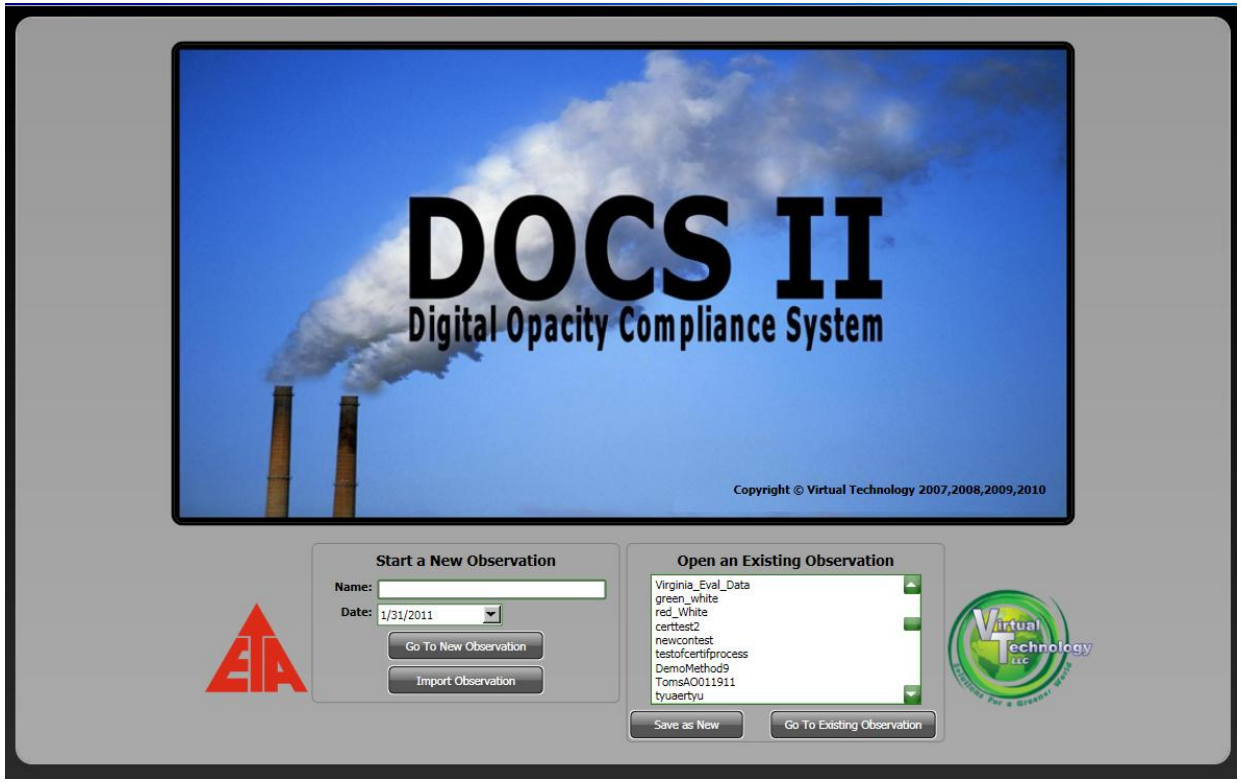
EPA Alternative Method 082 Digital Opacity Success Stories

