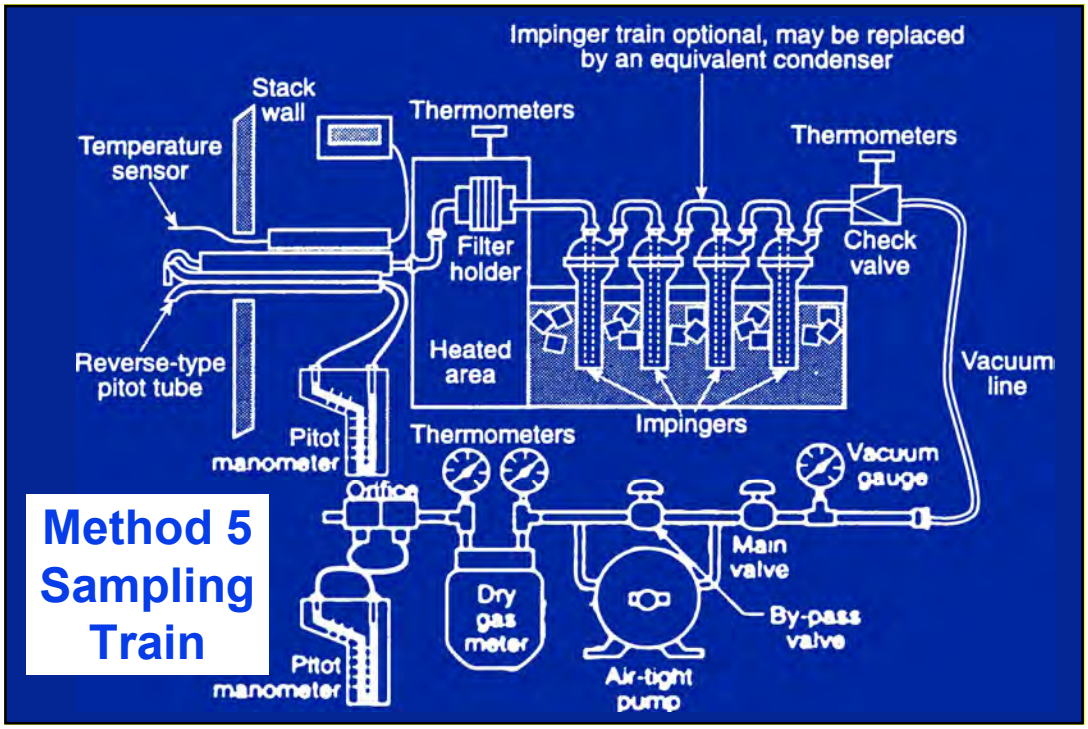
Course Overview

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

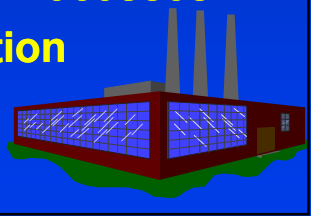


Purpose of Source Testing

- **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

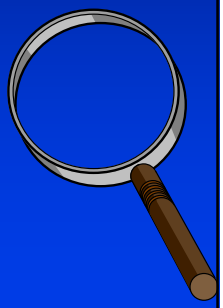


Authorities Requiring Source Testing

- 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

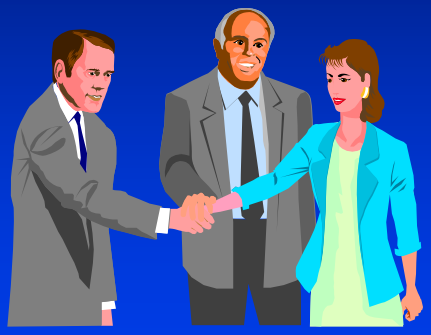
- Represent the Interests of Agency
  - Tests Satisfy the Needs of the Agency
  - Planning & Pretest
  - During the Test
  - Post Test
- QA/QC Officer

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

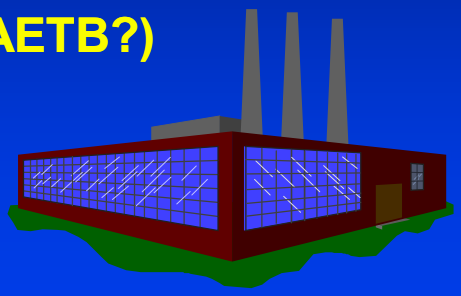
Role of the Observer

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



Test Protocol

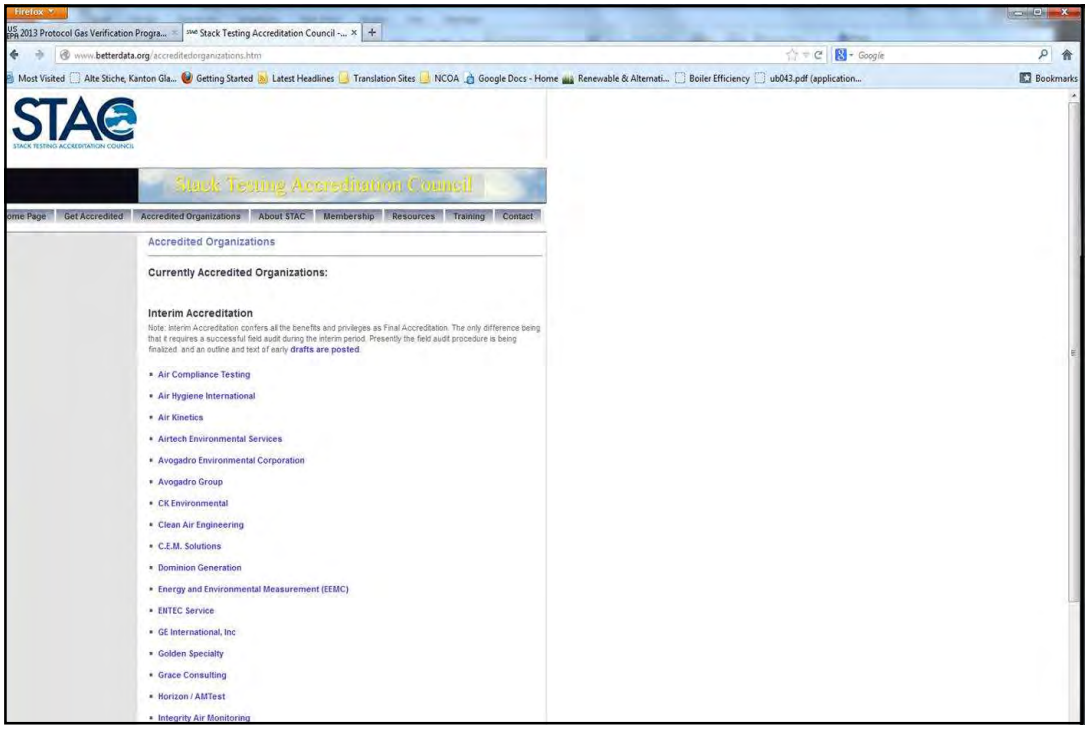
- Name & Location of Tested Facility
- When is Test (Adequate Notification?)
- Purpose of Test
- Testing Contractor (AETB?)
- Facility Description
- Process Description
- What is to be Tested

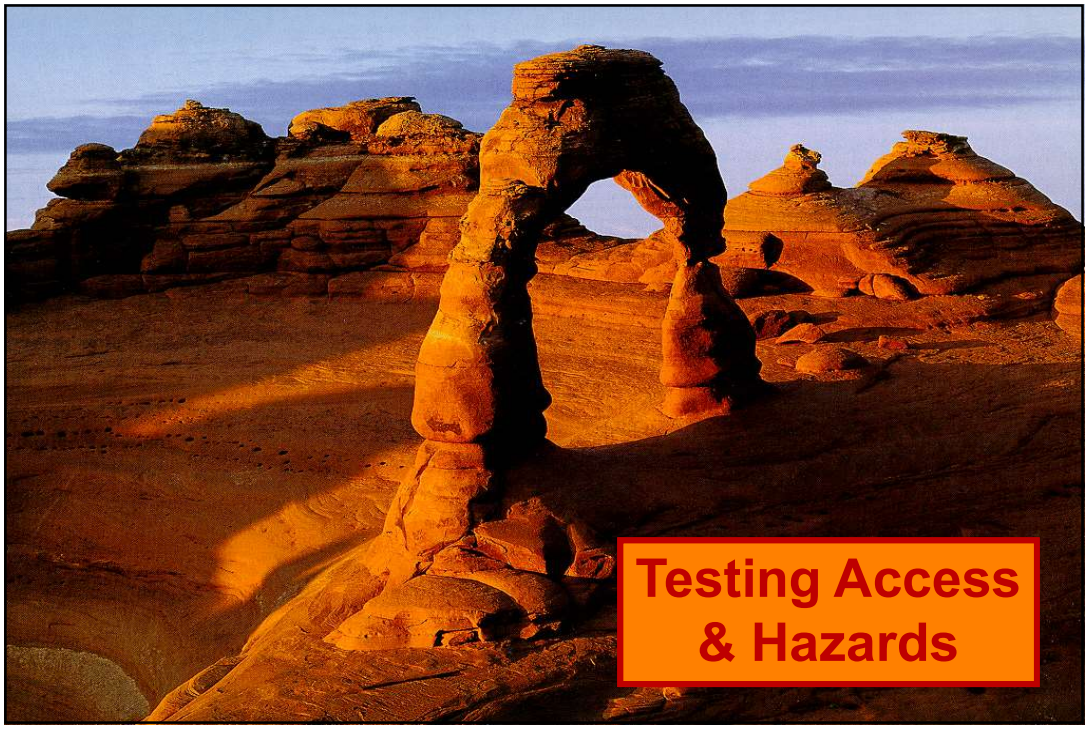


Test Protocol

- 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

NACT 224
Observing Source Tests





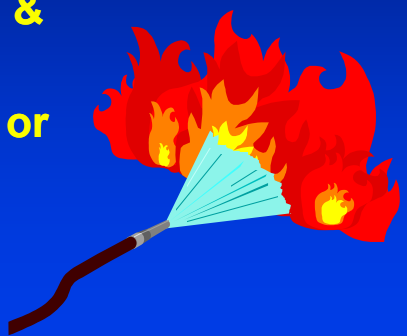
Testing Access

- **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?

NACT 224
Observing Source Tests

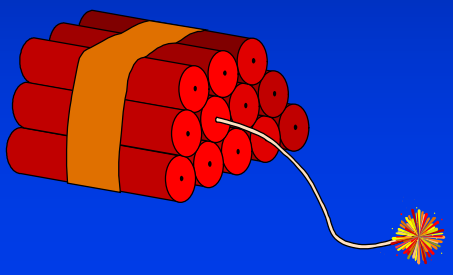
Hazards

- 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

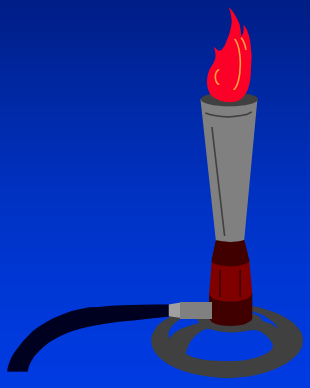
- What Protective Equipment is Needed?
  - Normally?
  - In the Event of an Accident or Plant Upset?
  - What are the Plant Safety Warnings?
- Weather Hazards
  - High Winds
  - Heat Lightning
  - Cold, Ice, & Snow



NACT 224
Observing Source Tests

Problem Sources

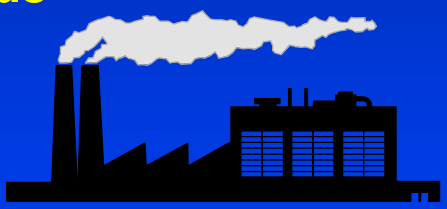
- Eccentric & Tapered Stacks
- Horizontal Ducts
- Unconfined Flow
- High Temperatures
- Saturated Stack Gas



NACT 224
Observing Source Tests

Problem Sources

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



Observing the Source Test

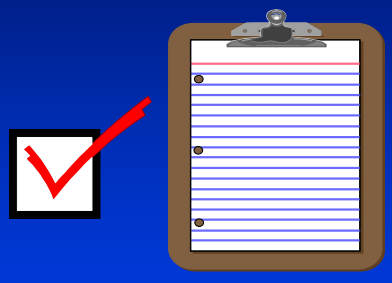
- Physical Inspection Points
- Procedural Inspection Points
- Calculation Inspection Points
- Preliminary Data Collection
- QC Audits

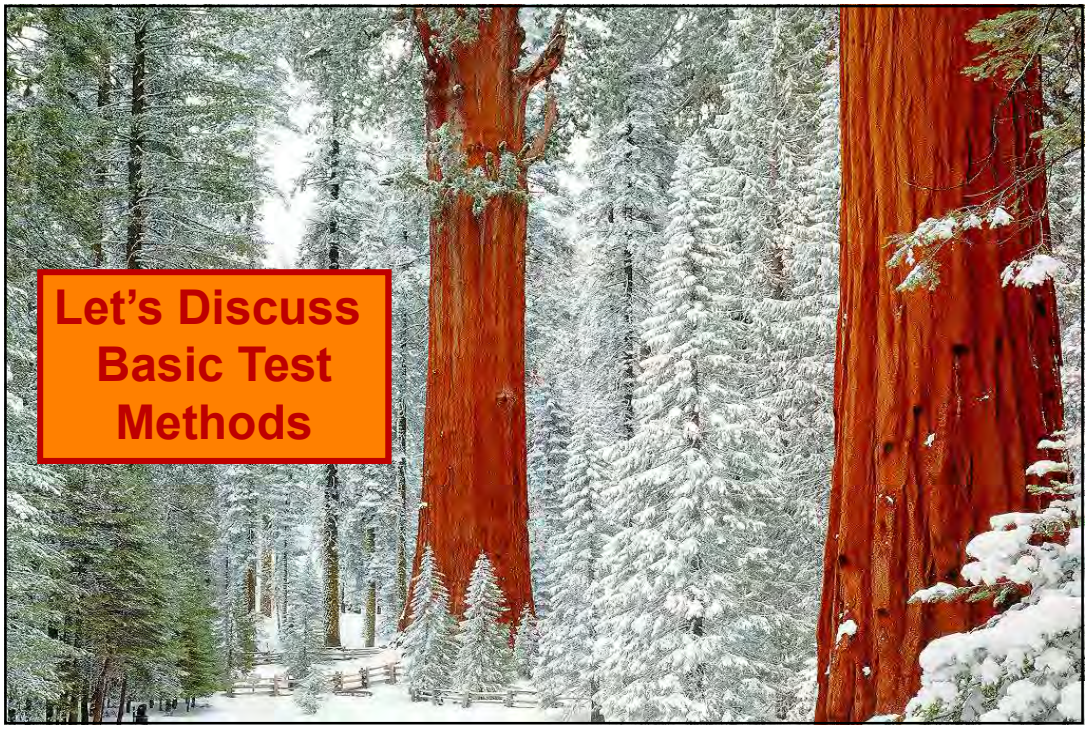
Documentation

- 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





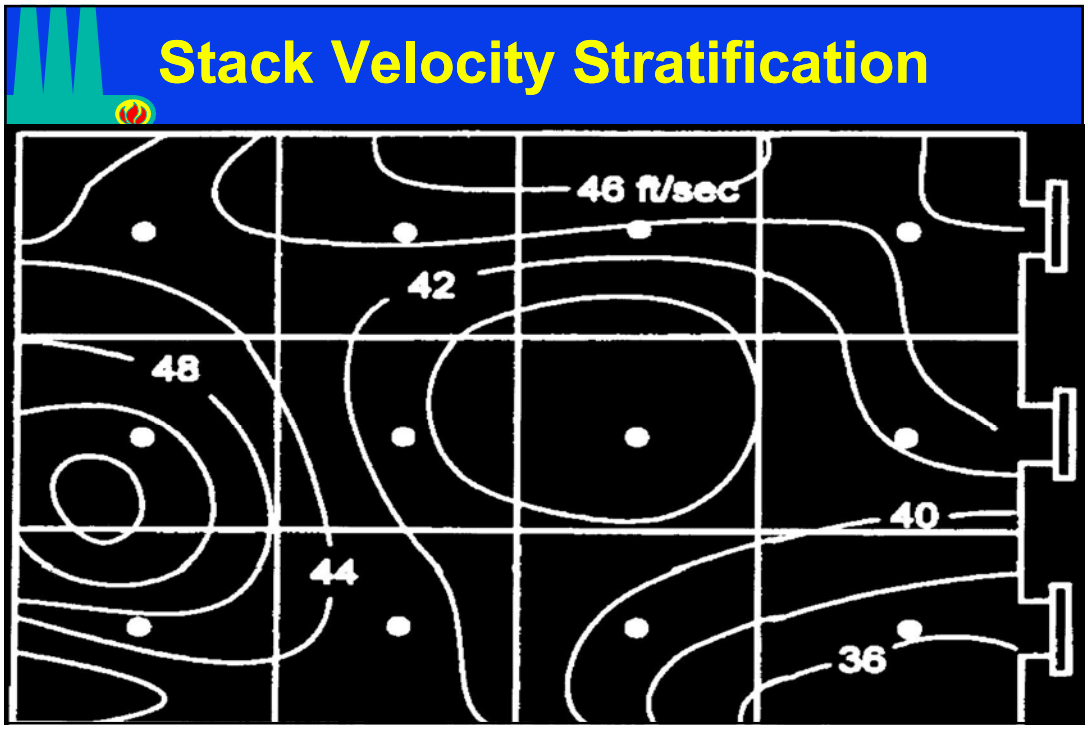
Basic Test Methods

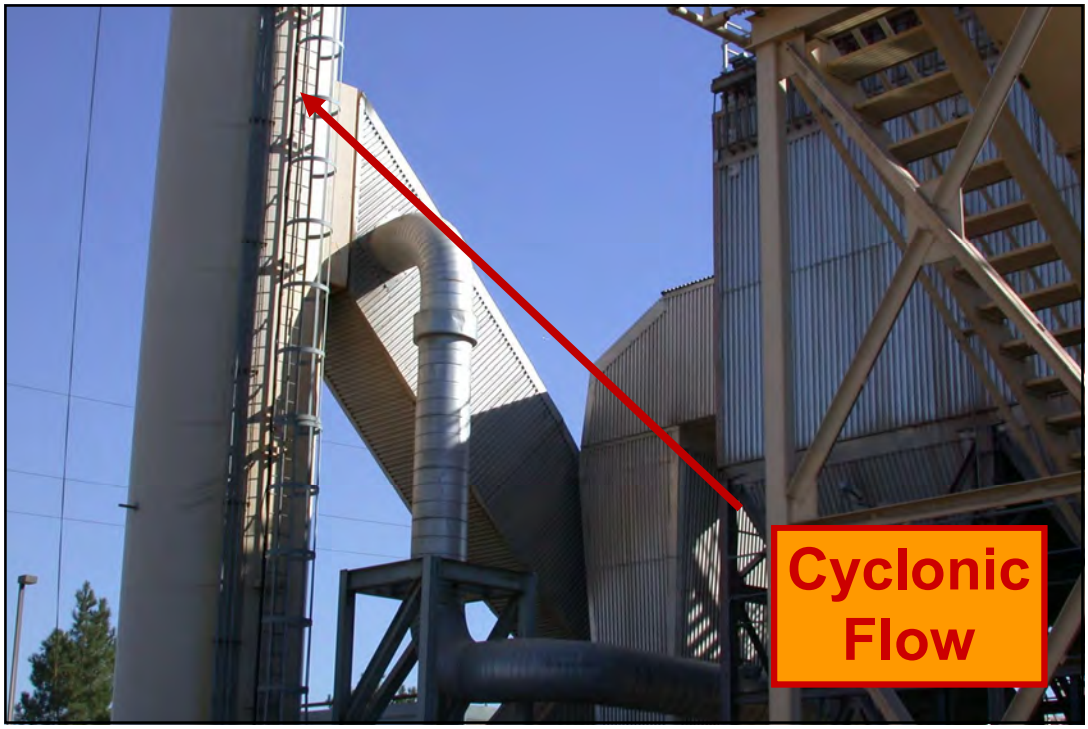
- Method 1 - Sampling Point Location
- Method 2 - Stack Gas Velocity
- Method 3 - Dry Molecular Weight
- Method 4 - Moisture Content of Stack Gases
- Method 5 - Particulate Emissions
- Method 6 - Sulfur Dioxide Emissions
- Method 7 - Nitrogen Oxide Emissions
- Method 10 - Carbon Monoxide Emissions

