United States
Environmental
Protection Agency

Air Quality Planning and Standards
Education and Outreach Group
Air Pollution Training Institute
Research Triangle Park, NC

EPA XXX/X-XX-XXX
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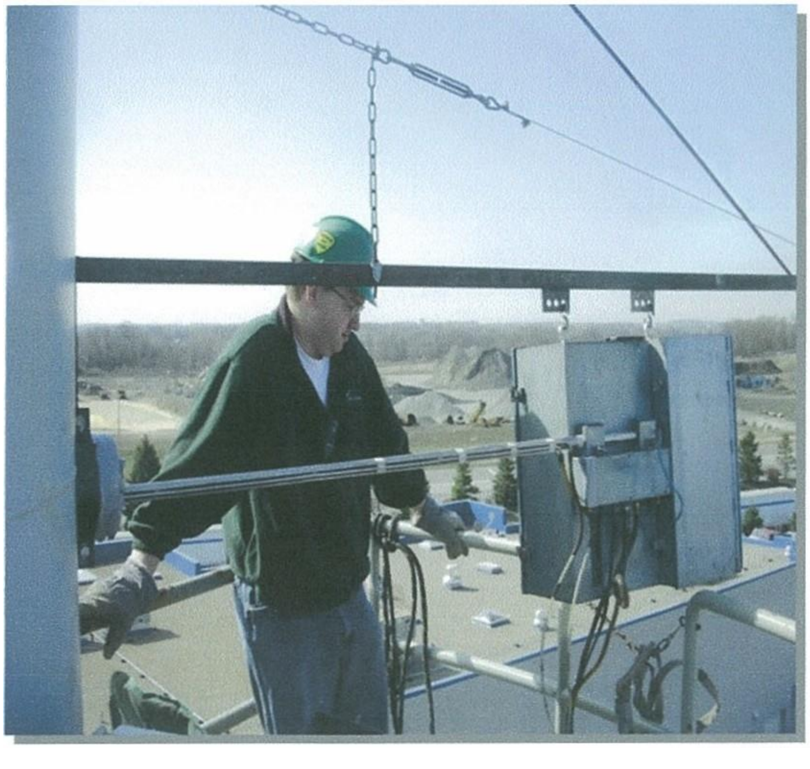
EPA's APTI
Course #450/#468
Monitoring Compliance Test And Source Test Observation

Reference Materials



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Notice

This is not an official policy and standards document. The opinions and selections are those of the author and not necessarily those of the Environmental Protection Agency. Every attempt has been made to represent the present state of the art as well as subject areas still under evaluation. Any mention of products or organizations does not constitute endorsement by the United States Environmental Protection Agency (USEPA).

Usage of This Manual

The Central States Air Resource Agencies Association (CenSARA) is one of several multi- jurisdictional organizations (MJOs) operating for the U.S. Environmental Protection Agency (USEPA), through the Air Pollution Training Institute (APTI), to update more of the frequently used APTI courses. The primary objectives of the MJOs are to:

- Promote the exchange of information between the States;
- Serve as a forum to discuss regional air quality issues of common concern;
- Share resources for the common benefit of the member states; and
- Provide training services to their member air pollution control agencies.

APTI provides courses on air pollution control technology, ambient air and source monitoring, and air quality management. Historically, APTI designed courses that meet the job training needs of governmental agency personnel and others in the field of air pollution. This requires a thorough examination of both the materials for instruction and the characteristics of the student audience. Based on studies conducted by APTI of those who have participated in the various training courses, courses were developed and revised to provide training that enables every student to achieve specific course objectives. A basic goal of APTI was to provide training that will enable a student to do specific jobs in his or her home environmental agency. However, recently APTI has taken a new direction and has given money to the various MJOs, of which CenSARA is one, to update needed training course for their member states.

CenSARA meets these training needs of its member states by identifying, designing, developing and delivering needed, cost-effective, responsive, and focused educational opportunities for state and local air agency staff. Agenda and course materials are obtained from a variety of sources including EPA, colleges and universities, regional training consortia, and individual instructors. Yet, due to changes in environmental regulations, the implementation of new policies, and the advancement of technologies, agendas and course materials become out-of-date. When this happens, staffs' ability to enhance skills, knowledge and abilities are constrained, limiting their ability to excel in the dynamic field of air pollution control. So by providing up-to-date, high quality educational opportunities for staff, their chances to greatly enhance their skills, knowledge and abilities is significantly improved.

Consequently, CenSARA announced a Request for Proposals (RFP) to the environmental training community to solicit technical proposals and cost bids to review current compliance test and observation programs within the USEPA and to **update** as necessary the content title, agenda topics, course length, instructor and student manuals, lectures involving presentation slides, classroom and homework exercises, and other handouts and materials for EPA's APTI Course #450/#468 entitled: *"Monitoring Compliance Test and Source Test Observation.* " In response to CenSARA's RFP, EnviroTech Solutions, William T. "Jerry" Winberry, 1502 Laughridge Drive, Cary, North Carolina 27511, jwinberrv@mindspring.com, 919-467-2785, was awarded the contract to update EPA's APTI Course #450/#468. Mr. Winberry is the author of this Student Workbook (SW) and every attempt has been made to represent the most recent advances in sampling and analytical methodology

Disclaimer

This material has been developed and assembled to provide training associated with EPA's APTI Course #450/#468 entitled: *"Monitoring Compliance Test and Source Test Observation.* " It is not intended to be used for regulatory purposes, or to be a substitute for, nor interpreted as official Agency policy. Every attempt was made to reflect the technical state of art and regulatory information as of the date of this publication. This is not an official policy and standards document. The opinions and selections are those of the author and not necessarily those of the EPA. Any mention of produces or organizations does not constitute endorsement by the EPA.

U.S. Environmental Protection Agency Air Pollution Training Institute

Course #450/#468

Monitoring Compliance Test and Source Test Observation

Student Workbook (SW)

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The updated Course #450/#468 is targeted primarily at agency personnel who have the responsibility to monitor compliance test and source test observation of various FRMs and SW- 846 methodologies. The revised course materials provide the best available and most current information as well as relevant example exercises to improve the knowledge and expertise of agency observer personnel. The desired outcome of this effort is that agency staff be able to properly observe compliance test and perform source test observations to protect public health and the environment by developing an understanding of EPA's stack testing programs and strategy, various stack test methodologies for quantifying HAPs from industrial processes, and associated quality assurance/quality control activities and requirements.

The specific objectives of updating APTI Course #450/#468 materials include:

- Explain why sampling of source emissions for PM and HAPs is important in air pollution control agency programs;
- Define symbols and common terms used in the application of FRMs 1-5 and SW-846 source sampling;
- Recognize, interpret and apply sections of the Code of Federal Regulations, Appendix A, pertinent to source sampling for particulate pollutants;
- Understand the construction, operation and calibration of the component parts of the FRM 5 particulate matter sampling train;
- Define "Isokinetic sampling" and illustrate why it is important in sampling for PM;
- Understanding the "working" isokinetic rate equation and its derivation
- Learn how to use specific software for determining isokinetic sampling rates;
- Apply FRMs 1 through 4 in preparation for applying FRM 5 at a source to characterize PM emissions;
- Understand how the "S-type" pitot tube is constructed and standardized and how it is applied in source sampling;
- Understand the difference between systematic error and precision as applied to source test measurements;
- Properly assemble and leak check a FRM 5 sampling train;
- Describe the operation of the VOST, Semi-VOST, Acid Gas and FRM 201/201A sampling trains;
- Describe what are "condensibles" and how the FRM 202 sampling train operates to measure condensibles; and
- Calculate the "% Isokinetic" value for a source test, and interpret the effect of over or under- isokinetic values on the source test results.

One of the products of the #450/#468 update is the Student Workbook (SW). The SW provides copies of visuals presented in each technical lecture. Contained in this SW are the visuals for each of the Sessions and lessons presented in APT! Course #450/#468.

I. Background

Over the last several years, public awareness of air pollution and its sources has increased steadily. Specifically, since the passage of the Clean Air Act Amendments (the Act) of 1990 and the implementation of EPA's maximum achievable control technology (MACT) program, more emphasis has been placed on local, State, and Federal agencies to keep the public informed on health effects of various air pollutants and their levels of exposure. This awareness has required industry to become accountable for air pollution emissions as part of their source's compliance strategy and regulatory agencies to become knowledgeable of the methodology used to quantify reported emissions.

Traditionally, air pollution control agencies require all sources to quantitate their emissions in order to demonstrate compliance. To insure that the source test methods utilized to demonstrate compliance are performed according to EPA guidelines, regulatory agencies observe stack test to document compliance with the methodology. This has meant that sources must know how to properly sample and report emissions using EPA reference methods and that regulatory agencies must know how to properly observe these test to insure that reliable and accurate data is gathered and reported.

In addition, with the passage of the Act and Title IV, Acid Rain, those fossil-fueled-fired-steam generators (FFFSG) covered must report emissions in units of pollutant mass rate (pmr) as part of EPA's emission trading program. This required the installation and certification of velocity monitors if the continuous emission monitoring system (CEMS) data was to be used as part of EPA's market base-trading program. These new regulatory requirements have now required Agency personnel to know how to observe and verify the proper use and implementation of Federal Reference Methods 2F, 2G, and 2H in certification of the velocity CEMS as part of a source's market base-trading emission program.

Consequently, the Act has required regional, state, and local air pollution control agencies to better understand the stack test methodologies that are used to quantitate air pollution emissions from industrial sources. Agencies see a need to provide training to it's personnel on how to properly observe stack test used to meet regulatory compliance for criteria and hazardous air pollutants (HAPs).

II. Course Objective

The objective of EPA's APTI Course #450/#468 is to provide Agency personnel the needed background information, checklist, and guidance associated with EPA methodologies involving stack test for characterizing and quantifying criteria and HAPs from industrial sources. This course will address Federal Reference Methods (FRMs)1-5 (isokinetic stack testing and stack test basics), FRMs 2F, 2G, and 2H (velocity), stack testing for volatile organic compounds (FRMs 18, 25, 25A/B), SO_2 (FRMs 6, 6A, and 8), NOx (FRMs 7, 7C), dioxin/furans and PCBs (FRM 23), heavy metals (FRM 29), and instrumental (FRMs 3A, 6C, and 7E).

The course will present standardized stack test methodology for sampling and analysis of air pollutants as identified in the Code of Federal Regulations (CFR), Part 60, Appendix A. In addition, information will be presented on EPA’s stack test monitoring programs associated with PM-10 (Methods 201 A/B) and condensable particulate (Method 202) monitoring from CFR 51 Subpart M. Specific source test checklists will be demonstrated during the presentation for each test methodology as part of the course. Participants will learn how to use the checklist in performing source test observations, how to observe mandated QA/QC requirements associated with each methodology, and how to use source test databases available to the air pollution scientist.

At the end of this course, the agency personnel will gain an understanding of the unique source test methods used to accurately characterize air pollutant emissions from industrial sources. The agency personnel will learn about EPA’s programs that require characterization of air pollutants from industrial sources utilizing FRMs.

III. Course Manuals

Course presentations and videos will be supported by four manuals. They are:

- **#468 Student Workbook (Hard Copy):** The updated Student Workbook (SW) contains copies of selected slides from each of the lecture presentations, and **Agency Inspector Checklist.**
- **#468 Stack Test Manual (Flash Drive):** The Stack Test Manual contains full copies of selected stack test sampling and analytical methods found in the CFR, Part 60, Appendix A, and SW-846, Standard Methods.
- **Apex Instruments Federal Reference Method 5 Operational Manual:** The Federal Reference Method 5 Operation Manual is a document describing specifically the construction and operation of Federal Reference Method 5 stack testing sampling train. **http://www.apexinst.com/cms/wp-content/uploads/2015/03/Model-500-Series-Manual-Method-5.pdf**.

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Appendix A

Equations

General

$$\Delta H = K\,(\Delta p)$$

$$\overline{pmr}_s = c_s\, Q_s$$

$$A_s = \pi \left(\frac{D_s}{2} \right)^2$$

$$A_s = LW$$

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

$$\%EA = \frac{(\%O_2) + 0.5(\%CO)}{0.0264(\%N_2) - (\%O_2) + 0.5(\%CO)}$$

$$\%N_2 = 100 - \%CO_2 - \%O_2 - \%CO$$

Method 1

Equation 1-1

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

Equation 1-2

$$R_i = \text{arccos}ine\left[(\cos ineY_i)(\cos ineP_i)\right]$$

Equation 1-3

$$\overline{R} = \frac{\sum R_i}{n}$$

Equation 1-4

$$S_d = \sqrt{\frac{\sum_{i=1}^{n} (R_i - \overline{R})^2}{(n-1)}}$$

Method 2

Equation 2-1

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

Equation 2-2

$$C_{p(s)} = C_{p(std)} \sqrt{\frac{\Delta p_{std}}{\Delta p_s}}$$

Equation 2-3

$$Deviation = C_{p(s)} - \overline{C}_p\ (A\, or\, B)$$

Equation 2-4

$$\sigma\,(side\ A\, or\, B) = \frac{\sum_{1}^{3} \left| C_{p(s)} - \overline{C}_p\ (A\, or\, B) \right|}{3}$$

Equation 2-5

$$= M_d\,(1 - B_{ws}) + 18.0\,B_{ws}$$

Equation 2-6

$$= P_{bar} + P_g$$

Equation 2-7

$= 273 + t_s$ for metric.

Equation 2-8

$= 460 + t_s$ for English.

Equation 2-9

$$v_s = K_p\,C_p\,(\sqrt{\Delta p}\,)_{avg}\sqrt{\frac{T_{s(avg)}}{P_s\,M_s}}$$

Equation 2-10

$$Q_{sd} = 3{,}600\,(1 - B_{ws})\,v_s\,A\,\frac{T_{std}}{T_{s(avg)}}\,\frac{P_s}{P_{std}}$$

Method 2F

Equation 2F-1

$$F_1 = \frac{(P_4 - P_5)}{(P_1 - P_2)}$$

Equation 2F-2

$$F_2 = C_p\sqrt{\frac{\Delta p_{std}}{(P_1 - P_2)}}$$

Equation 2F-3

$$\%\,Diff = \frac{F_2^{\max} - F_2^{\min}}{F_2^{\min}}\;x\;100\%$$

Equation 2F-4

$$M_s = M_d\,(1 - B_{ws}) + 18.0\,B_{ws}$$

Equation 2F-5

$$P_s = P_{bar} + \frac{P_g}{13.6}$$

Equation 2F-6

$$T_{s(i)} = 273 + t_{s(i)}$$

Equation 2F-7

$$T_{s(i)} = 460 + t_{s(i)}$$

Equation 2F-8

$$v_{a(i)} = K_p\,F_{2(i)}\sqrt{\frac{(P_1 - P_2)_i\,T_{s(i)}}{P_s\,M_s}}\,(\cos\theta_{y(i)})(\cos\theta_{p(i)})$$

Equation 2F-9

$$v_{a(avg)} = \frac{\sum_{i=1}^{n} v_{a(i)}}{n}$$

Equation 2F-10

$$Q_{sw} = 3{,}600\,(v_{a(avg)})\,(A)\left(\frac{T_{std}}{T_{s(avg)}}\right)\left(\frac{P_s}{P_{std}}\right)$$

Equation 2F-11

$$Q_{sw} = 3{,}600\,(1 - B_{ws})\,(v_{a(avg)})\,(A)\left(\frac{T_{std}}{T_{s(avg)}}\right)\left(\frac{P_s}{P_{std}}\right)$$

