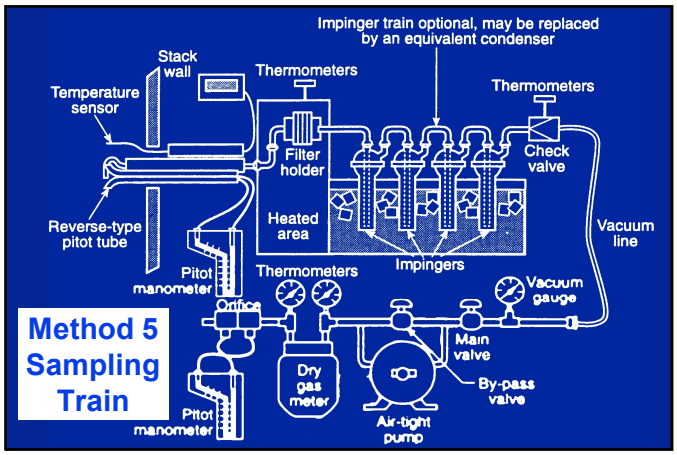
NACT 224
Observing Source Tests

Course Overview

- Planning a Source Test
- Source Test Basics
- Observing the Test
- Problem Areas
- Reviewing Test Data



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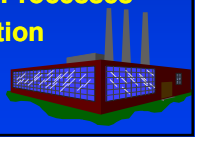
Purpose of Source Testing

- **For the Agency :**
  - Provide Data to Evaluate Compliance
  - Provide Data to Formulate Control Strategies
  - Provide Data for Regulation Development

Purpose of Source Testing

- **For the Facility :**
  - Provide Data to Evaluate Compliance Status
  - Meet Permit-To-Operate (PTO) Conditions
  - Provide Info. on Control Device Efficiency
  - Provide Info. for Design of New Processes
  - Provide Info. on Process Operation
  - Certify CEMs
  - Certify PEMS



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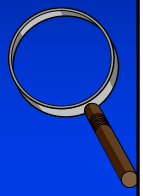
Authorities Requiring Source Testing

- Federal
  - NSPS
  - NESHAP
  - Title V Permits
- State and Local Requirements
  - Enforcement
  - Permitting
  - Emissions Inventory

Role of the Observer

- Evaluate Representativeness of a Test
  - Process & Control Equipment Operation
  - Sampling Port Location
  - Sample Collected
  - Sample Recovery & Analysis
  - Report



Role of the Observer

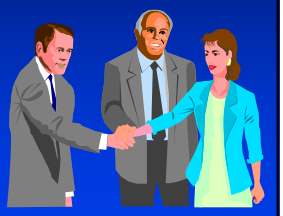
- Represent the Interests of Agency
  - Tests Satisfy the Needs of the Agency
  - Planning & Pretest
  - During the Test
  - Post Test
- QA/QC Officer

Role of the Observer

- Is the Source Test Legally Defensible?
  - Evaluate the Test Activities
  - Evaluate the Test Company/Team Qualifications & Competence
  - Evaluate the Laboratory Qualifications & Competence
  - Reliable & Appropriate Test Methods
  - Chain-of-Custody

Role of the Observer

- Observer Behavior
  - Test is Successful
  - Cooperate with Both Facility & Testers
  - Specific & Firm Requests
  - DO NOT Intrude or Interfere Unnecessarily



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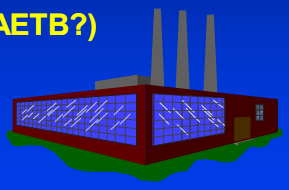
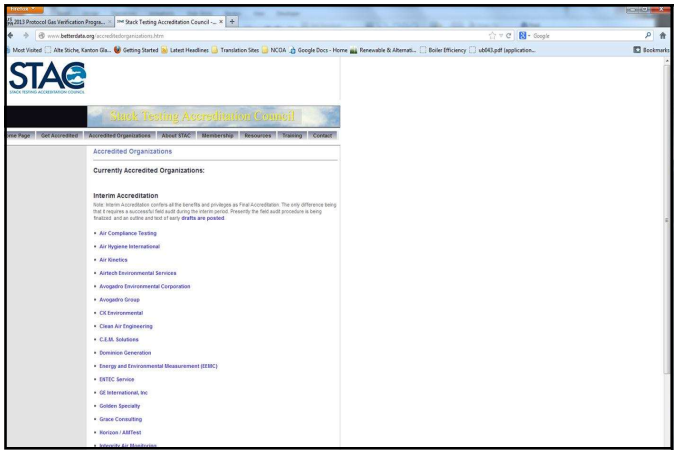
Test Protocol

- Name & Location of Tested Facility
- When is Test (Adequate Notification?)
- Purpose of Test
- Testing Contractor (AETB?)
- Facility Description
- Process Description
- What is to be Tested



Test Protocol

- Regulatory Requirements
- Test Methods to be Used
- Schedule of the Test
- Test Location Configuration & Type
- Number & Size of Test Ports
- Process Rate to be Tested
- Report Requirements
- Unusual Requirements



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Testing Access

- **Access to the Stack**
  - Getting Equipment to the Stack, Vehicle Access
  - How far up is the Testing Platform?
  - Getting Personnel & Equipment up the Stack
  - Is the Platform Secure?
- **Logistics**
  - Are there Electrical Outlets at the Stack?
  - What Load will the Electrical Circuits Hold?
  - Explosion Proof Electrical Equipment Required?

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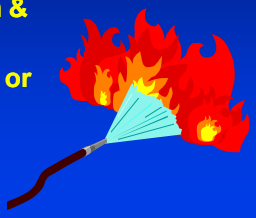
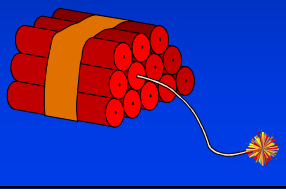
Hazards

- What are the Stack Emissions?
- What Heat & Gas Hazards Exist?
- What are the Facility Health & Safety Procedures?
- Are Entry, Confined Space, or Other Permits Required?



Hazards

- What Protective Equipment is Needed?
  - Normally?
  - In the Event of an Accident or Plant Upset?
  - What are the Plant Safety Warnings?
- Weather Hazards
  - High Winds
  - Heat Lightning
  - Cold, Ice, & Snow



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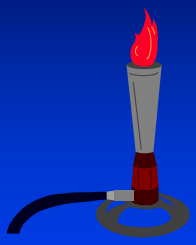
Problem Sources

- Eccentric & Tapered Stacks
- Horizontal Ducts
- Unconfined Flow
- High Temperatures
- Saturated Stack Gas



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Problem Sources

- Low Flow Rate
- Cyclonic Flow
- Condensables
- Reactive Compounds
- Soot Blowing

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Observing the Source Test

- Physical Inspection Points
- Procedural Inspection Points
- Calculation Inspection Points
- Preliminary Data Collection
- QC Audits

Documentation

- What Process & Control Room Data Area Available?
- What Data Are Required for the Test?
- What Data Are Required to Document Process Conditions?
- What Data Are Required to Document Continued Compliance?
- Is Any Control Room Data Confidential?

Checklists

- Ensure All Inspection Points Are Covered
- Ensure All Data Points Are Properly Collected
- Should Be Reviewed & Modified for the Source Being Tested

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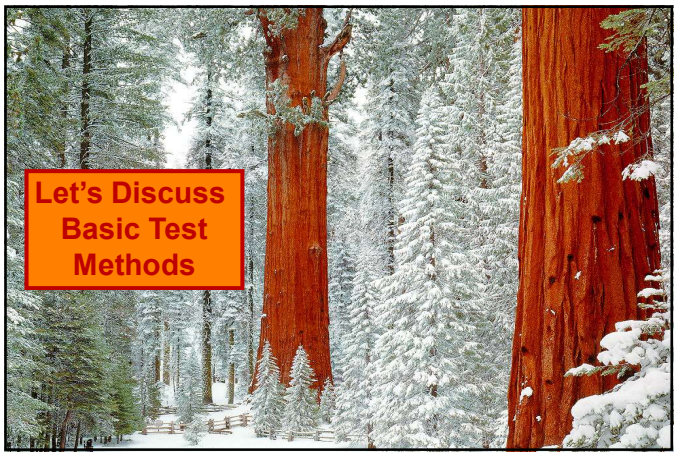

Basic Test Methods

- Method 1 - Sampling Point Location
- Method 2 - Stack Gas Velocity
- Method 3 - Dry Molecular Weight
- Method 4 - Moisture Content of Stack Gases
- Method 5 - Particulate Emissions
- Method 6 - Sulfur Dioxide Emissions
- Method 7 - Nitrogen Oxide Emissions
- Method 10 - Carbon Monoxide Emissions

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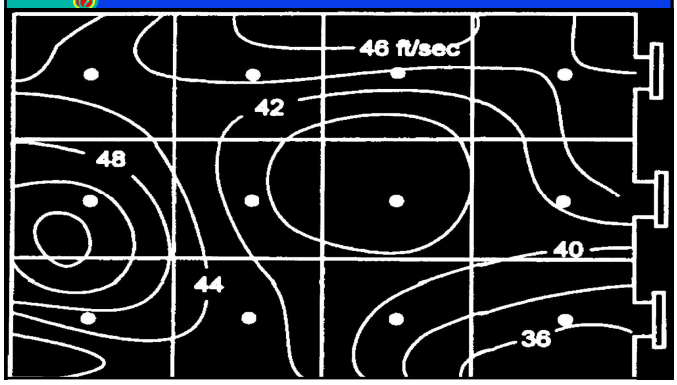
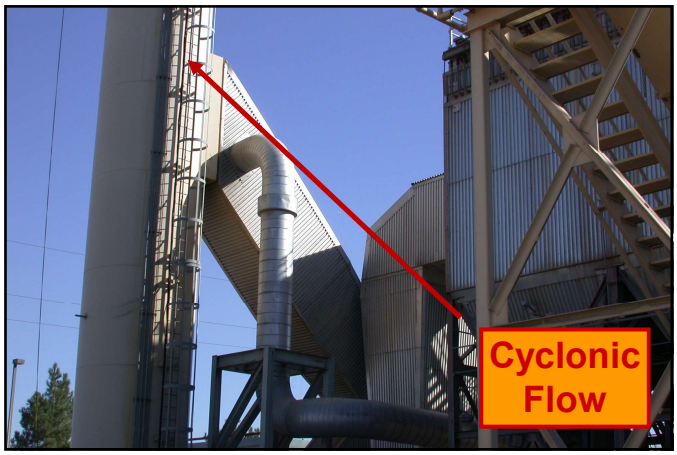
Method 1

Sample & Velocity Traverses for Stationary Sources

- Specifies Both the Sampling Site Location & the Location of the Sampling Points
- The More Convoluted the Ductwork, the More Points that Will Need to be Tested