Method 1

Sample & Velocity Traverses for Stationary Sources

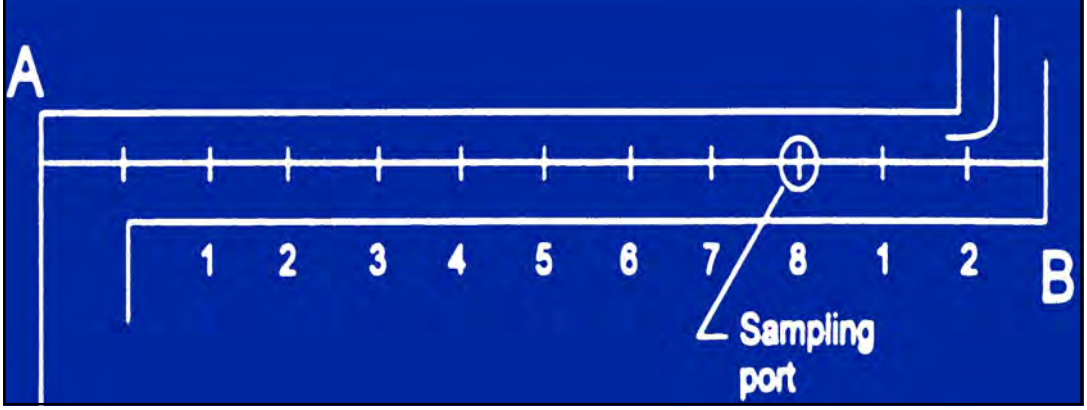
- Specifies Both the Sampling Site Location & the Location of the Sampling Points
- The More Convoluted the Ductwork, the More Points that Will Need to be Tested


Stack Velocity Stratification
46 ft/sec
42
48
40
44
36


Cyclonic
Flow

Sampling Site Criteria

Ideal: Port is 8 duct diameters downstream of A and 2 duct diameters upstream of B



NACT 224
Observing Source Tests

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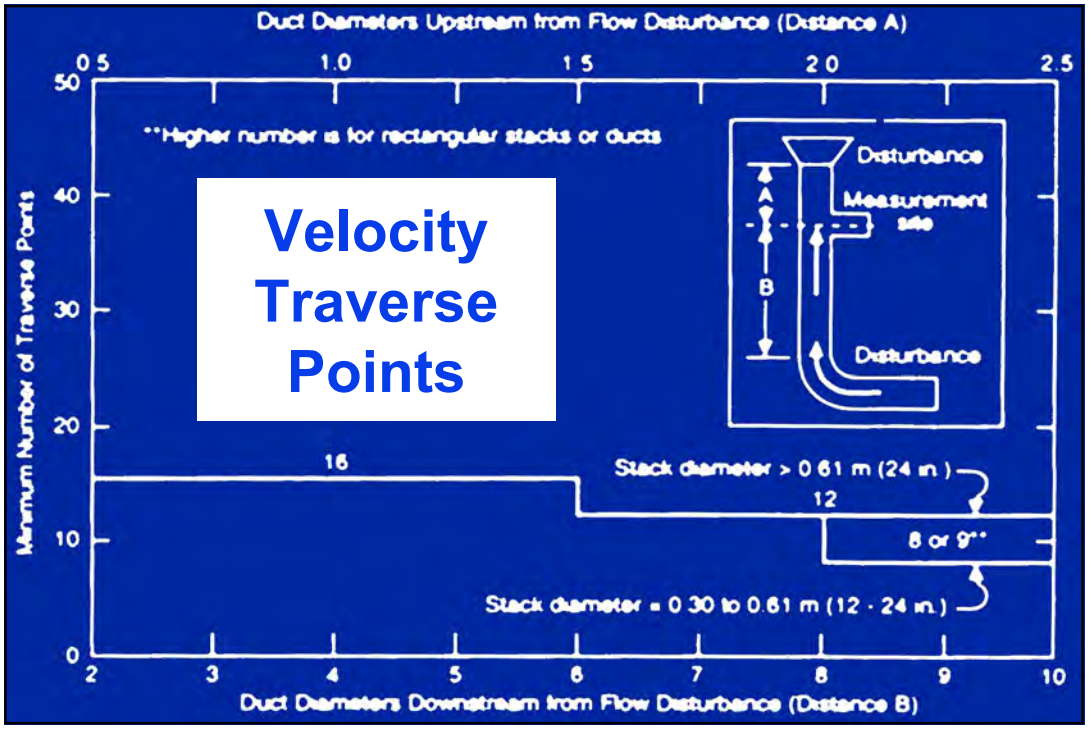
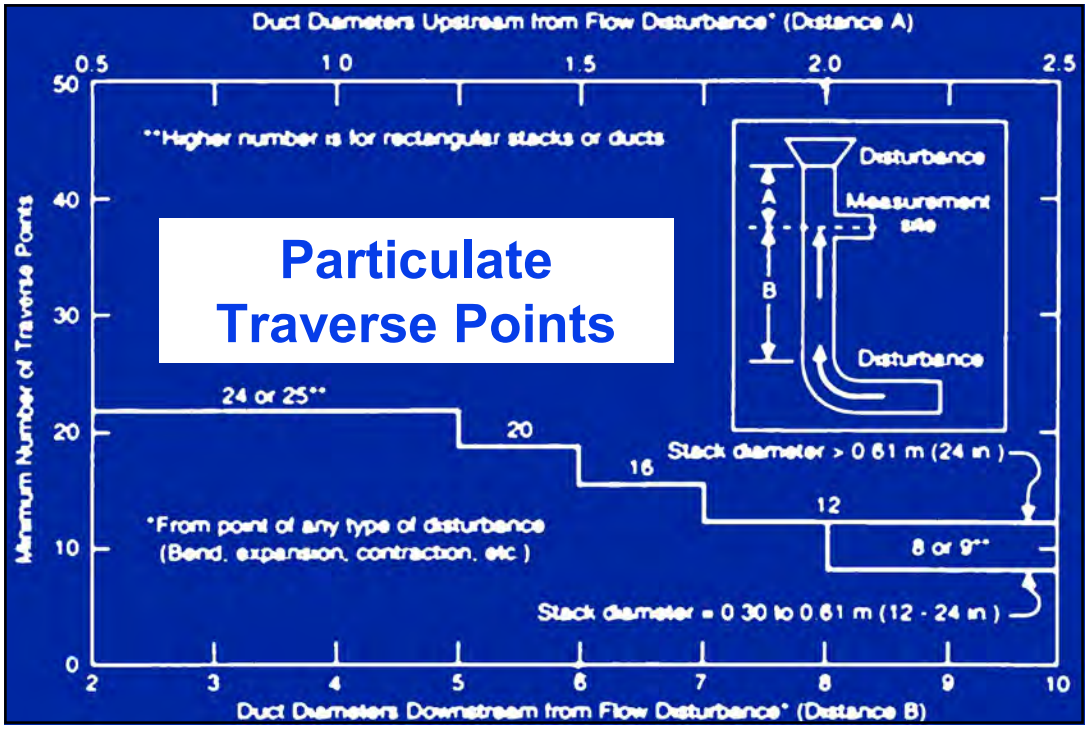
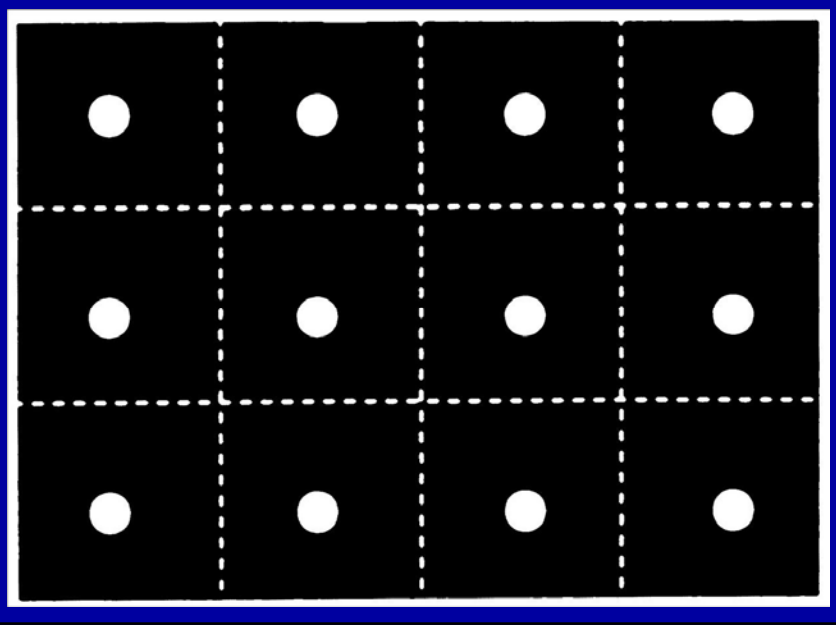


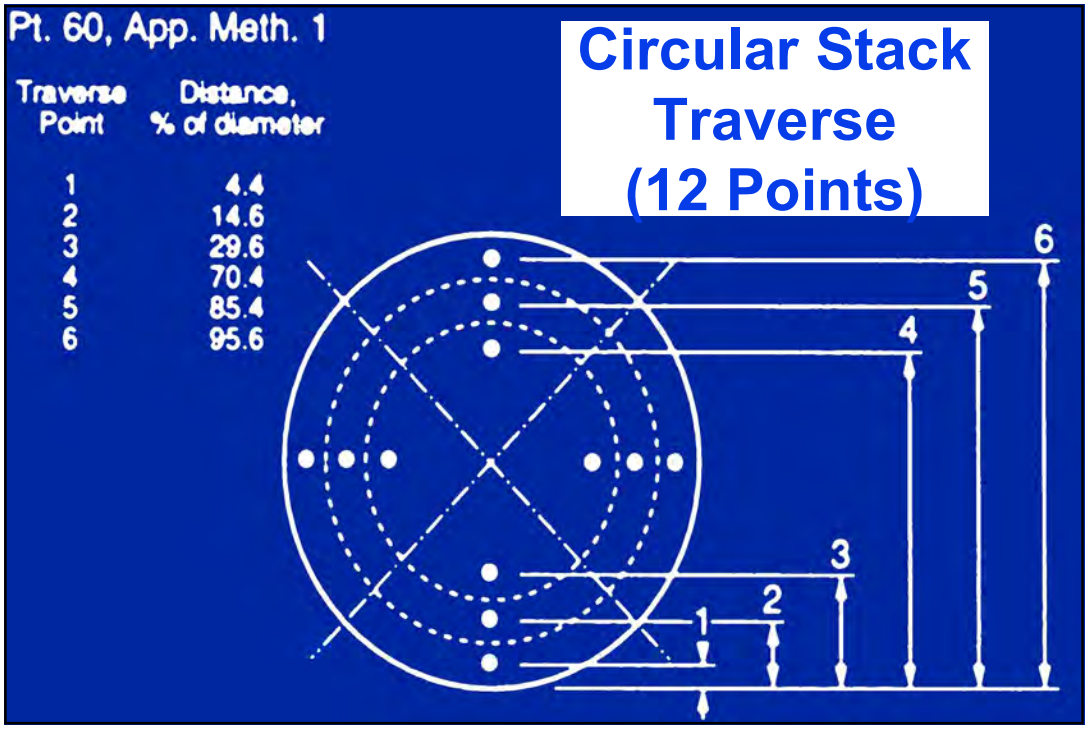


Rectangular Duct Cross-Section Layout

# 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

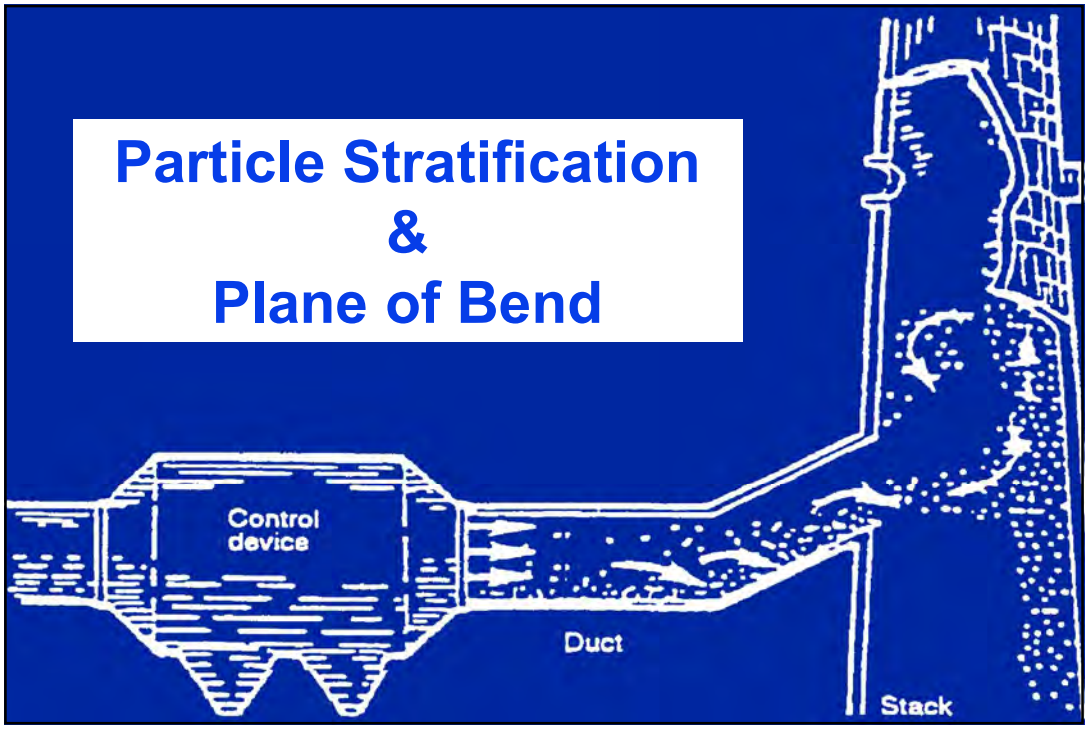
Rectangular Duct Traverse (12 points)





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


Particle Stratification
&
Plane of Bend
Control device
Duct
Stack


Cyclonic Flows

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

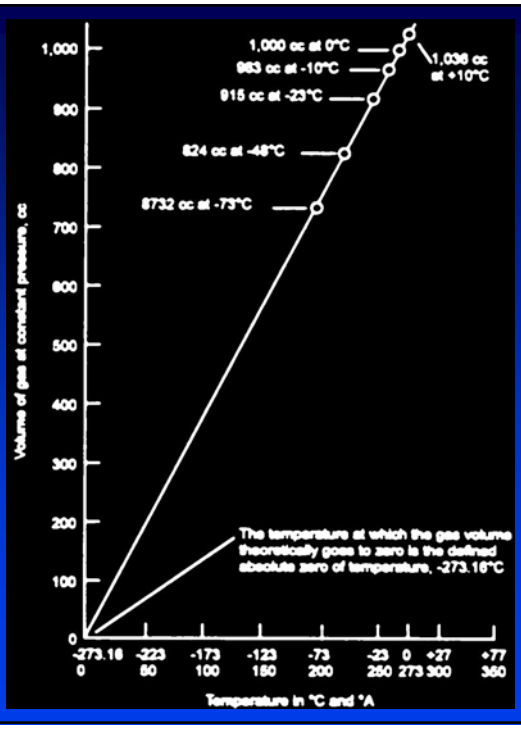
$$D_e = \frac{2\,LW}{L+W}$$

Method 2

Determination of Stack Gas Velocity and Volumetric Flow Rate

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

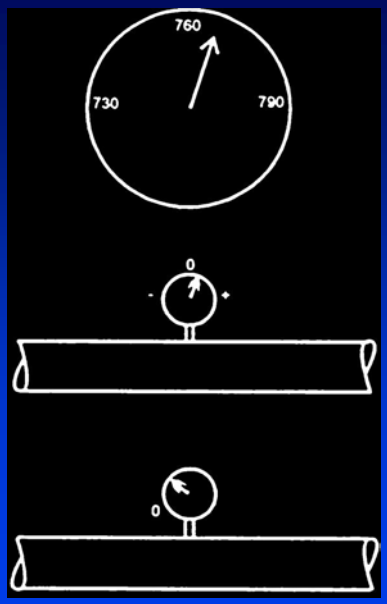
Stack Volumetric Flow Rate : $Q_s = A_s V_s$