Method 3

Equation 3-1

$$M_d = 0.440\,(\%CO_2) + 0.320\,(\%O_2) + 0.280\,(\%N_2 + \%CO)$$

Method 3A

Equation 3A-1

$$C_{gas} = \frac{C_{ma} - C_{oa}}{C_m - C_o}\,(\overline{C} - C_m) + C_{ma}$$

Method 4

Equation 4-1

$$\begin{aligned} V_{wc(std)} &= \frac{(V_f - V_i)\,\rho_w\, R T_{std}}{P_{std} M_w} \\ &= K_1\,(V_f - V_i) \end{aligned}$$

Equation 4-2

$$\begin{aligned} V_{wsg(std)} &= \frac{(W_f - W_i) R T_{std}}{P_{std} M_w} \\ &= \mathrm{K}_2\,(W_f - W_i) \end{aligned}$$

Equation 4-3

$$\begin{aligned} V_{m(std)} &= V_m Y \frac{(P_m)(T_{std})}{(P_{std})(T_m)} \\ &= K_3 Y \frac{V_m P_m}{T_m} \end{aligned}$$

Equation 4-4

$$B_{ws} = \frac{V_{wc(std)} + V_{wsg(std)}}{V_{wc(std)} + V_{wsg(std)} + V_{m(std)}}$$

Equation 4-5

$$\begin{aligned} V_{wc} &= \frac{(V_f - V_i)\,\rho_w\, R T_{std}}{P_{std}\, M_w} \\ &= K_1\,(V_f - V_i) \end{aligned}$$

Equation 4-6

$$\begin{aligned} V_{m(std)} &= V_m \left(\frac{P_m}{P_{std}}\right)\left(\frac{T_{std}}{T_m}\right) \\ &= K_2 \frac{V_m P_m}{T_m} \end{aligned}$$

Equation 4-7

$$B_{ws} = \frac{V_{wc}}{V_{wc} + V_{m(std)}} + B_{wm}$$

Method 5

Equation 5-9a

$$\Delta H_{@} = 0.0319\,\Delta H\,\frac{T_m}{P_{bar}}\,\frac{\theta^2}{Y^2 {V^2}_m}$$

Equation 5-1

$$V_{m(std)} = V_m Y \left(\frac{T_{std}}{T_m} \right) \left[\frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}} \right]$$

$$= K_1 V_m Y \frac{P_{bar} + \left(\frac{\Delta H}{13.6} \right)}{T_m}$$

Equation 5-1a

$$\left[V_m - (L_p - L_a) \right]$$

$$\left[V_m - (L_1 - L_a)\theta_1 - \sum_{i=2}^{n} (L_i - L_a)\theta_i - (L_p - L_a)\theta_p \right]$$

Equation 5-2

$$V_{w(std)} = \frac{V_{lc}\,\rho_w R T_{std}}{M_w P_{std}}$$

$$= K_2 V_{lc}$$

Equation 5-3

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}}$$

Equation 5-4

$$C_a = \frac{m_a}{V_a\,\rho_a}$$

Equation 5-5

$$W_a = C_a V_{aw} \rho_a$$

Equation 5-6

$$c_s = (0.001\ g/mg) \left(\frac{m_n}{V_{m(std)}} \right)$$

Equation 5-7

$$\mathrm{I} = \frac{100 T_s \left[K_3 V_{lc} + \left(\frac{V_m Y}{T_m} \right) \left(P_{bar} + \frac{\Delta H}{13.6} \right) \right]}{60 \theta V_s P_s A_n}$$

Equation 5-8

$$\mathrm{I} = \frac{100 T_s V_{m(std)} P_{std}}{60 T_{std}\, v_s\, \theta\, A_n\, P_s\, (1 - B_{ws})}$$

$$= \frac{K_4 T_s V_{m(std)}}{P_s\, v_s\, A_n\, \theta (1 - B_{ws})}$$

Equation 5-8a

$$Q = K_1 \frac{P_{bar}}{t_w + t_{std}} \frac{V_w}{\theta}$$

Equation 5-9

$$K' = \frac{K_1 V_m Y \left(P_{bar} + \frac{\Delta H}{13.6} \right) \sqrt{T_{amb}}}{P_{bar} T_m \theta}$$

Equation 5-10

$$V_m(std) = K_1 V_m \frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}$$

Equation 5-11

$$V_{cr}(std) = K' \frac{P_{bar}\,\theta}{T_{amb}}$$

Equation 5-12

$$Y = \frac{V_{cr(std)}}{V_{m(std)}}$$

Method 6

Equation 6-1

$$V_{m(std)} = V_m\, Y \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar}}{P_{std}}\right)$$
$$= K_1\, Y \left(\frac{V_m\, P_{bar}}{T_m}\right)$$

Equation 6-2

$$C_{SO_2} = K_3 \frac{(V_t - V_{tb})\, N \left(\frac{V_{soln}}{V_a}\right)}{V_{m(std)}}$$

Equation 6-3

$$RE = \frac{C_d - C_a}{C_a}(100)$$

Equation 6-4

$$V_{sb(std)} = V_{sb}\left(\frac{T_{std}}{T_{amb}}\right)\left(\frac{P_{bar}}{P_{std}}\right)$$

Equation 6-5

$$Q_{std} = \frac{V_{sb(std)}}{\theta}$$

Equation 6-6

$$V_{m(std)} = \overline{Q}_{std}\,\theta_s\,(1 - B_{wa})\left(\frac{P_{bar} + P_{sr}}{P_{bar} + P_c}\right)$$

Equation 6-7

$$V_{m(std)} = \overline{Q}_{std}\,\theta_s\,(1 - B_{wa})\sqrt{\frac{M_a}{M_s}}\left(\frac{P_{bar} + P_{sr}}{P_{bar} + P_c}\right)$$

Method 6A

Equation 6A-1

$$V_{CO2(std)} = 5.467\,x\,10^{-4}\,(m_{af} - m_{ai})$$

Equation 6A-2

$$V_{w(std)} = 1.336\,x\,10^{-3}\,(m_{wf} - m_{wi})$$

Equation 6A-3

$$C_{SO_2} = 32.03 \frac{(V_t - V_{tb})\, N \left(\frac{V_{soln}}{V_a}\right)}{V_{m(std)} + V_{CO_2(std)}}$$

Equation 6A-4

$$C_{CO_2} = \frac{V_{CO_2(std)}}{V_{m(std)} + V_{CO_2(std)}}\,x\,100$$

Equation 6A-5

$$C_w = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)} + V_{CO2(std)}}$$

Equation 6A-7

$$m_{SO_2} = 32.03 (V_t - V_{tb}) N \left(\frac{V_{so\ln}}{V_s} \right)$$

Equation 6A-8

$$E_{SO_2} = F_c \, (1.829 \, x \, 10^9) \frac{m_{SO_2}}{(m_{af} - m_{ai})}$$

Method 6C

Equation 6C-1

$$C_{gas} = (\overline{C} - C_o) \frac{C_{ma}}{C_m - C_o}$$

Method 7

Equation 7-1

$$K_c = 100 \frac{A_1 + 2A_2 + 3A_3 + 4A_4}{{A_1}^2 + {A_2}^2 + {A_3}^2 + {A_4}^2}$$

Equation 7-2

$$V_{sc} = \left(\frac{T_{std}}{P_{std}} \right) \left(V_f - V_a \right) \left(\frac{P_f}{T_f} - \frac{P_i}{T_i} \right)$$

$$= K_1 \, (V_f - 25 \, ml) \left(\frac{P_f}{T_f} - \frac{P_i}{T_i} \right)$$

Equation 7-3

$$m = 2 K_c \, A \, F$$

Equation 7-4

$$C = K_2 \frac{m}{V_{sc}}$$

Equation 7-5

$$RE = \frac{C_d - C_a}{C_a} (100)$$

Method 8

Equation 8-1

$$V_{m(std)} = V_m \, Y \left(\frac{T_{std}}{T_m} \right) \left(\frac{P_{bar} + \left(\frac{\Delta H}{13.6} \right)}{P_{std}} \right)$$

$$= K_1 \, V_m \, Y \left(\frac{P_{bar} + \left(\frac{\Delta H}{13.6} \right)}{T_m} \right)$$

Equation 8-2

$$C_{H_2SO_4} = K_2 \frac{N \left(V_t - V_{tb} \right) \left(\frac{V_{so\ln}}{V_a} \right)}{V_{m(std)}}$$

Equation 8-3

$$C_{SO_2} = K_3 \frac{N \left(V_t - V_{tb} \right) \left(\frac{V_{so\ln}}{V_a} \right)}{V_{m(std)}}$$

Equation 8-4

$$I=\frac{100T_s\left[K_3\,V_{lc}+\left(\frac{V_m Y}{T_m}\right)\left(P_{bar}+\frac{\Delta H}{13.6}\right)\right]}{60\,\theta\,V_s P_s A_n}$$

Equation 8-5

$$I=\frac{100\,T_s\,V_{m(std)}\,P_{std}}{60\,T_{std}\,v_s\,\theta\,A_n\,P_s\,(1-B_{ws})}$$

$$=\frac{K_4\,T_s\,V_{m(std)}}{P_s\,v_s\,A_n\,\theta\,(1-B_{ws})}$$

Method 11

Equation 11-1

$$N_s=2.039\frac{W}{V_s}$$

Equation 11-2

$$N_A=0.2039\frac{W}{V_s}$$

Equation 11-3

$$N_1=N_T\,\frac{V_T}{V_1}$$

Equation 11-4

$$V_{m(std)}=V_m\,Y\left[\left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar}}{P_{std}}\right)\right]$$

Equation 11-5

$$C_{H2S}=\frac{K\left[\left(V_{\mathrm{IT}}\,N_{\mathrm{I}}-V_{\mathrm{TT}}\,N_{\mathrm{T}}\right)sample-\left(V_{\mathrm{IT}}\,N_{\mathrm{I}}-V_{\mathrm{TT}}\,N_{\mathrm{T}}\right)\right]}{V_{m(std)}}$$

Method 15

Equation 15-1

$$C=\frac{(K)(P_r)}{ML}$$

Equation 15-2

$$SO_2\ equivalent=\sum(H_2S,COS,2\,CS_2)\,d$$

Equation 15-3

$$Average\,SO_2\ equivalent=\frac{\sum_{i=1}^{N}SO_2\ equiv_i}{N}$$

Method 15A

Equation 15A-1

$$V_{ms(std)}=\frac{V_{ms}\,Y\,(T_{std})\,(P_{bar})}{(T_m)\,(P_{std})}=\frac{K_1\,Y\,(V_m)\,(P_{bar})}{T_m}$$

Equation 15A-2

$$V_{mc(std)}=\frac{k_1\,Y_c\,(V_{mc})\,(P_{bar})}{T_m}$$

Equation 15A-3

$$C_{TRS} = \frac{K_2 \, (V_t - V_{tb}) \, N \left(\frac{V_{soln}}{V_a} \right)}{V_{ms(std)} - V_{mc(std)}}$$

Equation 15A-4

$$C_{RG} = \frac{(C_{COS})(Q_{COS})}{Q_{COS} + Q_{N2}}$$

Equation 15A-5

$$R = \frac{C_{TRS}}{C_{RG}} x100$$

Method 16

Equation 16-1

$$C = K \frac{P_r}{ML}$$

Equation 16-2

$$TRS = \sum (H_2S, MeSH, DMS, 2DMDS) \, d$$

Equation 16-3

$$AverageTRS = \frac{\sum_{i=1}^{N} TRS_i}{N(1 - B_{WO})}$$

Equation 16-4

$$C = \frac{\sum_{i=1}^{N} S_i}{N}$$

Method 16A

Equation 16A-1

$$V_{m(std)} = V_m \, Y \frac{T_{std}}{T_m} \frac{P_{bar}}{P_{std}} = K_1 \, Y \frac{V_m - P_{bar}}{T_m}$$

Equation 16A-2

$$C_{TRS(ppm)} = \frac{K_2 \, (V_t - V_{tb}) \, N \left(\frac{V_{soln}}{V_a} \right)}{V_{m(std)}}$$

Equation 16A-3

$$C_{RG} = \frac{(Q_{H2S})(C_{H2S})}{Q_{H2S} + Q_{CG}}$$

Equation 16A-4

$$R = \frac{C_{TRS}}{C_{RG}} x100$$

Equation 16A-5

$$N_T = \frac{1}{ml \ Na_2 \, S_2 \, O_3 \ Consumed}$$

Equation 16A-6

$$N_1 = \frac{N_T \, V_T}{V_1}$$

Equation 16A-7

$$V_{m(std)} = (\overline{Q}_{std})(\theta_s)(1 - B_{wa})\frac{M_a}{M_b}$$

Equation 16A-8

$$C_{H2S} = \frac{K\, N_T\,(V_{TB} - V_T)}{V_{m(std)}}$$

Method 16B

Equation 16B-1

$$C_{TRS} = (C_{SO2})(d)$$

Equation 16B-2

$$C_{TRS} = \frac{\sum_{i=1}^{n} C_{TRS}}{N}$$

Method 18

Equation 18-1

$$C_s = \frac{10^6\,(\bar{x}\, q_c)}{q_c + q_d}$$

Equation 18-2

$$C_s = 106\,\bar{x}\left(\frac{q_{c1}}{q_{c1} + q_{d1}}\right)\left(\frac{q_{c2}}{q_{c2} + q_{d2}}\right)$$

Equation 18-3

$$C_s = \frac{G_V\, x10^6\, \frac{293}{T_s}\,\frac{P_s}{760}}{V_m\, Y\,\frac{293}{T_m}\,\frac{P_m}{760}\,1000}$$

$$= \frac{G_V\, x10^3\, \frac{P_s}{T_s} \cdot \frac{T_m}{P_m}}{V_m\, Y}$$

Equation 18-4

$$C_s = \frac{\frac{L_V}{M}\,\rho\,(24.055\, x10^6)}{V_m\, Y\,\frac{293}{T_m}\,\frac{P_m}{760}\,1000} = 6.24\, x10^4\,\frac{L_V\,\rho\, T_m}{M\, V_m\, Y\, P_m}$$

Equation 18-5

$$C_c = \frac{C_s\, P_r\, T_i\, F_r}{P_i\, T_r\,(1 - B_{ws})}$$

Method 20

Equation 20-1

$$C_d = \frac{C_w}{1 - B_{ws}}$$

Equation 20-2

$$F_o = \frac{0.209\, F_d}{F_c}$$

Equation 20-3

$$X_{CO2} = \frac{5.9}{F_o}$$

Equation 20-4

$$C_{adj} = C_d \frac{5.9}{20.0 - \%O_2}$$

Equation 20-5

$$C_{adj} = C_d \frac{X_{CO2}}{\%CO_2}$$

Equation 20-6

$$E = C_d \ F_d \frac{20.9}{20.9 - \%O_2}$$

Equation 20-7

$$E = C_d \ F_c \frac{100}{\%CO_2}$$

Equation 20-8

$$E = C_w \ F_c \frac{100}{\%CO_{2w}}$$

Method 23

Equation 23-1

$$RRF_i = \frac{1}{n} \sum_{j=1}^{n} \frac{A_{cij} \ m*_{ci}}{A*_{cij} \ m_{ci}} -$$

Equation 23-2

$$C_i = \frac{m_i * A_i}{A_i * RRF_i \ V_{mstd}}$$

Equation 23-3

$$RRF_{rs} = \frac{A_{ci} * m_{rs}}{A_{rs} \ m_{ci} *}$$

Equation 23-4

$$R* = \frac{A_i * m_{rs}}{A_{rs} \ RF_{rs} \ m_i *} x100\%$$

Equation 23-5

$$RRF_s = \frac{A_{ci} * m_s}{A_{cis} \ m_{ci} *}$$

Equation 23-6

$$R_s = \frac{A_s \ m_i *}{A_i * RRF_s \ m_s} x100\%$$

Equation 23-7

$$MDL = \frac{2.5 \ A_{ai} \ m_i *}{A_{ci} * \ RRF_i}$$

Equation 23-8

$$C_{Tr} = \sum_{i=1}^{n} C_i$$

Method 25

Equation 25-1

$$\Delta P = 0.01 \frac{FP_b \ \theta}{V_t}$$

Equation 25-2

$$V_s = 0.3857\,V\left[\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}\right]$$