Stack Velocity Stratification





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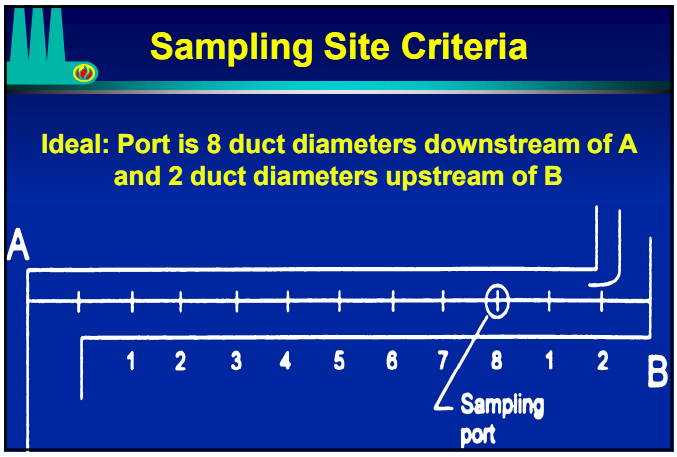

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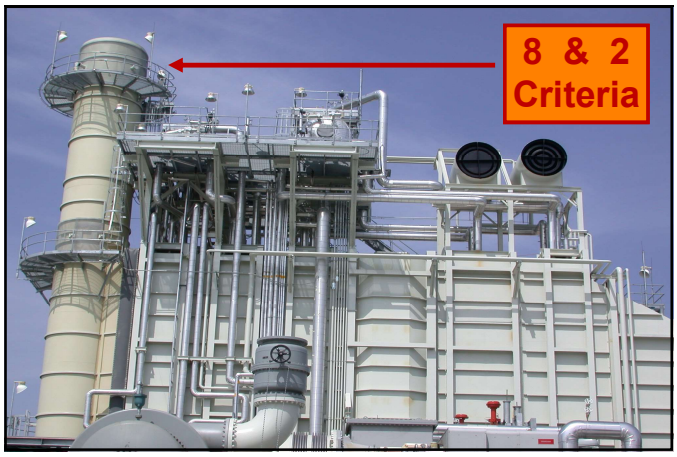
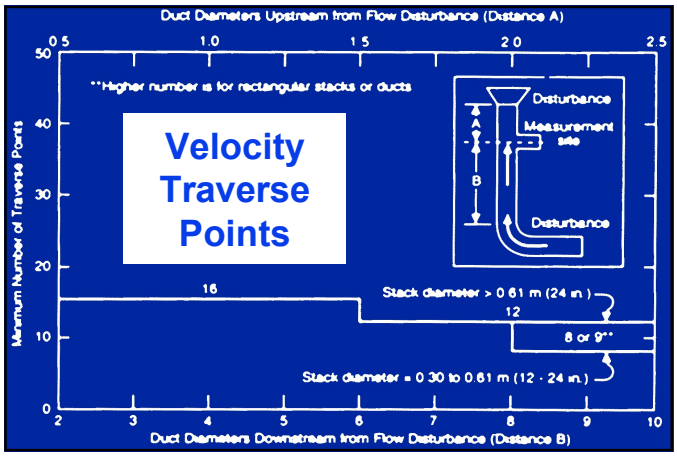
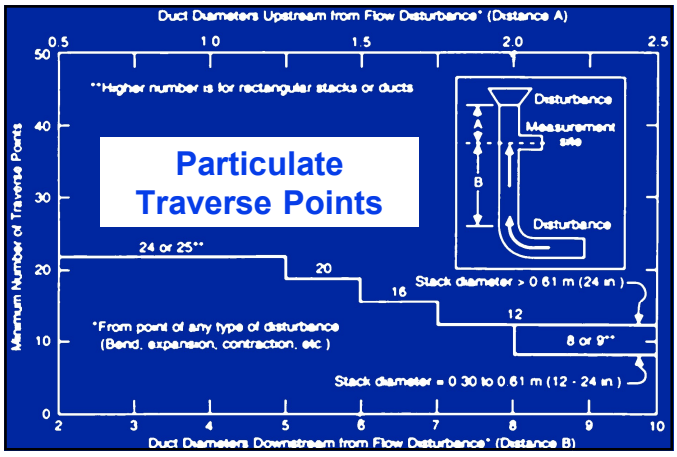


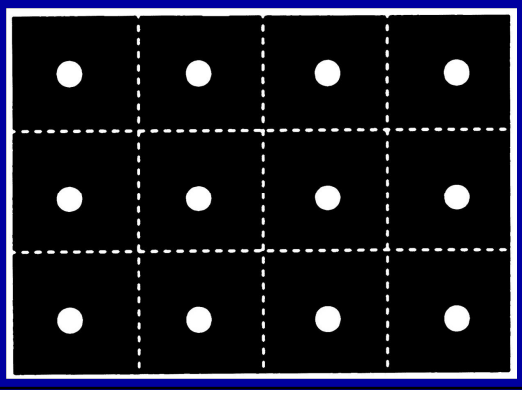




Rectangular Duct Cross-Section Layout

# of Traverse Points	Matrix
9	3 x 3
12 (example on next slide)	4 x 3
16	4 x 4
20	5 x 4
25	5 x 5
30	6 x 5
36	6 x 6
42	7 x 6
49	7 x 7

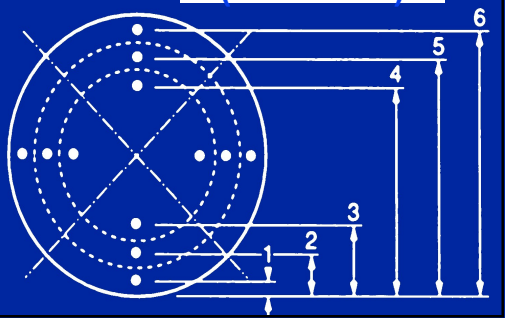
Rectangular Duct Traverse (12 points)



Pt. 60, App. Meth. 1

Circular Stack Traverse (12 Points)

Traverse Point	Distance, % of diameter
1	4.4
2	14.6
3	29.6
4	70.4
5	85.4
6	95.6



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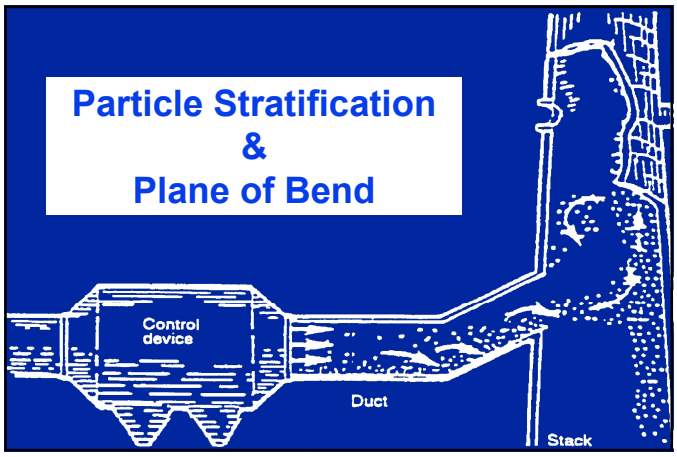
Traverse Point #	Number of traverse points on a diameter											
	2	4	*6	8	10	12	14	16	18	20	22	24
1	14.6	6.7	4.4%	3.2	2.6	2.1	1.8	1.6	1.4	1.3	1.1	1.1
2	85.4	25.0	14.6%	10.5	8.2	6.7	5.7	4.9	4.4	3.9	3.5	3.2
3		75.0	29.6%	19.4	14.6	11.8	9.9	8.5	7.5	6.7	6.0	5.5
4		93.3	70.4%	32.3	22.6	17.7	14.6	12.5	10.9	9.7	8.7	7.9
5			85.4%	67.7	34.2	25.0	20.1	16.9	14.6	12.9	11.6	10.5
6			95.6%	80.6	65.8	35.6	26.9	22.0	18.8	16.5	14.6	13.2
7				89.5	77.4	64.4	36.6	28.3	23.6	20.4	18.0	16.1
8				96.8	85.4	75.0	63.4	37.5	29.6	25.0	21.8	19.4
9					91.8	82.3	73.1	62.5	38.2	30.6	26.2	23.0
10					97.4	88.2	79.9	71.7	61.8	38.8	31.5	27.2
11						93.3	85.4	78.0	70.4	61.2	39.3	32.3
12						97.9	90.1	83.1	76.4	69.4	60.7	39.8
13							94.3	87.5	81.2	75.0	68.5	60.2
14							98.2	91.5	85.4	79.6	73.8	67.7
15								95.1	89.1	83.5	78.2	72.8
16								98.4	92.5	87.1	82.0	77.0
17									95.6	90.3	85.4	80.6
18									98.6	93.3	88.4	83.9
19										96.1	91.3	86.8
20										98.7	94.0	89.5
21											96.5	92.1
22											98.9	94.5
23												96.8
24												98.9

Location of Traverse Points in Circular Stacks



Calculation Inspections

- Confirm Input Data
  - Stack
    - Dimensions
    - Calculate Equivalent Diameter (If Stack is Not Circular)
    - Location of Disturbances
  - Traverse Points
    - Evaluate Number of Points
    - Evaluate Location of Points

Equivalent Diameter

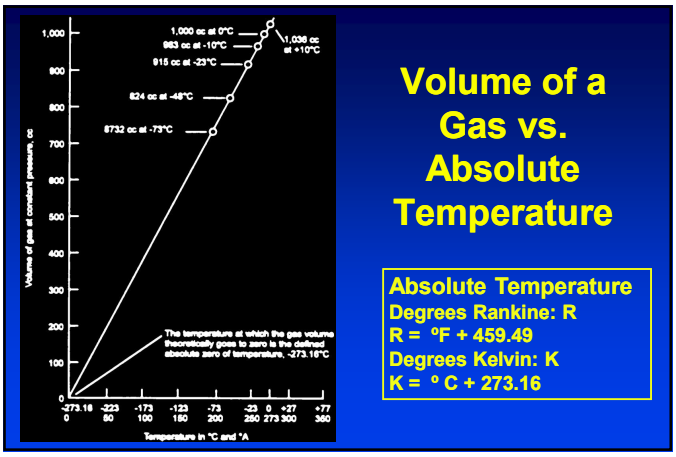
$$D_e = \frac{2\,LW}{L+W}$$

Method 2

Determination of Stack Gas Velocity and Volumetric Flow Rate

- Method Uses Type S Pitot Tube
- Method Also Used to Certify Flow Monitors

Stack Volumetric Flow Rate : $Q_s = A_s\ V_s$



Volume of a Gas vs. Absolute Temperature

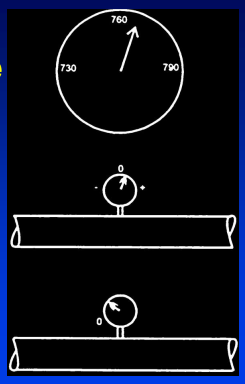
Absolute Temperature
Degrees Rankine: R
R = °F + 459.49
Degrees Kelvin: K
K = ° C + 273.16

