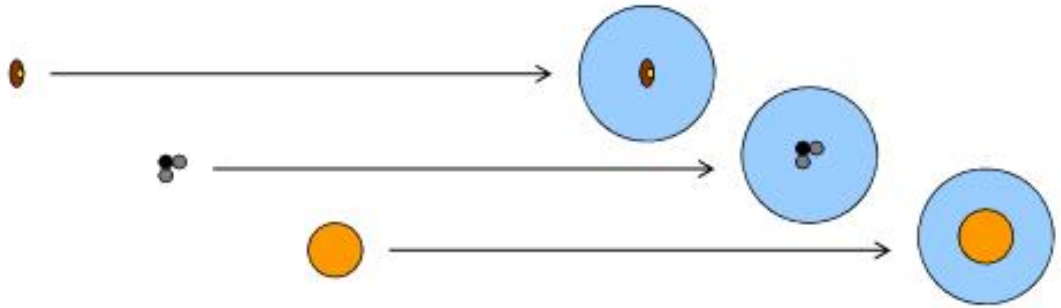
Particle Counting Less Than 0.1 μm

Fact: Real-time airborne (aerosol) particle concentration measurements use scattered laser light to detect particles.

1. The particles are passed through a laser beam and create a light pulse.
2. Every particle pulse event is detected and counted.

Problem: Detection of light scattering "peters out" for particles less than 0.1 μm or 100 nm.

Solution: Make the particles BIGGER using a condensation technique.



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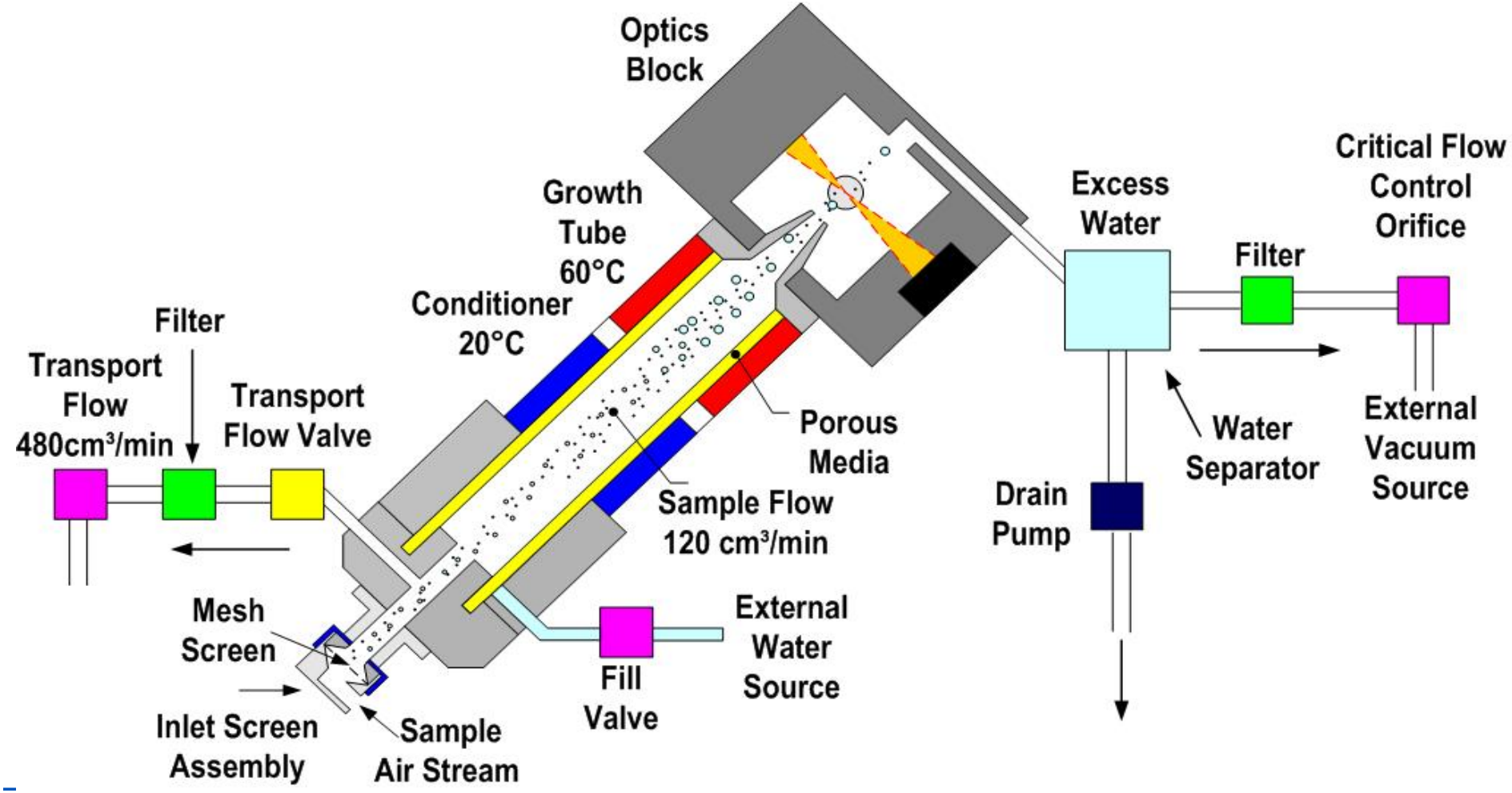
Model 651 UFP Monitor



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Routine Maintenance

- Once per month (15 minutes total time)
  - Refill water bottle
  - Replace wick
  - Clean mesh screen
  - Verify sample flow rate (~0.120 lpm)
  - Inspect and clean cyclone inlet
  - Verify Date / Time, update if necessary
- Once per three months
  - Clean water bottle and fill lines
- Once per year
  - Change flow orifices
  - Change inline filters
- As needed
  - Calibrate flow (i.e. reset flow constant)
  - Factory calibration of optics

Documentation

Operating Manual

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OPERATION MANUAL

Ultrafine Particle Monitor
MODEL 651

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Email: api-sales@teledyne.com
Website: http://www.teledyne-api.com/

07508C DCN6727
17 June 2013

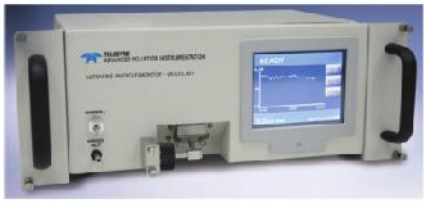
Standard Operating Procedure

TELEDYNE-API

Model 651 Ultrafine Particle Monitor

Standard Operating Procedure

10/15/2013



The purpose of this document is to provide guidance on the set up, operation, maintenance, and calibration of the TAPI Model 651 Ultrafine Particle Monitor.

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Thanks for your attention!
Questions?




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