Equation 25-3

$$C_t = \left[\frac{\dfrac{P_{tf}}{T_{tf}}}{\dfrac{P_t}{T_t} - \dfrac{P_{ti}}{T_{ti}}}\right]\left[\frac{1}{r}\sum_{j=1}^{r} C_{tm_j}\right]$$

Equation 25-4

$$C_c = 0.3857\frac{V_v\,P_f}{V_s\,T_f}\left[\frac{1}{q}\sum_{k=1}^{q} C_{cm_k}\right]$$

Equation 25-5

$$C = C_t + C_c$$

Equation 25-6

$$m_c = 0.4993\,C$$

Equation 25-7

$$Percent\ \text{recovery} = 1.604\frac{M}{L}\frac{V_v}{P}\frac{P_t}{T_f}\frac{C_{cm}}{N}$$

Equation 25-8

$$RSD = \frac{100}{\bar{x}}\sqrt{\frac{\sum(x_i - \bar{x})^2}{n-1}}$$

Method 25A

Equation 25A-1

$$C_c = K\,C_{meas}$$

Method 26

Equation 26-1

$$\mu g\frac{Cl^-}{ml} = g\ of\ NaCl\ x\ 10^3\ x\ \frac{35.453}{58.44}$$

Equation 26-2

$$\mu g\frac{Br^-}{ml} = g\ of\ NaBr\ x\ 10^3\ x\ \frac{79.904}{102.90}$$

Equation 26-3

$$\mu g\frac{F^-}{ml} = g\ of\ NaF\ x\ 10^3\ x\ \frac{18.998}{41.99}$$

Equation 26-4

$$m_{HX} = K\,V_s\,(S_X{}^- - B_X{}^-)$$

Equation 26-5

$$m_{X2} = V_s\,(S_X{}^- - B_X{}^-)$$

Equation 26-6

$$C = K\frac{m_{HX,X2}}{V_{m(std)}}$$

Method 26A

Equation 26A-1

$$\mu g\ \frac{Cl^-}{ml} = g\ of\ NaCl\ x\ 10^3\ x\ \frac{35.453}{58.44}$$

Equation 26A-2

$$\mu g\ \frac{Br^-}{ml} = g\ of\ NaBr\ x\ 10^3\ x\ \frac{79.904}{102.90}$$

Equation 26A-3

$$\mu g\ \frac{F^-}{ml} = g\ of\ NaF\ x\ 10^3\ x\ \frac{18.998}{41.99}$$

Equation 26A-4

$$m_{HX} = K\,V_s\,(S_{X-} - B_{X-})$$

Equation 26A-5

$$m_{X2} = V_s\,(S_{X-} - B_{X-})$$

Equation 26A-6

$$C = K\,\frac{m_{HX,X2}}{V_{m(std)}}$$

Method 29

Equation 29-1

$$M_{fh} = C_{a1}\,F_d\,V_{so\ln,1}$$

Equation 29-2

$$M_{bh} = C_{a2}\,F_a\,V_a -$$

Equation 29-3

$$M_t = (M_{fh} - M_{fhb}) + (M_{bh} - M_{bhb})$$

Equation 29-4

$$Hg_{fh} = \frac{Q_{fh}}{V_{f1B}}\left(V_{so\ln,1}\right)$$

Equation 29-5

$$Hg_{bh2} = \frac{Q_{bh2}}{V_{f2B}}\left(V_{so\ln,2}\right)$$

Equation 29-6

$$Hg_{bh3(A,B,C)} = \frac{Q_{bh3(A,B,C)}}{V_{f3(A,B,C)}}\left(V_{so\ln,3(A,B,C)}\right)$$

Equation 29-7

$$Hg_{bh} = Hg_{bh2} + Hg_{bh3A} + Hg_{bh3B} + Hg_{bh3C}$$

Equation 29-8

$$Hg_t = (Hg_{fh} - Hg_{fhb}) + (Hg_{bh} - Hg_{bhb})$$

Equation 29-9

$$C_s = \frac{K_4\,M_t}{V_{m(std)}}$$

Method 0010

$$\frac{Max\ POHC_i\ Mass}{DV_{eff(std)}} = Max\ POHC_i\ conc$$

$$\frac{LDL_{POHC}\ x\ 10}{POHC_{i\ conc}} = V_{TBC}$$

$$C_{POHC}\,(\mu g/ml)\ x\ sample\ volume(ml)$$
$$= amount(\mu g)\,of\ \ POHC\ in\ sample$$

Method 0030

$$C_g = \frac{Wt.\ of\ Analytes\ in\ Sample, \mu g(i.e.VOST\ tubes\ \&\ condensate)}{Volume\ of\ sample\ at\ standard\ conditions}$$

Method 0050

Equation 0050-4

$$m_{HCl} = S\,x\,V_s\,x\,\frac{36.46}{35.45}$$

Equation 0050-5

$$m_{Cl2} = S\,x\,V_2$$

Equation 0050-6

$$C = K\,x\,\frac{m}{V_{m(std)}}$$

Method 0051

$$m_{HCl} = S\,x\,V_s\,x\,\frac{36.46}{35.45}$$

$$m_{Cl2} = S\ \ x\ V_2$$

$$C = K\ \ x\ \frac{m}{V_{m(std)}}$$

Method 0060

$$M_{fh} = C_{a1}\,F_d\,V_{soln,1}$$

$$M_{bh} = C_{a2}\,F_a\,V_a$$

$$M_t = (M_{fh} - M_{fhb}) + (M_{bh} - M_{bhb})$$

Method 0061

$$m = (S - B)\ x\ V_{ls}\ \ x\ d$$

Appendix B

Abbreviations and Terminology

%CO	Percent CO by volume, dry basis
%CO2	Percent CO2 by volume, dry basis
%N2	Percent N2 by volume, dry basis
%O2	Percent O2 by volume, dry basis
0.280	Molecular weight of N2 or CO, divided by 100
0.320	Molecular weight of O2 divided by 100
0.440	Molecular weight of CO2 divided by 100
100	Conversion to percent.
13.6	Specific gravity of mercury.
18.0	Molecular weight of water, g/g mole (lb/lb mole).
3600	Conversion Factor, sec/hr.
60	Sec/min.
A	Cross sectional area of stack, m2 (ft2).
A	Absorbance of sample.
A	Analytical detection limit, µg/ml.
A1	Absorbance of the 100µg NO2 standard.
A2	Absorbance of the 200µg NO2 standard.
A3	Absorbance of the 300µg NO2 standard.
A4	Absorbance of the 400µg NO2 standard.
An	Cross-sectional area of nozzle, m2 (ft2).
B	Liquid volume of digested sample prior to aliquotting for analysis, ml.
Bws	Water vapor in the gas stream [from Method 4 (reference method) or Method 5], proportion by volume.
C	Corrected to standard conditions, mg/dsm3(lb/dscf).
C	TGNMO concentration of the effluent, ppm C equivalent.
Ca	Acetone blank residue concentration, mg/mg.

Ca	Actual concentration of SO2 in audit sample, mg/dscm.
Ca	Actual audit sample concentration, mg/dscm.
Ca1	Concentration of metal in Analytical Fraction 1A as read from the standard curve, µg/ml.
Ca2	Concentration of metal in Analytical Fraction 2A as read from the standard curve, (µg/ml).
Cc	Calculated condensible organic (condensate trap) concentration of the effluent, ppm C equivalent.
Ccm	Measured concentration (NMO analyzer) for the condensate trap ICV, ppm CO2.
Cd	Determined concentration of SO2 in audit sample, mg/dscm.
Cd	Determined audit sample concentration, mg/dscm.
CH2S	Concentration of H2S at standard conditions,mg/dscm.
Cp	Pitot tube coefficient, dimensionless.
Cp(s)	Type S pitot tube coefficient, dimensionless.
Cp(std)	Standard pitot tube coefficient; use 0.99 if the coefficient is unknown and the tube is designed according to the criteria of Sections 6.7.1 to 6.7.5 of this method.
cs	Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, g/dscm (gr/dscf).
Cs	Concentration of a metal in the stack gas, mg/dscm.
CSO$_2$	Concentration of SO2, dry basis, corrected to standard conditions, mg/dscm (lb/dscf).
Ct	Calculated noncondensible organic concentration (sample tank) of the effluent, ppm C equivalent.
Ctm	Measured concentration (NMO analyzer) for the sample tank, ppm NMO.
D	Diameter of stack, in.
De	Equivalent diameter.
F	Dilution factor. Required only if sample dilution was needed to reduce the absorbance into the range of the calibration).
F	Sampling flow rate, cc/min.
Fa	Aliquot factor, volume of Sample Fraction 2 divided by volume of Sample Fraction 2A (see Section 8.3.4.)

Fd	Dilution factor (Fd = the inverse of the fractional portion of the concentrated sample in the solution actually used in the instrument to produce the reading Ca1. For example, if a 2 mL aliquot of Analytical Fraction 1A is diluted to 10 mL to place it in the calibration range, Fd = 5).
ΔH	Average pressure differential across the orifice meter, mm H20 (in. H20).
Hgbh	Total mass of Hg collected in the back
Hgbh2	Total mass of Hg collected in Sample Fraction 2, µg.
Hgbh3(A,B,C)	Total mass of Hg collected separately in Fraction 3A, 3B, or 3C, µg.
Hgbhb	Blank correction value for mass of Hg detected in back
Hgfh	Total mass of Hg collected in the front
Hgfhb	Blank correction value for mass of Hg detected in front
Hgt	Total mass of Hg collected in the sampling train, µg.
I	Percent of isokinetic sampling.
K	0.127 mm H20 (metric units); 0.005 in. H20 (English units).
K4	103 mg/µg.
Kc	Spectrophotometer calibration factor.
Kp	Velocity equation constant.
L	Length.
L	Volume of liquid injected, µl.
L1	Individual leakage rate observed during the leak-check conducted prior to the first component change, m3/min (ft3/min)
La	pretest leak-check or for a leak-check following a component change; equal to 0.00057 m3/min (0.020 cfm) or 4 percent of the average sampling rate, whichever is less.
LI	Individual leakage rate observed during the leak-check conducted prior to the "ith" component change (i = 1, 2, 3...n), m3/min cfm).
Lp	Leakage rate observed during the post-test leak-check, m3/min (cfm).
m	Mass of NOx as NO2 in gas sample, µg.
M	Molecular weight of the liquid injected, g/g mole.
ma	Mass of residue of acetone after evaporation,mg.

Mbh	Total mass of each metal (except Hg) collected in the back
Mbhb	Blank correction value for mass of metal detected in back
Mc	TGNMO mass concentration of the effluent, mg C/dsm3.
Md	Dry molecular weight, g/g mole (lb/lb mole)
Md	Molecular weight of stack gas, dry basis (see Section 8.6), g/g mole (lb/lb mole).
Mfh	Total mass of each metal (except Hg) collected in the front half of the sampling train (Sample Fraction 1), µg.
Mfhb	Blank correction value for mass of metal detected in front
mn	Total amount of particulate matter collected, mg.
Ms	Molec Molecular weight of stack gas, wet basis, g/g mole (lb/lb mole).
Mt	Total mass of each metal (separately stated for each metal) collected in the sampling train, µg.
Mw	Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).
N	Total number of traverse points.
n	total number of traverse points.
N	Normality of barium standard titrant, meq/ml.
N	Carbon number of the liquid compound injected (N = 12 for decane, N = 6 for hexane).
NA	Normality of standard C6H5AsO solution, g eq/liter.
NI	Normality of standard I2 solution, g eq/liter.
NS	Normality of standard (0.1 N) Na2S2O3 solution, g eq/liter.
NT	Normality of standard (0.01 N) Na2S2O3 solution, assumed to be 0.1 NS, g eq/liter.
p	Velocity head of stack gas, mm H20 (in. H20).
P	Allowable pressure change, cm Hg.
Pb	Barometric pressure, cm Hg.
Pbar	Barometric pressure at measurement site, mm Hg (in. Hg).
Pf	Final pressure of the intermediate collection vessel, mm Hg absolute.
Pg	Stack static pressure, mm Hg (in. Hg).

pi	Individual velocity head reading at traverse point "i", mm (in.) H20.
Pi	pitch angle at traverse point i, degree.
PI	Initial absolute pressure of flask, mm Hg (in. Hg).
Ps	Absolute stack pressure (Pbar + Pg), mm Hg (in. Hg),
Δps	Velocity head measured by the Type S pitot tube, cm (in.) H20.
Pstd	Standard absolute pressure, 760 mm Hg (29.92 in. Hg).
Δpstd	Velocity head measured by the standard pitot tube, cm (in.) H20.
Pt	Gas sample tank pressure after sampling, but before pressurizing, mm Hg absolute.
Ptf	Final gas sample tank pressure after pressurizing, mm Hg absolute.
Pti	Gas sample tank pressure before sampling, mm Hg absolute.
q	Total number of analyzer injections of intermediate collection vessel during analysis (where k = injection number, 1 ... q).
Qbh2	Quantity of Hg, µg, TOTAL in the ALIQUOT of Analytical Fraction 2B selected for digestion and analysis . NOTE: For example, if a 10 mL aliquot of Analytical Fraction 2B is taken and digested and analyzed (according to Section 11.1.3 and its NOTES Nos. 1 and 2), then calculate and use the total amount of Hg in the 10 mL aliquot for Qbh2.
Qbh3(A,B,C)	Quantity of Hg, µg, TOTAL, separately, in the ALIQUOT of Analytical Fraction 3A, 3B, or 3C selected for digestion and analysis (see NOTES in Sections 12.7.1 and 12.7.2 describing the quantity "Q" and calculate similarly).
Qfh	Quantity of Hg, µg, TOTAL in the ALIQUOT of Analytical Fraction 1B selected for digestion and analysis . NOTE: For example, if a 10 mL aliquot of Analytical Fraction 1B is taken and digested and analyzed (according to Section 11.1.3 and its NOTES Nos. 1 and 2), then calculate and use the total amount of Hg in the 10 mL aliquot for Qfh.
Qsd	Dry volumetric stack gas flow rate corrected to standard conditions, dscm/hr (dscf/hr).
R	[(mm Hg)(m3)]/[(K)(g-mole)] {21.85 [(in. Hg)(ft3)]/[(R)(lb-mole)]}.
r	Total number of analyzer injections of sample tank during analysis (where j = injection number, 1 ... r).
Ravg	average resultant angle, degree.
RE	Relative error for QA audit samples, percent.

Ri	resultant angle at traverse point i, degree.
Sd	standard deviation, degree.
T	Sensitivity factor for differential pressure gauges.
Tf	Final absolute temperature of flask, K (R).
Tf	Final temperature of intermediate collection vessel, K.
Ti	Initial absolute temperature of flask, K (R).
Tm	Absolute DGM temperature
Ts	Stack temperature, C (F).
Ts(abs)	Absolute stack temperature, K (R).=273 + Ts for metric units, =460 + Ts for English units.
Tstd	Standard absolute temperature, 293 K (528 R).
Tt	Sample tank temperature at completion of sampling, K.
Ttf	Sample tank temperature after pressurizing, K.
Tti	Sample tank temperature before sampling, K.
V	Sample tank volume, m3.
Va	Volume of acetone blank, ml.
Va	Volume of sample aliquot titrated, ml.
Va	Volume of absorbing solution, 25 mL.
VA	Volume of C6H5AsO solution used for standardization, ml.
Va	Total volume of digested sample solution (Analytical Fraction 2A), mL
VAI	Volume of standard C6H5AsO solution used for titration analysis, mL.
Vaw	Volume of acetone used in wash, ml.
Vf	Volume of flask and valve, ml.
Vf1B	Volume of aliquot of Analytical Fraction 1B analyzed, ml. NOTE: For example, if a 1 mL aliquot of Analytical Fraction 1B was diluted to 50 mL with 0.15 percent HNO3 as described in Section 11.1.3 to bring it into the proper analytical range, and then 1 mL of that 50
Vf2B	Volume of Analytical Fraction 2B analyzed, ml. NOTE: For example, if 1 mL of Analytical Fraction 2B was diluted to 10 mL with 0.15 percent HNO3 as described in Section 11.1.3 to bring it into the proper analytical range, and then 5 mL of that 10 mL was analyzed, Vf2B would be 0.5 ml.