Atmospheric or Barometric Pressure

Gauge Pressure

Absolute Pressure

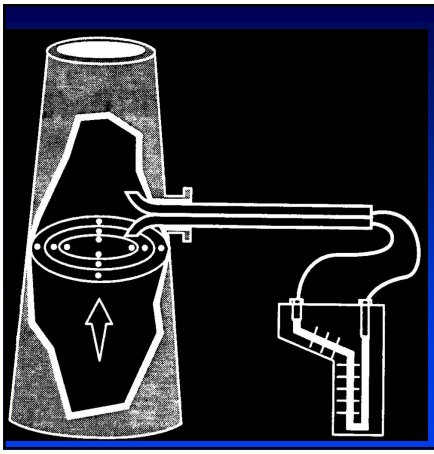
$P_a = P_b + P_g$



P_b

P_g

P_a



Differential Pressure Measuring

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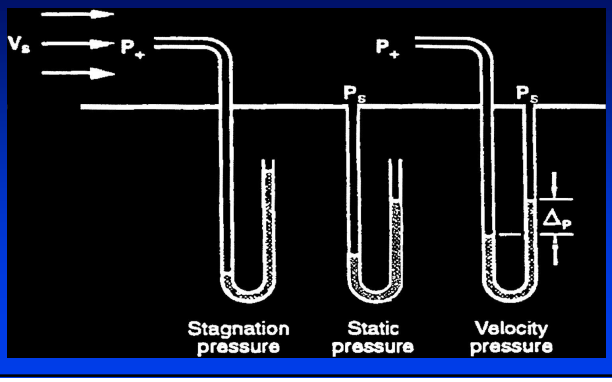
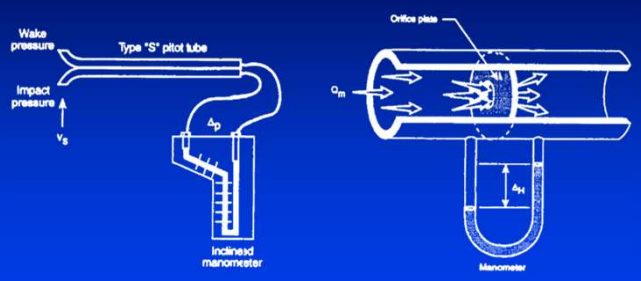
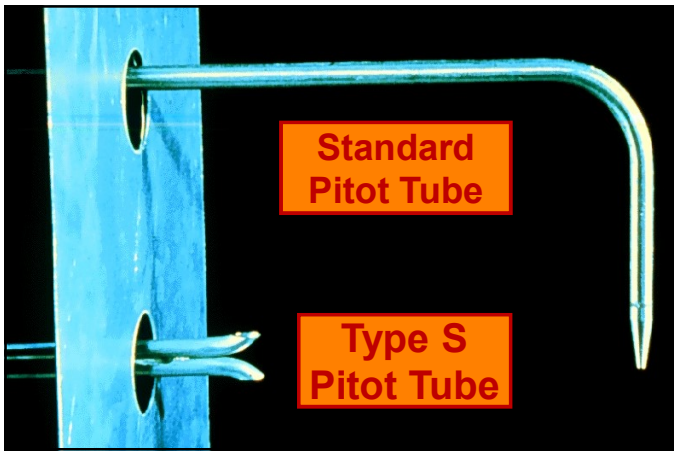
Differential Pressure Measuring

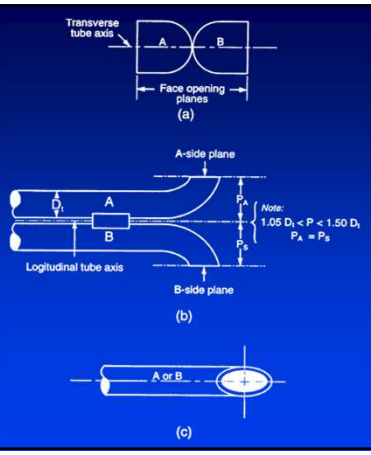


Type "S" Pitot Tube & Orifice Meter





Type S Pitot Tube Construction



Physical & Procedural Inspections

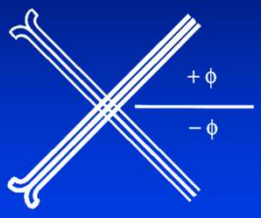
- Pitot tube
  - Construction & Condition
  - Alignment (Bent, etc.)
  - Orientation & Attachment to Probe
  - Calibration
  - Leak Checked (Both Sides)
- Pressure Instruments
  - Oil Manometer Leveled & Zeroed
  - Magnehelic Gauge Calibrated
- Cyclonic Flow Checked

Pitot Tube Roll and Pitch

Roll angle

Rotational

Pitch angle



Vertical

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Observing Source Tests

Calculation Inspections

- Confirm Input Data
  - Stack Pressures
  - Stack Temperature
  - Calibration Factors

Stack Gas Velocity

$$v_s = K_p C_p \sqrt{\frac{T_s \Delta p}{P_s M_s}}$$

$$P_s = P_b + \frac{p_s}{13.6}$$

Δp - Velocity pressure

The difference between the two pressure taps of a pitot tube (determined by averaging the square roots of all the Δp readings. Note -- DO NOT take average of readings and then take the square root).

Stack Gas Velocity

- $C_p = 0.84$
- $t_s = 345^oC$
- $T_s = 345^oC + 273^oC$
- $\Delta p = 38.1$ mm H_2O
- $P_b = 680$ mm Hg
- $M_s = 28.2$ g/mole
- $p_s = 35$ mm H_2O
- $K_p = 34.97$ (metric)

$$v_s = K_p C_p \sqrt{\frac{T_s \Delta p}{P_s M_s}}$$

$$32.5 \text{ m/s} = 34.97 \times 0.84 \sqrt{\frac{(345+273) \times 38.1}{(680+35/13.6) \times 28.2}}$$

Calculation Inspections

- Stack Volume
  - Stack Area
  - Flow

Stack Gas Volumetric Flow Rate $Q_s = A_s V_s$

$$Q_s = A_s K_p C_p \left(\frac{T_s \Delta p}{P_s M_s}\right)^{1/2}$$

$$Q_{sd} \text{ (ft}^3\text{/hr)} = 3600 \times (1 - B_{WS}) A_s V_s \frac{T_{STD} P_s}{T_s P_{STD}}$$

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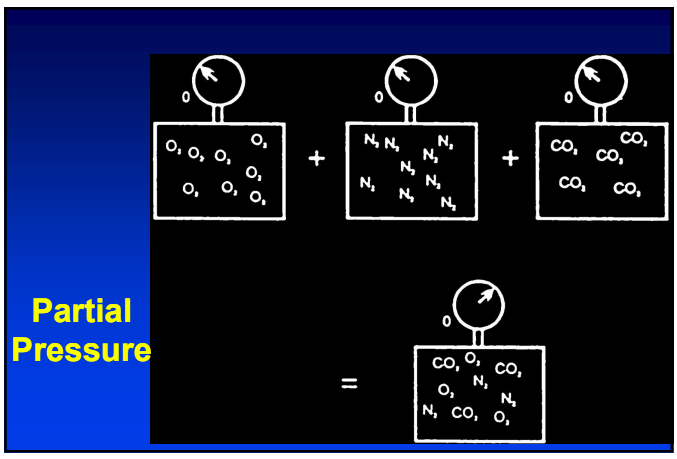
Method 3

Gas Analysis for Determination of Dry Molecular Weight

- Determines %CO_2, %O_2, & CO
- Balance is N_2
- Needed for Both Pitot Tube Equation & Isokinetic Rate Equation



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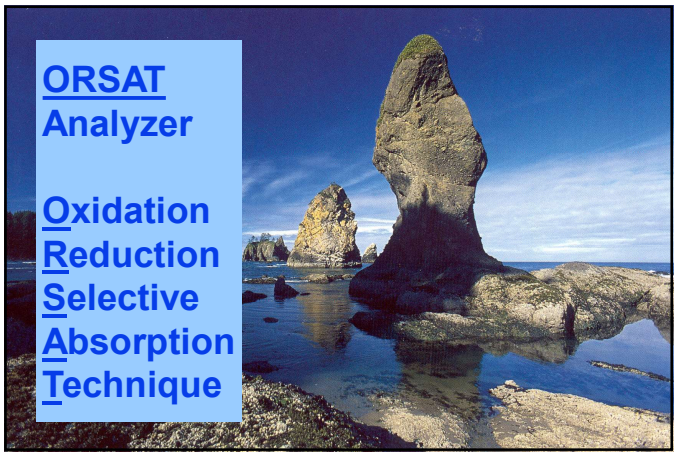

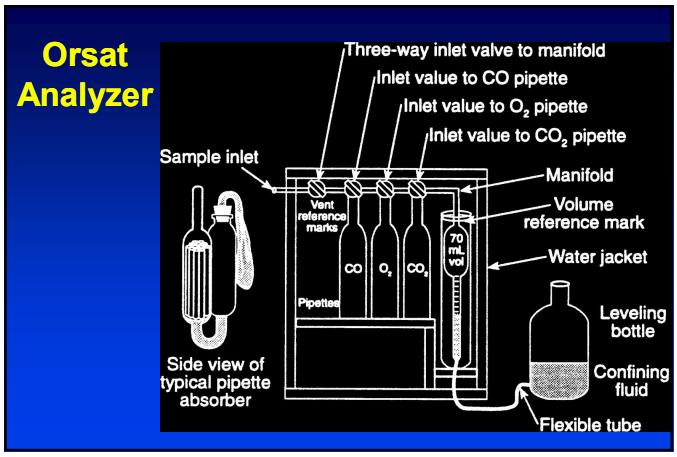

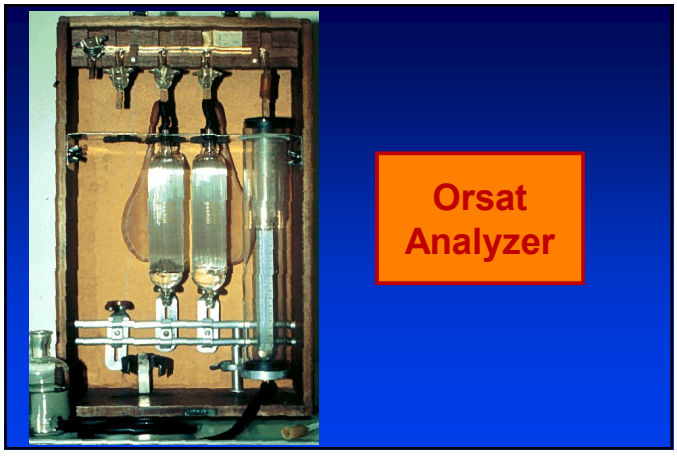

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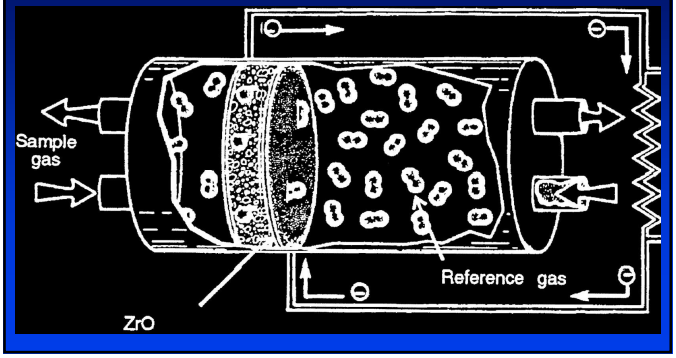
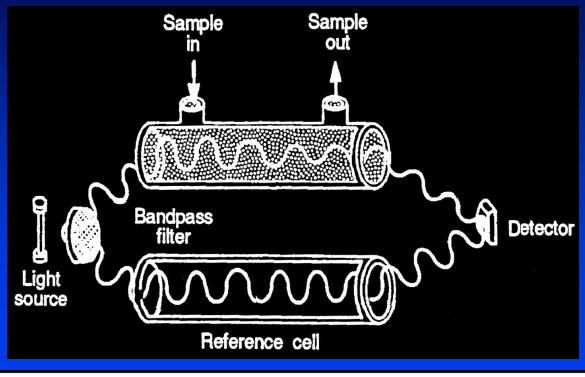
Electrocatalytic O_2 Analyzer