EUEC Conference, San Diego, Feb. 4 2016



Track B Session 4 PM/CEMS

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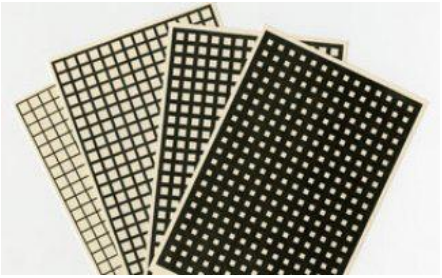
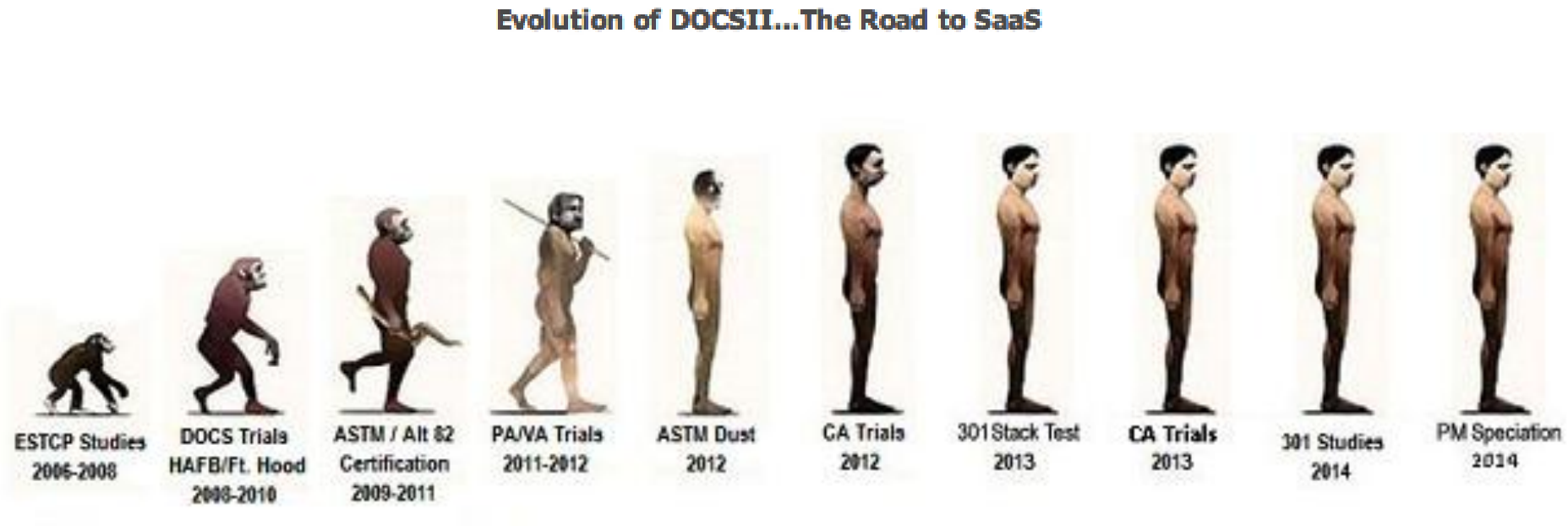
Origins of Opacity



- Late 1800s Maximillian Ringelmann developed the first means of monitoring emissions from coal-fired boilers
- Early 1950s Ringelmann concept was expanded to “equivalent opacity” which included smoke of all colors
- In 1974 USEPA promulgated Method 9 for reading all visible emissions in unit of percent opacity
- Opacity is a rough estimate of Particulate Mater in a plume the higher the opacity the more particulate

Evolution of DOCS II (2006-Present)



DOCS

DOCS II

DOCS II Web

DOCS II SaaS

Evolution of DOCS II

- 2000 to 2005 – Several research projects contracted by DOD & Universities
  - EPA Technology Transfer Network, Emission Technology Center Publishes PRE-008 - Determination of Visible Emissions Opacity from Stationary Sources Using Computer-based Photographic Analysis Systems

- 2005 to 2009 – Research continued by DOD
  - 2007 - ASTM Workgroup formed due to EPA consensus standard direction
  - 2009 - ASTM D7520-09 approved and published

- 2012 February – EPA Office of Air Quality Planning and Standards published US EPA Alternate Method 082 (ALT 082) in the Federal Register as a **Broadly Applicable Standard**, citing ALT 082 certified Digital Camera Opacity Techniques (DCOTs) can be used "in lieu" of Method 9, for all subparts of 40 CFR 60, 61 and 63
  - Federal Permit changes not required
  - Case by case allowed for stack exits > 7' (May 2012)