Vf3(A,B,C)	Volume, separately, of Analytical Fraction 3A, 3B, or 3C analyzed, mL (see previous notes in Sections 12.7.1 and 12.7.2, describing the quantity "V" and calculate similarly).
VI	Volume of standard I2 solution used for standardization, ml.
VIT	Volume of standard I2 solution used for titration analysis, normally 50 ml.
Vlc	Total volume of liquid collected in impingers and silica gel (see Figure 5-6), ml.
Vm	Volume of gas sample as measured by dry gas meter, dcm (dcf).
Vm	Dry gas volume as measured by the DGM, dcm (dcf).
Vm	Volume of gas sample at meter conditions, liters.
Vm(std)	Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscm(dscf).
vs	Stack gas velocity, calculated by Method 2,
vs	Average stack gas velocity, m/sec (ft/sec).
Vs	Gas volume sampled, dsm3.
Vsc	Sample volume(dry basis), ml. at standard conditions
VSI	Volume of 0.1 N Na2S2O3 solution used for standardization, ml.
Vsoln	Total volume of solution in which the SO2 sample is contained, 100 ml.
Vsoln,1	Total volume of digested sample solution (Analytical Fraction 1), ml.
Vsoln,2	Total volume of Sample Fraction 2, ml.
Vsoln,3(A,B,C)	Total volume, separately, of Analytical Fraction 3A, 3B, or 3C, ml.
Vt	Volume of barium standard titrant used for the sample (average of replicate titration), ml.
VT	Volume of standard (0.01 N) Na2S2O3 solution used in standardizing iodine solution (see Section 10.2.1), ml.
Vt	Sample train volume, cc.
Vtb	Volume of barium standard titrant used for the blank, ml.
VTT	Volume of standard (0.01 N) Na2S2O3 solution used for titration analysis, ml.
Vv	Intermediate collection vessel volume, m3.

$V_w(std)$	Volume of gas,corrected to standard conditions, scm (scf).
W	width.
W	Weight of $K_2Cr_2O_7$ used to standardize $Na_2s_2O_3$ or C_6H_5AsO solutions, as applicable (see Sections 10.2.2 and 10.2.3), g.
W_a	Weight of residue in acetone wash, mg.
x_i	Individual measurements.
Y	Dry gas meter calibration factor.
Y_i	yaw angle at traverse point i, degree.

STACK TESTING FOR HAZARDOUS AIR POLLUTANTS (HAPs)

FIELD OBSERVATION CHECKLIST

PRETEST CHECKLIST

PRETEST MEETING CHECKLIST

Plant Name ____________________ Date ____________

Plant Address ____________________

Source to be Tested ____________________

Plant Representative ____________________ Phone ____________

Plant Manager ____________________ Phone ____________

Test Team Company Name/Address ____________________

Team Representative ____________________ Phone ____________

Regulatory Agency(s)/Address ____________________

Agency ____________________

Representative ____________________ Phone ____________

Meeting Participants	**Affiliation**	**Phone**	**e-mail**

I. FACILITY OPERATION

A. Process

a. Process Description ______________________________

b. Method of process weight rate or fuel feed determination ______________________________

c. Process parameters (list below or use operation data sheet for process)

Process Parameters to be Monitored	Design/Normal Values	Acceptable Limits

See operations data sheet for ______________________________

d. Acceptable values of raw material and/or fuel composition ____________

e. Normal operating cycle and its effect on test plan ____________

f. Test Operating Cycle ____________

B. Control Devices

a. Control Device(s) ______________________________

b. Operating Parameters (list below or use operating data sheet for process)

Operating Parameters to be Monitored	**Design/normal Values**	**Acceptable Limits**

c. Normal Operating Cycle and Periodic Maintenance (e.g., ash hopper emptying)

____

d. Test Operating Cycle ______________________________

C. Incinerator Information

a. Type of Incinerator: Liquid Injection________Fixed Hearth____________
Multiple Hearth_________Rotary Kiln_________Fluidized Bed ________
Rotary Combustor ______________________________
b. Maximum Rated Heat Input ____________________________Btu/hr
c. Maximum Rated Air Flow ______________________________acfm
d. Dimensions of Combustion Chamber(s) ____________________
____
(Indicate Primary or Secondary)
e. Does Incinerator Include a Heat Recovery Device?________ Yes________ No
f. Maximum Stream Production or Hot Water Rate__________ lb/min or gal/min
g. Air Pollution Control Devices: Quench Tower_________ Pre-cooler ______
Venturi Scrubber________ Carbon Bed____________ Packed Tower _____
Cyclone_____________ Hydrosonic Jet_____________ Ionizing _________
h. Fluid Bed Media ______________________________
i. Rotation Speed ______________________________rpm
j. Liquid Injection_______________Type of Atomization ________________
k. Feed Material: Solid________ Liquid _______Gas ______Other________
l. Maximum Feed Rate: Btu/hr_____ Gal/hr_______ Lb/hr ____ton/hr______
m. Feed Delivery: Manual_____ Conveyor ______ Screw _____Pump______

n. Identify Feed Streams:
No. 1:___________No. 2:________No. 3:___________No. 4: _________

II. TRIAL BURN PARAMETERS

Parameter	**Item**	**Test Run #1**	**Test Run #2**	**Test Run #3**
Feed Rate				
Heat Content of Feed				
Auxiliary Fuel Rates	Gas Oil			
Feed Composition	Water, % Ash, %			
POHC (s), % or ppm				
Other Organics				
Sulfur Content, % or ppm				
Nitrogen Cont., % or ppm				
Phosphorus Cont., % or ppm				
Metals, % or ppm				
Liquid	Viscosity Specific Gravity			
Sludges	Moisture, %			
Gases	Density			

III. INCINERATOR PARAMETERS

Parameter	Item	Test Run #1	Test Run #2	Test Run #3
Temperature	Primary Combustion Chamber			
	Secondary Combustion Chamber			
	Heat Recovery Device Inlet			
	Heat Recovery Device Outlet			
	Air Pollution Control Device Inlet			
	Air Pollution Control Device Outlet			
	Stack Gases			
Draft (in. Water)	Primary Combustion Chamber			
	Secondary Combustion Chamber			
	Heat Recovery Inlet			
	Heat Recovery Outlet			
-ESP	Unit Voltage, Kv			
	Unit Current, ma			

-Baghouse	Pressure Drop, inches			
	Air Flow Rate, acfm			
-Dry Scrubber	Lime Feed Rate, gpm			
	Air Flow Rate, acfm			
Air Flow Rates	Primary, acfm			
	Secondary, acfm			
Stack Gas Monitoring				
	Oxygen, %			
	CO_2, %			
	CO, ppm			

Parameter	Item	Test Run #1	Test Run #2	Test Run #3
	NO_x, ppm			
	HC, ppm			
	Opacity, %			
	SO_2, ppm			
	Other, ppm/%			
Feed Sample Taken?	Feed No.			
	Feed No.			
	Feed No.			
Auxiliary Fuel Samples Taken?				
Scrubber pH				
Type of Alkaline Added?				
Rate of Addition, lb/hr				
Ash Removal Rate, lb/hr				
Automatic Feed Cutoffs	Low Tempertature, F			
	High CO, ppm			
	Low Oxygen, %			

IV. TESTING METHODOLOGY TO BE DISCUSSED

Sampling Location ______________________________
Sampling Points ______________________________
Cyclonic Flow Check ______________________________
Pollutant Measurement Methods ______________________________
Mandatory Calibrations Sheets to be Provided (If not provided immediately prior to starting test program, testing should be delayed until observer receives them or authorization to proceed by Task Manager)

Orifice ______ Dry Gas Meter (Y) ________ Nozzle _________ Pitot Tube __________
Delta H@ _________ Thermocouples ______________ Barometer ______________
Fuel, Raw Material/produce Sampling ____

Emission Rate Calculation ____

Destruction Removal Efficiency Calculation ____

Minimum Sample Volume Calculation ____

Sample Recovery Area ____

Dry Molecular Weight/dilution Determination ____
Integrated Bag ________________ Grab Sample ________________ Orsat __________
Fyrite ________________ CEM ____
Stack or Duct Condition ____

Safety Requirements ____

Test Reporting Requirements ____

Test Schedule ____

Plant Tour ____

V. SAMPLING METHODLOLGIES TO BE USED

Pollutant Parameter	Methodology	Remarks, Additional Quality Assurance, and/or Modifications

VI. GENERAL COMMENTS

Signature of Agency Representative Affiliation of Representative Date

Signature of Plant Represnetative Date

STACK TESTING FOR HAZARDOUS AIR POLLUTANTS (HAPs)

FIELD OBSERVATION CHECKLIST

FEDERAL REFERENCE METHODS 1, 2, 3, 4, AND 5

SOURCE INFORMATION

Facility________________________________ Location ______________________________

Source________________________________ Sampling Location ______________________

Test Team______________________________ Team Leader____________________________

Test Date Interval:______/______/______ to ______/______/______

Observer______________________________ Affiliation______________________________

Sketch of sample location (if different from pretest report).

(Note: Include: duct dimensions, location of distrubances and ports, X-section showing sampling points.)

Stack or duct condition:

Material of construction: Brick______ Concrete ________Stainless Steel ________

Carbon steel _______Other ______________________________

External corrosion visible? ______________________________

Leaks? ______________________________

Internal corrosion? ______________________________

Cake or pile up of particulate matter in sampling port area? ______________

Remove before test? ______________________________

Visible water droplets in stack? ______________________________

Particulate matter appears acidic? ______________________________

Insulation Thickness Stack under negative or positive pressure? __________

All ports accessible? ______________________________

Nipple:

ID _______________ Length ______________ Capped _______________

Flush with inside wall _______________Corrosion evident _____________

Port dimensions:

Round diameter ______________________________

Rectangular: L______________________W _______________

Equivalent diameter ______________________________

Facility for movement of sampling train:

Monorail ______________ Skateboard and rail ______________________

Other ______________________________

Electricity available?_________________ No. of receptors __________

Distance to receptors ______________________________

Ground fault circuit protection? ________________ Adequate? __________

Facility for getting equipment to port ______________________________

FEDERAL REFERENCE METHOD 1

Stack diameter properly determined? _____________ Method used _______________

[Note: If stack is between 4"-12" then Method 1a must be employed]

Stack Diameter? ________________ Measured on site? ____________________

Port distance from upstream disturbance (A)_________ Upstream Diameters(A) ________

Port distance from downstream disturbance (B)_______ Downstream Diameters (B) ______

Number of Sampling Points Required?__________(Draw a line vertically from the ADistance A≅ axis down to the step chart, and from ADistance B≅ axis up to the step chart. The maximum number of points marked on the chart yields the niminum number of points to be sampled.) Actual sampling points ____________________

Ports and points at sampling location:

Circular: No.of Ports ________________ Points/port ________________

Rectangular: Grid configuration

No. of Ports_____________ Points/port ________________

Points located centroid of area? ________________

First and last traverse points from ducts:

24 in. Diameter: 1.0 inch from wall? __________ Yes___________ No _____

12-24 in. Diameter: > 0.5 inch from wall? ________ Yes___________ No _____

Method 1 calculated correctly? ____________________

Points properly marked on pitot tube? ____________________

Port length/interior stack accounted for in calculation? ________________

Cyclonic flow check verified (<20 degrees) and completed? ______________

Average null point angle ____________________

Describe velocity profile of sampling plane ____________________

____

____

Draw picture of stack with port location and upstream/downstream disturbances marked and notated ____________________

Remarks ____________________

____

____

____

____

FEDERAL REFERENCE METHOD 2

Equipment identified matches pretest calibration list?

Pitot tube: Type S _____________ Standard ________________

Pitot tube coefficient ____________________ Calibration date ____________

Design to EPA specifications? ____________________

Properly attached to sampling probe, if applicable? ________________

Pitot tube, lines, and manometer assembled correctly? ______________

Differential pressure gauge has correct sensitivity? ______________

Measurement gauge: Manometer _________ Magnehelic _________ Range(s) ________

Gauge proper sensitivity for delta p range being measures? ____________

Magnehelic gauges calibrated against manometer? ____________ Date ____________

Differential pressure gauge leveled and zeroed? ____________

Visual check of pitot tube heads-good condition and meet EPA design specification? ______

____

Pitot tube pretest leak check? ____________

Cyclonic flow checked prior to test series? ____________

Static pressure measured during the test series? ____________

Orientation of pitot tube correct during traverse? ____________

Sampling port adequately sealed around pitot tube? ____________

Process operating at correct conditions? ____________

Stable readings taken at each traverse point? ____________

Barometric pressure recorded and adjusted for elevation? ____________

(Note: Barometric pressure must be adjusted minus 0.1 A per 100 ft elevation increase or visa versa for elevation decrease. Elevation at which barometric pressure is measured compared to elevation at the test platform.)

Airport: ____________ Location ____________ P_b at airport ____________

Sampling location elevation ____________ Change in ft. ____________

delta in. Hg +/- ____________ (0.10 in. Hg/100 ft) ____________

Stack temperature measured? ____________

Stack gas moisture content determined? ____________

Orsat samples taken? ____________ If not, explain why ____________

Posttest leak check performed? ____________ Leak rate results ____________

Data recorded properly ____________ Calculations correct? ____________

Remarks ____________

____

____

____

____

FEDERAL REFERENCE METHOD 3

Method used to acquire gas sample

Single point grab _______ Single point integrated _______ Multi-point integrated _______

Type of bag ____________ Type of probe ____________

Pump: One way squeeze bulb ____________ Diaphragm ____________ Other ____________

Instrument used to determine concentration ? Orsat _______ Fyrite _______ CEM _______

Is a filter used to remove particulate matter? ____________

Sample train leak checked? ____________

Sample train purged with stack gas prior to collecting the sample? ____________

Sampling port properly sealed? ________ Sampling rate constant? ____________

What rate?

Orsat performed in triplicate? ____________ Analysis consistent? ____________

All readings averaged and reported to nearest 0.1%? ____________

Orsat:

Reagents at the proper level? ____________ Analyzer level? ____________

Reagents fresh?________________Date charged to orsat? ________________
Analyzer leak checked?________________ Analyzed within 8 hours? ________
Sample line purged?__________________Complete absorption of gases? ______
Analysis repeated until following analysis criteria met?