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



P_b

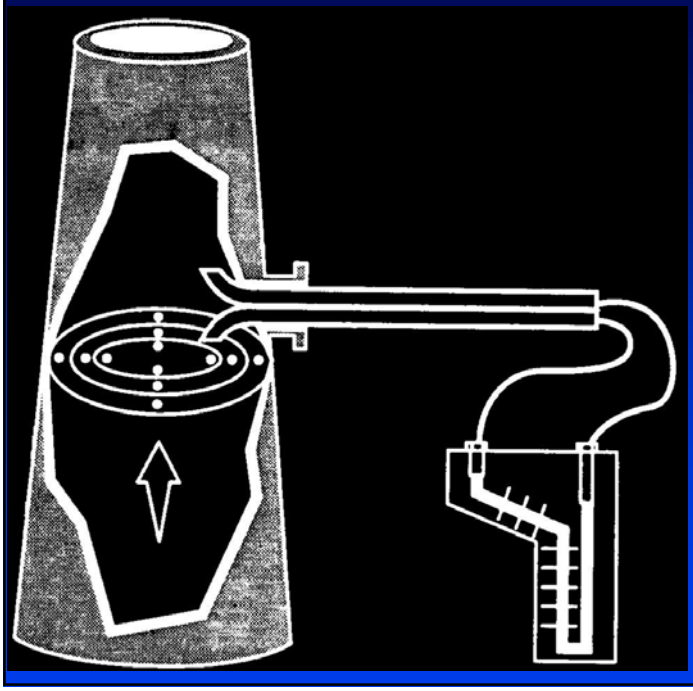
Gauge Pressure

P_g

Absolute Pressure

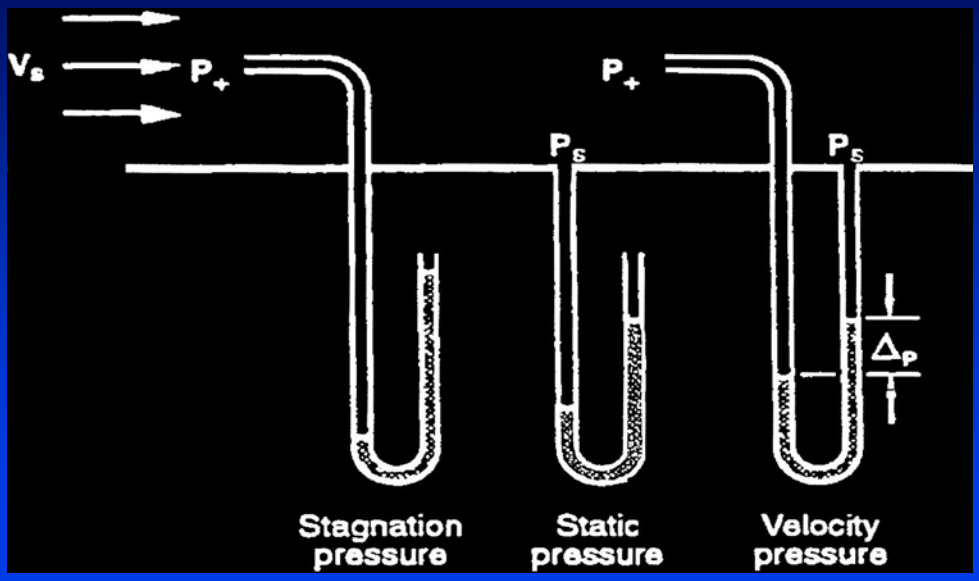
$P_a = P_b + P_g$

P_a

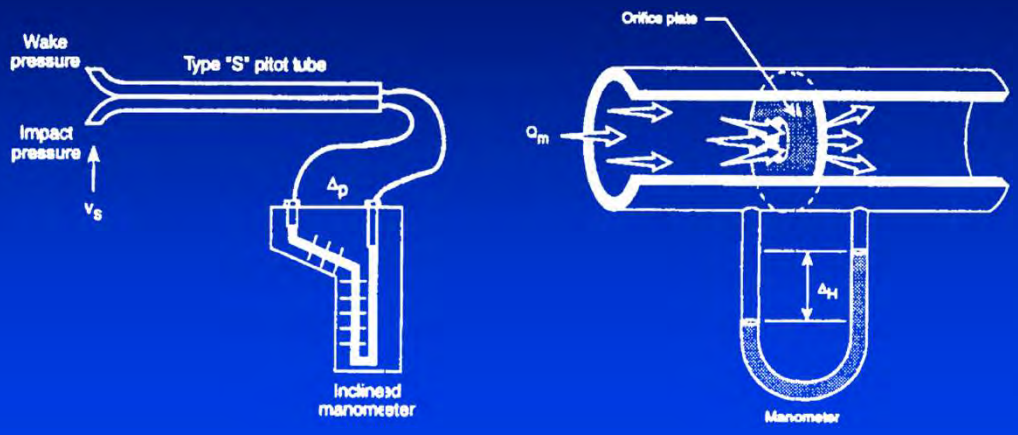


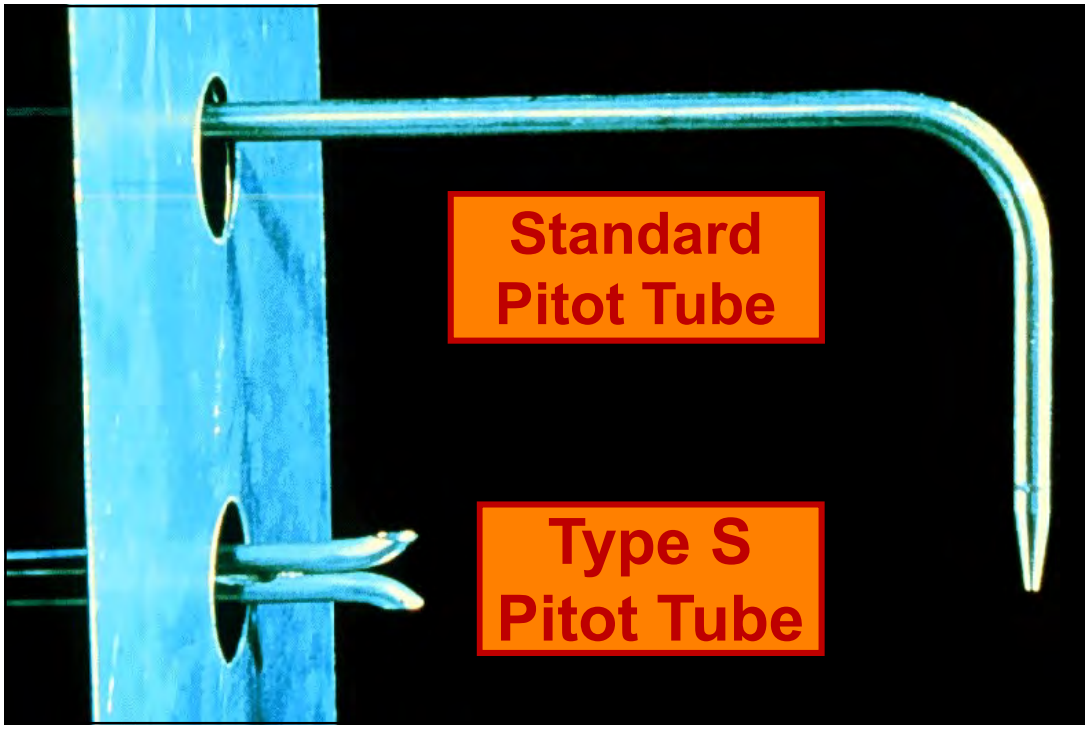
Differential Pressure Measuring

Differential Pressure Measuring

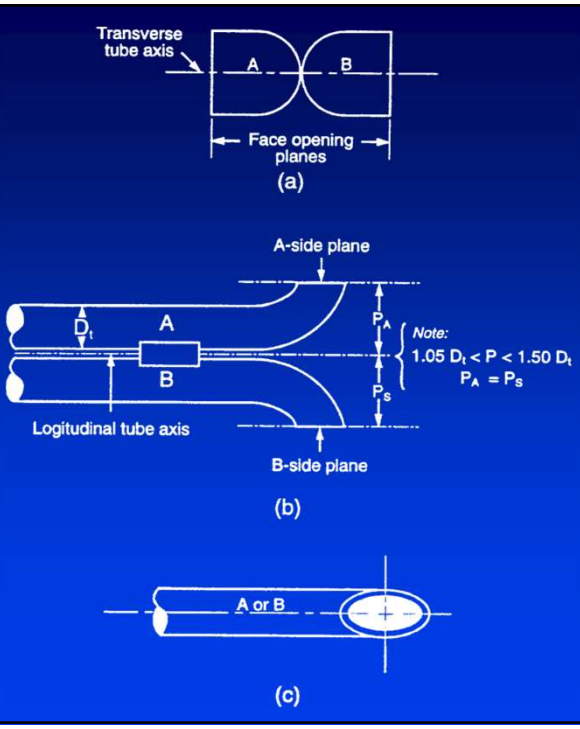


Type "S" Pitot Tube & Orifice Meter





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

Pitch angle

Rotational

Vertical

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)

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

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

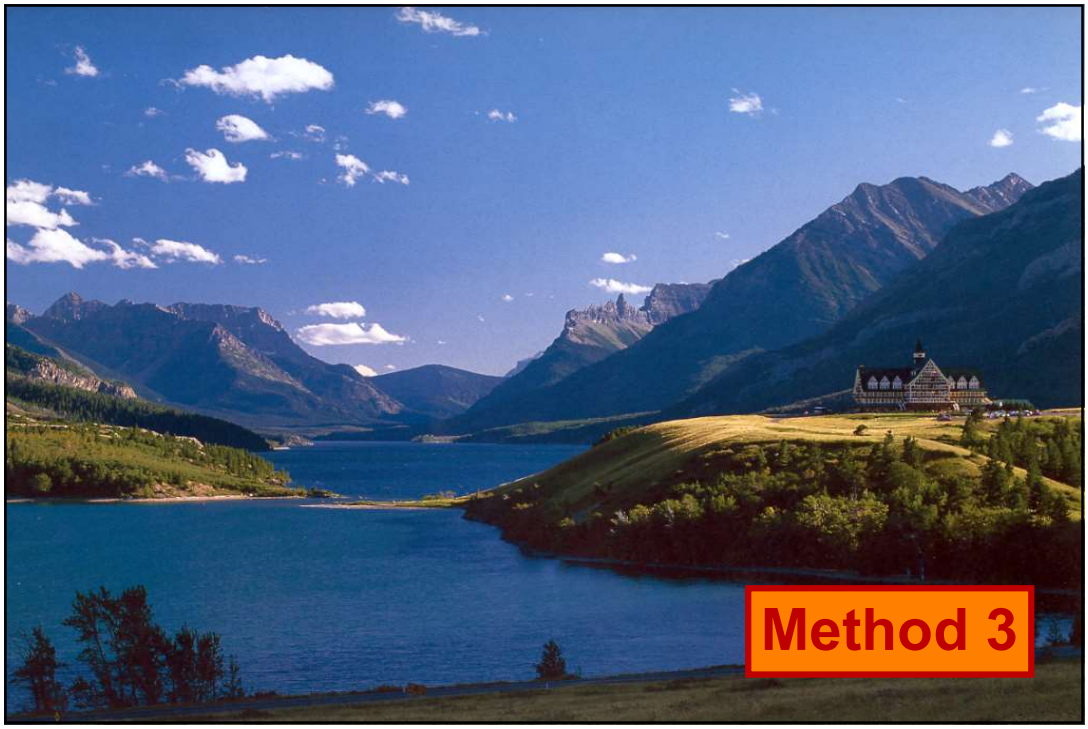
Calculation Inspections

- Stack Volume
  - Stack Area
  - Flow

Stack Gas Volumetric Flow Rate $Q_s = A_s V_s$

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

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

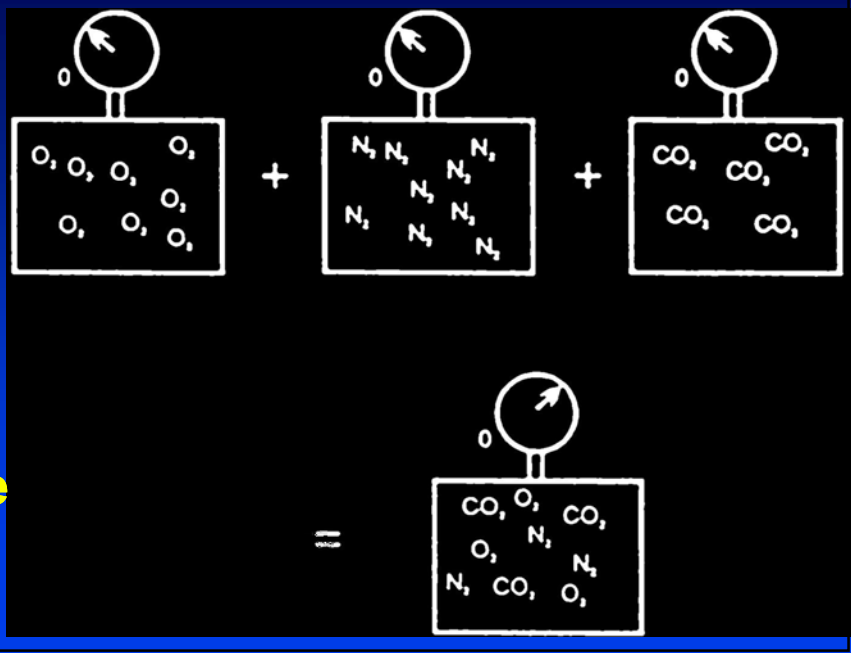


Method 3

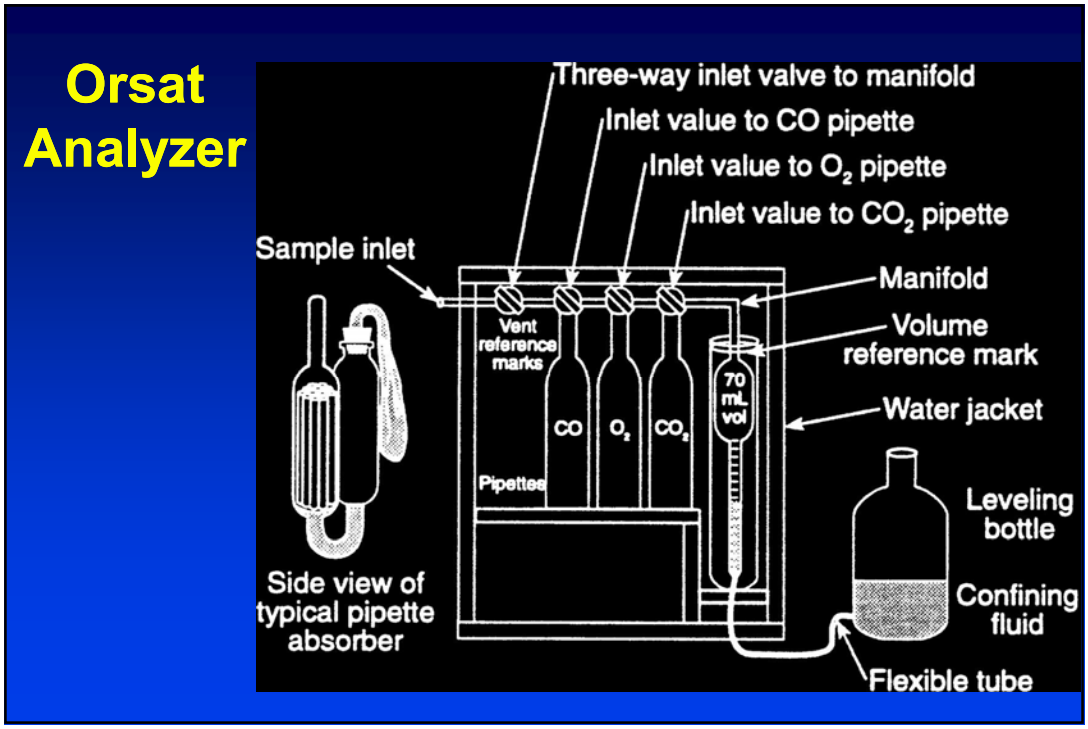
Gas Analysis for Determination of Dry Molecular Weight

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

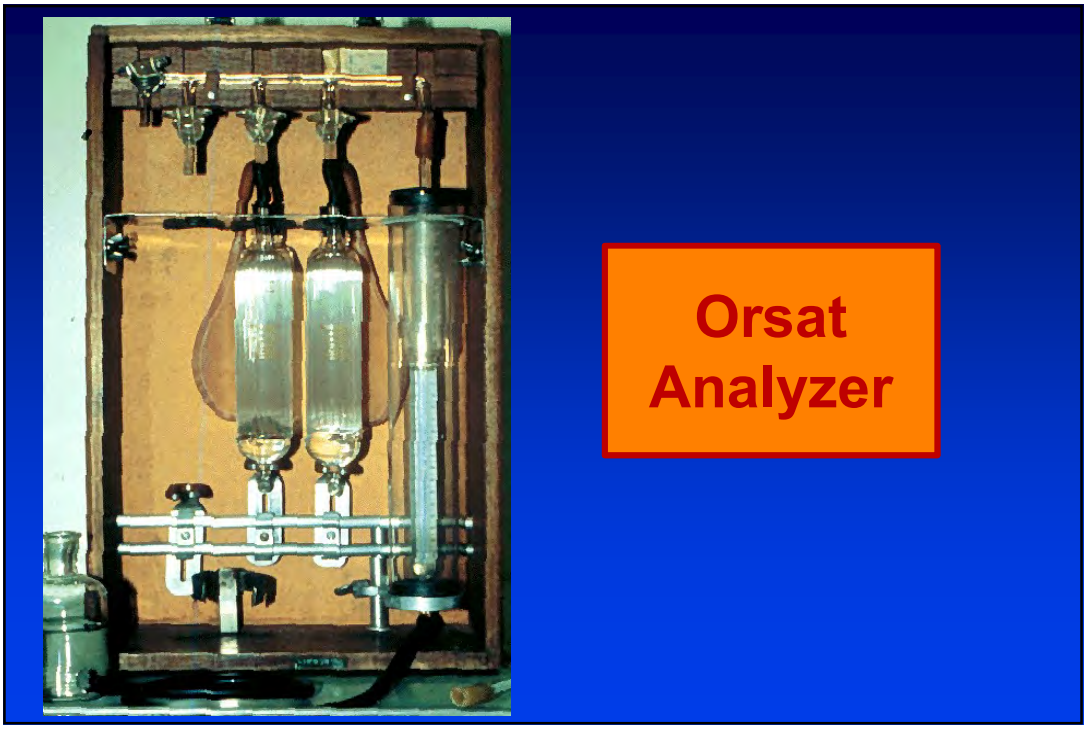
Partial Pressure

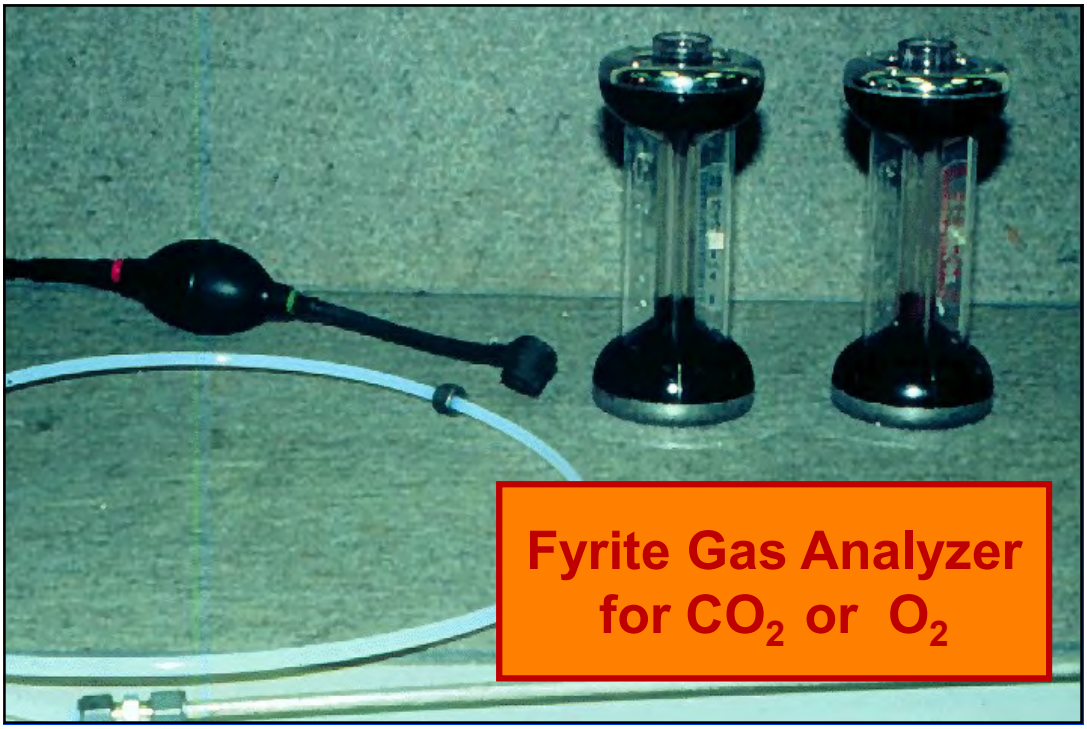



ORSAT
Analyzer
Oxidation
Reduction
Selective
Absorption
Technique

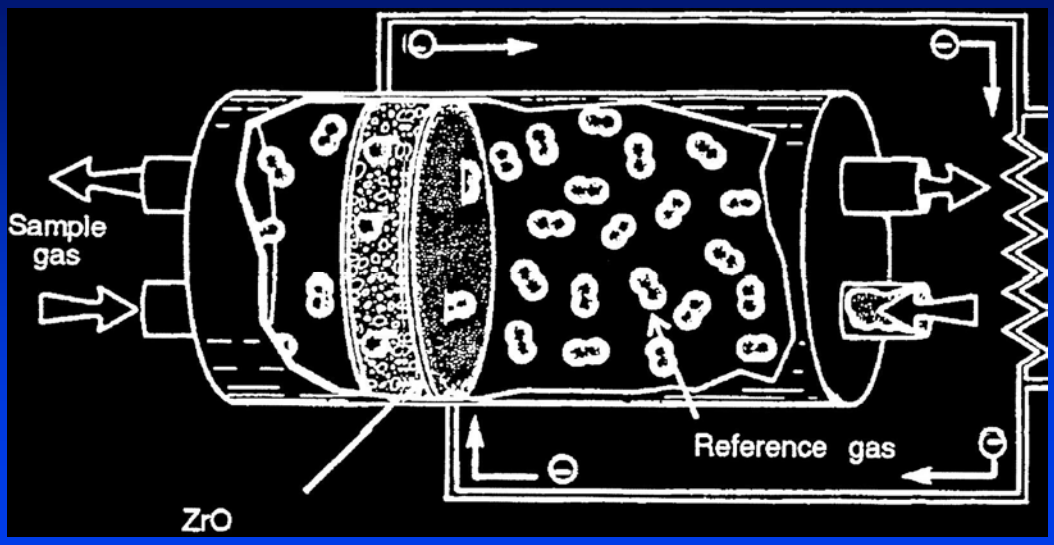

Orsat
Analyzer
Three-way inlet valve to manifold
Inlet value to CO pipette
Inlet value to O_2 pipette
Inlet value to CO_2 pipette
Sample inlet
Manifold
Vent reference marks
Volume reference mark
70 mL vol
Water jacket
CO
O_2
CO_2
Pipettes
Leveling bottle
Confining fluid
Side view of typical pipette absorber
Flexible tube

NACT 224
Observing Source Tests

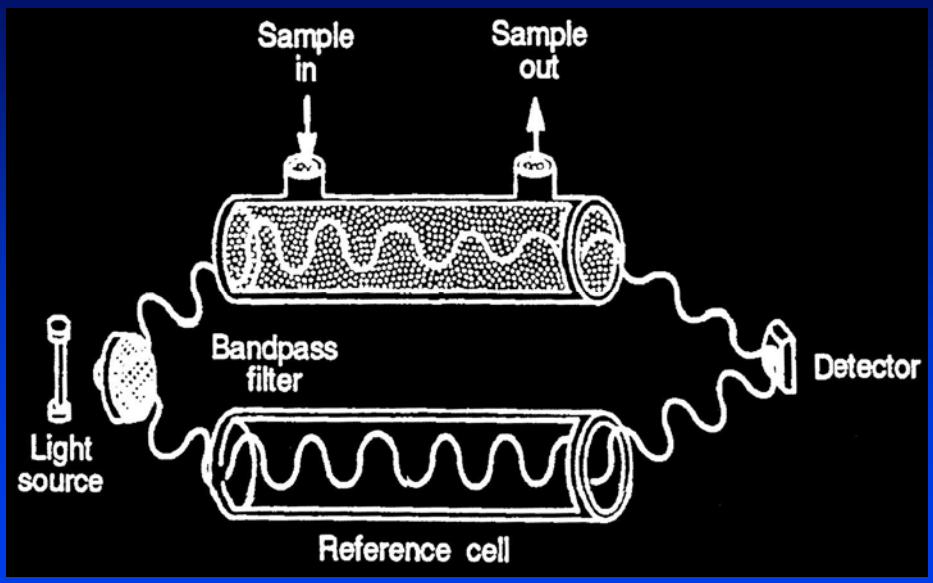




Electrocatalytic O_2 Analyzer



NDIR 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[1]
							1.210-1.370[1]
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