NDIR CO_2 Analyzer



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CO_2 Analyzer

Molecular Weight by Mole Fraction

- O_2 = 55 mm Hg (8.1%)
- CO_2 = 65 mm Hg (9.6%)
- CO = 8 mm Hg (1.1%)
- N_2 = 552 mm Hg (81.2%)
- P_b = 680 mm Hg

$$M = \Sigma B_i M_i$$

$$\frac{55}{680} x32 + \frac{8}{680} x28 + \frac{65}{680} x44 + \frac{552}{680} x28$$

= 30.0 g/mole

Fuel Type	F_d		F_w		F_c		F_o
	dscm/J (x10⁷)	dscf/ 10⁶ BTU	wscm/J (x10⁷)	dscf/ 10⁶ BTU	scm/J (x10⁷)	scf/ 10⁶ BTU	
Coal:							
Anthracite	2.71	10,100	2.83	10,540	0.530	1,970	1.016-1.130
Bituminous	2.63	9,780	2.86	10,640	0.484	1,800	1.083-1.230
Lignite	2.65	9,860	3.21	10,950	0.513	1,910	1.016-1.130
Oil:	2.47[1]	9,190[1]	2.77[1]	10,320[1]	0.383[1]	1,420[1]	1.260-1.413[3]
							1.210-1.370[4]
Gas:							
Natural	2.43	8,710	2.85	10,610	0.287	1,040	1.600-1.836
Propane	2.34	8,710	2.74	10,200	0.321	1,190	1.434-1.586
Butane	2.34	8,710	2.79	10,390	0.337	1,250	1.405-1.553
Wood	2.48	9,240			0.492	1,830	1.000-1.120
Wood Bark	2.58	9,600			0.516	1,920	1.003-1.130
Municipal Waste	2.57	9,570			0.488	1,820	

F Factors

ORSAT Analysis Check by F_o

- O_2 = 8.1%
- CO_2 = 9.6%

$$F_o = \frac{20.9 - \%O_2}{\%CO_2}$$

$$F_o = \frac{20.9 - 8.1}{9.6} = 1.33$$

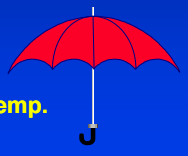
Table value for oil combustion = 1.260 - 1.413

ORSAT analysis is OK

Method 4

Determination of Moisture Content in Stack Gas

- Needed for Both Pitot Tube Equation & Isokinetic Rate Equation
- 4 Methods Can be Used
  - Saturation Pressure: T_{GAS}
  - Psychrometry: Wet & Dry Bulb Temp.
  - Adsorption: Silica Gel Tubes
  - Condensation: Impingers (Vol of H_2O ÷ Vol of Gas)



Calculation & Procedural Inspections

- Recovery
  - No Spillage
  - Measured Correctly
- Moisture
  - Preliminary
  - Final
  - Dry *vs* Wet Molecular Weight

$M_{saturated} = M_{dry} (1 - B_{ws}) + 18B_{ws}$

Wet Basis Molecular Weight

- $M_d = 30.0$ (dry)
- $B_{ws} = 15\%$

$M_s = M_d (1 - B_{ws}) + 18B_{ws}$

$M_s = 30.0 (1 - 0.15) + 18 \times 0.15$

$= 28.2$ g/mole

B_{ws} = Vol of H_2O ÷ Vol of Gas

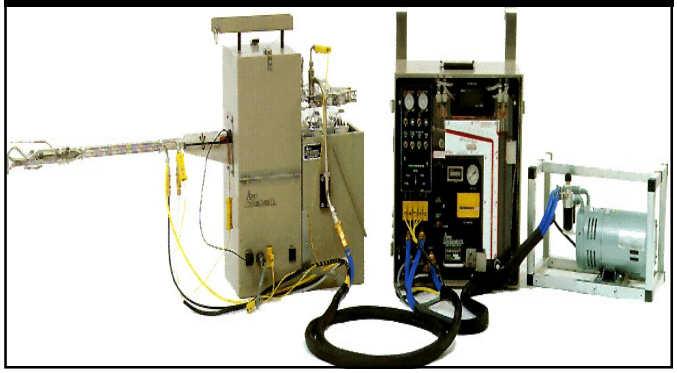
NACT 224
Observing Source Tests

Method 5

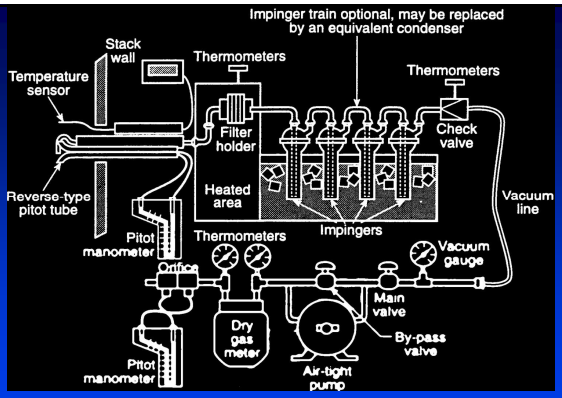
Determination of Particulate Emissions from Stationary Sources

- **Isokinetic Sampling -- The sample is drawn into the probe nozzle at the same rate as it is moving in the flue gas.**

Isokinetic Source Sampling System

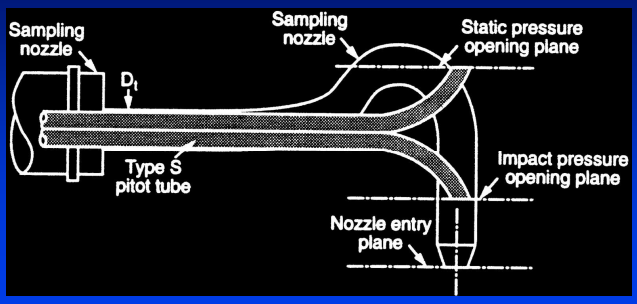


NACT 224
Observing Source Tests



Method 5 Sampling Train

Nozzle Design and Placement

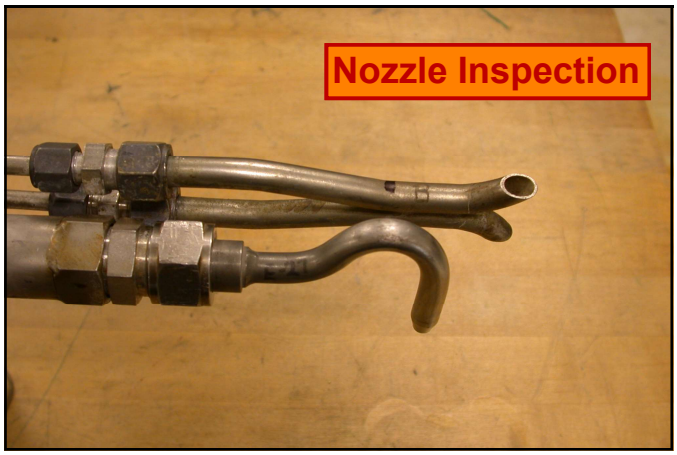


Sample Nozzles

NACT 224
Observing Source Tests

Physical Inspections

- Nozzle
  - Construction (SS or Glass)
  - Alignment & Installation on the Probe
  - Dents, etc.
  - Calibration
  - Rinsed During Sample Recovery



Calculation Inspections

- Nozzle Diameter

$$D_n = \sqrt{\frac{K_D Q_m P_m}{T_m C_p (1-B_{ws})}} \sqrt{\frac{T_s M_s}{P_s \Delta p_{est}}}$$

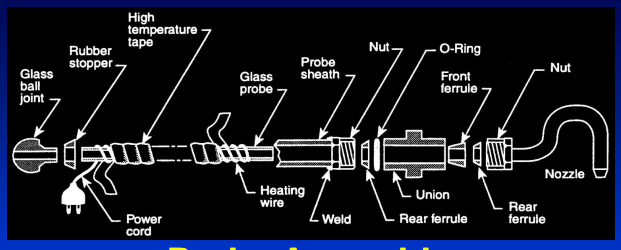
K_D = 6.07 (0.0358 English units)

Nozzle Diameter

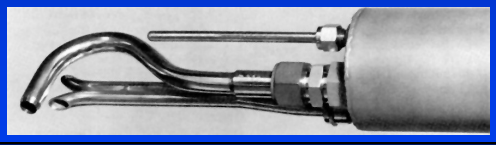
- K_D = 6.07
- Q_m = 0.021 m^3
- P_m = 683.6 mm Hg
- T_m = 28°C
- C_p = 0.84
- B_{ws} = 0.15
- T_s = 345°C
- M_s = 28.2 g/mole
- p_s = 35 mm H_2O
- Δp_{est} = 38 mm H_2O

$$D_n = \sqrt{\frac{6.07 \times 0.021 \times 683.6}{(28+273) \times 0.84 \times (1-0.15)}} \sqrt{\frac{(345+273) \times 28.2}{(680+35/13.6) \times 38}}$$

D_n = 0.576 cm



Probe Assembly

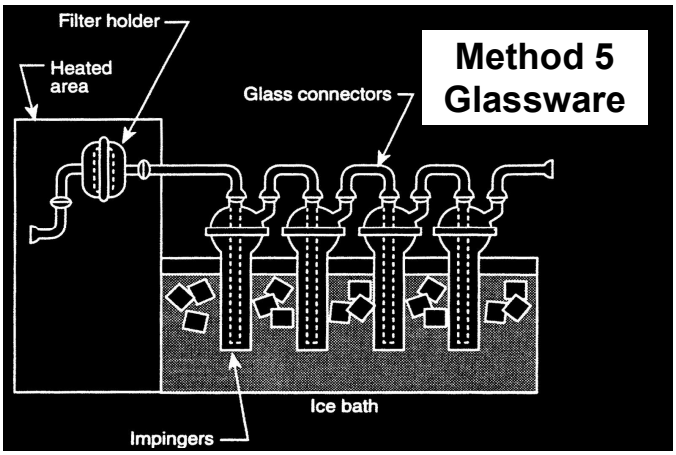


NACT 224
Observing Source Tests

Physical Inspections

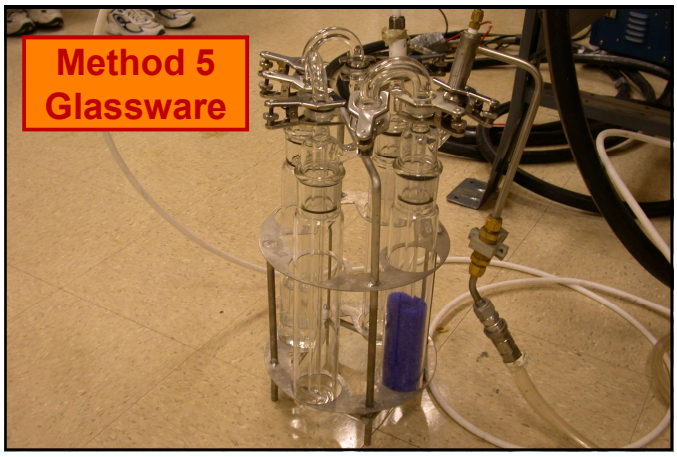
- Temperature Probe
  - Condition
  - Calibrated
- Probe
  - Long Enough to Reach, Not Too Long
  - Heated
  - SS or Glass Liner
  - Marked (Heat Resistant) for Traverse Points
  - Rinsed During Sample Recovery