CO_2-any three analyses differ by
- A) ≤ 0.3 % when $CO_2 \geq 4.0$ %
- B) ≤ 0.2 % when $CO_2 < 4.0$ %

O_2- any three analyses differ by
- A) ≤ 0.3 % when $O_2 \geq 15.0$ %
- B) ≤ 0.2 % when $O_2 < 15$ %

Method 3A for O_2/CO_2:

System leak checked during test day? ________________________
Sample conditioner/dryer used? ___________________________
Heated sample lines used prior to sample conditioner? ____________
Moisture visible in sample lines? __________________________
Filter used: In-stack or out-of-stack? ________________________
Sample system flow rates within 10 % of calibration gas flow rates? ________
All calibration gases measured below the span value of the analyzer? ________
Data recording performed by strip chart, digital, manual or other? __________
Fuel _____________________ F_o Range _______________________
Calculate F_o: $F_o = (20.9 - \%O_2 / \%CO_2)=$ ____________________

Expected Fo Range:

Anthracite/Lignite	1.015-1.130	Natural Gas	1.600-1.836
Bituminous	1.083-1.230	Wood Bark	1.000-1.120
Distillate Oil	1.260-1.413	Municipal Gargage	1.043-1.177
Residual Oil	1.210-1.370	Other	____________

Remarks ____

FEDERAL REFERENCE METHOD 4

Method used to acquire moisture concentration in stack? _________________
Impinger method________Partial pressure method________ Wet bulb/dry Bulb _______
Nomograph ____________ Other? __________________________________
Estimate of moisture: ____
Method conducted in conjunction with pollutant emission test? ____________
Preliminary run: Conducted ____________________ Estimated ______________
Impinger method:

Impingers properly placed? _____________________________________
Impinger contents: 1st________2nd________3rd________4th_________5th ________

Modifications? ____
Cooling system: Crushed ice? ______________ Other ______________
Sampling time per point ____________ Number of points ____________
Probe heater on? ____________ Temperature ____________ Stable ________
Crushed ice in ice bath around impingers? ________________________
Pretest leaks check conducted? ______________ Leak rate ____________
Sampling rate constant ______________ Isokinetic? ______________
All data recorded properly? ______________________________
Post leak check conducted? ____________ Leakage rate? ____________
Recovery-Impinger Contents
Method: Volumetric? ____________ Gravimetric? ____________
Trip balance calibrated (gravimetric)? ______________________
Measurement of silica gel: Balance? ____________ Other ____________
Color of silica gel? ____________ Condition? ____________
(Note: Blue-good; pink-spent (unable to absorb water)
All analytical data recorded properly? ______________________
All readings averaged and reported to nearest 0.1 %? ______________________
Moisture value consistent with historical process values and quick-check value? __________

Remarks ____
____
____
____
____

FEDERAL REFERENCE METHOD 5

Equipment identified matches pretest calibration list? ______________________

Appratus:

NOZZLE

Probe nozzle: Stainless steel ____________ Glass ____________ Other ____________
Probe design: Button-hook ____________ Elbow ____________ Streight tube ________
Nozzle size: ____________ Calculated________ Measured three times ____________
Nozzle condition: Nicks ____________ Bent opening ____________

PROBE/PROBE LINER

Probe material: Borosilicate ______________ Quartz ______________
Stainless steel ____________ Inconel ______________ Other ________
Heating system: ______________________ Temperature ______________
Water cooled? ____________ Length ______________________

PITOT TUBE

Type: Type S ____________ Standard ______________ Other ____________

Properly attached to probe? ____________________

Meets EPA guidelines for attachment to probe?________ Yes ________ No ________

Modifications ____________________

Pitot tube coefficient ____________________

FILTER HOLDER

Construction: Borosilicate____________ Quartz ____________Other ____________

Frit construction: Glass frit? ____________ Teflon frit? ____________

Filter support ____________ Silicone gasket ____________

Other ____________ Clean? ____________

Cyclone and flask used (optional): ____________________

FILTER HEATING SYSTEM

Description ____________________

Temperature ____________________

Gas temperature at exit of box ____________________

CONDENSER

Number of impingers? ____________ Clean? ____________

Impinger contents: 1st____________2nd____________3rd ____________

4th____________5th____________6th____________7th ____________

Cooling system? ____________________

Proper connections? ____________________

Modifications? ____________________

METER BOX ASSEMBLY

Manufacturer ____________ Model No. ____________ Unit No. ____________

Delta H@ value ____________ Date ____________

Dry gas meter AY≅ value ____________ Date ____________

Condition of sampling equipment? ____________________

Meter box leveled? ________ Timer/temperature readouts operational? ________

Manometer leveled? ____________________

Thermocouples calibrated? ____________________

Operation

Filter properly numbered and recorded on field test data sheet? ____________

Filter checked visually for irregularities? ____________

Filter media type? ____________________

Sampling site selected?____________ Stack temperature ____________

Stack velocity head?____________ Stack dry molecular weight calculated? ________

Nozzle size properly selected? ____________________

Calibration data certified available:

Pitot tubes ____________ Meter box Y factor ____________

Meter box delta H@ Magnehelic guage ____________ Thermocouples ____________

Probe nozzle ____________________

Note: If calibration sheets are not available, contact Task Manager for authorization to proceed. Authorization to proceed: Yes ___________ No ____
Date____________Time_______________Task Manager ____________________

Selection of sampling points and time according to methodology? ______________
Number of sample points________________Sample time/point ___________
Minimum sample volume required? ____________________________________
Minimum run time required? ____
Total sample time actual? ____

Sampling train assembled properly? ___________________________________
Filter properly centered? _____________ Impingers properly charged? ___________
Number of impingers required? __________________ Which FRM? ____________
Volume in each impinger: 1st__________2nd__________3rd___________4th _____
5th____________6th____________7th______________8th ___________
Drying medium: Silica gel? _________________ Drierite ___________________
Weight ____
Pitot tube lines checked for plugging or leaks? _________________________
Stopcock grease used: Acetone-insoluble? _____________ Heat-stable? _________
Meter box leveled?____________ Manometers leveled? ___________________
Probe heat uniform along length of probe? ______________________________
Dry gas meter field observation check:

A. Operating Meter Box Assembly Operate metering system for 10 minutes at the H@ value. Record the volume metered, DGM temperature and barometric pressure.

Final: DGM reading________ft^3 Temp_________ ^{o}F P_b ___________ in. Hg
Initial: DGM reading_________ft^3 Temp_________ ^{o}F P_b ___________ in. Hg
Net: V_m = _______________ft^3 Avg. T_m = ________ ^{o}F + 460 = _________

$Y_c = 10/V_m\ [\ 0.0319\ (T_m = 460)/P_b]$
$Y_c =$ 0.97 Y = 1.03 Y = ______________________________

Criteria: $0.97\ Y < Y_c < 1.03\ Y$; System meets?_______ Exceeds? _______

B. Utilizing EPA's Method 5 Dry Gas Meter Performance Test Device
   a. Remove the performance test device from its case and insert it into the gas inlet quick-connect coupling on the source sampling meter box.
   b. Turn the power to the meter box on and start the pump.
   c. Completely open the coarse flow rate control valve and close the fine flow rate control valve to give a maximum vacuum reading.
   d. Allow the orifice and source sampling meter obox to warm up for 45 minutes with flow controls adjusted as described in step c before starting quality assurance runs.

e. Make triplicate quality assurance runs. For each run, record initial and final dry gas meter volume, dry gas meter inlet and outlet temperatures, internal orifice pressure drop (Delta H), ambient temperature, and barometric pressure. Each run duration should be greater than 15 minutes. As the needle reaches the zero (12 o'clock) position, pump and stopwatch are stopped simultaneously. The dry gas volume and time are recorded.

QA Table For Evaluating DGM Orifice Value

Item	**Run 1**	**Run 2**	**Run 3**
DGM, final			
DGM, initial			
DGM, net			
DGM, T inlet (°F)			
DGM, T outlet (°F)			
DGM, T avg (°F)			
Ambient Temp. (°F)			
Pb (in. Hg)			
Orifice meter, Delta H			

f. Calculate the corrected dry gas volume for each run using the following equation:

$Y_c = 10/V_m [0.0319 (T_m = 460)/P_b]^2 =$ ______________________

$Y_c = 0.97 Y = 1.03 Y =$ ______________________

Criteria: $0.97 Y < Y_c < 1.03 Y$; System meets?_______ Exceeds? ________

Nomograph/calculator check:

a. Nomograph:

If Delta H@ = 1.80, T(meter) = 100 F, % moisture = 10 %, Ps/Pm = 1.00, calculate C.

C = ____________ (0.95)

If C = 0.95, T_s = 200 F, D_n = 0.375, Delta p reference = ________ (0.118)

Align Delta p = 1.0 with Delta H = 10; and lock nomograph. Set p = 0.01.
Read Delta H______________________________(0.01)
Nomograph O.K.? ______________________________

b. Calculator:

Calculate Delta H/delta p using the following equation:

$$\text{Delta H/Delta p} = \{846.72\, D_n^4[\text{Delta H@}]\, Cp^2\, (1\text{-}B_{ws})^2(M_d T_m P_s/M_s T_s P_m)\}$$

= ______________________________
= ______________________________
= ______________________________

Parameters for calculator check:

Item DimensionsGivenCalculated

A. Orifice meter coefficient, Delta H@ in. Water1.80 ______________
B. Pitot tube coefficient, Cp dimensionless 0.84 ______________
C. Abs. stack pressure, $P_s = P_b + P_{st}$ in. Hg 29.96 ______________
D. Abs. meter pressure, P_m +/- P_b in. Hg 29.92 ______________
E. Abs. meter temperature, $T_m = t_m + 460$ degrees R 560 ______________
F. Abs. stack temperature, $T_s = t_s + 460$ degrees R 760 ______________
G. Dry molecular weight, M_{wd} lb/lb-mole 30 ______________
H. Moisture content, B_{ws} + % water/100 dimensionless 0.10 ______________
I. Exact nozzle diameter, D_n in.0.375 ______________
J. Average velocity head, Delta p in. Water 0.1 ______________
K. K factor = Delta H/Delta p 13.24 (______________)
L. Delta H calculated for delta p = 0.1 in. Water 1.324 (______________)

Calculator equation set-up O.K.? ______________________________

Nomograph /calculator setup:

A. Delta H@ = ______________________________
B. C_p = ______________________________
C. P_s = ______________________________
D. P_m = ______________________________
E. T_m = ______________________________
F. T_s = ______________________________
G. M_d = ______________________________
H. % M = ______________________________
I. C Factor = ______________________________
J. D_n desired = ______________ in. Actual ______________ in.

K. Avg. Delta p = ____________________
L. Delta H calculated = ____________________

Nomograph set up O.K.? ____________________
Calculator set up O.K.? ____________________
K-facotr figured properly? ____________________
Care taken to avoid scrapping nipple or stack wall? ____________________
Effective seal made around probe when in-stack? ____________________
Pretest leak check performed? ____________________
Probe moved at proper time? ____________________
Pitot tube/probe marking correct for correct sampling points? ____________________
Nozzle and pitot tube parallel to stack wall at all times? ____________________
Filter changed during run? ____________________
Any particulate loss during changing? ____________________
Leak check before changing components during run? ____________________
Data sheets completed, in ink, and data properly recorded? ____________________
Percent isokinetics calculated at each point?__________Within 90-110 %? __________
Perform % isokinetic rate check:

Delta H/Delta p = {846.72 D_n^4[Delta H@] Cp^2 $(1-B_{ws})^2$($M_d T_m P_s / M_s T_s P_m$)}
= K-factor changed during run?____________ New K-factor____________
Velocity pressures and orifice pressure readings recorded accurately? __________
Post-test leak check performed? (Mandatory) ____________________
Leakage rate____________________@ in. Hg ____________________
If data sheets cannot be copied, record approximate stack temperature, average stack velocity delta p, average stack delta H, approximate stack gas moisture, approximate dry stack gas molecular weight nozzle diameter, pitot tube coefficient.
Gas density determination: Temp. sensor type __________ Pressure gauge __________
Temperature sensor attached to probe?______________ Other ______________

Recovery:

Construction of probe recovery brushes: Nylon________ Clean ________Other ________
Wash bottle: Clean? ____________________
Storage containers: Borosilicate glass?__________ Other__________ Clean?__________
Leak free? ____________________
Petri-dishes: Glass? __________ Polyethylene________ Other________ Clean? ________
Graduated cylinder/or balance: Subdivisions </= 2 mL?__________Other __________
Balance type?__________________Calibrated? ____________________
Plastic storage containers: Air-tight?____________Clean?____________
Probe allowed to cool sufficiently? ____________________
(Note: Cap placed over nozzle tip to prevent loss of particlate matter?)
During sampling train disassembly, are all openings capped? ____________________
Clean-up area: Description ____________________
____
____

Clean-up area clean and protected from wind? ______________________

Filter handling: Tweezers used?__________Material of construction? __________

Surgical gloves worn?___________Other ______________________

Any particulate matter spilled? ______________________

Water: Distilled? ______________________

Stopcock grease: Acetone-insoluble?____________Heat-stable Silicone? _______

Probe handling: Acetone rinse?___________Distilled water rinse? ___________

Particulate recovery: Probe nozzle?____________Probe fitting? ___________

Probe liner?__________Front half of filter holder? ______________

Blanks: Acetone_________________Distilled water ______________

Acetone reagent <.001 % residue? ______________________

Glass bottles residue <.001 %?______________________

Acteone blanks residue <.001 %______________________

Any visible particles on filter holder inside probe? ______________________

Color of silica gel?_____________________Condition? ______________

Method of silica gel transfer? ______________________

All jars adequately labeled? ______________________

Jars sealed tightly?__________Liquid level marked on jars? ________

Jars locked up and chain-of-custody completed? ______________

All data forms signed and chain-of-custody completed? ______________

Remarks ____

____

____

____

____

____

Container No. 6 (0.1 M nitric acid blank):

Equal volume placed in Container No. 6 used to rinse sample train? ____________

(Note: Need only if total chromium is being measured and only one blank per field test.)

Fluid level properly marked? ____________

All jars adequately labeled? ____________

Jars sealed tightly?__________ Liquid level marked on jars? ____________

Jars locked up and chain-of-custody completed? ____________

Teflon tape used to secure seal of jars?____________

All data forms signed and chain-of-custody completed? ____________

Gas sample volume corrected to standard temperature and pressure? ____________

Remarks: ____________

____

____

____

f. Calculate the corrected dry gas volume for each run using the following equation:

$Y_c = 10/V_m [\, 0.0319\ (T_m = 460)/P_b]^2 =$ ____________________

$Y_c =$ ______________________________

$0.97\ Y =$ ____________________________

$1.03\ Y =$ ____________________________

Criteria: $0.97\ Y < Y_c < 1.03\ Y$; System meets?__________ Exceeds? ____________

Nomograph/calculator check:

a. Nomograph:

If Delta H@ = 1.80, T(meter) = 100 F, % moisture = 10 %, Ps/Pm = 1.00, calculate C.

C = ____________ (0.95)

If C = 0.95, T_s = 200 F, D_n = 0.375, Delta p reference = __________(0.118)

Align: Delta p = 1.0 with Delta H = 10; and lock nomograph. Set p = 0.01.

Read Delta H____________ (0.01)

Nomograph O.K.?______________________________

b. Calculator:

Calculate Delta H/delta p using the following equation:

$$\text{Delta H/Delta p} = \{846.72\ D_n^4[\text{Delta H@}]\ Cp^2\ (1\text{-}B_{ws})^2(\ M_dT_mP_s/M_sT_sP_m)\}$$

= ______________________________

= ______________________________

= ______________________________

Parameters for calculator check:

Item Dimensions Given Calculated

A. Orifice meter coefficient, Delta H@ in. Water 1.80 ____________________

B. Pitot tube coefficient, Cp dimensionless 0.84 ____________________

C. Abs. stack pressure, $P_s = P_b + P_{st}$ in. Hg 29.96 ____________________

D. Abs. meter pressure, P_m +/- P_b in. Hg 29.92____________________

E. Abs. meter temperature, $T_m = t_m + 460$ degrees R 560____________________

F. Abs. stack temperature, $T_s = t_s + 460$ degrees R 760____________________

G. Dry molecular weight, M_{wd} lb/lb-mole 30 H. Moisture content, B_{ws} + % water/100 dimensionless 0.10 ____________________

I. Exact nozzle diameter, D_n in 0.375 ____________________

Criteria: $0.97\ Y < Y_c < 1.03\ Y$; System meets?__________ Exceeds _________

B. Utilizing EPA's Method 5 Dry Gas Meter Performance Test Device

a. Remove the performance test device from its case and insert it into the gas inlet quick-connect coupling on the source sampling meter box.
b. Turn the power to the meter box on and start the pump.
c. Completely open the coarse flow rate control valve and close the fine flow rate control valve to give a maximum vacuum reading.
d. Allow the orifice and source sampling meter box to warm up for 45 minutes with flow controls adjusted as described in step c before starting quality assurance runs.
e. Make triplicate quality assurance runs. For each run, record initial and final dry gas meter volume, dry gas meter inlet and outlet temperatures, internal orifice pressure drop (Delta H), ambient temperature, and barometric pressure. Each run duration should be greater than 15 minutes. As the neddle reaches the zero (12 o'clock) position, the pump and stopwatch are stopped simultaneously. The dry gas meter volume and time are recorded.