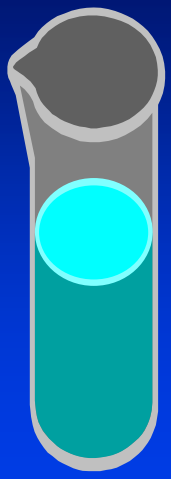
Method 4

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%

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

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

$$= 28.2 \text{ g/mole}$$

B_{ws} = Vol of H_2O ÷ Vol of Gas

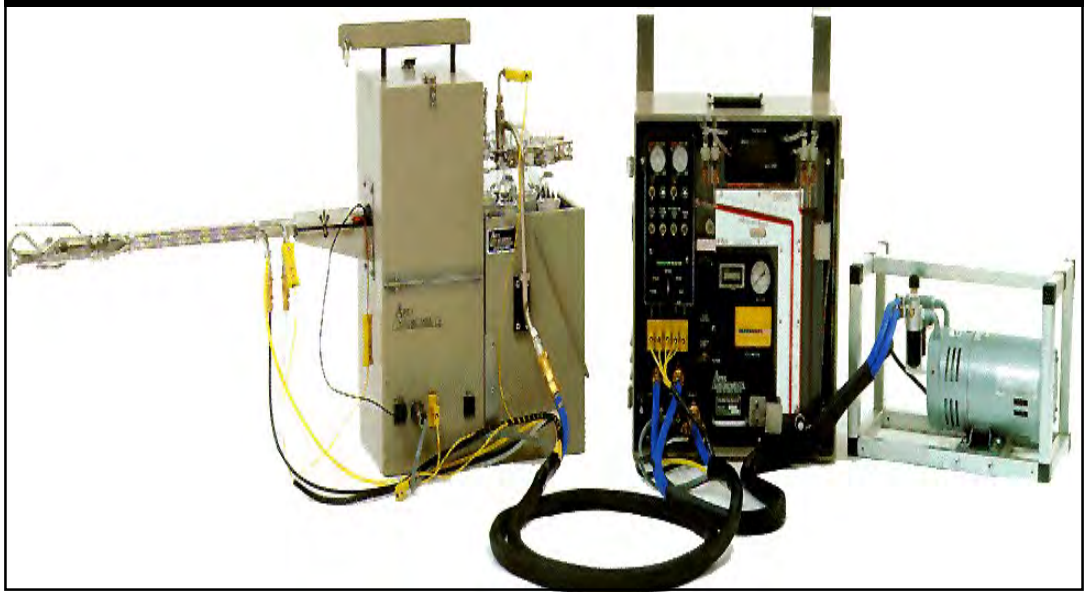
Method 5

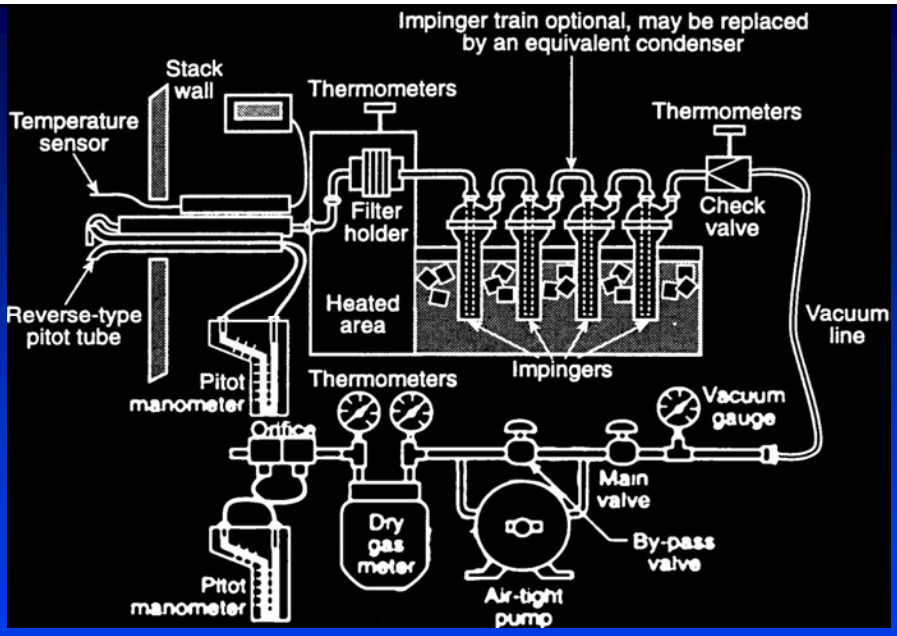
Determination of Particulate Emissions from Stationary Sources

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

NACT 224
Observing Source Tests

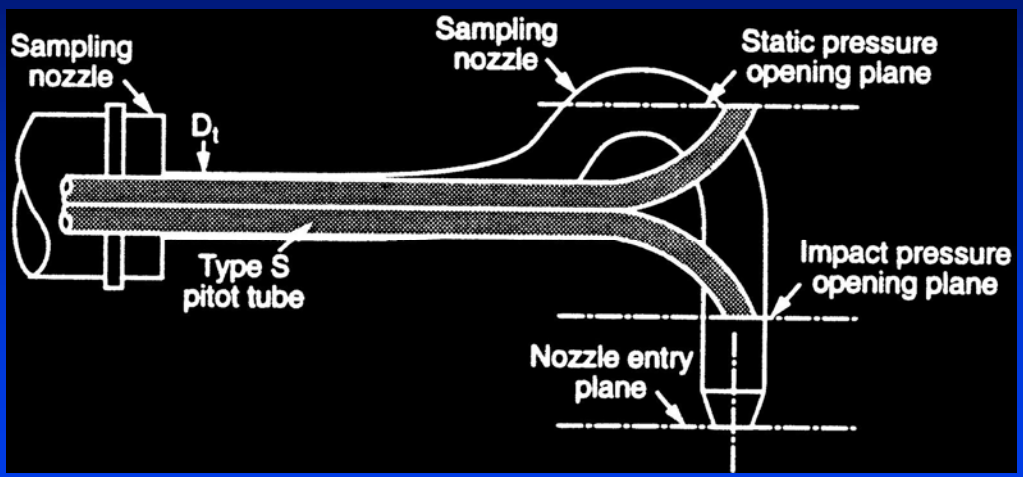
Isokinetic Source Sampling System





Method 5 Sampling Train

Nozzle Design and Placement

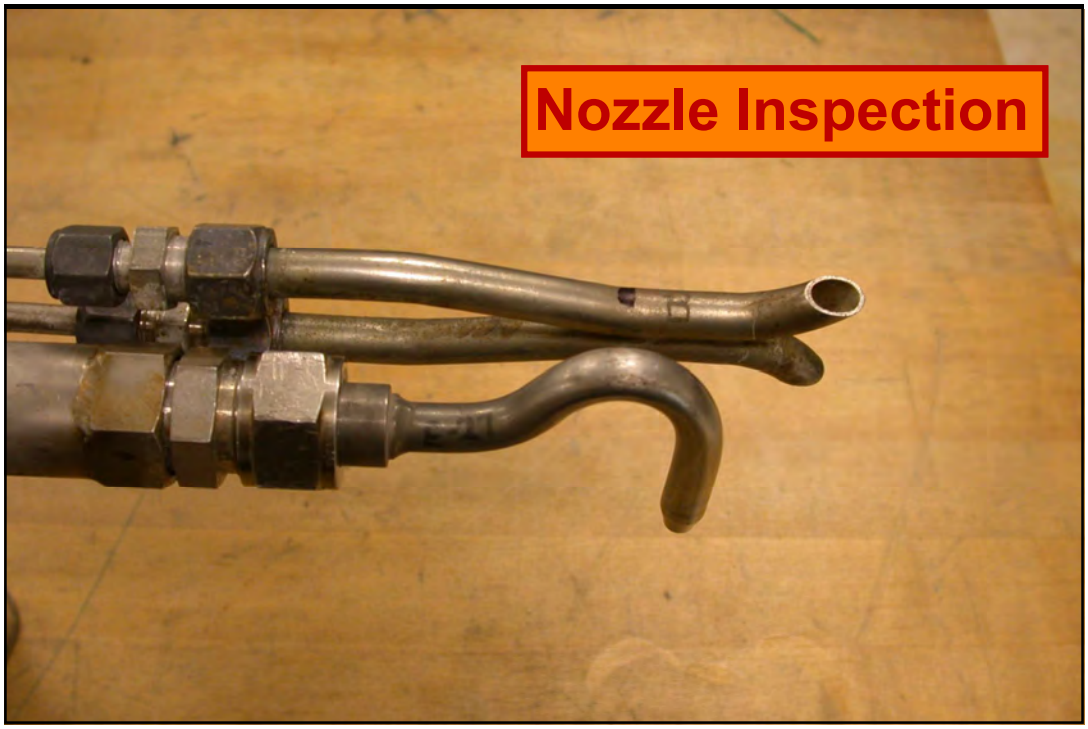



Sample Nozzles


Sample Nozzles

Physical Inspections

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



Calculation Inspections

- Nozzle Diameter

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

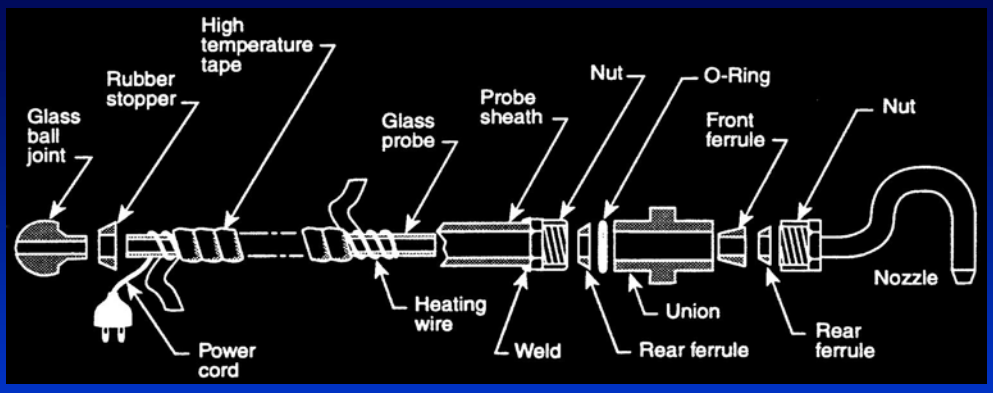
$K_D = 6.07$ (0.0358 English units)

Nozzle Diameter

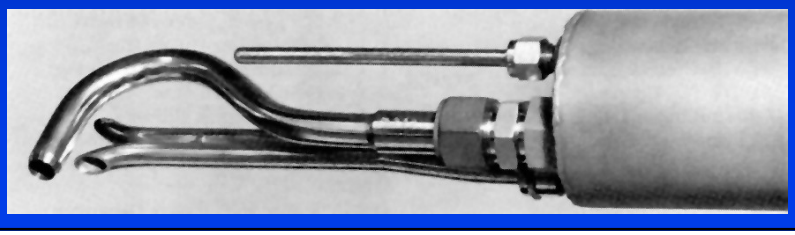
- $K_D = 6.07$
- $Q_m = 0.021\ m^3$
- $P_m = 683.6$ mm Hg
- $T_m = 28^oC$
- $C_p = 0.84$
- $B_{ws} = 0.15$
- $T_s = 345^oC$
- $M_s = 28.2$ g/mole
- $p_s = 35$ mm H_2O
- $\Delta p_{est} = 38$ mm H_2O

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

$D_n = 0.576$ cm



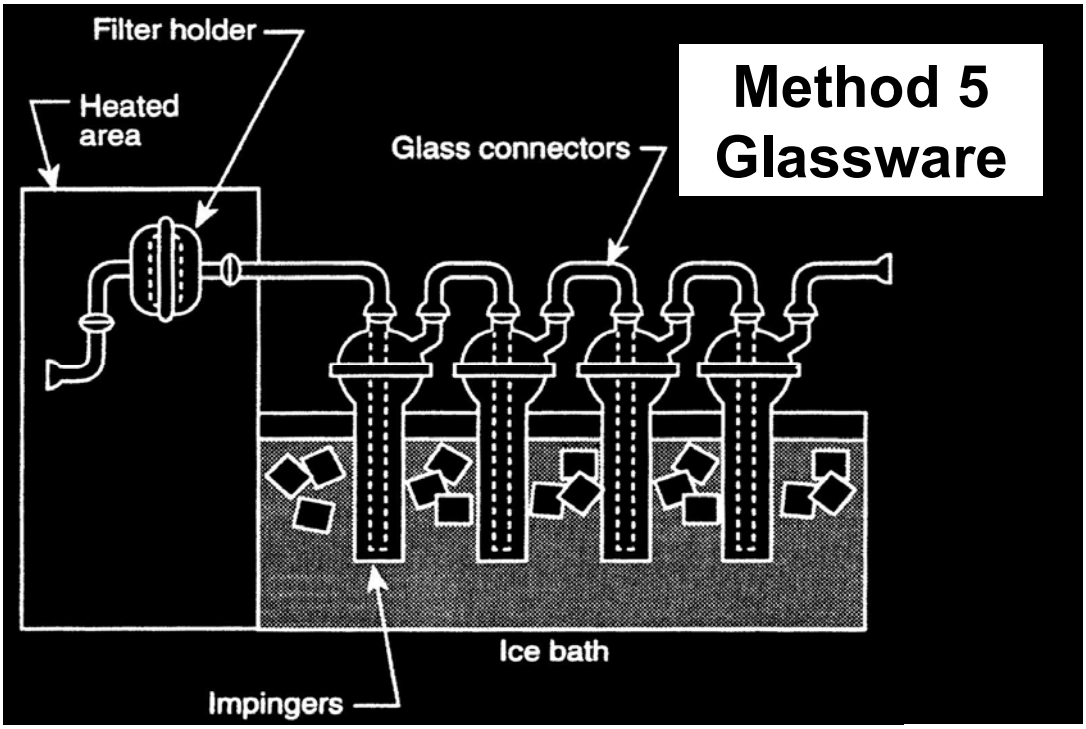
Probe Assembly



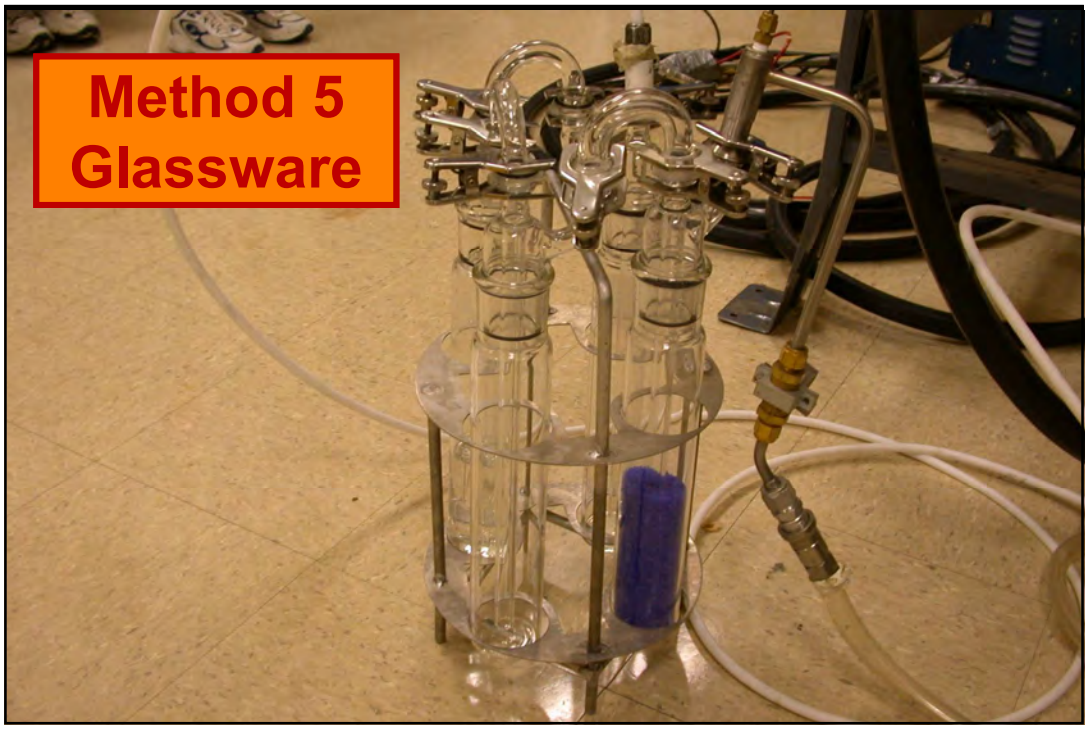
Physical Inspections

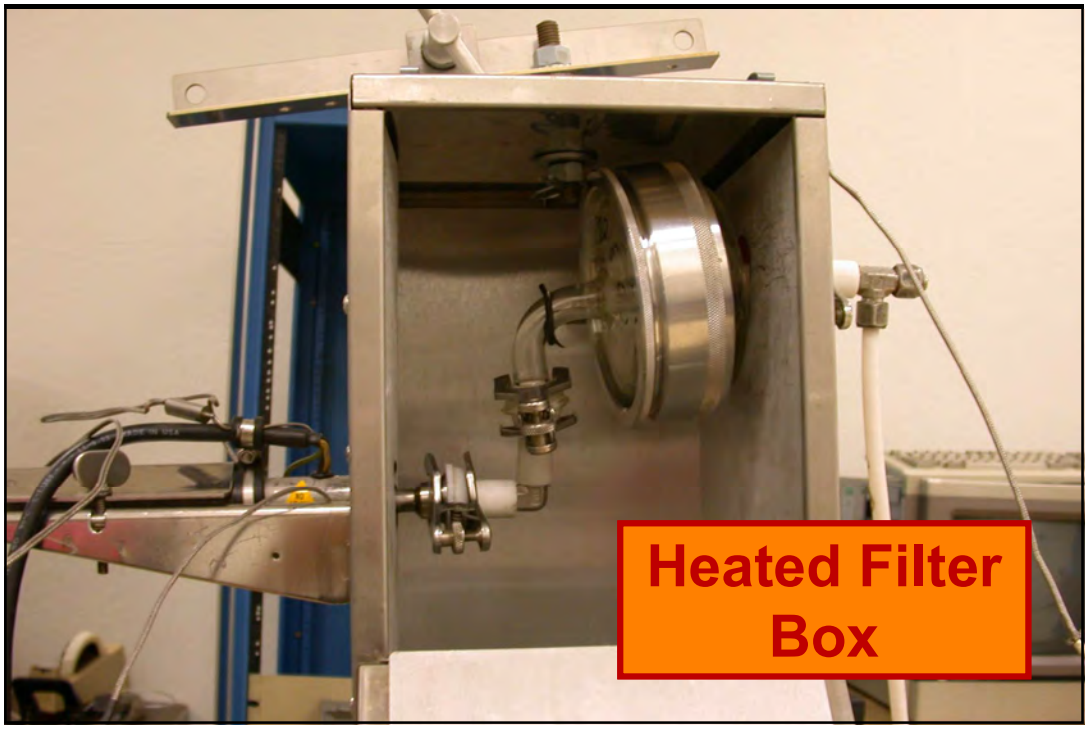
- Temperature Probe
  - Condition
  - Calibrated
- Probe
  - Long Enough to Reach, Not Too Long
  - Heated
  - SS or Glass Liner
  - Marked (Heat Resistant) for Traverse Points
  - Rinsed During Sample Recovery