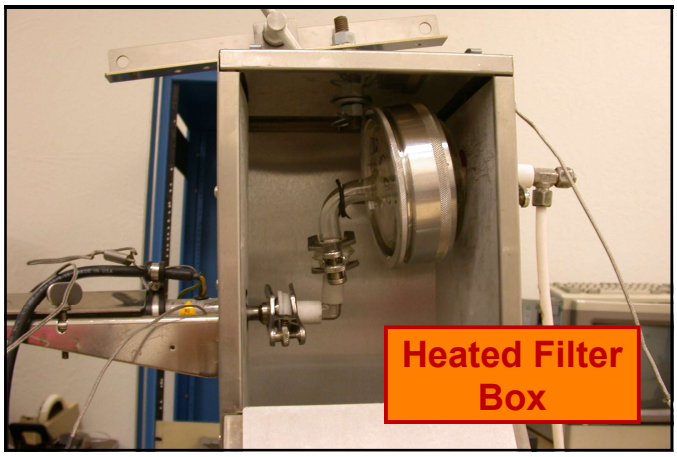
Modular Sample Unit



Method 5 Glassware

NACT 224
Observing Source Tests

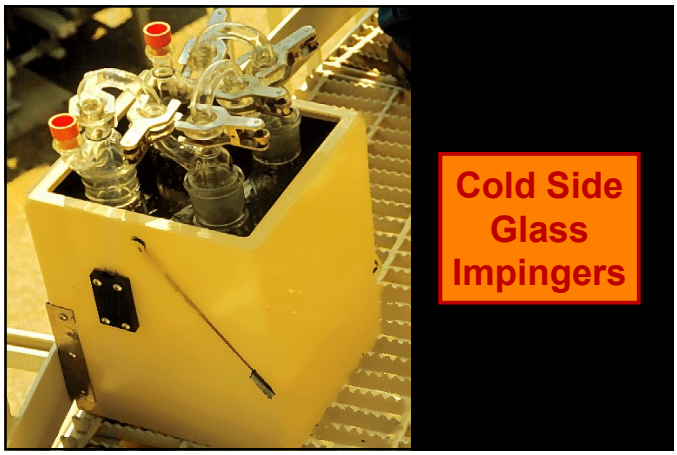




NACT 224
Observing Source Tests

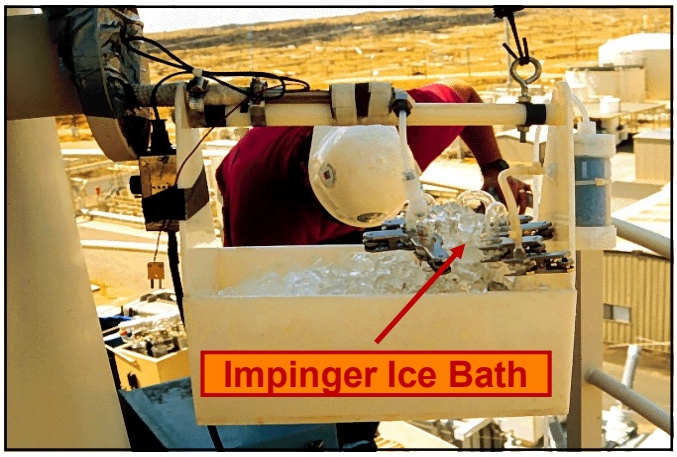
Physical Inspections

- Sampling Case - Hot Side
  - Heated (Check Method for Proper Temperature)
    - Temperature Gauge Installed
  - Glassware Properly Assembled



Cold Side Glass Impingers

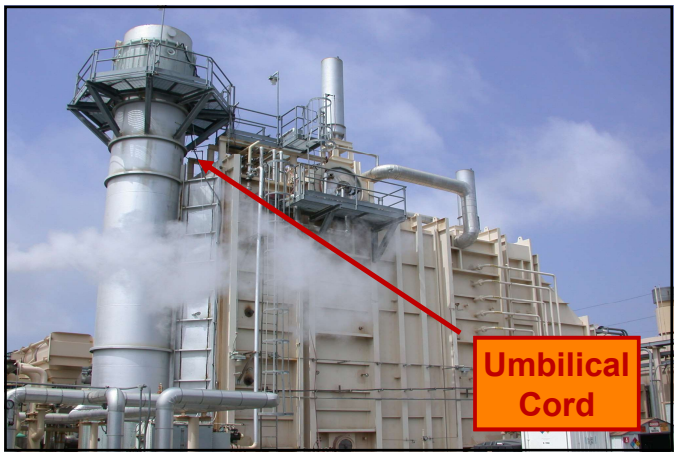
NACT 224
Observing Source Tests



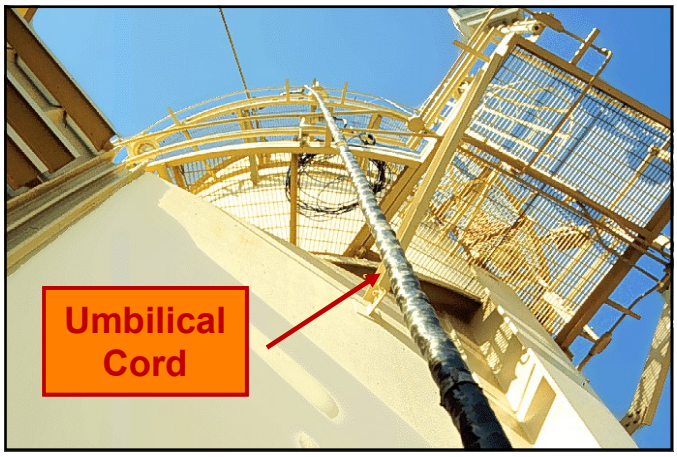
Physical Inspections

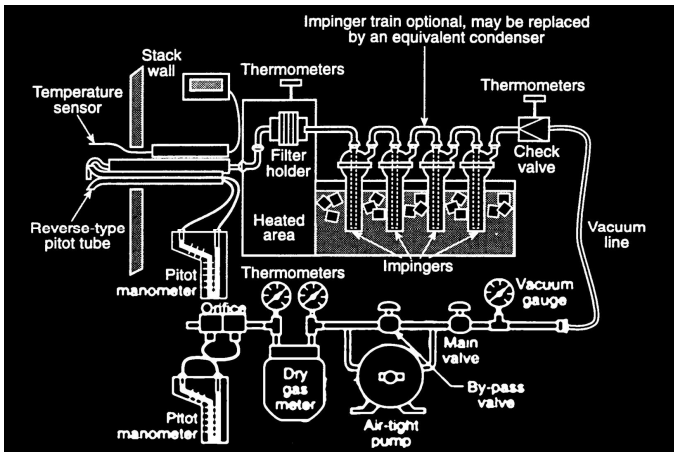
- Sampling Case - Cold Side
  - Glassware Properly Set-Up
  - Proper Solutions in Impingers
  - Ice & Water Bath - Exit Temperature

NACT 224
Observing Source Tests

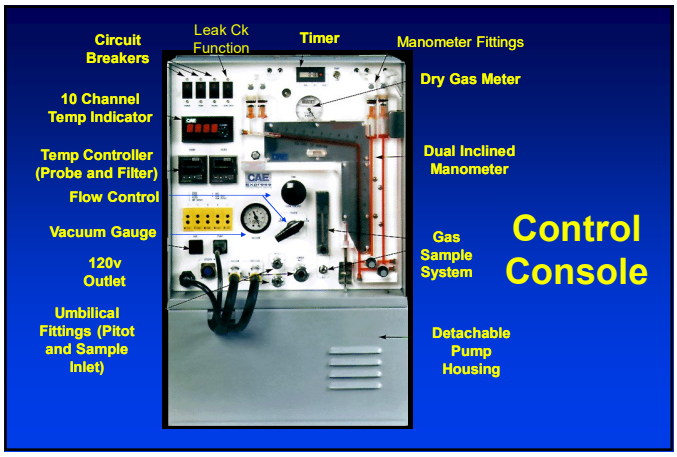


NACT 224
Observing Source Tests





NACT 224
Observing Source Tests



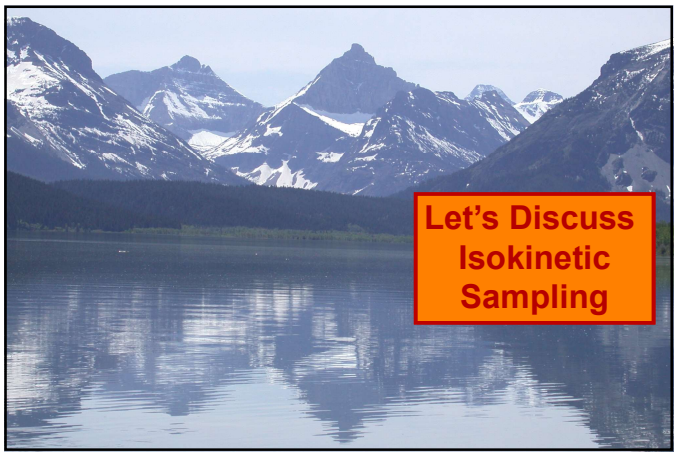
Physical Inspections

- Pump
  - Non-reactive and leak free
- Dry gas meter
  - Leak free
  - Calibrated
- Orifice meter
  - Calibrated