QA Table For Evaluating DGM Orifice Value

Item	**Run 1**	**Run 2**	**Run 3**
DGM, final			
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DGM, net			
DGM, T inlet (°F)			
DGM, T outlet (°F)			
DGM, T avg (°F)			
Ambient Temp. (°F)			
Pb (in. Hg)			
Orifice meter, Delta H			

STACK TESTING FOR HAZARDOUS AIR POLLUTANTS (HAPs)

FIELD OBSERVATION CHECKLIST

SW-846, METHOD 0061

DETERMINATION OF HEXAVALENT CHROMIUM EMISSIONS FROM STATIONARY SOURCES

SOURCE INFORMATION

Facility________________________________ Location ________________________________
Source________________________________ Sampling ________________________________
Location ____
Test Team________________________Team Leader________________________________
Test Date Interval:______/______/_____ to _______/_______/_____
Observer__________________________Affiliation ________________________________

PRETEST MEETING CHECKLIST

Please reference Pretest Checklist.

FEDERAL REFERENCE METHODS 1 THROUGH 5

Please reference Federal Reference Methods 1 through 5 Checklist

SW-846, METHOD 0061

DETERMINATION OF HEXAVALENT CHROMIUM EMISSIONS FROM STATIONARY SOURCES

Equipment identified matches pretest calibration list? ________________________________
Train Design: Recirculating train where the impinger reagent is continuously recirculated to the nozzle. Aspirator design? ______________________Pump/Sprayer design?____________

Apparatus:

NOZZLE

Probe nozzle: Glass/Teflon (Required)________________Other ________________
Probe design: Button-hook _______________Elbow __________Other ___________
Nozzle size:______________Calculated____________Measured three times _______
Nozzle condition: Nicks/Chips ____

PROBE/PROBE LINER

Probe material: Glass/Teflon (Required) ____

300 mL of 0.1 M nitric acid used in sample recovery placed in Container 8A? ______

Fluid level properly marked? ______

(Note: Need only one blank per field test.)

Container No. 8B (Reagent water blank):

100 mL of reagent water blank placed in Container 8B? ______

Fluid level properly marked? ______

(Note: Need only one blank per field test).

Container No. 9 (Nitric acid impinger reagent blank):

200 mL of nitric acid impinger reagent placed in Container 9? ______

Fluid level properly marked? ______

(Note: Need only one blank per field test).

Container No. 10 (Permanganate reagent blank):

100 mL of permanganate impinger reagent placed in Container 10? ______

Fluid level properly marked? ______

(Note: Need only one blank per field test).

Container No. 11 (8M HCl blank):

200 mL of reagent water placed in Container No. 11? ______

25 mL of 8 M HCl placed in Container No. 11? ______

Fluid level properly marked? ______

(Note: Need only one blank per field test).

Container No. 12 (Filter blank):

Unused filter from same lot of field filter placed in Container No. 12? ______

Petri dish sealed? ______

All jars adequately labeled? ______

Jars sealed tightly? ______

Liquid level marked on jars? ______

Jars locked up and chain-of-custody completed? ______

Teflon tape used to secure seal of jars? ______

All data forms signed and chain-of-custody completed? ______

Gas sample volume corrected to standard temperature and pressure? ______

Remarks ______

- Container No. 2 (Probe rinse/acetone):
  - Acetone rinse?______________Distilled water rinse? ______________
  - Probe nozzle?______________Probe fitting? ______________
  - Probe liner?__________Front half of filter holder?______________
  - Fluid levels properly marked?______________________________
- Container No. 3 (Probe rinse/ 100 mL nitric acid)
  - Exactly 100 mL of nitric acid used?______________________________
  - Probe nozzle?______________Probe fittings?______________
  - Probe liner?__________Front half of filter holder?______________
  - Fluid levels properly marked?______________________________
  - Any visible particles or permanganate solution (brown color) on filter holder or inside probe?
- Container No. 4 (Impingers 1 through 3):
  - Liquids measured volumetrically to within 0.5 mL? ______________
  - Liquids in one or several containers?______________________
  - Impingers, back half of filter housing, connecting glassware rinsed withexactly 100 mL of 0.1 M nitric acid?______________________
  - Fluid levels properly marked?______________________________
- Container No. 5A (Normally empty impinger 4):
  - Liquid measured volumetrically to within 0.5 mL?______________
  - Impinger rinsed with exactly 100 mL of 0.1 M nitric acid? __________
  - Fluid levels properly marked?______________________________
- Container No. 5B (Impingers 5 and 6 containing permanganate solutions):
  - Permanganate solution color?______________________________
  - Spent (Complete bleaching of purple color)?______________________
  - Liquid measured volumetrically to with 0.5 mL?______________
  - Impingers rinsed with freshly prepared 100 mL permanganate sol.? ___
  - Impingers rinsed with 100 mL reagent water? ______________
  - Fluid levels properly marked?______________________________
    - (Note: Bottles should not be filled completely to allow venting.)
- Container No. 5C (Rinsing of impingers 5 and 6 with 8 M HCl):
  - 200 mL reagent water added to Container No. 5C?______________
  - Exactly 50 mL of 8 M HCl used to rinse impingers 5 and 6?__________
  - Fluid level properly marked? ______________________________
- Container No. 6 (Impinger 7 containing silica gel):
  - Color of recovered silica gel? ______________________________
  - Method of silica gel transferred? ______________________________
  - Silica gel weighted to nearest 0.5 g? ______________________________
  - Container properly labeled/sealed? ______________________________
- Container No. 7 (Acetone blank):
  - 100 mL placed in Container 7? ______________________________
  - Fluid level properly marked? ______________________________
    - (Note: If particulate matter is not being determined, then an action lank is not necessary.)
- Container No. 8A (0.1 M nitric acid blank):

Care taken to avoid scrapping nipple or stack wall?____________________
Effective seal made around probe when in-stack? ____________________
Pretest leak check performed? ____________________
Probe moved at proper time? ____________________
Pitot tube/probe marking correct for correct sampling points?____________________
Nozzle and pitot tube parallel to stack wall at all times? ____________________
Filter changed during run? ____________________
Any particulate loss during changing? ____________________
Leak check before changing components during run? ____________________
Data sheets completed, in ink, and data properly recorded?____________________
Percent isokinetics calculated at each point?__________Within 90-110 %? __________
Perform % isokinetic rate check:

Delta H/Delta p = {846.72 D_n^4[Delta H@] Cp^2 $(1-B_{ws})^2$($M_dT_mP_s/M_sT_sP_m$)} =
K-factor changed during run? ____________________
New K-factor____________________
Velocity pressures and orifice pressure readings recorded accurately? __________
Post-test leak check performed?(Mandatory) ____________________
Leakage rate____________________@ in. Hg____________________
If data sheets cannot be copied, record approximate stack temperature, average stack velocity delta p, average stack delta H, approximate stack gas moisture, approximate dry stack gas molecular weight, nozzle diameter, pitot tube coefficient. Gas density determination: Temp. sensor type____________ Pressure gauge ____________
Temperature sensor attached to probe?____________Other ____________

Recovery:
Construction of probe recovery brushes: Nylon______Clean______Other ______
Wash bottle: Clean/glass? ____________________
Storage containers: Borosilicate glass?______Other______Clean?______
Leak free?__________Teflon-lined caps? __________
Petri-dishes: Glass?______Polyethylene______Other______Clean? ____
Graduated cylinder/or balance: Subdivisions </= 2 mL?______Other______
Balance type?__________Calibrated? __________
Plastic storage containers: Air-tight?________Clean?________
Probe allowed to cool sufficiently?____________________
(Note: Cap placed over nozzle tip to prevent loss of particulate matter?(____)
During sampling train disassembly, are all openings capped? ____________
Clean-up area: Description ____________________

Clean-up area clean and protected from wind?____________________
Sample recovery:
Container No. 1 (Filter):
Filter handling: Polypropylene tweezers used?____________
Surgical gloves worn?__________Other __________
Any particulate matter spilled? ____________________

Calculate Delta H/delta p using the following equation:

Delta H/Delta p = {846.72 D_n^4[Delta H@] Cp^2 $(1-B_{ws})^2$($M_d T_m P_s / M_s T_s P_m$)}

= ____________________

= ____________________

= ____________________

Parameters for calculator check:

Item	Dimensions	Given	Calculated
A. Orifice meter coefficient, Delta H@	in. Water	1.80	____________
B. Pitot tube coefficient, Cp	dimensionless	0.84	____________
C. Abs. stack pressure, $P_s = P_b + P_{st}$	in. Hg	29.96	____________
D. Abs. meter pressure, P_m +/- P_b	in. Hg	29.92	____________
E. Abs. meter temperature, $T_m = t_m + 460$	degrees R	560	____________
F. Abs. stack temperature, $T_s = t_s + 460$	degrees R	760	____________
G. Dry molecular weight, M_{wd}	lb/lb-mole	30	____________
H. Moisture content, B_{ws} + % water/100	dimensionless	0.10	____________
I. Exact nozzle diameter, D_n	in.	0.375	____________
J. Average velocity head, Delta p	in. Water	0.1	____________
K. K factor = Delta H/Delta p		13.24(	____________)
L. Delta H calculated for delta p = 0.1	in. Water	1.324(	____________)

Calculator equation set-up O.K.? ____________________

Nomograph /calculator setup:

A. Delta H@ = ____________________

B. C_p = ____________________

C. P_s = ____________________

D. P_m = ____________________

E. T_m = ____________________

F. T_s = ____________________

G. M_d = ____________________

H. % M = ____________________

I. C Factor = ____________________

J. D_n desired = ____________ in. Actual ____________ in..

K. Avg. Delta p = ____________________

L. Delta H calculated = ____________________

Nomograph set up O.K.? ____________________

Calculator set up O.K.? ____________________

K-factor figured properly? ____________________

QA Table For Evaluating DGM Orifice Value

Item	**Run 1**	**Run 2**	**Run 3**
DGM, final			
DGM, initial			
DGM, net			
DGM, T inlet (°F)			
DGM, T outlet (°F)			
DGM, T avg (°F)			
Ambient Temp. (°F)			
Pb (in. Hg)			
Orifice meter, Delta H			

f. Calculate the corrected dry gas volume for each run using the following equation: .

$Y_c = 10/V_m\,[\,0.0319\ (T_m = 460)/P_b]^2 =$ ____________________________

$Y_c = 0.97\ Y = 1.03\ Y =$ ____

Criteria: $0.97\ Y < Y_c < 1.03\ Y$; System meets?__________ Exceeds? _______

Nomograph/calculator check:

a. Nomograph:

If Delta H@ = 1.80, T(meter) = 100 F, % moisture = 10 %, Ps/Pm = 1.00, calculate C.

C = _______________ (0.95)

If C = 0.95, $T_s = 200$ F, $D_n = 0.375$, Delta p reference = __________(0.118)

Align Delta p = 1.0 with Delta H = 10; and lock nomograph. Set p = 0.01.
Read Delta H______________ (0.01)
Nomograph O.K.? ____

b. Calculator:

A. Operating Meter Box Assembly

Operate metering system for 10 minutes at the   H@ value. Record the volume metered, DGM temperature and barometric pressure.

Final: DGM reading________ft^3 Temp________ ^{o}F P_b________ in. Hg
Initial: DGM reading________ft^3 Temp________ ^{o}F P_b________ in. Hg
Net: V_m = ____________ft^3 Avg. T_m = ______ ^{o}F + 460 = ________

$Y_c = 10/V_m\ [\ 0.0319\ (T_m = 460)/P_b]^2 =$ ________________
$Y_c = 0.97\ Y = 1.03\ Y =$ ________________

Criteria: $0.97\ Y < Y_c < 1.03\ Y$; System meets?________ Exceeds? ________

B. Utilizing EPA's Method 5 Dry Gas Meter Performance Test Device

a. Remove the performance test device from its case and insert it into the gas inlet quick-connect coupling on the source sampling meter box..
b. Turn the power to the meter box on and start the pump.
c. Completely open the coarse flow rate control valve and close the fine flow rate control valve to give a maximum vacuum reading.
d. Allow the orifice and source sampling meter box to warm up for 45 minutes with flow controls adjusted as described in step c before starting quality assurance runs.
e. Make triplicate quality assurance runs. For each run, record initial and final dry gas meter volume, dry gas meter inlet and outlet temperatures, internal orifice pressure drop (Delta H), ambient temperature, and barometric pressure. Each run duration should be greater than 15 minutes. As the needle reaches the zero (12 o'clock) position, the pump and stopwatch are stopped simultaneously. The dry gas meter volume and time are recorded.

(Note: If particulate emissions are not to be determined, the filter need not be desiccated or weighted.)

Filter checked visually for irregularities? ______________________________

Filter media type? ______________________________

Sampling site selected?____________________ Stack temperature ____________

Stack velocity head?______________ Stack dry molecular weight calculated? ______

Nozzle size properly selected? ______________________________

Calibration data certified available: Pitot tubes ________ Meter box Y factor ______

Meter box delta H@____________Magnehelic gauge ____________________

Thermocouples____________Probe nozzle ____________________

(Note: If calibration sheets are not available, contact Task Manager for authorization to proceed. Authorization to proceed:

Yes____________No____________

Date____________Time____________Task Manager __________________)

Selection of sampling points and time according to methodology? ______________

Number of sample points______________Sample time/point____________

Minimum sample volume required? ______________________________

Minimum run time required? ______________________________

Total sample time actual? ______________________________

Sampling train assembled properly? ______________________________

Filter properly centered?____________Impingers properly charged? ____________

Number of impingers required? ______________________________

Sample train preparation (Volume added to each impinger):

1st (normally empty)______________________________

2nd/3rd (100 mL of HNO_3/H_2O_2) ______________________________

4th (normally empty)______________________________

5th/6th (100 mL of permanganate solution) ______________________________

(Note: Reagent prepared fresh daily? ______________________________

7th (200-300 g of preweighted silica gel) ______________________________

Weight (Initial) ______________________________

Pitot tube lines checked for plugging or leaks? ______________________________

Stopcock grease used: Acetone-insoluble?______________Heat-stable?__________

Meter box leveled?____________Manometers leveled? ____________________

Probe heat uniform along length of probe?______________________________

Dry gas meter field observation check:

PITOT TUBE

Type: Type S__________ Standard__________ Other __________
Properly attached to probe?__________
Meets EPA guidelines for attachment to probe?______ Yes______ No ______
Modifications __________
Pitot tube coefficient __________

FILTER HOLDER

Construction: Borosilicate__________ Quartz__________ Other __________
Frit construction: Glass frit?__________ Teflon frit?__________
Filter support material?__________ Silicone gasket?__________
Without organic binder?__________ Clean? __________
Cyclone and flask used (optional): __________

FILTER HEATING SYSTEM

Description __________
Temperature __________
Gas temperature at exit of box __________

CONDENSER

Number of impingers?__________ Clean? __________
Teflon impingers used?__________
Impinger contents: 1st__________ 2nd__________ 3rd__________
4th__________ 5th__________ 6th__________ 7th __________
Cooling system? __________
Proper connections (leak free/ground glass/ or other material)? __________
Modifications? __________
All glassware properly cleaned as specified in methodology (Hot tap water, then hot soapy water, 3X with tap water, 3X reagent water, soaked in 10 % nitric acid for 4 hours, 3X reagent water, rinsed with acetone, then air dry, then opening covered with paraffin until use?) __________

METER BOX ASSEMBLY

Manufacturer__________ Model No.__________ Unit No. __________
Delta H@ value__________ Date __________
Dry gas meter "Y" value__________ Date __________
Condition of sampling equipment?__________
Meter box leveled? __________
Timer/temperature readouts operational? __________
Manometer leveled? __________
Thermocouples calibrated? __________

Operation

Filter properly numbered and recorded on field test data sheet?__________

STACK TESTING FOR HAZARDOUS AIR POLLUTANTS (HAPs)

FIELD OBSERVATION CHECKLIST
SW-846, METHOD 0060

DETERMINATION OF METALS IN STACK EMISSIONS

SOURCE INFORMATION

Facility____________________________Location ____________________________________
Source____________________________Sampling __________________________ Location
Test Team_________________________Team Leader__________________________________
Test Date Interval:______/______/_____ to ______/_______/_____
Observer___________________________Affiliation____________________________________

PRETEST MEETING CHECKLIST

Please reference Pretest Checklist

FEDERAL REFERENCE METHODS 1 THROUGH 5

Please reference Federal Reference Methods 1 through 5 Checklist.