Modular Sample Unit



NACT 224
Observing Source Tests





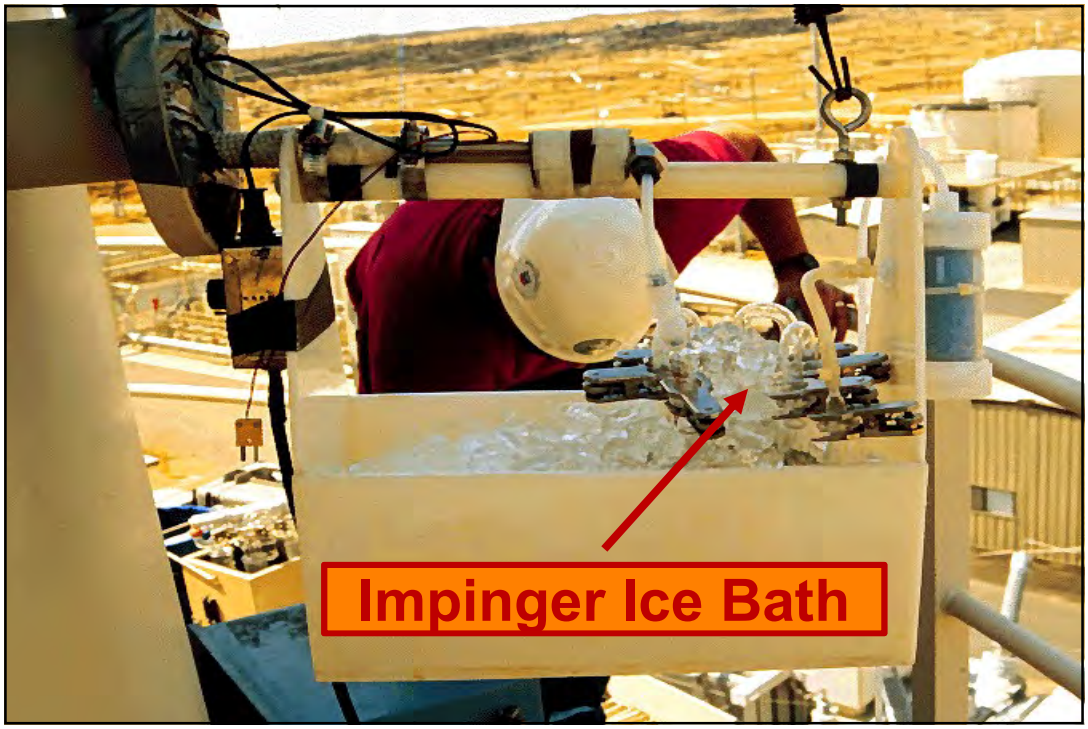
NACT 224
Observing Source Tests

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

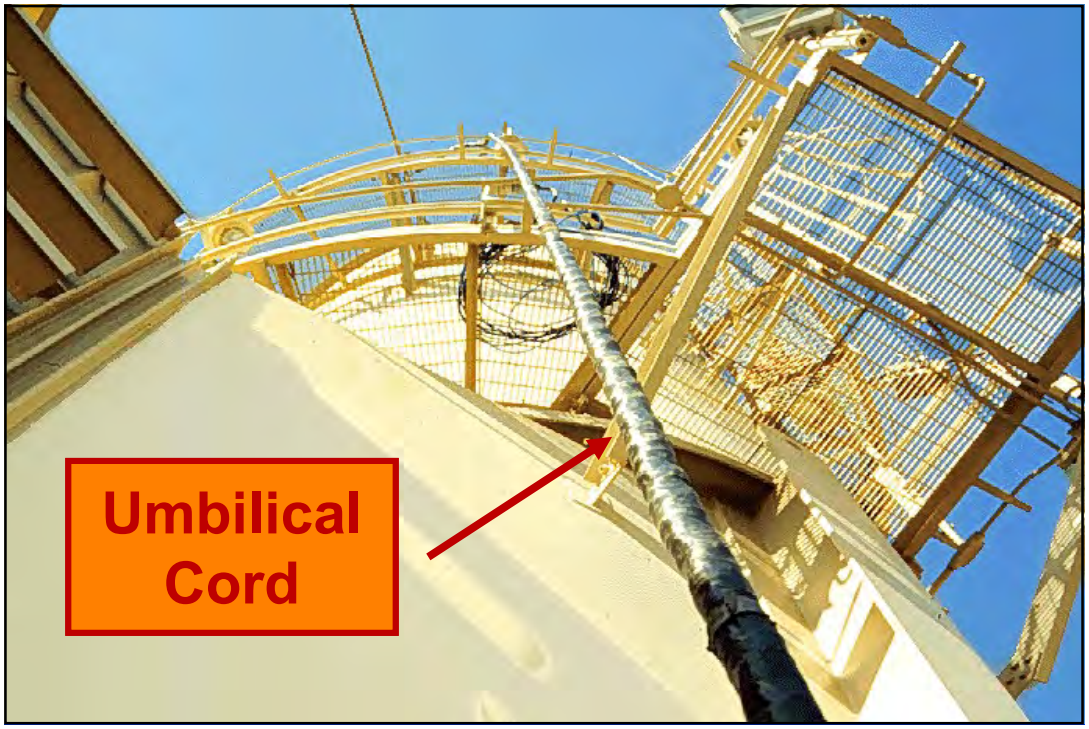


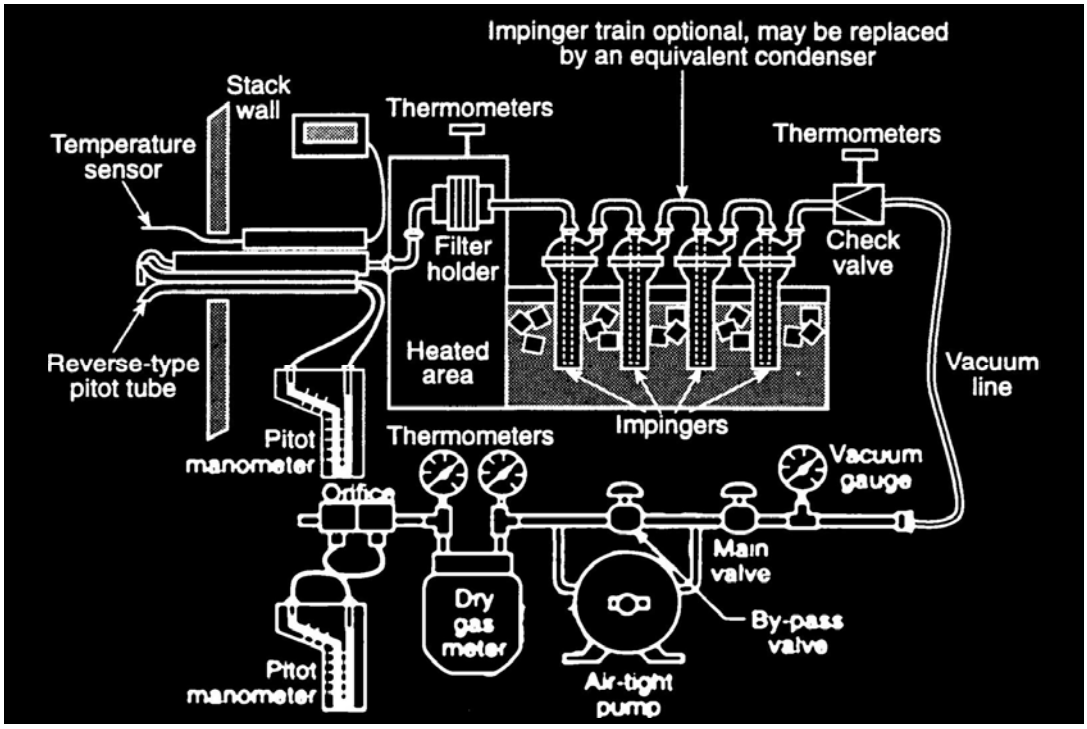
Physical Inspections

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

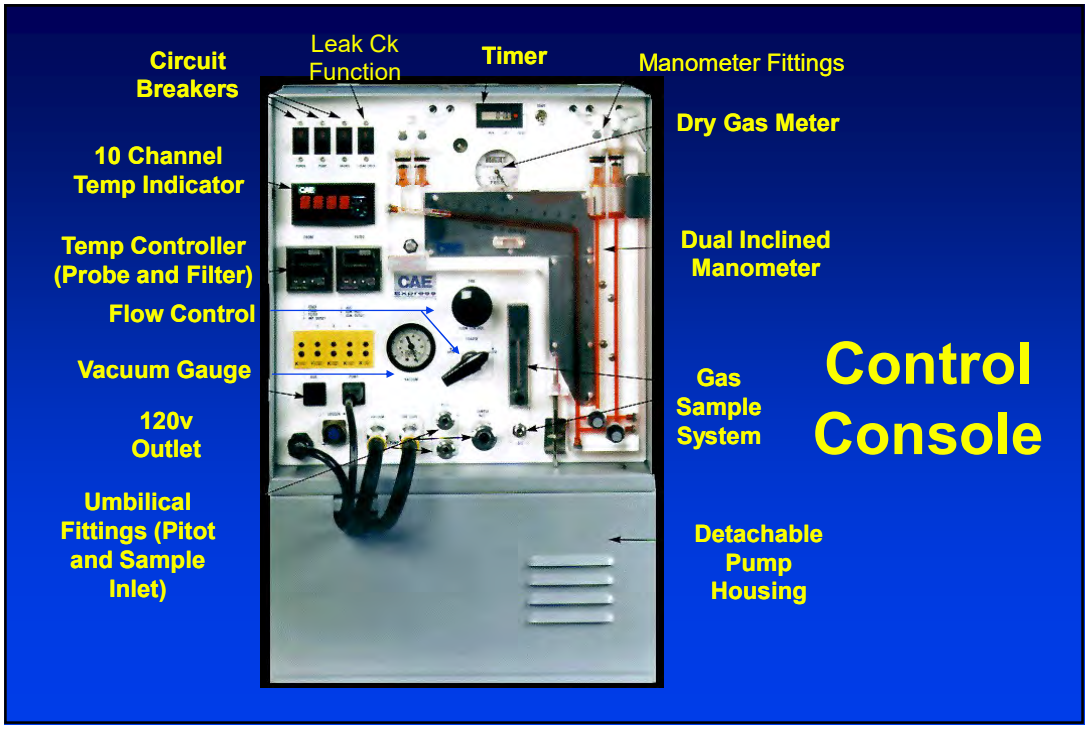
NACT 224
Observing Source Tests

NACT 224
Observing Source Tests





NACT 224
Observing Source Tests



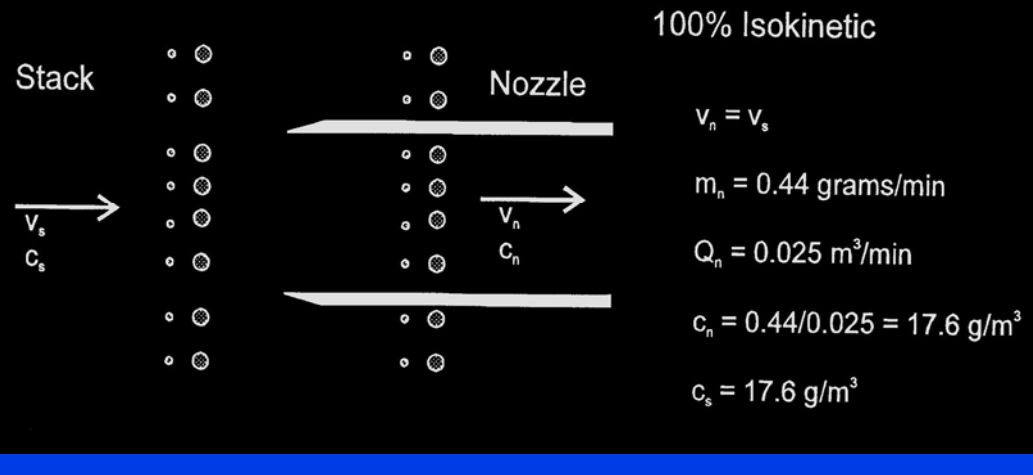
Physical Inspections

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

Sampling Rate

- Constant Rate
- Proportional
- Isokinetic

Isokinetic Sampling



100% Isokinetic

$v_n = v_s$

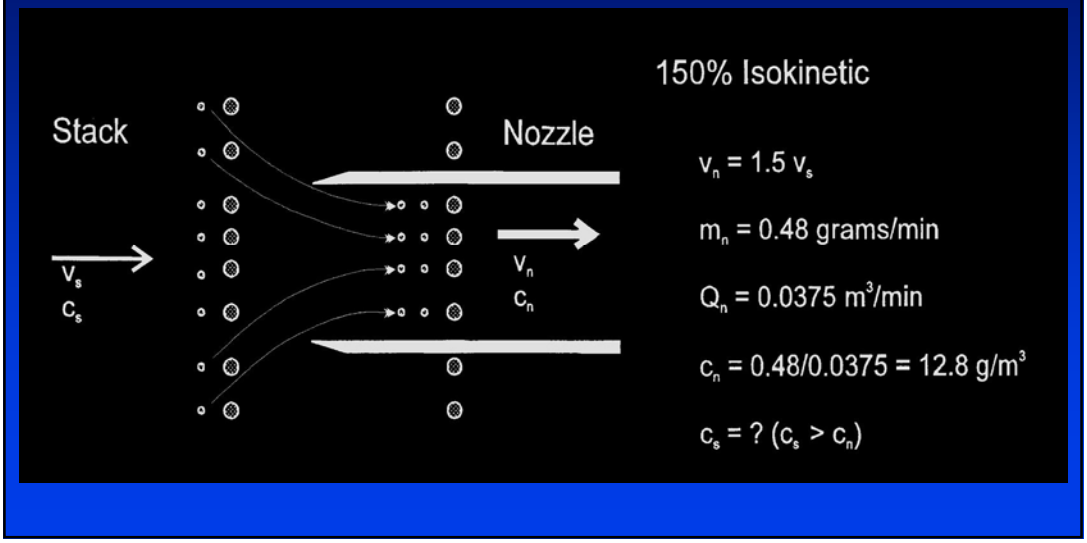
$m_n = 0.44$ grams/min

$Q_n = 0.025$ m^3/min

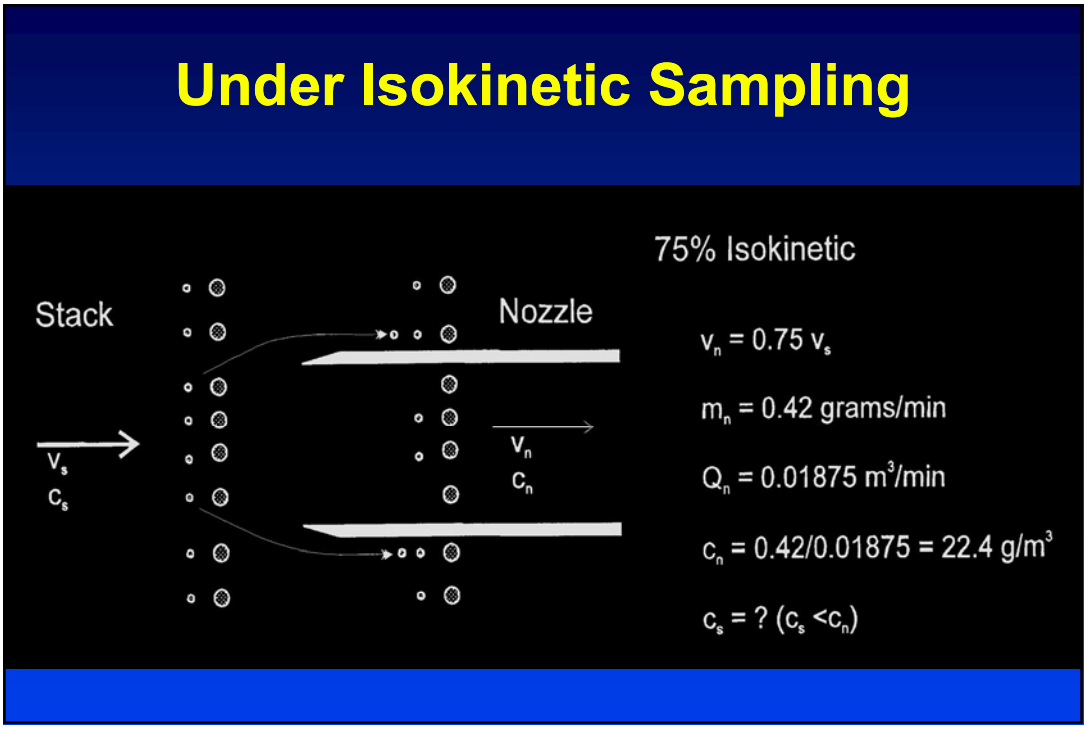
$c_n = 0.44/0.025 = 17.6$ g/m^3

$c_s = 17.6$ g/m^3

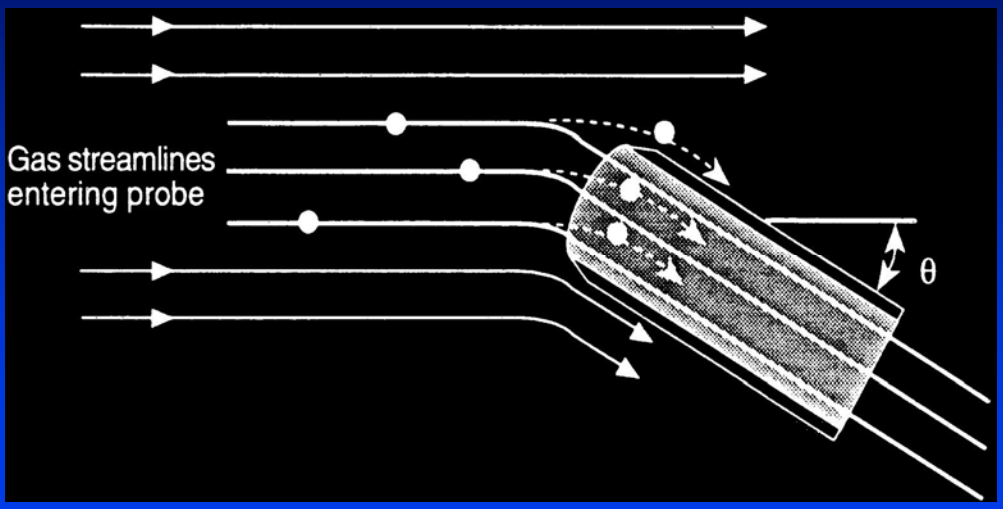
Over Isokinetic Sampling



Under Isokinetic Sampling



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)

K Factor and ΔH

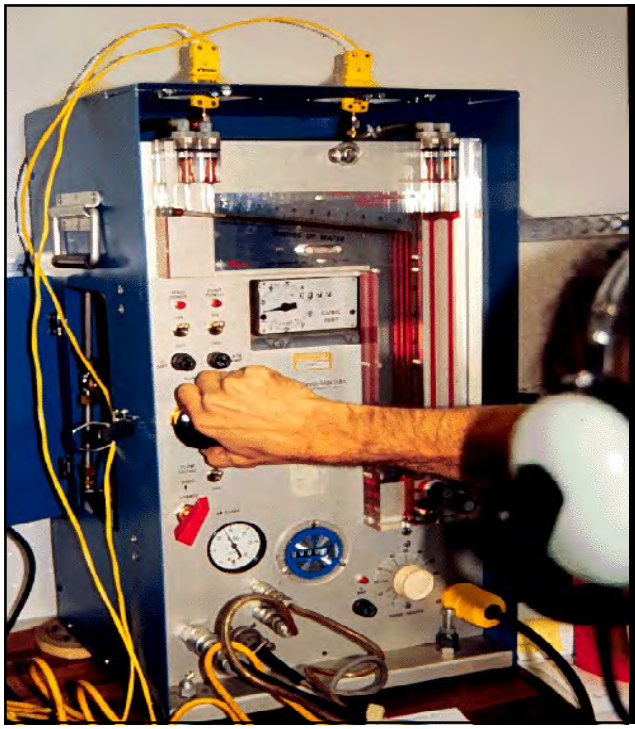
- K_H = 0.803
- D_n = 0.576 cm
- $\Delta H_@$ = 49.3 mm H_2O
- C_p = 0.84
- B_{ws} = 15%
- Δp = 38.1 mm H_2O
- M_d = 30.0 g/mole
- M_s = 28.2 g/mole
- T_m = 28°C
- T_s = 345°C
- p_s = 35 mm H_2O
- P_m = 683.3 mm Hg

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

K Factor = 1.15

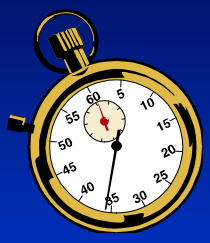
Δp = 38.1

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



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 m^3/ml K
(0.002669 in Hg ft^3/ml ^oR)

Percent Isokinetic

- ↓ T_s = 345°C
- ↓ Θ = 48 min
- ↓ V_{lc} = 113 ml
- ↓ V_m = 1.008 m^3
- ↓ T_m = 28°C
- ↓ P_b = 680 mm Hg
- ↓ ΔH = 43 mm H_2O
- ↓ A_n = 2.6x10^{-5} m^2
- ↓ V_s = 32.5 m/s
- ↓ p_s = 35 mm H_2O