US EPA ALT 082 Broadly Applicable Standard

Evolution of DOCS II Continued

- 2012 October – ASTM D7520-13 Update Approved by ASTM
  - Allows use of any Digital Image Device: High Definition Digital Recorders (Digital Video), CDMA based Cameras (Cell Phones), CCD based Cameras (98% of Digital Cameras)
  - Allows certification of optical and digital zoom
- 2012 to Present – Fugitive Dust Applicability
  - Original research performed June 05'- June 11'
  - Full NIST Long Path Trans. certification completed January 2012
  - Applicable to fugitives per 40 CFR 60 Subpart ooo October 2012
- 2013 – 301 Testing began to eliminate 7' ASTM stack exit limit
  - EPA desired "comparison with current compliance method"
  - Results show ALT 082 is the same as certified Method 9 observers on stack exits greater than 7', standard update in progress to reflect this research.
- 2015- EPA opinion "Any Creditable Evidence" rule of Clean Air Act, makes applicable to all sources and emission types, including stacks greater than 7'. "a picture says a thousand words".
- 2015 – EPA Final Rule Ferro-Alloy NESHAP Best Available Control Technology is Digital Camera Opacity Technique (DCOT) for Opacity monitoring. Mandatory use of DCOT for fugitive and large stack opacity monitoring.

DOCS II is the only ASTM D7520-13 & ALT 082 certified DCOT

Next Generation Air Embraces Mobile Apps Image based monitoring

DRAFT Roadmap for Next Generation Air Monitoring

Ferro-Alloy NESHAP BACT Determination Requires DCOT for Opacity measurement

This Rule document was issued by the **Environmental Protection Agency** (EPA)

For related information, **Open Docket Folder**

Comments Not Accepted

Action

Final rule.

Summary

This action finalizes the residual risk and technology review (RTR) conducted for the Ferroalloys Production source category regulated under national emission standards for hazardous air pollutants (NESHAP). These final amendments include revisions to particulate matter (PM) standards for electric arc furnaces, metal oxygen refining processes, and crushing and screening operations, and expand and revise the requirements to control process fugitive emissions from furnace operations, tapping, casting, and other processes. We are also finalizing opacity limits, as proposed in 2014. However, regarding opacity monitoring, in lieu of Method 9, we are requiring monitoring with the digital camera opacity technique (DCOT). Furthermore, we are finalizing emissions standards for four previously unregulated hazardous air pollutants (HAP): Formaldehyde, hydrogen chloride (HCl), mercury (Hg) and polycyclic aromatic hydrocarbons (PAH). Other requirements related to testing, monitoring, notification, recordkeeping, and reporting are included. This rule is health protective due to the revised emissions limits for the stacks and the requirement of enhanced fugitive emissions controls that will achieve significant reductions of process fugitive emissions, especially manganese.

Dates

This final action is effective on June 30, 2015. The incorporation by reference of certain publications listed in the rule is approved by the Director of the Federal Register as of June 30, 2015.

Addresses

The Environmental Protection Agency (EPA) has established a docket for this action under Docket ID No. EPA-HQ-OAR-2010-0895. All documents in the docket are listed on the *www.regulations.gov* Web site. Although listed in the index, some information is not publicly available, *e.g.*, confidential business information (CBI) or other information whose disclosure is restricted by statute. Certain other material, such as copyrighted material, is not placed on the Internet and will be publicly available only in hard copy form. Publicly available docket materials are available either electronically through *http://www.regulations.gov*, or in hard copy at the EPA Docket Center, EPA WJC West Building, Room Number 3334, 1301 Constitution Ave. NW., Washington, DC. The Public Reading Room hours of operation are 8:30 a.m. to 4:30 p.m. Eastern Standard Time (EST), Monday through Friday. The telephone number for the Public Reading Room is (202) 566-1744, and the telephone number for the Air Docket is (202) 566-1742.

For Further Information Contact

For questions about this final action, contact Phil Mulrine, Sector Policies and Programs Division (D243-02), Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, 27711; telephone number: (919) 541-5289; fax number: (919) 541-3207; and email address: *mulrine.phil@epa.gov*. For specific information regarding the risk modeling methodology, contact Darcie Smith, Health and Environmental Impacts Division (C539-02), Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711; telephone number: (919) 541-2076; fax number: (919) 541-0840; and email address: *smith.darcie@epa.gov*. For information about the applicability of the NESHAP to a particular entity, contact Cary Secrest, Office of Enforcement and Compliance Assurance, U.S. Environmental Protection Agency, EPA WJC Building, 1200 Pennsylvania Ave. NW., Washington, DC 20460; telephone number: (202) 564-8661; and email address: *secrest.cary@epa.gov*.