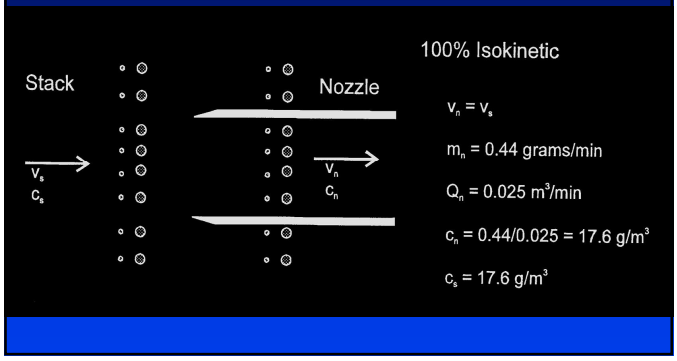
Sampling Rate

- Constant Rate
- Proportional
- Isokinetic

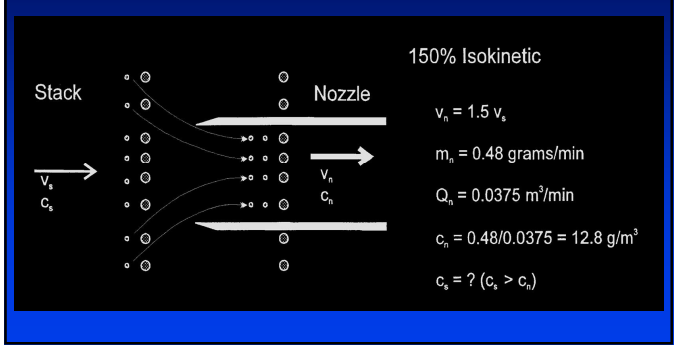
NACT 224
Observing Source Tests



Isokinetic Sampling

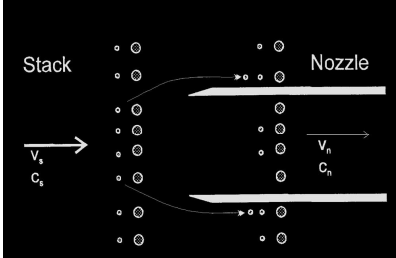


Over Isokinetic Sampling



NACT 224
Observing Source Tests

Under Isokinetic Sampling



75% Isokinetic

$v_n = 0.75\ v_s$

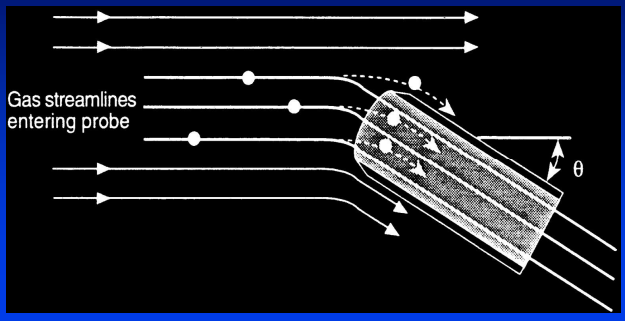
$m_n = 0.42$ grams/min

$Q_n = 0.01875\ m^3$/min

$c_n = 0.42/0.01875 = 22.4\ g/m^3$

$c_s = ?\ (c_s < c_n)$

Nozzle Misalignment



Calculation Inspections

- Orifice Meter (Sample Flow Rate) Settings

$$\Delta H = K_H D_n^4 \Delta H_@ C_p^2 (1-B_{ws})^2 \frac{M_d T_m P_s}{M_s T_s P_m} \Delta p$$

K factor - used for rapid calculation of ΔH

$K_H = 0.803$ (846.72 English units)

NACT 224
Observing Source Tests

K Factor and ΔH

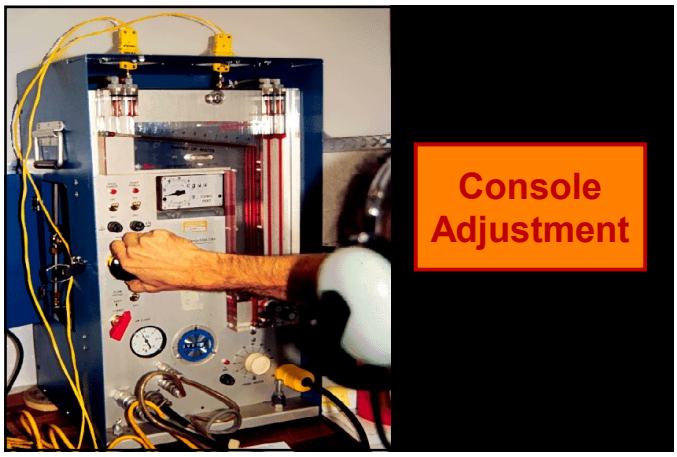
- K_H = 0.803
- D_n = 0.576 cm
- $\Delta H_@$ = 49.3 mm H_2O
- C_p = 0.84
- B_{ws} = 15%
- Δp = 38.1 mm H_2O
- M_d = 30.0 g/mole
- M_s = 28.2 g/mole
- T_m = 28°C
- T_s = 345°C
- p_s = 35 mm H_2O
- P_m = 683.3 mm Hg

$$\Delta H = 0.803 \times (0.576)^4 \times 49.3 \times 0.84^2 \times (1-0.15)^2 \frac{30.0 \times (28+273) \times (680 + {}^{35}/_{13.6})}{28.2 \times (345+273) \times 683.3} \times 38.1$$

K Factor = 1.15

Δp = 38.1

$$\Delta H = K \times \Delta p = 43.81$$



Console Adjustment

Procedural Inspections

- **Sampling Points**
  - Properly Laid Out
  - Move Between Points on Time
  - Move Between Points Quickly
  - Data Read & Recorded Quickly & Accurately
  - Delta H Calculated & Adjusted Quickly
- **Dry Gas Meter**
  - Start/Stop Times & Volume Readings Accurately Recorded
  - Sampling Times & Volume Requirements Met

Calculation Inspections

- Percent Isokinetic

$$\%I = 100 \frac{T_s[V_{lc}K+V_m/T_m (P_b+ {}^{\Delta H}/_{13.6})]}{60 \Theta A_n V_s P_s}$$

K = 0.003454 mm Hg m³/ml K
(0.002669 in Hg ft³/ml °R)

Percent Isokinetic

- T_s = 345°C
- Θ = 48 min
- V_{lc} = 113 ml
- V_m = 1.008 m³
- T_m = 28°C
- P_b = 680 mm Hg
- ΔH = 43 mm H_2O
- A_n = 2.6x10⁻⁵ m²
- V_s = 32.5 m/s
- p_s = 35 mm H_2O

$$\%I = 100 \frac{(345+273)[113x0.003454+1.008/(28+273)(680+43/13.6)]}{60x48x2.6x10^{-5}x32.5x(680+35/13.6)}$$

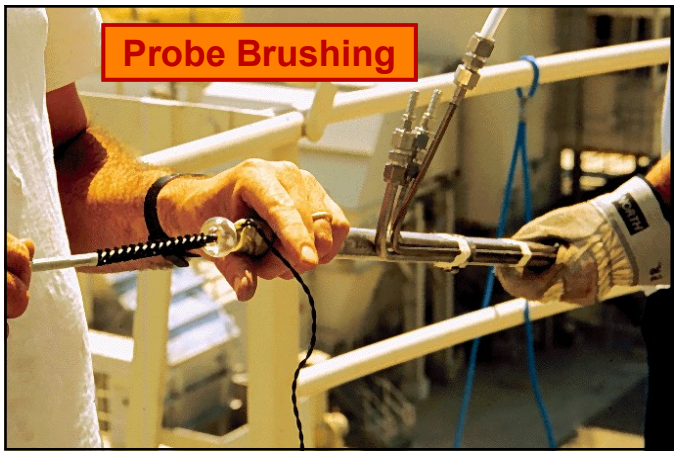
%I = 99.7%

NACT 224
Observing Source Tests

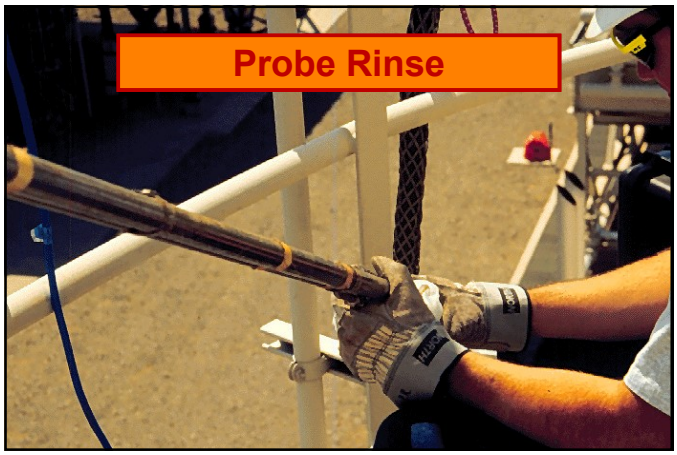
Procedural Inspections

- Sample Recovery
  - Sampling Completion Procedure
  - Leak-Check
  - Cool-Down
  - Probe & Glassware Cleanup
  - Impinger Recovery
  - Filter Recovery

Sampling Train Leak Test



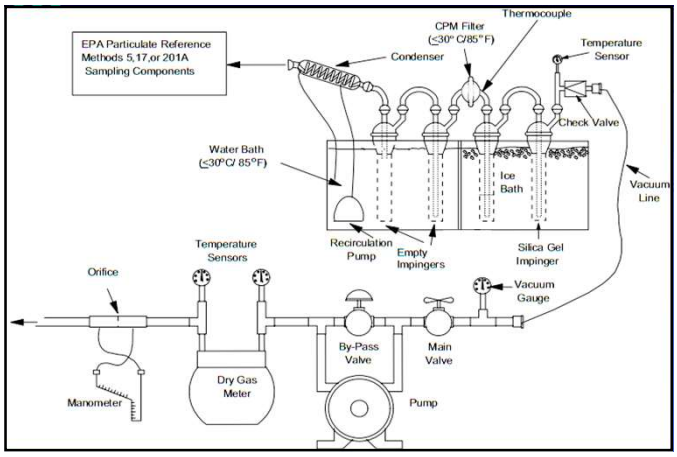
NACT 224
Observing Source Tests

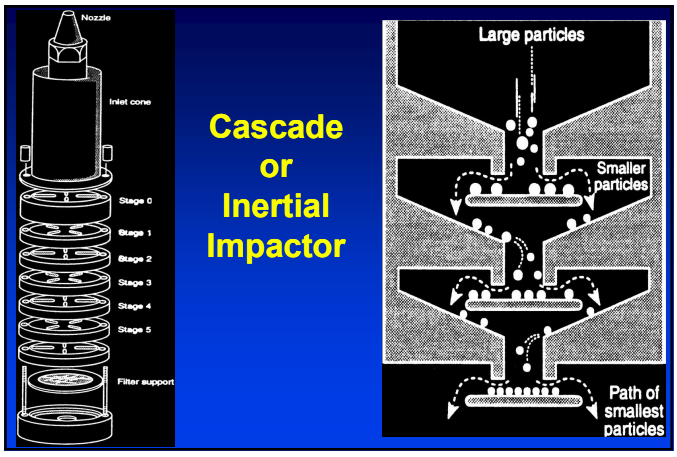


Physical Inspections

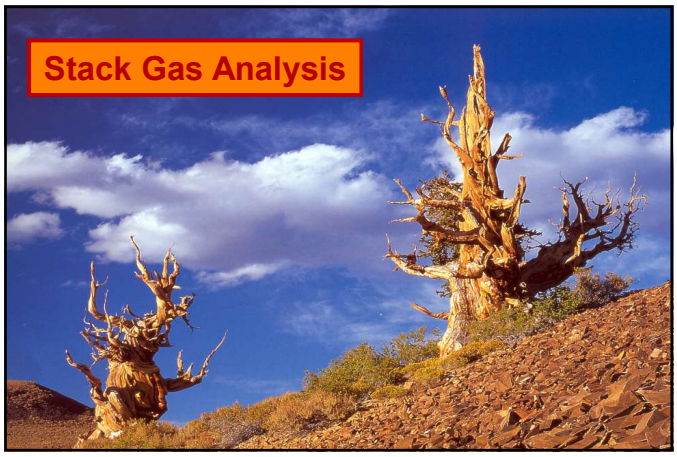
- Sample Properly Recovered
  - Good Particulate Deposit - No Evidence of Leaks
  - Impinger Solution Weighed &/or Recovered After Sampling
  - Rinse Front Half of Filter Holder Back Half Also
  - Probe Properly Cleaned
  - Filter Properly Weighed