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

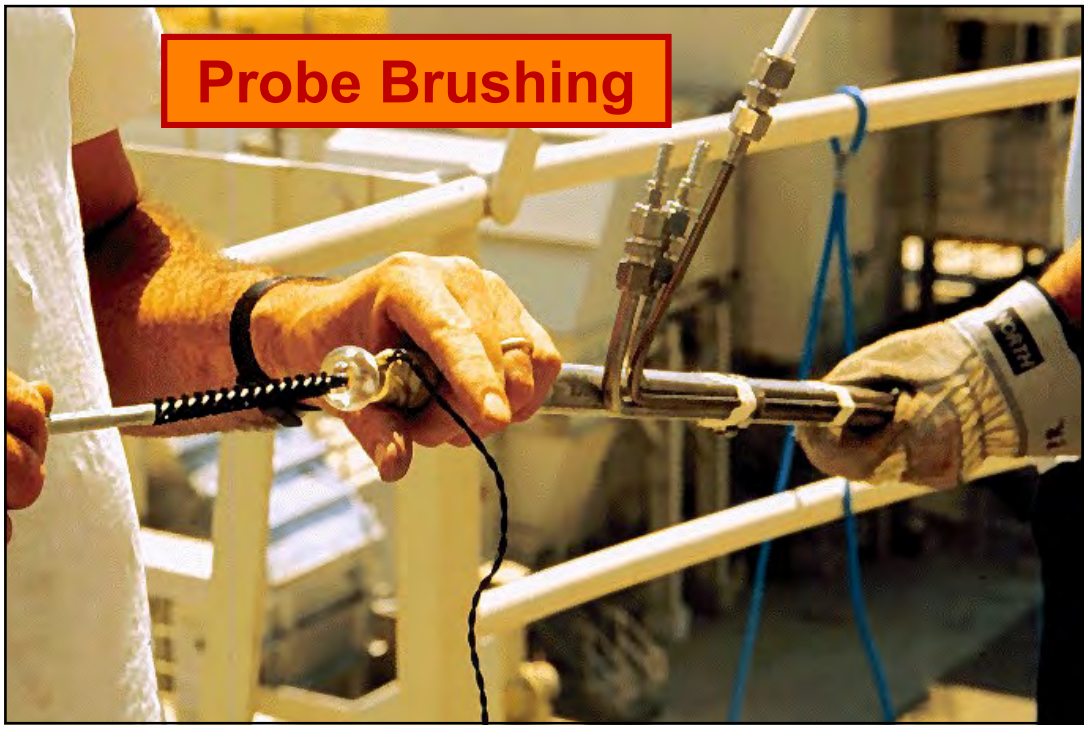
$$\%I = 99.7\%$$

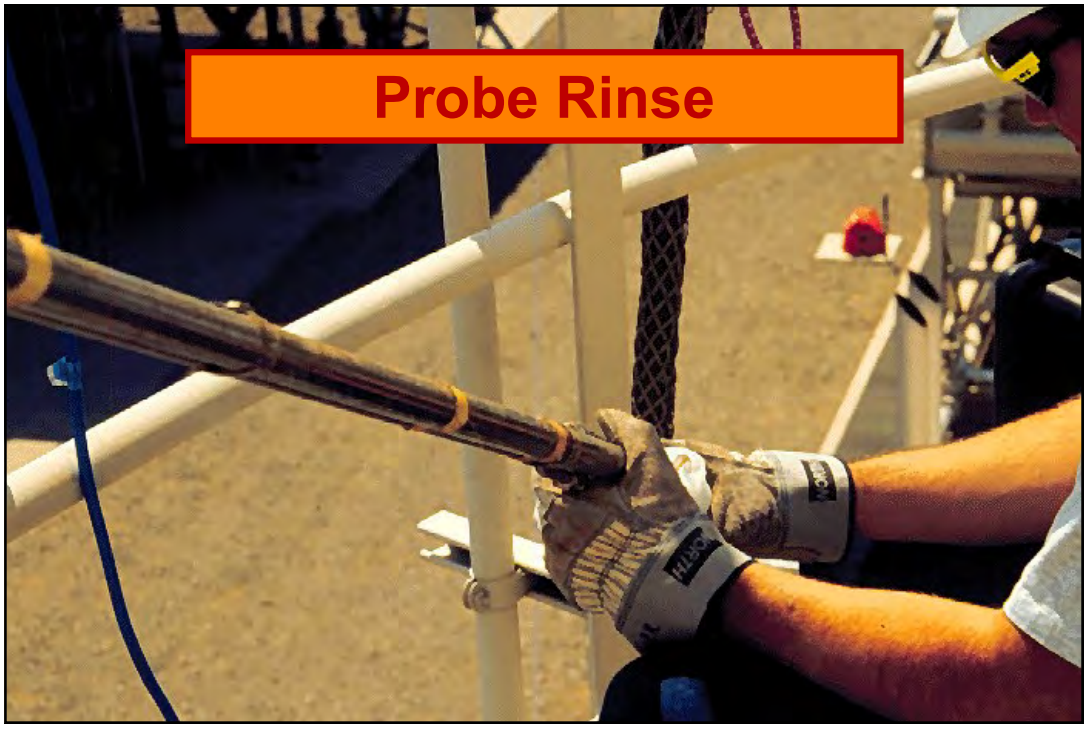
Procedural Inspections

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

Sampling Train Leak Test

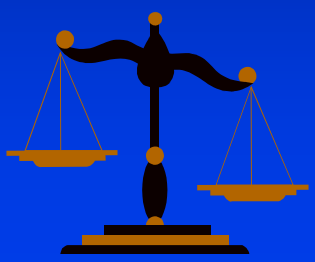
NACT 224
Observing Source Tests



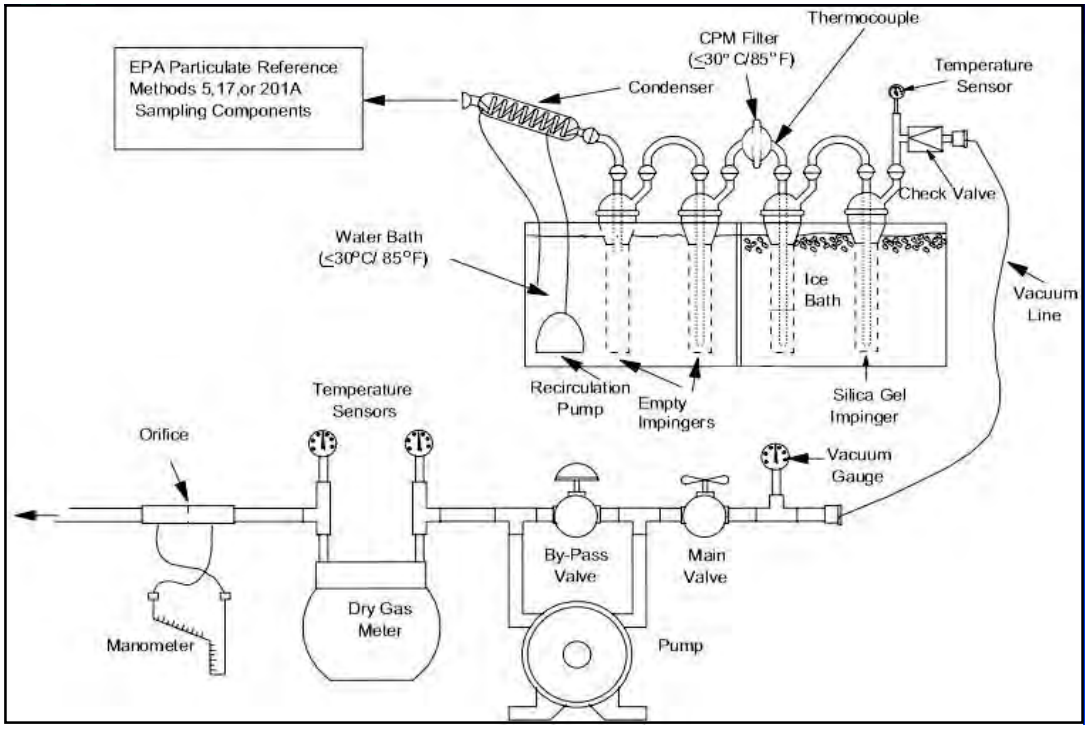


Physical Inspections

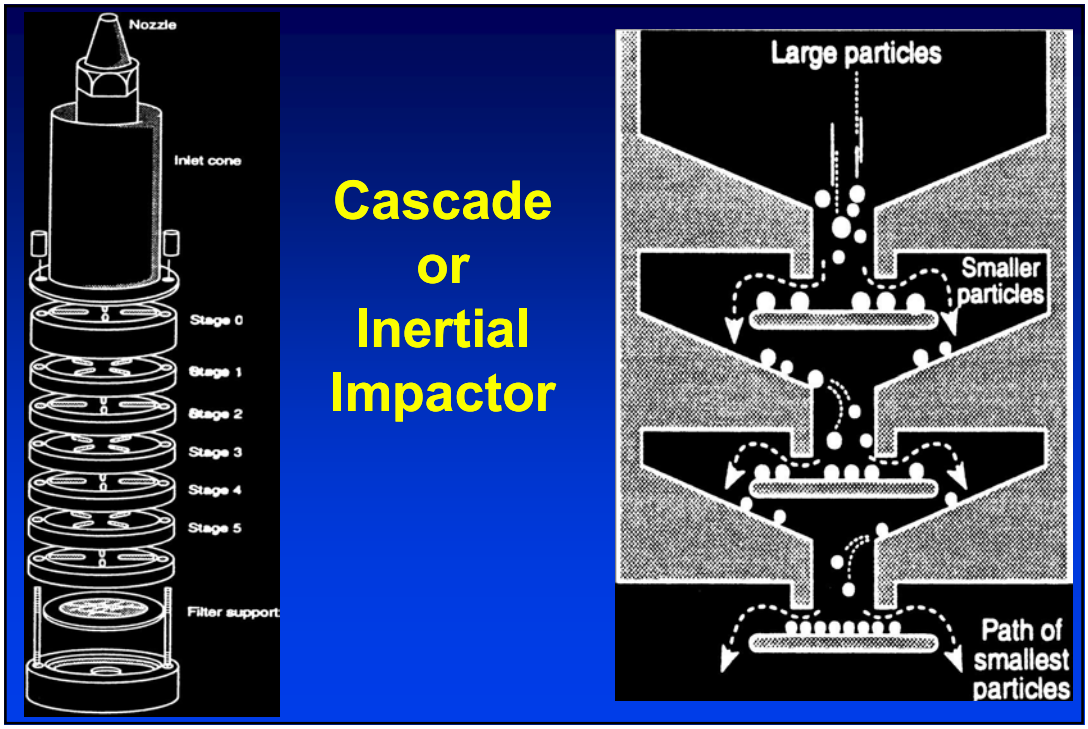
- Sample Properly Recovered
  - Good Particulate Deposit - No Evidence of Leaks
  - Impinger Solution Weighed &/or Recovered After Sampling
  - Rinse Front Half of Filter Holder Back Half Also
  - Probe Properly Cleaned
  - Filter Properly Weighed

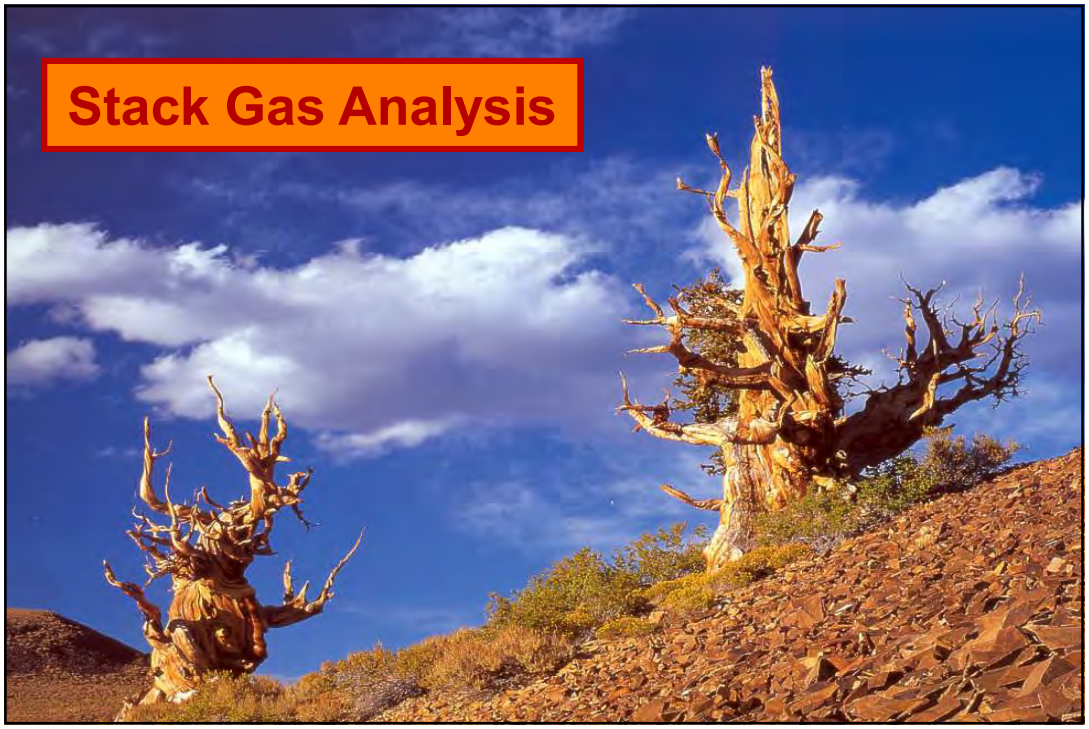


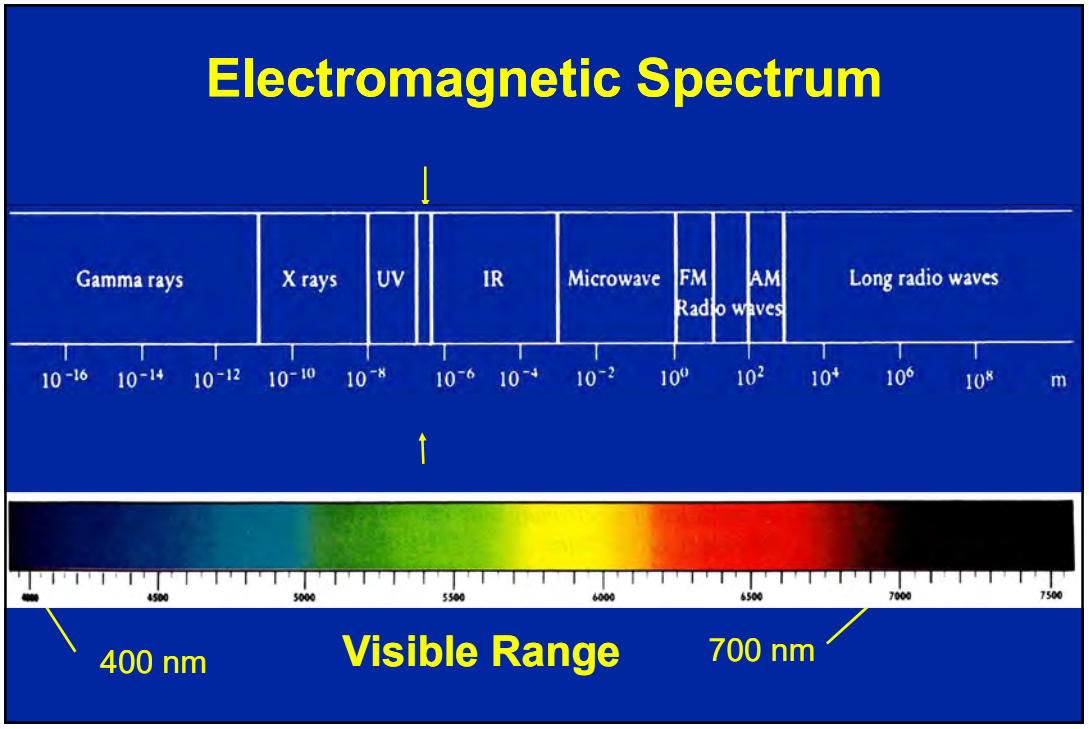
NACT 224
Observing Source Tests



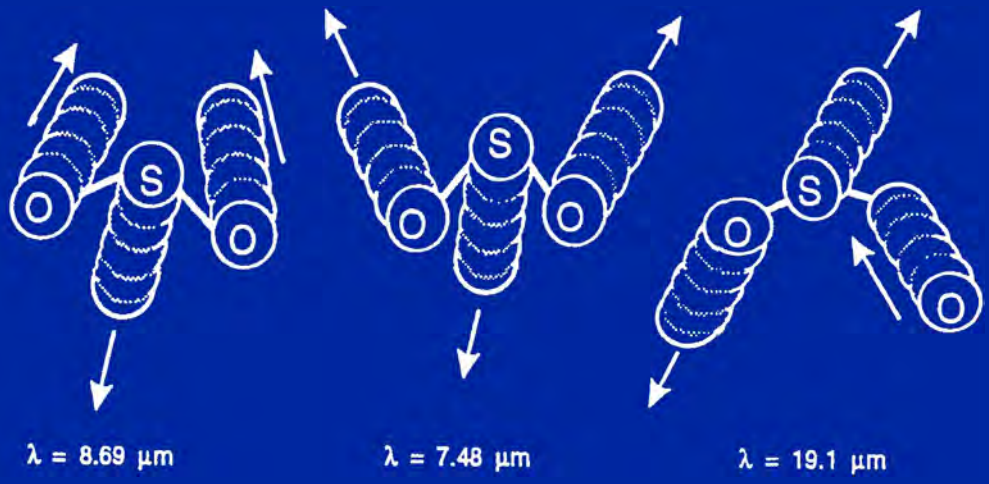
NACT 224
Observing Source Tests



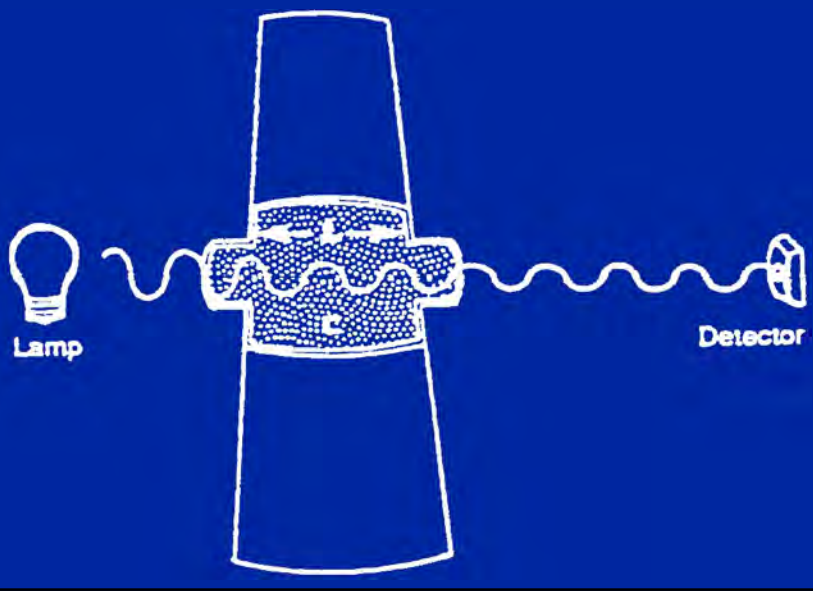

Stack Gas Analysis


Electromagnetic Spectrum
Gamma rays
X rays
UV
IR
Microwave
FM Radio waves
AM
Long radio waves
10⁻¹⁶ 10⁻¹⁴ 10⁻¹² 10⁻¹⁰ 10⁻⁸ 10⁻⁶ 10⁻⁴ 10⁻² 10⁰ 10² 10⁴ 10⁶ 10⁸ m
4000 4500 5000 5500 6000 6500 7000 7500
400 nm
Visible Range
700 nm