Supplementary Information

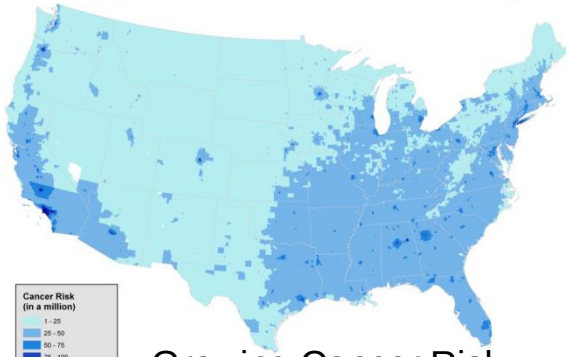
Document Information

Date Posted: Jun 30, 2015
RIN: 2060-AQ11
CFR: 40 CFR Part 63
Federal Register Number: 2015-15038
Show More Details

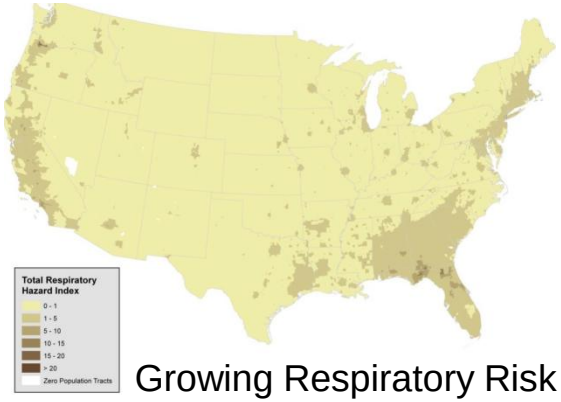
Docket Information

This document is contained in EPA-HQ-OAR-2010-0895
Related Dockets: None
Related RINs: None
Related Documents:
- National Emission Standards for Hazardous Air Pollutants...
- National Emission Standards for Hazardous Air Pollutants...
- National Emission Standards for Hazardous Air Pollutants...

Document text and images courtesy of the Federal Register



Growing Cancer Risk



Growing Respiratory Risk

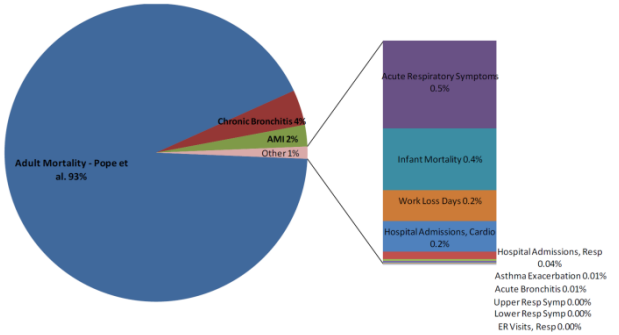


Figure 6-1. Breakdown of Monetized $PM_{2.5}$ Health Benefits Estimates using Mortality Function from Pope et al. (2002)[a]

[a] This pie chart breakdown is illustrative, using the results based on Pope et al. (2002) as an example. Using the Laden et al. (2006) function for premature mortality, the percentage of total monetized benefits due to adult mortality would be 97%. This chart shows the breakdown using a 3% discount rate, and the results would be similar if a 7% discount rate was used.

Monetizing Mortality

The Growing Risk of PM 2.5 Alone is Monetized into the Billions of Dollars Annually
Next Generation Monitoring is a Reality, Everybody Cares and Everybody has a Cell Phone

Method 9 vs. ALT 082, aka ASTM D7520

EPA Method 9

- Per Person 25 White and 25 Black (50) reading, certification
  - EPA Required Content Training
  - 50 plume certification
  - ±7.5% overall and <= 15% within each set of 25.
- Cert. duration 6 months
- Operational conditions
  - Unlimited backgrounds
  - Unlimited weather conditions
- Paper Non-Validated Record

EPA ALT 082

- **System certification (Done by Vendor)**
- (6) sets of (25) White and (25) Black against various backgrounds (300 images)
- 4 independent Analyst use System to derive Opacity of each image (1200 results)
- All (4) Analyst must pass all (6) sets, ±7.5% overall and <= 15% within each set of 25
- Cert. duration 3 ½ years
- **Camera Operator training (Each User)**
  - EPA Required Content Training
  - Camera Operator Training
  - No reoccurring training required
- Operational conditions
  - Unlimited backgrounds
  - Unlimited weather conditions
- Digital Validated Record