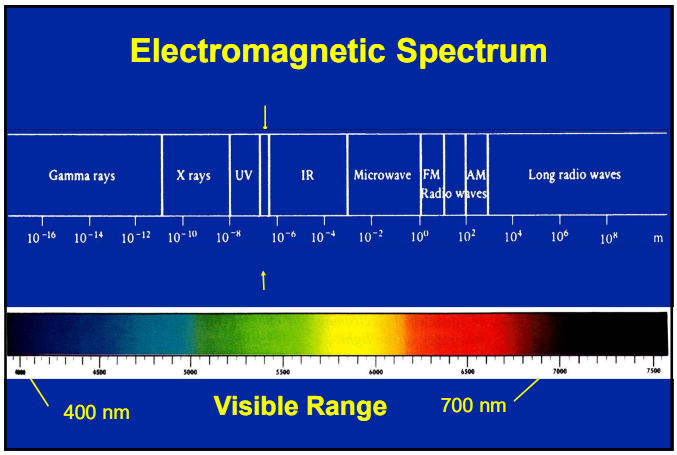
NACT 224
Observing Source Tests





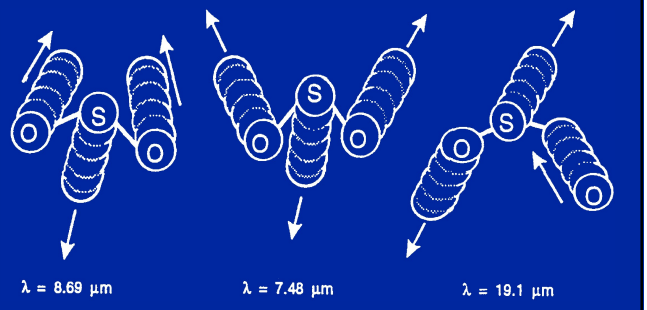
NACT 224
Observing Source Tests



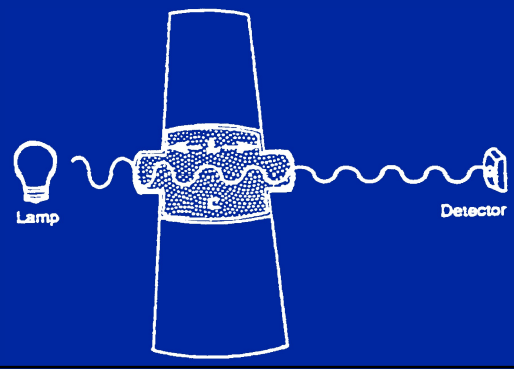


NACT 224
Observing Source Tests

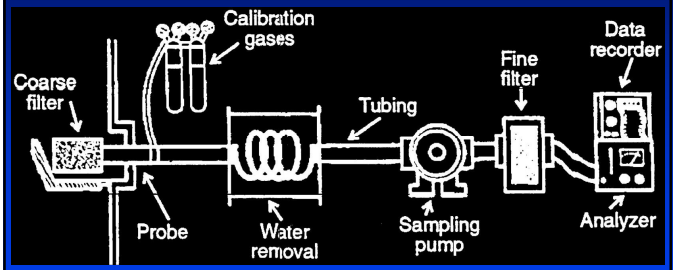
Normal Vibration of SO_2 Molecules



Simplified Stack Sample System

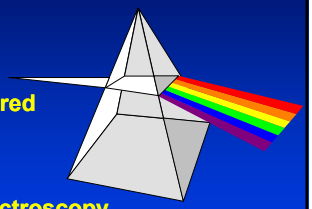


Basic Extractive System



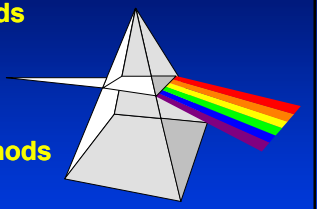
Source Test Analytical Techniques

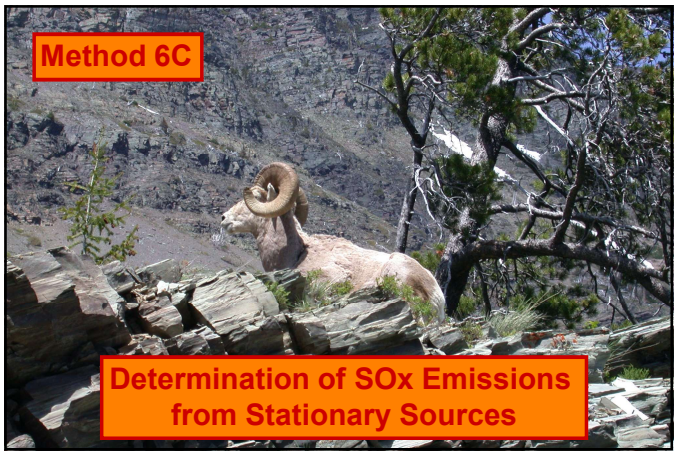
- Infrared Methods
  - Differential Absorption
  - Gas Filter Correlation
  - Fourier Transform Infrared
- Ultraviolet Methods
  - Differential Absorption
  - Second Derivative Spectroscopy
- Visible Light
  - Scattering & Absorption



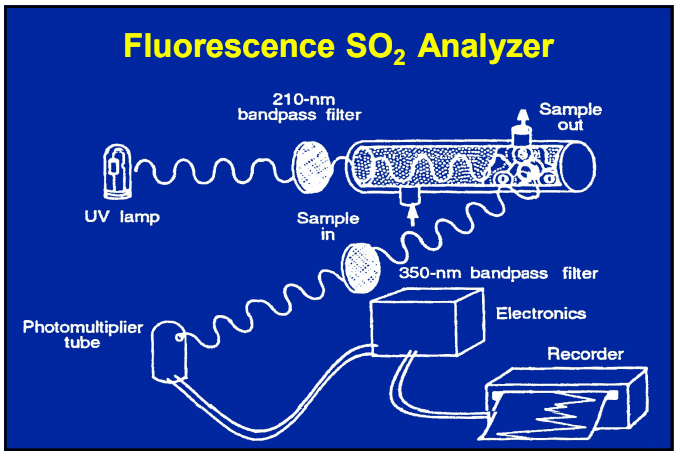
Source Test Analytical Techniques

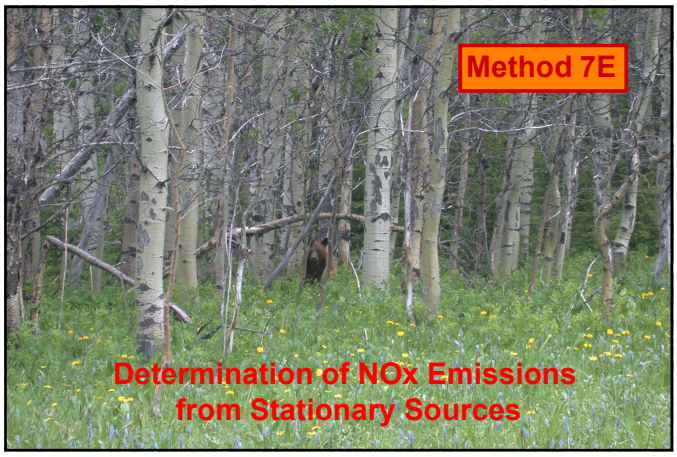
- Luminescence Methods
  - Fluorescence
  - Chemiluminescence
  - Flame Photometry
- Electroanalytical Methods
  - Polarography
  - Electrocatalytic
  - Paramagnetism
  - Conductivity