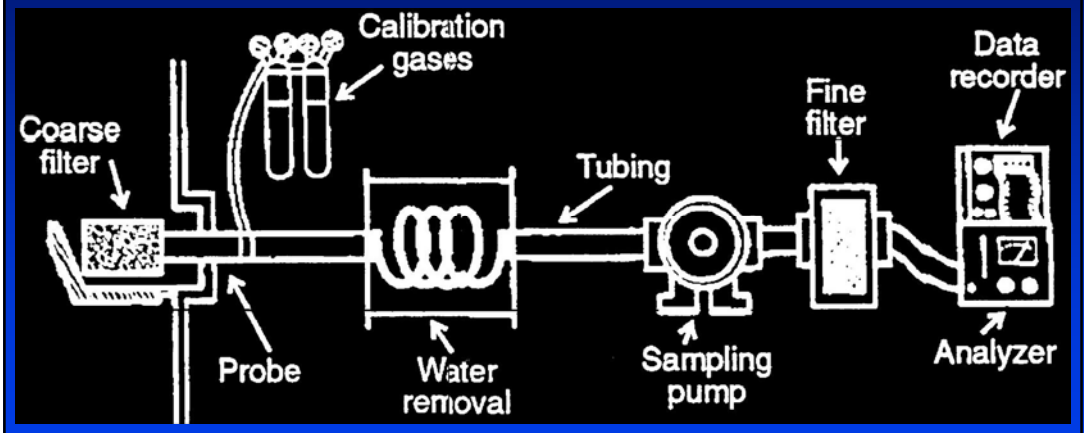
Normal Vibration of SO_2 Molecules



Simplified Stack Sample System

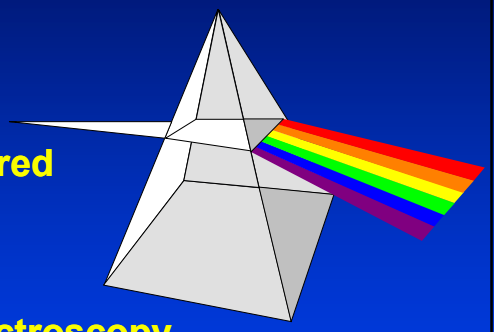


Basic Extractive System



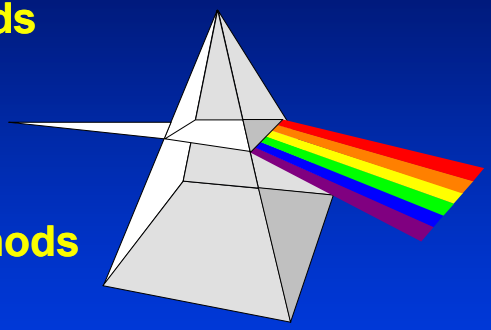
Source Test Analytical Techniques

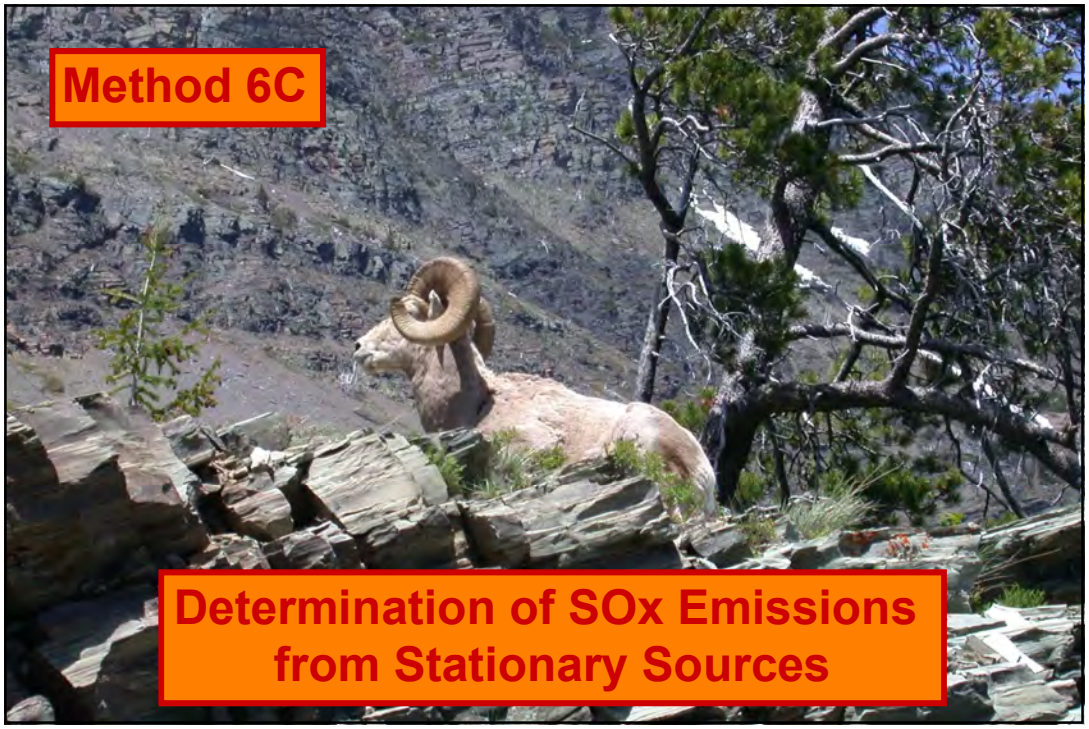
- Infrared Methods
  - Differential Absorption
  - Gas Filter Correlation
  - Fourier Transform Infrared
- Ultraviolet Methods
  - Differential Absorption
  - Second Derivative Spectroscopy
- Visible Light
  - Scattering & Absorption

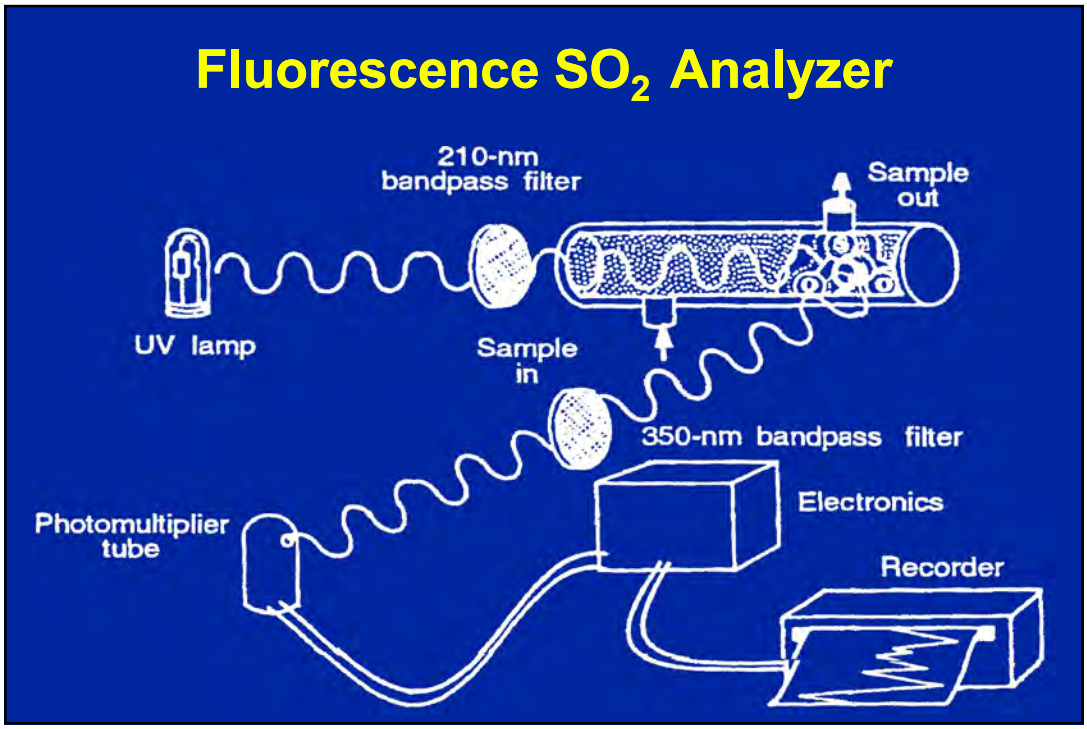


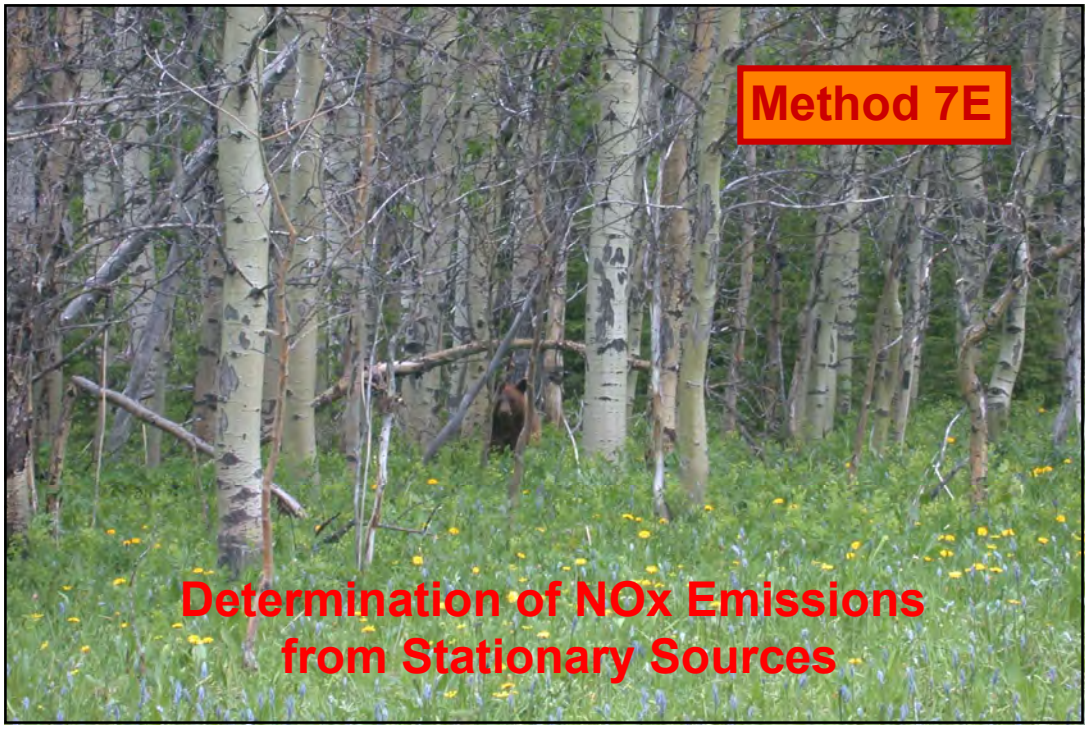
Source Test Analytical Techniques

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

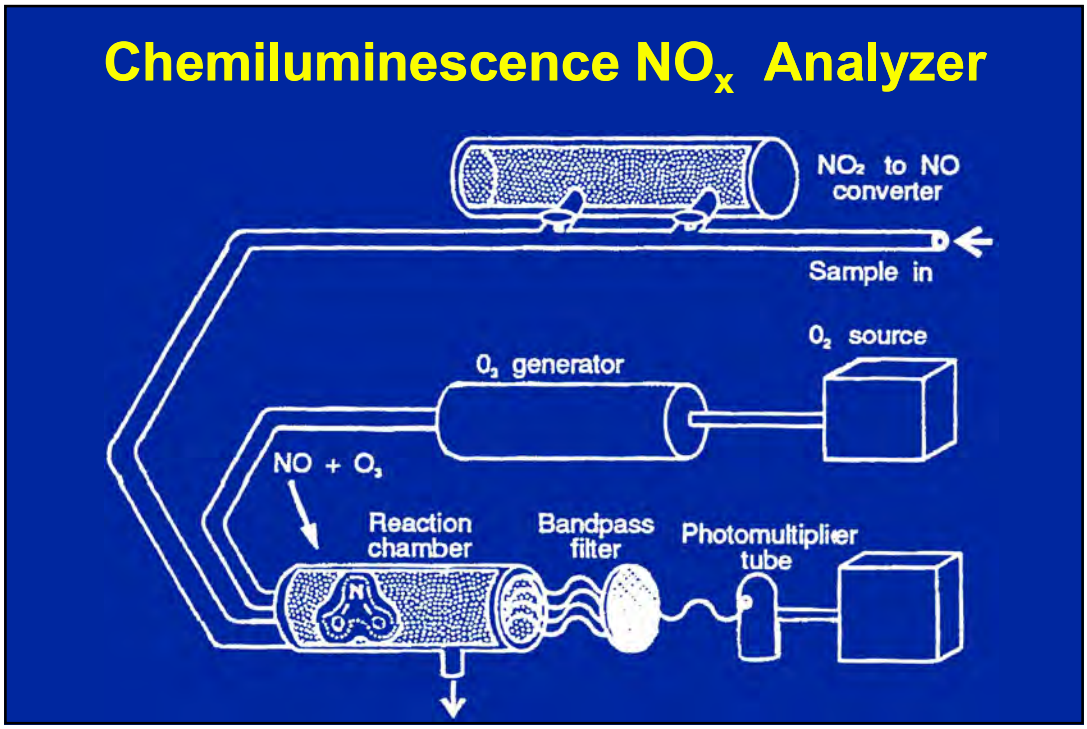


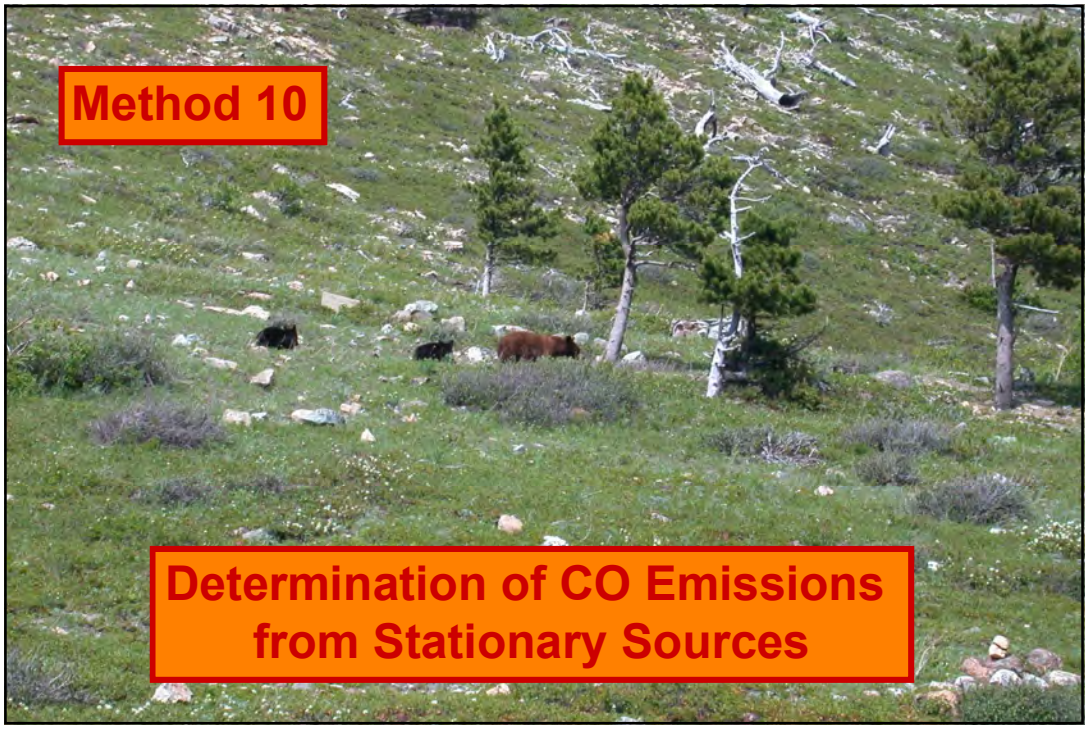


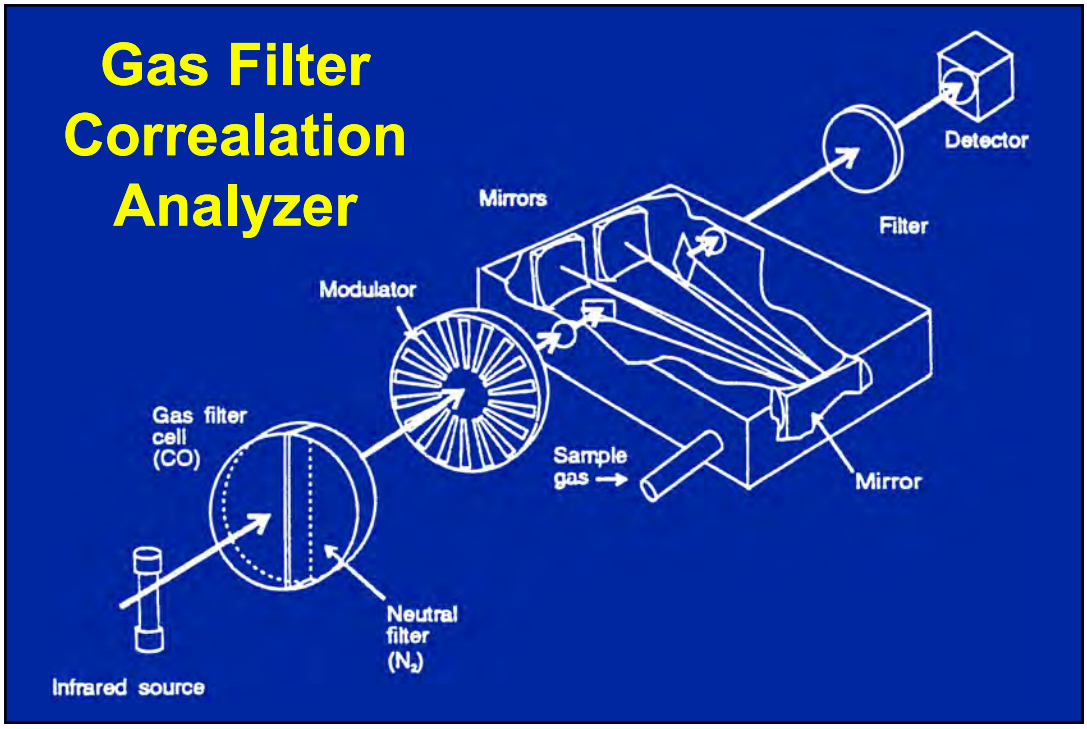

Fluorescence SO_2 Analyzer
210-nm bandpass filter
Sample out
UV lamp
Sample in
350-nm bandpass filter
Electronics
Photomultiplier tube
Recorder


Method 7E
Determination of NOx Emissions from Stationary Sources

NACT 224
Observing Source Tests



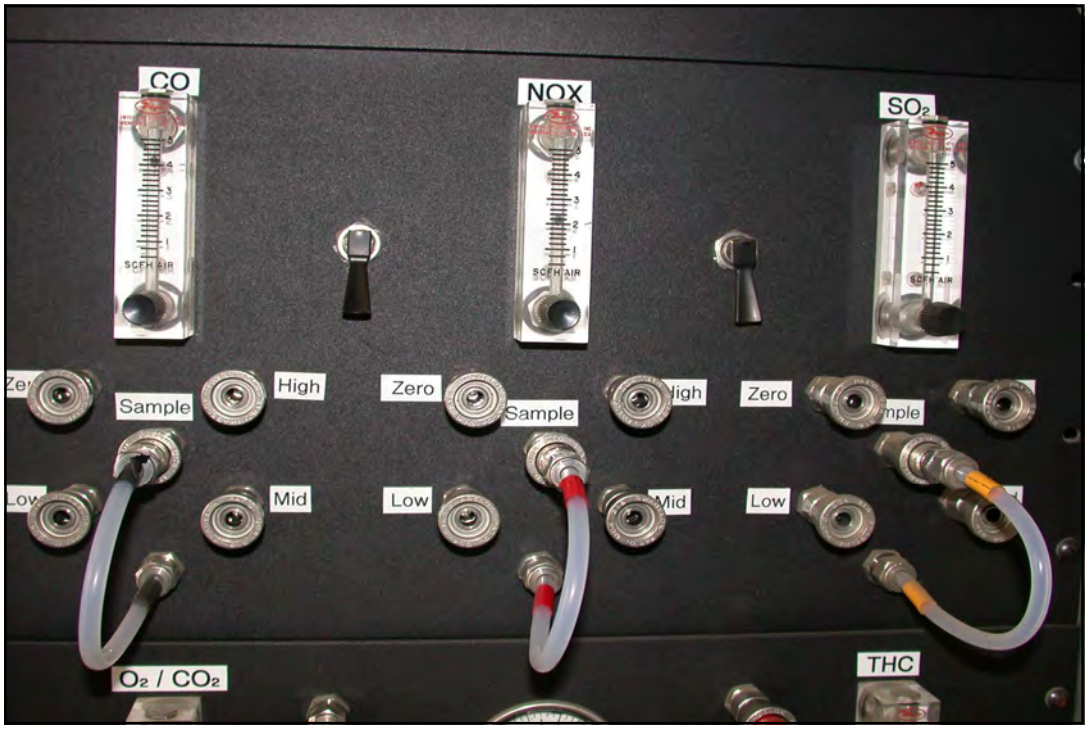

Method 10
Determination of CO Emissions from Stationary Sources


Gas Filter Correalation Analyzer
Detector
Mirrors
Filter
Modulator
Gas filter cell (CO)
Sample gas
Mirror
Neutral filter (N_2)
Infrared source

NACT 224
Observing Source Tests

Instrument Inspections

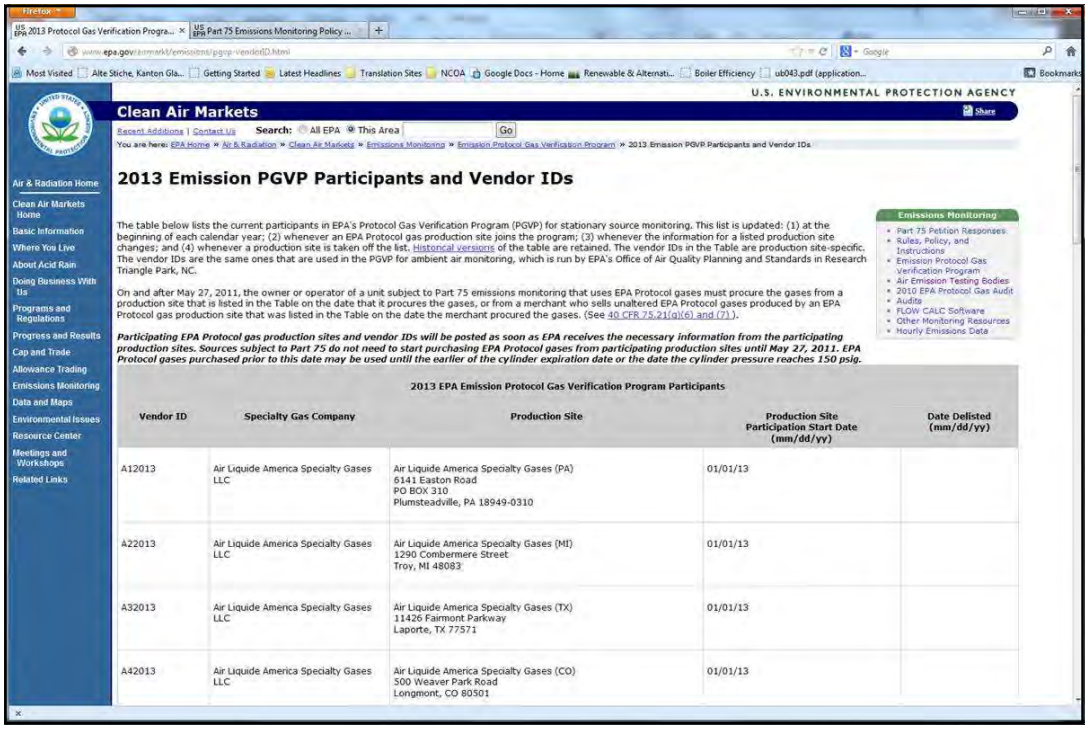
- Always Check Applicable Method & Subpart
- Instrument Span
- Calibration Error
  - <+/- 2 % of Span for Zero, Mid, & High Range Gases
- Sampling System Bias
  - <+/- 5% of Span for Zero & Mid or High Range Gases
- Zero Drift & Calibration Drift
  - <+/- 3% of Span Over the Period of Each Run
- Interference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



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

NACT 224
Observing Source Tests



U.S. ENVIRONMENTAL PROTECTION AGENCY

Clean Air Markets

Air & Radiation Home
Clean Air Markets Home
Basic Information
Where You Live
About Acid Rain
Doing Business With Us
Programs and Regulations
Progress and Results
Cap and Trade
Allowance Trading
Emissions Monitoring
Data and Maps
Environmental Issues
Resource Center
Meetings and Workshops
Related Links

2013 Emission PGVP Participants and Vendor IDs

The table below lists the current participants in EPA's Protocol Gas Verification Program (PGVP) for stationary source monitoring. This list is updated: (1) at the beginning of each calendar year; (2) whenever an EPA Protocol gas production site joins the program; (3) whenever the information for a listed production site changes; and (4) whenever a production site is taken off the list. Historical versions of the table are retained. The vendor IDs in the Table are production site-specific. The vendor IDs are the same ones that are used in the PGVP for ambient air monitoring, which is run by EPA's Office of Air Quality Planning and Standards in Research Triangle Park, NC.