Electronic Method 9, allows separation of data "Capture" from "Analysis"

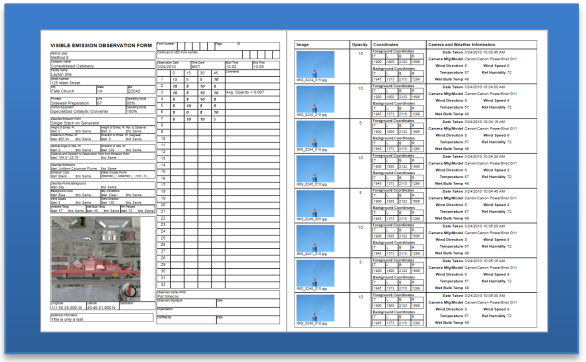
Digital Opacity Compliance System Second Generation (DOCS II)

Capture

Transfer images automatically or manually

Send for analysis

Receive Validated Digital **Report**



Analysis

http://www.virtuallc.com/DocsTestTheWeb/Ani

Docs Web - Analysis

Observation Name: mapei i4 2012-06-06

DOCS II SaaS

Hello Shawn2 Dolan | Logout | Help

Home | Properties | Source | Plume | Location | Analyze | Reports

Duration 1:5:0
Image Count 24
Average Opacity 47.71

Method Total Average

Minimum Number Of Images N/A Rolling High Count N/A
Seconds Between Images N/A Duration in Minutes N/A

Single Image Background

Manual
Automatic
Override

Color Black Background Blue

Get Images | Clear Images

File Name IMG_0628.jpg Camera Mfg/Model Canon Canon PowerShot G11 Date Taken 1/19/2012 9:58:36 AM

Normal Processed Rolling High Background Error

Skip to Content | Legal | Privacy | Security | Terms of Service

12:31 AM
6/13/2012

Report

VISIBLE EMISSION OBSERVATION FORM

Form Number | Page | Of

Continued on VEO Form Number

Method Used: Method 9
Company Name: Consolidated Cabinetry
Facility Name: Layton Site
Street Address: 125 Main Street
City: Falls Church | State: VA | Zip: 22040

Process: Sidewall Preparation | Unit: 67 | Operating Mode: 80%
Control Equipment: Specialized Catalytic Converter | Operating Mode: 100%

Describe Emission Point: Single Stack on Generator
Height of Emiss. Pt. Start 0 End Same | Height of Emiss. Pt. Rel. to Observer Start 0 End Same
Distance to Emiss. Pt. Start 405.34 End Same | Direction to Emiss. Pt. (Degrees) Start 0 End Same
Vertical Angle to Obs. Pt. Start 0 End Same | Direction to Obs. Pt. Start 339 End Same
Distance and Direction to Observation Point from Emission Point Start 184.8 / 28.76 End Same

Describe Emissions: Start Uniform Columnar Plume End Same
Emission Color Start Black End Same | Water Droplet Plume Attached: ( ) Detached: ( ) N/A: (X)

Describe Plume Background: Start Sky End Same
Background Color Start Blue End Same | Sky Conditions Start Clear End Same
Wind Speed Start 9 End Same | Wind Direction Start 180 End Same
Ambient Temp. Start 57 End Same | Wet Bulb Temp. Start 48 End Same | RH Percent Start 72 End Same

Longitude: 111.55.25.000 W | Latitude: 40.46.21.000 N | Declination:

Additional Information: This is only a test

Observation Date: 3/24/2010 | Time Zone: MST | Start Time: 10:02 | End Time: 10:09

	0	15	30	45	Comments
1	10	5	0	*10*	
2	*10*	*5*	*10*	*5*	
3	*10*	*5*	*10*	*10*	Avg. Opacity = 6.667
4	*0*	*5*	*10*	*5*	
5	*5*	*10*	*5*	*5*	
6	*5*	*0*	*5*	*10*	
7	*0*	*10*	*10*	5	
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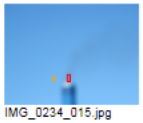
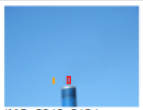
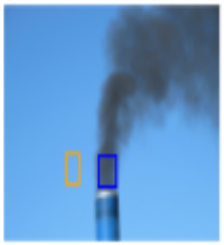
31					
32					