SW-846, METHOD 0060

DETERMINATION OF METALS IN STACK EMISSIONS

Equipment identified matches pretest calibration list? ________________________________
Particulate matter measured concurrently with metals? _______________________________
Metals under evaluation: Sb____As___Ba___Be___Cd___Cr___Co___Cu___Pb____Mn __
Hg___Ni___P___Se___Ag___Tl___Zn___Other___Other___Other___Other ______
Mercury emissions being measured (If mercury emissions are not being measured, then impingers 4, 5, and 6 are not necessary and may be eliminated)? _______________________

Apparatus:

NOZZLE

Probe nozzle: Glass (Required)__________________________Other ______________
Probe design: Button-hook__________________________Other ________________
Nozzle size:______________Calculated____________Measured three times _______
Nozzle condition: Nicks/Chips ____

PROBE/PROBE LINER

Probe material: Borosilicate__________________Quartz_______________________
Heating system:_________________________Temperature ______________________
Water cooled?_________________________Length _____________________________

SW-846, METHOD 0030/0031 TEST OBSERVATION SHEET (CON'T)

	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
9. DATA SHEETS						
a. Observer Signed Data Sheets?						
b. Data Sheets Submitted to Observer?						
10. AUDIT CYLINDER RUN						
a. Audit Cylinder Acquired From EPA?						
b. Compound Group and Range Within Guidelines?						
c. Source Test Team To Conduct four (4) Runs According to Audit Procedures Supplied with Kit. Can Be Conducted Either Prior To or After Scheduled Test Runs.						
d. Audit Runs:						
- Date						
- Time Interval						
- Sampler ID						
- Cylinder No.						
- Range						
- Expiration Date						
- Cylinder Pressure (Before)						
(After)						
- Run						
1. Leak Check Before Run?						
2. Leak Check After Run?						
3. Volume Collected						
4. Cartridge Sealed?						
5. Cartridge Labeled Properly?						
6. Cartridge Stored < 4 °C?						
7. Cartridge ID Number						

SW-846, METHOD 0030/0031 TEST OBSERVATION SHEET (CON'T)

	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
7. BLANKS						
a. **Field Blank:** For Every 6 Cartridge Sets, Obtain One Set, Place Near Sampling Train For 5 Minutes, Replace Caps, Store < 4° C. - Field Blank Set Taken? - Labeled Properly? - Stored Properly < 4 °C?						
b. **Trip Blank:** For Every 6 Cartridge Sets, Obtain One Set, Do Not Uncap, Store < 4 °C. - Trip Blank Set Taken? - Labeled Properly? - Stored Properly < 4 °C?						
c. **Field Blank D.I. Water:** Fill One Vial With Field D.I. Water to Overflow, Cap, Store. - Field Blank D.I. Water Take? - Labeled Properly? - Stored Properly?						
8. SHIPPING						
a. Chain-of-Custody Sheets Completed? b. Samples Shipped at < 4 °C? c. Shipping Mode (UPS, Fed. Exp., Other)?						

SW-846, METHOD 0030/0031 TEST OBSERVATION SHEET (CON'T)

	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6
5. TRAIN OPERATION						
a. Probe in Stack At Sampling Point?						
b. Sample Port Sealed?						
c. Stack Gas Purged Through Probe via Isolation Valve Prior To Starting Run?						
d. Valve Opened for Condenser?						
e. Inlet to 1st Sorbent < 20 °C?						
f. Test Time:						
- Run Start						
- Run End						
- Net Sampling Time						
- Sampling Rate						
- Minimum Sampling Time Met?						
h. Dry Gas Meter						
- Final (L)						
- Initial (L)						
- Net (L)						
- Minimum Volume of Liters Met?						
6. SAMPLE RECOVERY						
a. Cartridges Removed With Gloved Hands and End Caps Replaced?						
b. Cartridges Properly Labeled?						
c. Cartridges Stored at < 4 °C?						
d. Condensate Recovered in Vial and Topped Off With DI Water?						
e. Condensate Vial Properly Labeled?						
f. All Samples Logged Into Master Field Log Book?						
g. Chain-of-Custody Completed and Signed?						

SW-846, METHOD 0030/0031 TEST OBSERVATION SHEET

1. GENERAL

a. Date
b. Run No.
C. Code No.

2. CARTRIDGE INFORMATION	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 5**	**Run 6**
a. Cartridge ID - Cartridge No. 1 - Cartridge No. 2 - Cartridge No. 3 Certificate of Cleaniness? (Yes/No)						
3. TRAIN SET-UP						
a. Cartridges Placed Properly and Correctly Oriented? (Yes/No) b. Condensers Operating Properly? c. Condenser Trap in Place? d. Silica Gel in Place? e. Probe at Operating Temperature?						
4. TRAIN LEAK CHECK						
Initial a. Checked @ - 10 " Hg? b. Leak Rate (<0.1 " Hg for 1 min.)? c. Vented through Charcoal Tube? **Intermittent** a. Checked at Highest Vacuum? b. Leak Rate (< 0.1 " Hg for 1 min.)? c. Vented through Charcoal Tube?.						

Gas temperature exiting sorbent bed at a maximum of 20 °C?________________

Data recorded on field data sheet properly? ________________

Recovery:

Storage containers: Borosilicate glass?________________Other________________Clean? ________________

Leak free?________________Teflon liners? ________________

Clean-up area: Description

Clean-up area clean and protected from wind?________________

Recovery personnel cover hands with cotten gloves for sorbent tubes recovery? ______

Sorbent cartridges capped at both ends?________________

Sorbents properly marked for particular run? ________________

Sorbents stored at < 4 °C until analyzed? ________________

Knockout trap capped? ________________

All data forms signed and chain-of-custody completed? ________________

____

____

Station Pb ____________________________________

[Inches of Hg to be added or subtracted from Station Pb (0.1 " Hg X ft per 100 ft)

Describe condition of sampling equipment: ____________________________________

____

____

____

Operation

Sampling site selected?____________________Stack temperature __________

Stack velocity head?______________Stack dry molecular weight calculated?______

Nozzle size properly selected (if applicable)? ____________________

Calibration data certified available: Pitot tubes________Meter box Y factor ____________

Rotameters____________________Magnehelic guage ____________________

Thermocouples____________Probe nozzle ____________________

(Note: If calibration sheets are not available, contact Task Manager for authorization to proceed. Authorization to proceed: Yes__________No ______________

Date__________Time__________Task Manager ______________

Selection of sampling points and time according to methodology? ______________

Number of sample points______________Sample time/point______________

Minimum sample volume calculated per cartridge set: ______________

Minimum run time required? ____________________

Total sample time actual? ____________________

Sampling point > 1 meter from side of wall? ____________________

Sampling point at average stack gas velocity? ____________________

Average stack gas temperature? ____________________

Sampling train assembled properly?____________________

(Note: During preparation of sampling train, keep all openings where contamination can occur covered with Teflon film or aluminum foil.)

Sorbent traps properly orientated in sampling train? ______________

List orientation of sorbent cartridges:1.____________2.____________3. ________

Drying medium: Silica gel?______________Drierite ______________

Pitot tube lines checked for plugging or leaks? ______________

Meter box leveled?____________Manometers leveled? ______________

Probe heat uniform along length of probe?____________________

Condenser water recirculating properly? ____________________

Care taken to avoid scrapping nipple or stack wall?____________________

Effective seal made around probe when in-stack? ____________________

Pretest leak check performed (Required)?________Leak rate <0.1 " Hg? __________

Leak check performed through probe? ____________________

Pitot tube/probe marking correct for correct sampling point? ______________

Pitot tube parallel to stack wall at all times? ____________________

Data sheets completed, in ink, and data properly recorded?______________

Probe maintained at 120 +/- 14 °C? ____________________

Isolation valve?____________ Quantity?______________ Stainless steel?__________

ORGANIC SAMPLING MODULES

Three sections: condenser____________________ sorbent trap ______________

condensate knockout trap ______________________________________

Condenser maintains stack gas not exceeding 20 °C ____________________

Condenser: water cooled?__________ coolant?____________________________

Sorbent trap jacketed to maintain the internal gas temperature not exceeding 20 °C (68 °F)? ______________________________________

Design of sorbent trap: Single unit?____________ Dual units?______________

Thermocouple well in bed of sorbent trap? ______________________________

Sorbent in traps?1.__________________ 2.______________ 3. ______________

Sorbent certified clean (< 10 ng per target analyte?)? ____________________

Date of sorbent certification?______________ Within 4 weeks?______________

Sorbent stored < 4 °C before use?__________________________________

Chain-of-custody with sorbent trap?__________________________________

Sorbent trap received wrapped in aluminum foil? ________________________

Coolant? (Ice water?) ____

Knockout trap directly below sorbent trap? ____________________________

Type of knockout trap? ____

Vacuum grease of any kind PROHIBITED! ______________________________

METER BOX ASSEMBLY

Manufacturer________________ Model No.____________ Unit No. ____________

Dry gas meter measuresin liters?__________ Yes______________ No____________

Dry gas meter "Y" value______________ Date________________________________

Dry gas meter measure volume within 1 %? ____________________________

Rotameters calibrated?__________________ Yes____________________ No

Calibration date? ____

Condition of sampling equipment?_____________________________________

Meter box leveled? ____

Timer/temperature readouts operational? ______________________________

Manometer leveled? ____

Thermocouples calibrated (Read within 3 °C?)? __________________________

Barometer: Mercury, Aneroid, Other___________________________________

Barometer capable of measuring atmospheric pressure within 2.5 mm Hg? ________

Vacuum gauge: After silica gel trap?____________ Range (0-30 " Hg)? __________

Isolation valve: Located after vacuum gauge? ____________________________

Leak free pump? ____

Temperature readouts: Digital?________ Analog?________ Dial Thermometer? _____

Barometer: Anaroid?__________________ Mercury?__________________________

Calibrated against____________________ Date:______________________

AirportLocation____

Elevation ______________________________________ feet above sea level

Sampling location elevation ________________________ feet above sea level

Sampling rate: ____ Lpm

7. Total sample time per cartridge set:

Method 0030, VOST < 20 min? ______________________________
Method 0031, SLO-VOST < 40 min? ____________________________

8. Total number of cartridge sets per run:

Minimum of 4 sets? ____
Maximum of 6 sets? ____

9. Run time (2 hours actual):

Method 0030, VOST < 80 min ? ______________________________
Method 0031, SLO-VOST < 160 min? ___________________________

Appratus:

NOZZLE

Probe nozzle: Stainless steel ____________ Glass __-__________ Other ________
Probe design: Button-hook ____________ Elbow __________ Streight tube __________
Tapered (30 angle)? ____
Nozzle size: ____________ Calculated ____________ Measured three times _______
Nozzle condition: Nicks ____________ Bent opening ____________________

PROBE/PROBE LINER

Probe material: Borosilicate ________ Quartz _________ Stainless steel ____________
Inconel ____________________ Other ________________________
Heating system: ______________ Temperature (120 °C +/- 14 °C) ____________
Water cooled? ______________ Length ________________________
Probe liner: Borosilicate/quartz (up to 480 °C) ____________ Quartz(480-900 °C) _____
Temperature sensor attached to probe? ______________________________
Temperature sensor placed in an interference-free arrangement with probe? ________
Temperature probe calibrated? _______ Yes _________ No _________ Date __________
Probe plug used? ______________ Teflon? ____________________________

PITOT TUBE (If Applicable)

Type: Type S ____________ Standard ____________________ Other ______________
Properly attached to probe? ______________________________________
Meets EPA guidelines for attachment to probe? ____________ Yes _______ No ______
Modifications ____
Pitot tube coefficient ______________________________________

SAMPLE TRANSFER LINE

Construction: Borosilicate ______________ Quartz ____________ Teflon ____________
Length (< 5ft)? _________________________ Heat trace? ______________________
Other ___________________________ Clean? ___________________________

-Calibration range of GC/MS, ng (0-3,000 ng)

2. Calculation: Quantity of POHC to be collected:

Quantity collected (ng), = [A X (1-B) X C X D X E]/ (F X G X H)

Where:

A = POHC feed rate, lb/hr
B = DRE (as decimal)
C = 453. 59 g/lb
D = Sample volume, L
E = 1 X 10^9 ng/g
F = 60 min/hr
G = Stack gas flow rate, dscfm
H = 28.316 L/ft^3

3. Perform calculation for:
   % DRE of 99.9; 99.99; 99.999 and 99.9999
   Sample volumes: 5, 10, 15, and 20 liters
4. Consturct matrix for % DREs and sample volumes:

	Total ng collected			
% DRE	5 L	10 L	15 L	20 L
99.9				
99.99				
99.999				
99.9999				

5. Selection of sample volume:

At the required DRE, select the total volume to be sampled so that the maximum ng collected will be within the mid-range of the calibration curve. Sample volume must not exceed 20 liters.

Sample volume: ______________________________ Lpm

6. Sampling rate:

The sampling rate is dependent on the total sampling time and total volume to be collected and must be between 0.25 and 1.0 Lpm. At no time shall sample rate exceed 1.0 Lpm.

STACK TESTING FOR HAZARDOUS AIR POLLUTANTS

FIELD OBSERVATION CHECKLIST

SW-846, METHOD 0030 AND METHOD 0031

SAMPLING AND ANALYSIS FOR VOLATILE ORGANIC COMPOUNDS

SOURCE INFORMATION

Facility____________________ Location ____________________
Source____________________ Sampling Location____________________
Test Team____________________ Team Leader____________________
Test Date Interval:_____/_____/_____ to _____/_____/_____
Observer____________________ Affiliation ____________________

PRETEST MEETING CHECKLIST

Please reference Pretest Checklist

FEDERAL REFERENCE METHODS 1 THROUGH 5

Please reference Federal Reference Methods 1 through 5 Checklist.