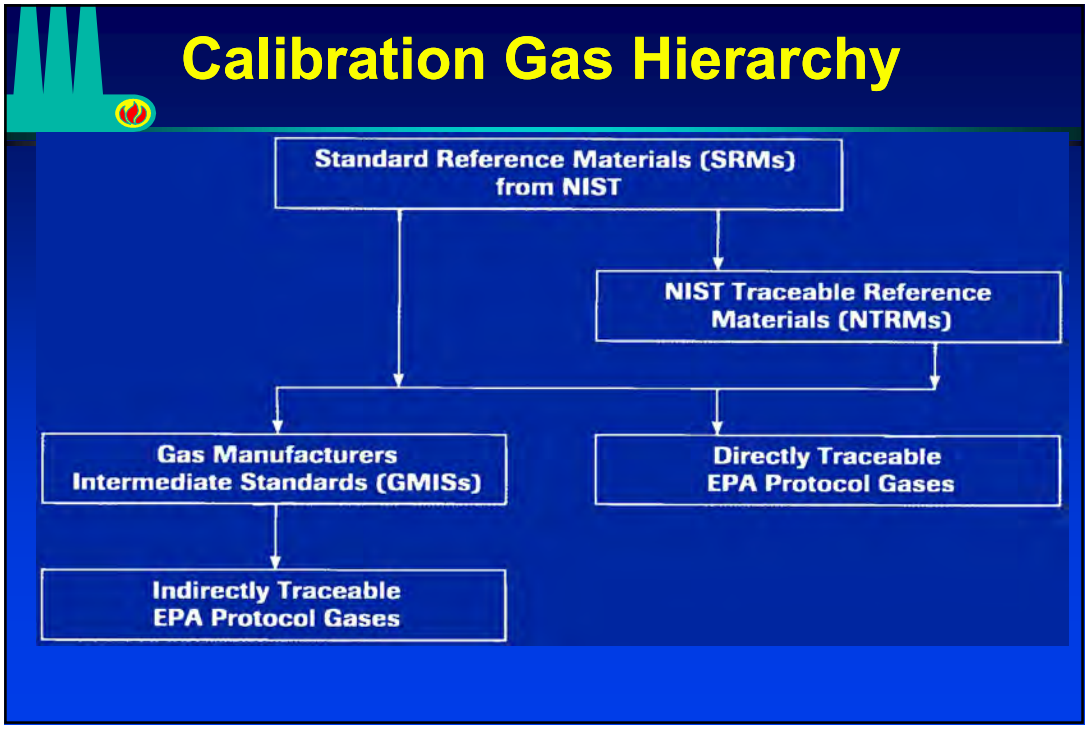
On and after May 27, 2011, the owner or operator of a unit subject to Part 75 emissions monitoring that uses EPA Protocol gases must procure the gases from a production site that is listed in the Table on the date that it procures the gases, or from a merchant who sells unaltered EPA Protocol gases produced by an EPA Protocol gas production site that was listed in the Table on the date the merchant procured the gases. (See 40 CFR 75.21(g)(6) and (7)).

Participating EPA Protocol gas production sites and vendor IDs will be posted as soon as EPA receives the necessary information from the participating production sites. Sources subject to Part 75 do not need to start purchasing EPA Protocol gases from participating production sites until May 27, 2011. EPA Protocol gases purchased prior to this date may be used until the earlier of the cylinder expiration date or the date the cylinder pressure reaches 150 psig.

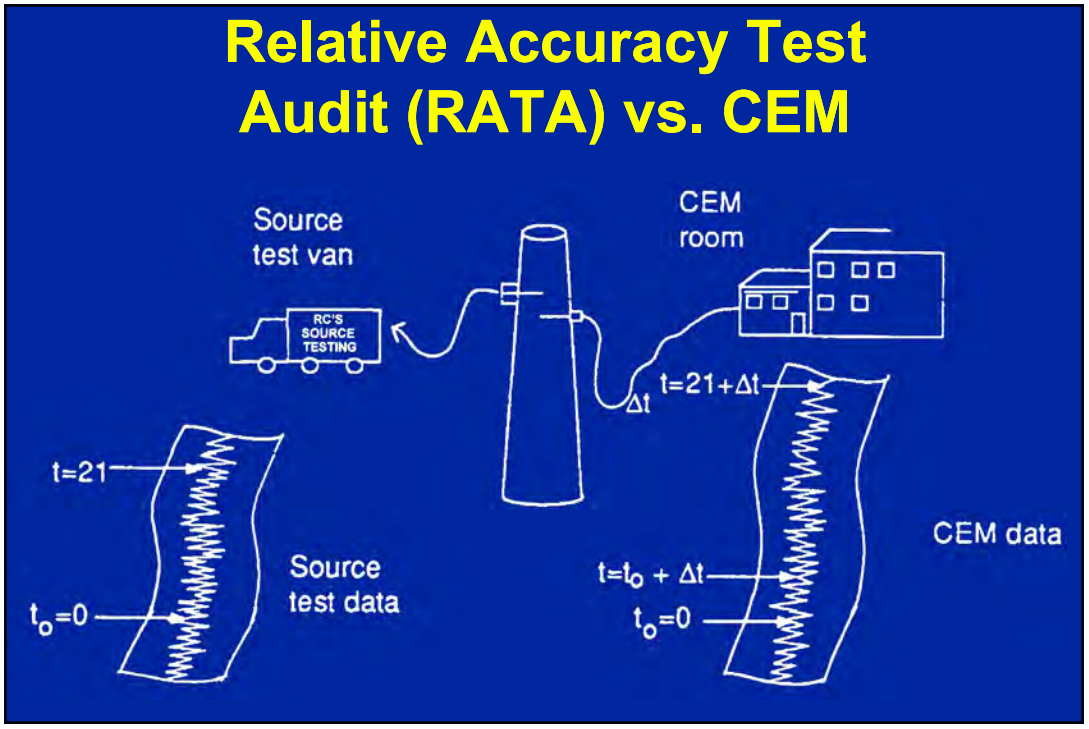
Emissions Monitoring
- Part 75 Petition Responses
- Rules, Policy, and Instructions
- Emission Protocol Gas Verification Program
- Air Emission Testing Bodies
- 2010 EPA Protocol Gas Audit
- Audits
- FLOW CALC Software
- Other Monitoring Resources
- Hourly Emissions Data

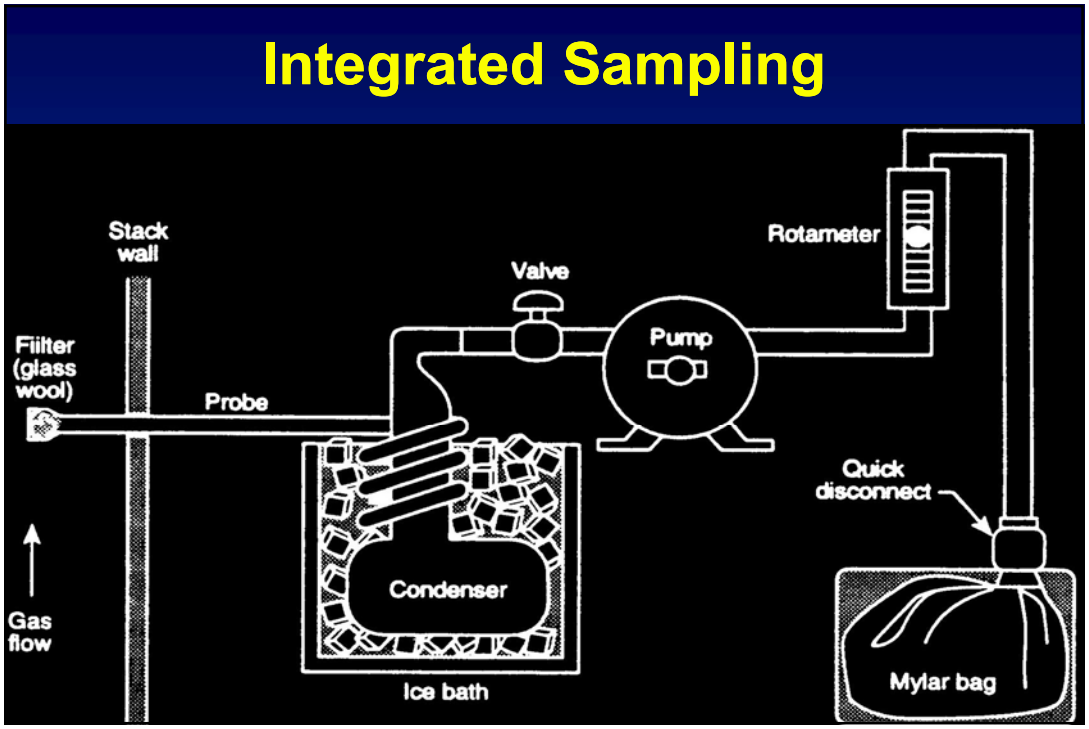
2013 EPA Emission Protocol Gas Verification Program Participants

Vendor ID	Specialty Gas Company	Production Site	Production Site Participation Start Date (mm/dd/yy)	Date Delisted (mm/dd/yy)
A12013	Air Liquide America Specialty Gases LLC	Air Liquide America Specialty Gases (PA) 6141 Easton Road PO BOX 310 Plumsteadville, PA 18949-0310	01/01/13	
A22013	Air Liquide America Specialty Gases LLC	Air Liquide America Specialty Gases (MI) 1290 Combermere Street Troy, MI 48083	01/01/13	
A32013	Air Liquide America Specialty Gases LLC	Air Liquide America Specialty Gases (TX) 11426 Fairmont Parkway Laporte, TX 77571	01/01/13	
A42013	Air Liquide America Specialty Gases LLC	Air Liquide America Specialty Gases (CO) 500 Weaver Park Road Longmont, CO 80501	01/01/13	



NACT 224
Observing Source Tests

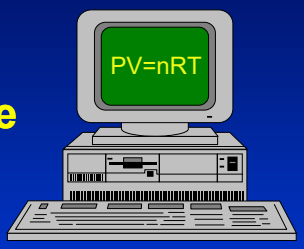



Integrated Sampling
Stack wall
Rotameter
Valve
Pump
Filter (glass wool)
Probe
Quick disconnect
Condenser
Gas flow
Ice bath
Mylar bag


Grab or Integrated Sample Canisters

Procedural Inspections

Data Recording

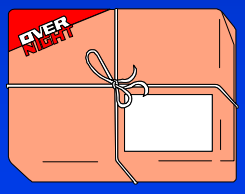


- Timely, Accurate, & Complete
- Standardized Form Used
- Computer Data Entry:
  - Automatic - Computer Controlled Equipment
  - On Site After Sampling or During Sample (Computer Data Entry Form)
  - After Sampling Completed

Procedural Inspections

Sample Conservation

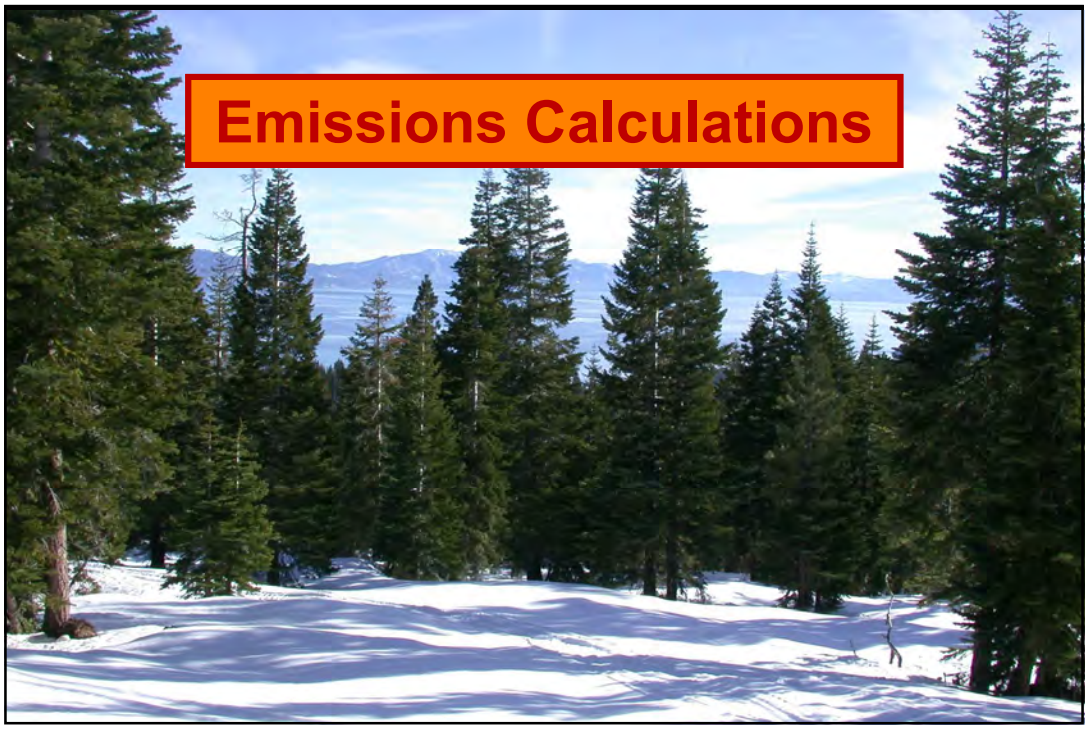
- Container Material Must be Compatible with Sample
- Storage Conditions
  - Refrigerate the Samples if Held Overnight
- Blanks Properly Prepared & Shipped with Field Samples
- Sample Container Must be Labeled
- Shipping
- Chain-of-Custody



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?

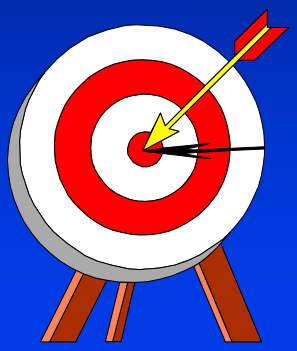
Effects of Errors

Accuracy

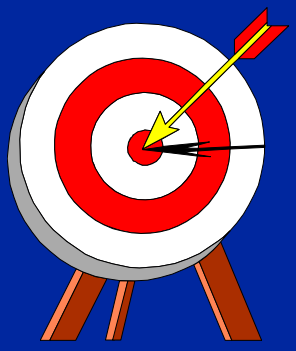
→ Compares Well with the Correct Value

Precision

→ Repeated Tests Give the Same Results

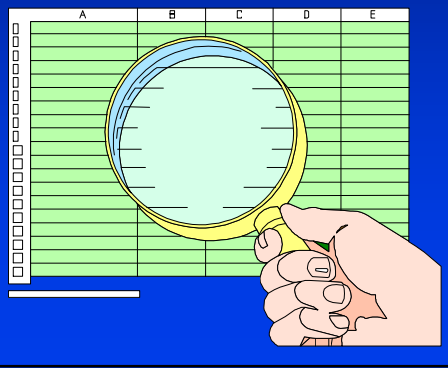


Accuracy & Precision



Post Test Activities

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

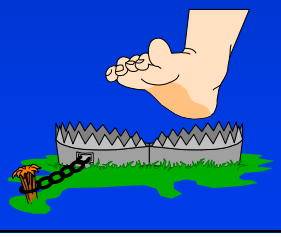


Post Test Activities

- 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

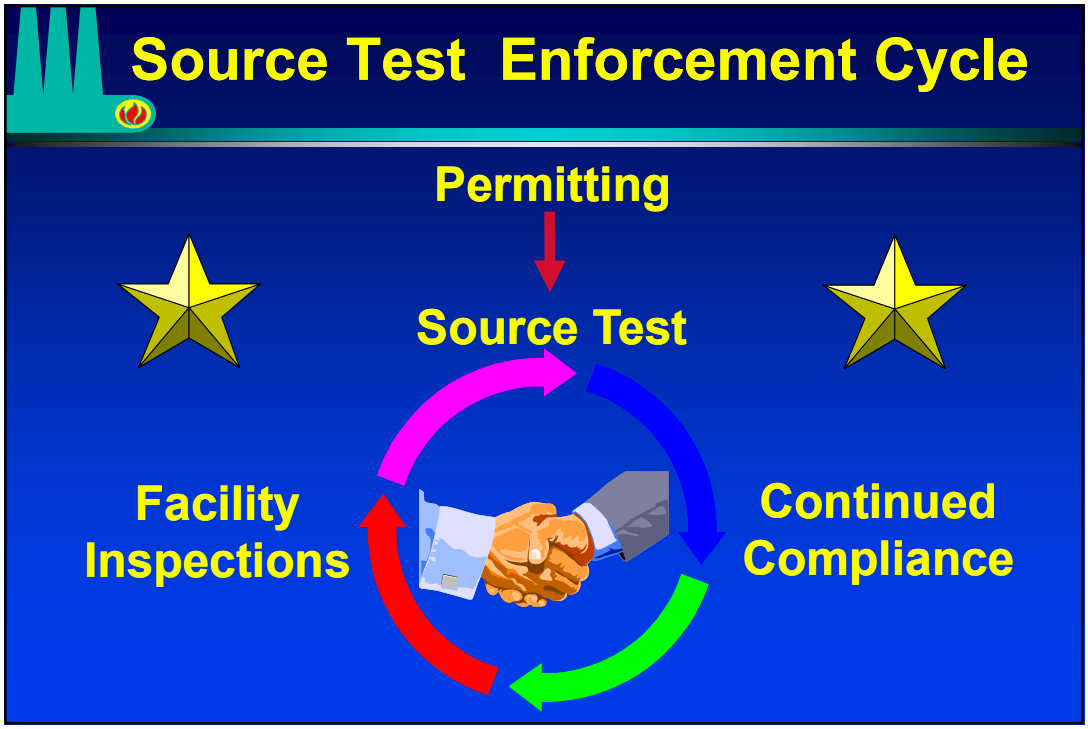


- Noise
- Moving parts
- Inhalation hazards
- Hazardous materials
- Machine disintegration
- Other hazards & traps

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


Source Test Enforcement Cycle
Permitting
Source Test
Facility Inspections
Continued Compliance


Thank You