Observers Name (Print): Pat Griecox
Observers Signature | Date
Organization
Certified By | Date

Image	Opacity	Coordinates	Camera and Weather Information
 IMG_0234_015.jpg	10	Foreground Coordinates T 1900 L 1800 B 2122 R 1686 Background Coordinates T 1945 L 1373 B 2110 R 1299	Date Taken 3/24/2010 10:03:45 AM Camera Mfg/Model Canon/Canon PowerShot G11 Wind Direction S Wind Speed 9 Temperature 57 Rel Humidity 72 Wet Bulb Temp 48
 IMG_0235_010.jpg	10	Foreground Coordinates T 1900 L 1800 B 2122 R 1686 Background Coordinates T 1945 L 1373 B 2110 R 1299	Date Taken 3/24/2010 10:04:00 AM Camera Mfg/Model Canon/Canon PowerShot G11 Wind Direction S Wind Speed 9 Temperature 57 Rel Humidity 72 Wet Bulb Temp 48
 IMG_0244_010.jpg	5	Foreground Coordinates T 1900 L 1800 B 2122 R 1686 Background Coordinates T 1945 L 1373 B 2110 R 1299	Date Taken 3/24/2010 10:04:15 AM Camera Mfg/Model Canon/Canon PowerShot G11 Wind Direction S Wind Speed 9 Temperature 57 Rel Humidity 72 Wet Bulb Temp 48
 IMG_0245_010.jpg	10	Foreground Coordinates T 1900 L 1800 B 2122 R 1686 Background Coordinates T 1945 L 1373 B 2110 R 1299	Date Taken 3/24/2010 10:04:30 AM Camera Mfg/Model Canon/Canon PowerShot G11 Wind Direction S Wind Speed 9 Temperature 57 Rel Humidity 72 Wet Bulb Temp 48
 IMG_0246_005.jpg	5	Foreground Coordinates T 1900 L 1800 B 2122 R 1686 Background Coordinates T 1945 L 1373 B 2110 R 1299	Date Taken 3/24/2010 10:04:45 AM Camera Mfg/Model Canon/Canon PowerShot G11 Wind Direction S Wind Speed 9 Temperature 57 Rel Humidity 72 Wet Bulb Temp 48
 IMG_0247_010.jpg	10	Foreground Coordinates T 1900 L 1800 B 2122 R 1686 Background Coordinates T 1945 L 1373 B 2110 R 1299	Date Taken 3/24/2010 10:05:00 AM Camera Mfg/Model Canon/Canon PowerShot G11 Wind Direction S Wind Speed 9 Temperature 57 Rel Humidity 72 Wet Bulb Temp 48
 IMG_0248_010.jpg	5	Foreground Coordinates T 1900 L 1800 B 2122 R 1686 Background Coordinates T 1945 L 1373 B 2110 R 1299	Date Taken 3/24/2010 10:05:15 AM Camera Mfg/Model Canon/Canon PowerShot G11 Wind Direction S Wind Speed 9 Temperature 57 Rel Humidity 72 Wet Bulb Temp 48
 IMG_0249_010.jpg	10	Foreground Coordinates T 1900 L 1800 B 2122 R 1686 Background Coordinates T 1945 L 1373 B 2110 R 1299	Date Taken 3/24/2010 10:05:30 AM Camera Mfg/Model Canon/Canon PowerShot G11 Wind Direction S Wind Speed 9 Temperature 57 Rel Humidity 72 Wet Bulb Temp 48

Forensic Data

Image	Opacity	Coordinates	Camera and Weather Information
 IMG_0222.JPG	55	Foreground Coordinates T: 1761, L: 1862, B: 2128, R: 1606 Background Coordinates T: 1788, L: 1280, B: 2183, R: 996	Date Taken 3/24/2010 10:00:40 AM Camera Mfg/Model Canon/Canon PowerShot G11 Wind Direction SW Wind Speed 10 Temperature 60 Rel Humidity 38 Wet Bulb Temp 34
 IMG_0223.JPG	75	Foreground Coordinates T: 1783, L: 1911, B: 2139, R: 1595 Background Coordinates T: 1714, L: 1181, B: 2018, R: 994	Date Taken 3/24/2010 10:00:57 AM Camera Mfg/Model Canon/Canon PowerShot G11 Wind Direction SW Wind Speed 10 Temperature 60 Rel Humidity 38 Wet Bulb Temp 34
 IMG_0224.JPG	85	Foreground Coordinates T: 1732, L: 1917, B: 2124, R: 1583 Background Coordinates T: 1703, L: 1291, B: 2093, R: 1033	Date Taken 3/24/2010 10:01:20 AM Camera Mfg/Model Canon/Canon PowerShot G11 Wind Direction SW Wind Speed 10 Temperature 60 Rel Humidity 38 Wet Bulb Temp 34