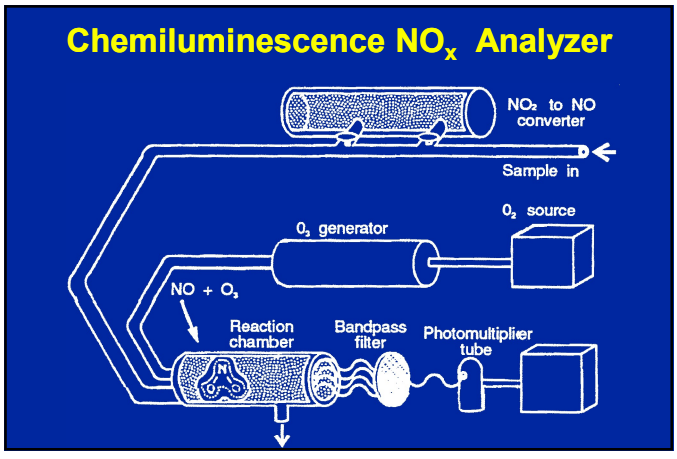




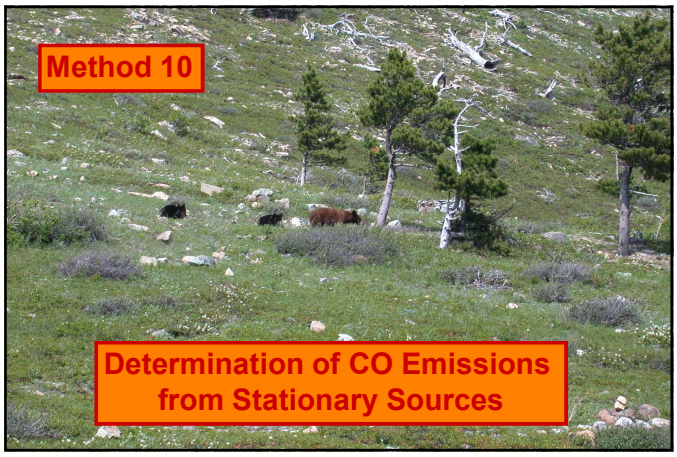
NACT 224
Observing Source Tests

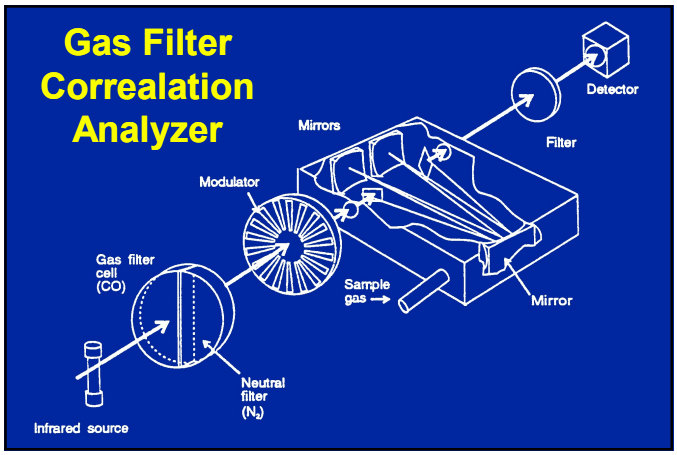






NACT 224
Observing Source Tests

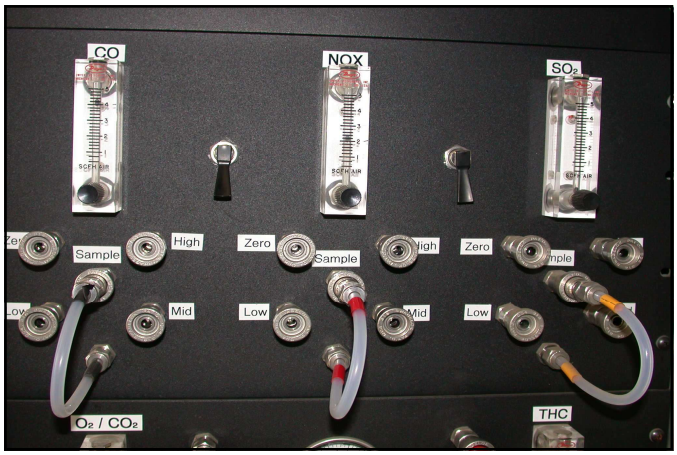




NACT 224
Observing Source Tests

Instrument Inspections

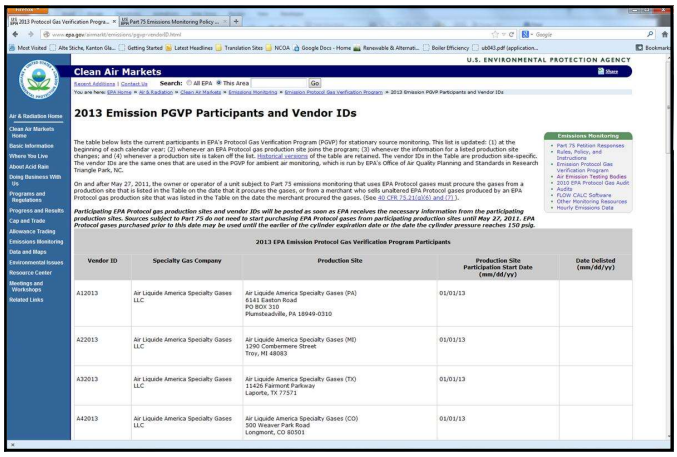
- Always Check Applicable Method & Subpart
- Instrument Span
- Calibration Error
  - <+/- 2 % of Span for Zero, Mid, & High Range Gases
- Sampling System Bias
  - <+/- 5% of Span for Zero & Mid or High Range Gases
- Zero Drift & Calibration Drift
  - <+/- 3% of Span Over the Period of Each Run
- Interference Check



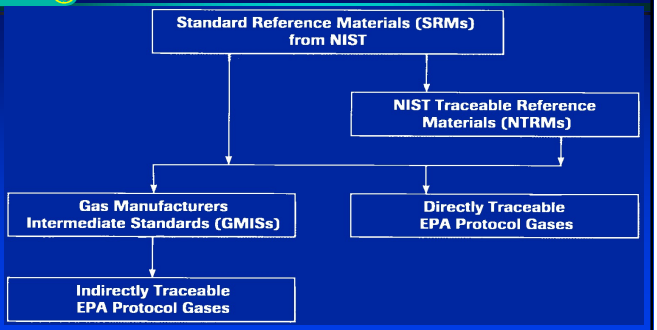
NACT 224
Observing Source Tests

Cal Gas Certificate Points

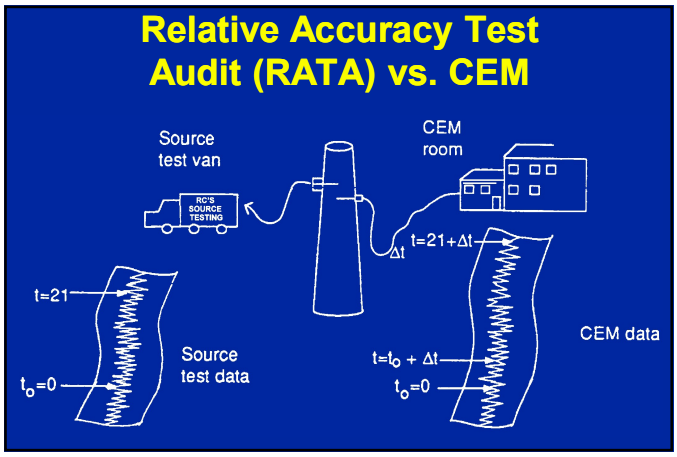
- Cylinder ID Number
- Balance Gas
- Cylinder Pressure
- Certification Date
- Expiration Date
- Lab & Analyst ID
- (PGVP – Part 75)
- Reference Standard Data
- Statement of Procedures
- Certified Concentration
- Gas Analyzer ID & Cal Date
- Analyzer Readings & Calc Used
- Chronological Cert Record

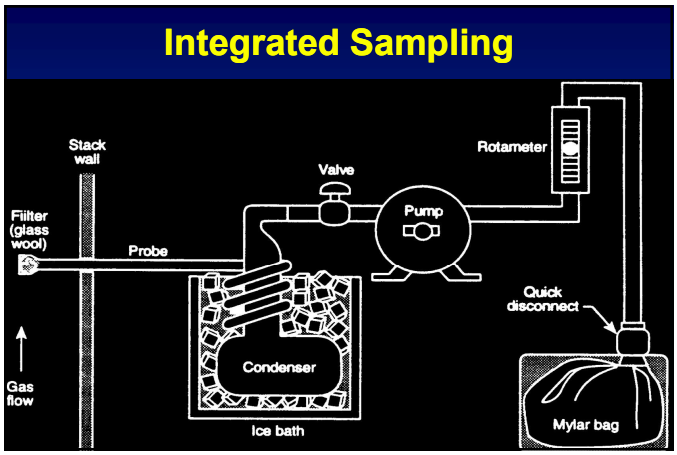


Calibration Gas Hierarchy



NACT 224
Observing Source Tests

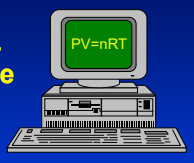




NACT 224
Observing Source Tests

Procedural Inspections

Data Recording

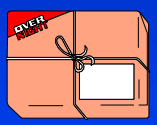


- Timely, Accurate, & Complete
- Standardized Form Used
- Computer Data Entry:
  - Automatic - Computer Controlled Equipment
  - On Site After Sampling or During Sample (Computer Data Entry Form)
  - After Sampling Completed

Procedural Inspections

Sample Conservation

- Container Material Must be Compatible with Sample
- Storage Conditions
  - Refrigerate the Samples if Held Overnight
- Blanks Properly Prepared & Shipped with Field Samples
- Sample Container Must be Labeled
- Shipping
- Chain-of-Custody

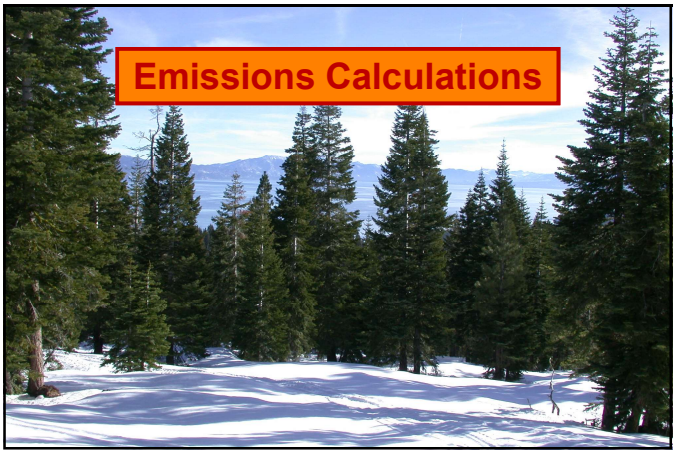


NACT 224
Observing Source Tests

Procedural Inspections

Analysis

- On Site
  - Weights & Volumes
  - Some Simple Titration's & Chemical Analysis can be Done on Site
  - Work Area Conditions must be Consistent with Good Laboratory Procedures
- Off Site
  - Analytical Lab Should be Certified
- QA Samples



Emission Calculations

Emission rates

- Concentration (c_s) : (ppm, g/dscm, gr/dscf)
- Pollutant mass rate (pmr_s) : (kg/hr, lb/hr)
- Process rate (E) : (ng/J, lb/10^6 BTU, lb/ton)
- Flow rates or F factors

Emissions

$$E = \frac{pmr_s}{Q_H} = \frac{c_s Q_s}{Q_H} \qquad E = c_s F\left(\frac{20.9}{20.9 - \%O_2}\right)$$

Calculation Inspections

- Normalized to Diluent Gas
  - O_2
  - CO_2

Conditions

12% CO_2

$$c_{s\ 12\%} = c_s \frac{12}{\%CO_2}$$

6 % O_2

$$c_{s\ 6\%} = \frac{15\ c_s}{21 - \%O_2}$$

Effects of Errors

Impact of Errors on Validity of Test

- What is the Data to be Used for?
- What is the Direction & Magnitude of any Biases?
- What is the Acceptable Bias Before Rejecting the Testing?

Effects of Errors

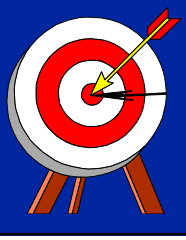
Accuracy

→ Compares Well with the Correct Value

Precision

→ Repeated Tests Give the Same Results

Accuracy & Precision



Accurate and Precise

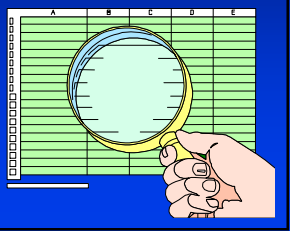
Neither Accurate nor Precise

Accurate but not Precise

Precise but not Accurate

Post Test Activities

- Post Test Conference
- Observer's Test Report
- Report Requirements & Submittal
- Test Report Review
  - Summary Data
  - Detailed Test Data
  - Raw Data

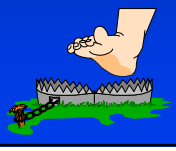


Post Test Activities

- Evaluation of Compliance in Light of the Test Result
  - Current Enforcement Action
  - Future Inspections
  - Enforcement

Inspector Safety

- Proper equipment
- Plant warnings
- Heat
- High pressure steam
- Electrical hazards



- Noise
- Moving parts
- Inhalation hazards
- Hazardous materials
- Machine disintegration
- Other hazards & traps

In Summary: Source Test Successful

If an Evaluator Can Evaluate Representativeness of :

- Process & Control Equipment Operation
- Sampling Port Location
- Sample Collected
- Sample Recovery & Analysis
- Final Report

NACT 224
Observing Source Tests