SW-846, METHOD 0030

VOLATILE ORGANIC SAMPLING TRAIN (VOST)

Equipment identified matches pretest calibration list? ____________________
Principle organic hazardous constituents (POHCs) 1._______________ 2. _______________
3._______________ 4._______________ 5._______________ 6._______________
7._______________ 8._______________ 9._______________ 10._______________
For each waste feed stream stream containing POHCs, calculate POHC feed rate:

1. POHC concentration in waste feed: ____________________ %
2. Waste feed rate lb/hr
   If liquid feed rateis gal/hr: ____________________
   gal/hr X __________ lb/gal (density) = lb/hr
3. POHC feed rate in each waste feed stream:
   ________ decimal wt (% POHC) X _____ waste feed rate (lb/hr) = ___ lb POHC/hr

Verification of Method 0030 (VOST) sample volume to be collected:

1. Basis:-% Destruction Removal Efficiency (DRE) expected, %
   -Quantity of POHC to be collected, ng.

Container #4 (Condensate trap): Labeled/volume measured? ____________________
Container #5 (Train component rinse): From filter to 1st impinger: ________________
Labeled/volume measured?____
Container #6 (Silica gel): Color noted/capped/weighted. Containers #2-5 stored under "blue ice " (<4 C) and during shipment? Container #1 shipped unrefrigerated?
All data forms signed and chain-of-custody completed? ____________________________
Remarks ____
____
____
____
____

approximate dry stack gas molecular weight ____________________, nozzle diam
Gas density determination: Temp. sensor type__________Pressure gauge ________
Temperature sensor attached to probe?__________Other ___________

Recovery:

Post-test leak check performed (Mandatory)? ____________________
Construction of probe recovery brushes: Nylon________Clean_________Other ____
Wash bottle: Clean?__________Three?__________Teflon/Glass? ___________
Storage containers: Borosilicate glass?_________Other__________Clean?_______
Leak free?_______________Teflon liners? ____________________
Petri-dishes (For storage/transport of filters):
Glass_________Polyethylene__________Other__________Clean?__________
Graduated cylinder/or balance: Subdivisions </= 2 mL?_________Other__________
Balance type?_______________Calibrated? ____________________
Plastic storage containers (To store silica gel): Air-tight?__________Clean?_______
Probe allowed to cool sufficiently?____________________
(Note: Cap placed over nozzle tip to prevent loss of particulate matter?)
During sampling train disassembly, are all openings capped? ___________
Clean-up area: Description ____________________
Clean-up area clean and protected from wind?____________________
Filter handling: Tweezers used?__________Material of construction?__________
Surgical gloves worn?__________Other ____________________
Any particulate matter spilled? ____________________
Water: Distilled?____________________
Stopcock grease: Acetone-insoluble?_________Heat-stable Silicone? __________
Probe handling: Acetone rinse?__________Distilled water rinse? __________
Particulate recovery: Probe nozzle?_________Probe fitting? __________
Probe liner?_______________Front half of filter holder? __________
Blanks: Methanol__________Methylene chloride____________________
Any visible particles on filter holder inside probe? ____________________
Color of silica gel?_______________Condition? ____________________
Method of silica gel transfer? ____________________
All jars adequately labeled? ____________________
Jars sealed tightly?__________Liquid level marked on jars? __________
Jars locked up and chain-of-custody completed? ____________________
Methylene chloride/methyl alcohol used in recovery? ____________________
Distilled-in-glass grade? ____________________
Resin bed capped at both ends? ____________________
Knockout trap capped? ____________________
Liquid in impinger train (first three impingers) measured/weighted? __________

Shipping Containers:

Container #1 (Petri dish): Filter inside? ____________________
Container #2 (Probe assembly rinse): Rinse with methanol/methylene chloride? _____
Container #3 (Sorbent trap): Labeled/ends sealed? ____________________

J. Average velocity head, Delta pin. Water 0.1 ______________________________
K. K factor = Delta H/Delta p13.24 (______________________________)
L. Delta H calculated for delta p = 0.1 in. Water1.324 (______________________________)
Calculator equation set-up O.K.? ______________________________

Nomograph /calculator setup:

A. Delta H@ = ______________________________
B. C_p = ______________________________
C. P_s = ______________________________
D. P_m = ______________________________
E. T_m = ______________________________
F. T_s = ______________________________
G. M_d = ______________________________
H. % M = ______________________________
I. C Factor = ______________________________
J. D_n desired = ____________________in. Actual in.
K.Avg. Delta p = ______________________________
L. Delta H calculated = ______________________________

Nomograph set up O.K.? ______________________________
Calculator set up O.K.?______________________________
K-facotr figured properly? ______________________________
Care taken to avoid scrapping nipple or stack wall?______________________________
Effective seal made around probe when in-stack? ______________________________
Pretest leak check performed? ______________________________
Probe moved at proper time? ______________________________
Pitot tube/probe marking correct for correct sampling points?______________________________
Nozzle and pitot tube parallel to stack wall at all times? ______________________________
Filter changed during run? ______________________________
Any particulate loss during changing? ______________________________
Leak check before changing components during run? ______________________________
Data sheets completed, in ink, and data properly recorded?______________________________
Percent isokinetics calculated at each point?__________Within 90-110 %? __________
Perform % isokinetic rate check:

Delta H/Delta p = $\{846.72\ D_n^4[\text{Delta H@}]\ Cp^2\ (1-B_{ws})^2(M_dT_mP_s/M_sT_sP_m)\}$ =

K-factor changed during run?________________New K-factor ________________
Velocity pressures and orifice pressure readings recorded accurately? ______________
Post-test leak check performed? ______________________________ (Mandatory)
Leakage rate______________________@ in. Hg ______________________________
If data sheets cannot be copied, record approximate stack temperature, average stack velocity delta p________________, average stack delta H ________________, approximate stack gas moisture______________________,

$Y_c = 0.97\ Y =$ ________________________________
1.03 Y = ________________________________

Criteria: $0.97\ Y < Y_c < 1.03\ Y$; System meets?__________ Exceeds? ________

Nomograph/calculator check:

a. Nomograph:

If Delta H@ = 1.80, T(meter) = 100 F, % moisture = 10 %, Ps/Pm = 1.00, calculate C.

C = ____________ (0.95)

If C = 0.95, T_s = 200 F, D_n = 0.375, Delta preference = (0.118)

Align Delta p = 1.0 with Delta H = 10; and lock nomograph. Set p = 0.01.
Read Delta H____________ (0.01)
Nomograph O.K.?________________________________

b. Calculator:

Calculate Delta H/delta p using the following equation:

$$\text{Delta H/Delta p} = \{846.72\ D_n^4[\text{Delta H@}]\ Cp^2\ (1\text{-}B_{ws})^2(\ M_dT_mP_s/M_sT_sP_m)\}$$

= ________________________________
= ________________________________
= ________________________________

Parameters for calculator check:

Item Dimensions Given Calculated
A. Orifice meter coefficient, Delta H@ in. Water 1.80 ____________
B. Pitot tube coefficient, Cp dimensionless 0.84 ____________
C. Abs. stack pressure, $P_s = P_b + P_{st}$in. Hg 29.96 ____________
D. Abs. meter pressure, P_m +/- $P_b$in. Hg 29.92 ____________
E. Abs. meter temperature, $T_m = t_m + 460$ degrees R 560 ____________
F. Abs. stack temperature, $T_s = t_s + 460$ degrees R 760 ____________
G. Dry molecular weight, M_{wd} lb/lb-mole 30 ____________
H. Moisture content, B_{ws} + % water/100 dimensionless 0.10 ____________
I. Exact nozzle diameter, $D_n$in. 0.375 ____________

a. Remove the performance test device from its case and insert it into the gas inlet quick-connect coupling on the source sampling meter box.
b. Turn the power to the meter box on and start the pump.
c. Completely open the coarse flow rate control valve and close the fine flow rate control valve to give a maximum vacuum reading.
d. Allow the orifice and source sampling meter box to warm up for 45 minutes with flow controls adjusted as described in step c before starting quality assurance runs.
e. Make triplicate quality assurance runs. For each run, record initial and final dry gas meter volume, dry gas meter inlet and outlet temperatures, internal orifice pressure drop (Delta H), ambient temperature, and barometric pressure. Each run duration should be greater than 15 minutes. As the needle reaches the zero (12 o'clock) position, the pump and stopwatch are stopped simultaneously. The dry gas meter volume and time are recorded.

QA Table For Evaluating DGM Orifice Value

Item	**Run 1**	**Run 2**	**Run 3**
DGM, final			
DGM, initial			
DGM, net			
DGM, T inlet (°F)			
DGM, T outlet (°F)			
DGM, T avg (°F)			
Ambient Temp. (°F)			
Pb (in. Hg)			
Orifice meter, Delta H			

f. Calculate the corrected dry gas volume for each run using following equation:

$Y_c = 10/V_m [\ 0.0319\ (T_m = 460)/P_b]^2 =$ ______________________

(Note: If calibration sheets are not available, contact Task Manager for authorization to proceed. Authorization to proceed: Yes____________No__________
Date____________Time_____________Task Manager __________________________)
Selection of sampling points and time according to methodology? ______________
Number of sample points_______________Sample time/point___________
Minimum sample volume required (3 dscm or 105.9 scf)? _______________
Minimum run time required? ______________________________________
Total sample time actual? ____
Probe can reach all traverse points? ________________________________
Sampling train assembled properly?____
(Note: During preparation of sampling train, keep all openings where ________ contam
Filter properly centered?______________Impingers properly charged? ____________
Number of impingers required?__________Which FRM? _______________________
Volume in each impinger: 1st__________2nd__________3rd__________4th________
5th__________6th____________7th______________8th ______________________
Distilled organic-free water (Type II) used? ____________________________________
Drying medium: Silica gel?_________________Drierite ___________________________
Weight (200-300 grams?)_____________6-16 mesh?____________________
Pitot tube lines checked for plugging or leaks? ____________________________________
Stopcock grease used: Acetone-insoluble?_____________Heat-stable?_____________
(Note: Do not use stopcock grease upstream of sorbent bed!)
Meter box leveled?_____________Manometers leveled? _________________________
Probe heat uniform along length of probe?______________________________________
If glass liner used, install nozzle using Viton-A O-ring when stack temperatures are< 260°C______________Woven glass-fiber gasket >260°C____________________

Dry gas meter field observation check:

A. Operating Meter Box Assembly

Operate metering system for 10 minutes at the Delta H@ value. Record the volume metered, DGM temperature and barometric pressure.

Final: DGM reading__________ft^3 Temp___________^oF P_b__________ in. Hg
Initial: DGM reading__________ft^3 Temp___________^oF P_b__________ in. Hg
Net: V_m = ________________ft^3 Avg. T_m = _________ ^oF + 460 = ___________

$Y_c = 10/V_m\, [\, 0.0319\, (T_m = 460)/P_b]^{\,2} =$ ______________________________

$Y_c = 0.97\, Y =$ ____
$1.03\, Y =$ ____

Criteria: $0.97\, Y < Y_c < 1.03\, Y$; System meets?__________ Exceeds?____________

B. Utilizing EPA's Method 5 Dry Gas Meter Performance Test Device

Impinger stem in knockout trap one-half length of normal stem? ________________

IMPINGER TRAIN

Number of impingers?__________________Clean? _________________________
Impinger contents: 1st (Water?)____________2nd (Water?) ________________
3rd (Empty/ or caustic solution?)__________4th (Silica Gel?) ______________
5th_______________6th_______________7th_____________8th ________________
Volume/weight of contents of impingers: 1st (100 mL?)_______2nd (100 mL?)_____
3rd (Empty?)______________4th (200-300 g silica gel?)______________________
5th_______________6th_______________7th_____________8th ________________
Impinger types: Greenburg-Smith?____________Standard?_________________
Impinger tip design: Tapered tip?_____________Standard tip? _______________
Cooling system? ____
Proper connections? ____
Modifications? ____

METER BOX ASSEMBLY

Manufacturer________________Model No._____________Unit No. ____________
Delta H@ value_____________________ Date ________________________
Dry gas meter "Y" value______________ Date_________________________
Dry gas meter measure volume within 1 %? ______________________________
Condition of sampling equipment?____________________________________
Meter box leveled? ____
Timer/temperature readouts operational? ______________________________
Manometer leveled? ____
Thermocouples calibrated (Read within 3 C?)? __________________________
Barometer: Mercury___________Aneroid____________Other ________________
Barometer capable of measuring atmospheric pressure within 2.5 mm Hg? _________

Operation

Filter properly numbered and recorded on field test data sheet? ________________
Filter type: Glass?__________________Quartz-fiber? ________________________
Filter has organic binder (Method requires no organic binder)?__________________
Filter manufacturer__________________Filter manuf. Number_________________
Filter weighted to constant weight/recorded? ____________________________
Filter checked visually for irregularities? ______________________________
Filter collection efficiency meets EPA's specification of 99.95 %?______________
Stopcock grease used is solvent-insoluble, heat-stable silicone grease? ___________
Sampling site selected?________________________Stack temperature __________
Stack velocity head?___________Stack dry molecular weight calculated?__________
Nozzle size properly selected? ____
(Note: During sampling run, nozzle can not be changed!)
Calibration data certified available: Pitot tubes________Meter box Y factor ________
Meter box delta H@_____________Magnehelic guage _____________________
Thermocouples_____________Probe nozzle________________________________

Nozzle condition: Nicks__________ Bent opening __________

PROBE/PROBE LINER

Probe material: Borosilicate__________ Quartz__________ Stainless steel __________
Inconel__________ Other __________
Heating system:__________ Temperature (120 C +/- 14 °C) __________
Water cooled?__________ Length __________
Probe liner: Borosilicate/quartz (up to 480 °C)__________ Quartz(480-900 °C)__________
Temperature sensor attached to probe?__________
Temperature sensor placed in an interference-free arrangement with probe? __________

PITOT TUBE

Type: Type S__________ Standard__________ Other __________
Properly attached to probe?__________
Meets EPA guidelines for attachment to probe?__________ Yes__________ No __________
Modifications __________
Pitot tube coefficient __________

FILTER HOLDER

Construction: Borosilicate__________ Quartz__________ Other __________
Frit construction: Glass frit?__________ Teflon frit? __________
Filter support__________ Silicone gasket __________
Other__________ Clean? __________
Cyclone and flask used(optional):__________

FILTER HEATING SYSTEM

Description __________
Temperature (120+/- 14 °C __________
Gas temperature at exit of Box __________

ORGANIC SAMPLING MODULE

Three sections: Condenser__________ Sorbent trap__________
Condensate knockout trap__________
Condenser maintains stack gas not exceeding 20 °C (68 °F)? __________
Sorbent trap jacketed to maintain internal gas temperature not exceeding 20°C (68°F)?__________
Design of sorbent trap: Single unit?__________ Dual units? __________
Thermocouple well in bed of sorbent Trap? __________
Sorbent in trap? (XAD-2?)__________ 20 grams?__________
Sorbent certified clean (< 10 ng per target analyte?)? __________
Date of sorbent certification?__________ Within 4 weeks?__________
Chain-of-custody with sorbent trap?__________
Sorbent trap received wrapped in aluminum foil? __________
Coolant? (Ice water?) __________
Knockout trap directly below sorbent trap? __________
Type of knockout trap? __________

SOURCE SAMPLING FOR HAZARDOUS AIR POLLUTANTS (HAPs)

FIELD OBSERVATION CHECKLIST

SW-846, METHOD 0010

SAMPLING AND ANALYSIS FOR SEMI-VOLATILE ORGANIC COMPOUNDS

SOURCE INFORMATION

Facility ______________________________
Location ______________________________
Source ______________________________
Sampling Location ______________________________
Test Team ______________________________
Team Leader ______________________________
Test Date Interval:______/______/_____ to _______/_______/_____
Observer ______________________________
Affiliation ______________________________

PRETEST MEETING CHECKLIST

Please reference Pretest Checklist

FEDERAL REFERENCE METHODS 1 THROUGH 5

Please reference Federal Reference Methods 1 through 5 Checklist.

SW-846, METHOD 0010

SAMPLING AND ANALYSIS FOR SEMI-VOLATILE ORGANIC COMPOUNDS

Equipment identified matches pretest calibration list? ______________________________

Apparatus:

NOZZLE

Probe nozzle: Stainless steel___________Glass____________Other _______________
Probe design: Button-hook_____________Elbow_________Streight tube__________
Tapered (30 angle)? ______________________________
Nozzle size:_______________Calculated____________Measured three times _______