DOCS II Compared to Humans

- Less variation than Method 9 against NIST traceable transmissometer
  - Average deviation count for students at CARB certification is 23
  - Typical deviation count for DOCS II on same certification run is 15
  - Over 95% of DOCS II readings were zero or 1 deviation count
- Average deviation under ideal conditions (high contrast)
  - DOCS II ±5%
  - Method 9 ±10%
- Average deviation under difficult conditions (low contrast)
  - DOCS II ±10%
  - Method 9 ±15%
- Flexible applicability
  - Clouds, Rain, Snow, Trees, & Buildings
  - Day or Night
  - Close & Far (Limited only by camera zoom)

Simple, Fast, Reliable, Repeatable

Sample Customers in:

Conservation, Compliance, Sustainability, Training
Regulatory Policy and Enforcement, Local and International

FAMILIES FOR CLEAN AIR

SIERRA CLUB

Carbon County
Utah's Castle Country

GATX Rail

Utah Physicians for a Healthy Environment

Hawaii Independent Energy

USG

BELCO

ArcelorMittal

MAPEI
ADHESIVES · SEALANTS · CHEMICAL PRODUCTS FOR BUILDING

Industrial Technology Institute
Sri Lanka

California Environmental Protection Agency
Air Resources Board

ADEQ
Arizona Department of Environmental Quality

Fairbanks North Star Borough 50 Years

Bay Area Air Quality Management District
A HEALTHY BREATHING ENVIRONMENT FOR EVERY BAY AREA RESIDENT

United States Environmental Protection Agency

GOLDEN SPECIALTY

Connecticut Energy Environment

EPA ALT 082, The "Best" solution

Customer Comments Trends

- Lower cost of maintaining certifications
- Less time spent achieving certification
- Unbiased opacity measurements
- Better record keeping
- More defendable
- More dependable
- More onsite visible emission capability
- User friendly
- Reproducible

Simply the Easiest to Operate, Most Economical Means to Measure Opacity

Certified Cameras & Digital Video Recorders

- VIVOTEK 83X Day/Night All Weather

- Canon Powershot G11, G12, G16
- Canon Powershot SX60HS

- Nikon D3100, D3200, D5100
- JVC HandiCam

"Certified Visible Emission Observation" = Certified Cam.
"Credible Evidence" all digital cameras work

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Contact

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Shawn.dolan@virtuallc.com

(888) 872 3836

How DOCS II Works

- An image or images of the emission source are captured by trained/certified camera operator using a certified camera.
- The images are uploaded to “the Cloud” where they are acquired by a certified analyst who identifies the region of interest within the imagery.
- Regions of Interest are marked according to explicit rules
- DOCS II then applies algorithms to the Regions of Interest and calculates the opacity of each image and the average, based on selected rule, e.g. 6 min. avg., 3 min. avg.
- DOCS II stores an archive of the draft VEE report.
- Source owner accepts/rejects the draft VEE report.
- DOCS II generates final VEE report and archive record.

Simple, Fast, Reliable, Repeatable

Problems & Solutions

- The top three problems defending Human Method 9 readings.
  I. VEE record not technically correct, missing data, sun angle, point of view…..
  II. VEE not performed by Certified Observer
  III. Smoke School Quality Assurance Protocol not meeting the requirements set forth by USEPA for VE certification programs.

- DOCS II SaaS Model separates data collection from Certified Analysis.
  I. VEE record completely validated upon save.
  II. Certified Analyst always available to perform analysis
  III. Certified Analyst history of opacity determination across hundreds of readings eliminating personnel bias.

DOCS II SaaS,
Complete & Validated, Certified, Reproducible
Most Samples are sent to Labs
Why not Opacity samples?